Regional and Surgical Anatomy of Bovines

Syed Sajjad Hussain
Tahseen Lone
Bashir Ahmad Moulvi

International Book Distributing Co.

Regional and Surgical Anatomy of Bovines

Syed Sajjad Hussain
Director Resident Instruction-cum-Dean PG Studies
Sher-e-Kashmir University of Agricultural Sciences and Technology-Kashmir
Shalimar, Srinagar, J&K, India

Tahseen Lone
Assistant Professor, Division of Veterinary Anatomy
Faculty of Veterinary Sciences and Animal Husbandary
Sher-e-Kashmir University of Agricultural Sciences and Technology-Kashmir
Shuahma, Srinagar, J&K, India

Bashir Ahmad Moulvi
Associate Professor, Division of Surgery and Radiology
Faculty of Veterinary Sciences and Animal Husbandary
Sher-e-Kashmir University of Agricultural Sciences and Technology-Kashmir
Shuahma, Srinagar, J&K, India

IBDC
International Book Distributing Co.
(Publishing Division)

Published by

INTERNATIONAL BOOK DISTRIBUTING CO.
(Publishing Division)
Khushnuma Complex Basement
7, Meerabai Marg (Behind Jawahar Bhawan)
Lucknow 226 001 U.P. (INDIA)
Tel. : 91-522-2209542, 2209543, 2209544, 2209545
Fax : 0522-4045308
E-Mail : ibdco@airtelmail.in

First Edition 2009

ISBN 978-81-8189-284-3

Composed & Designed at :

Panacea Computers
2nd Floor, Agarwal Sabha Bhawan, Subhash Mohal
Sadar Cantt., Lucknow-226 002
Phone : 0522-2483312, 9335927082
E-mail : prasgupt@rediffmail.com

Printed at:

Salasar Imaging Systems
C-7/5, Lawrence Road Industrial Area
Delhi - 110 035
Tel. : 011-27185653, 9810064311

Dedicated To

Syed Ubaid-ur-Rehman

Aug. 1983 - Dec. 2008

Born in 1983, Syed Ubaid-ur-Rehman S/O Prof. Syed Sajjad Hussain lived a short but meaningful life and died at a young age of 25. In his prime youth Ubaid was a symbol of character, courage and determination. He was studying bio-medical engineering at Hyderabad when the dreadful disease called GCT (Mediastum) struck him in early 2007. Ubaid not only lived the disease but devoted every moment to the mission for which he was created by Almighty. The obvious fate could not stop him from delivering his duties towards his family, friends, society or career. When whole family was so devastated and psychologically wrecked, it was Ubaid who stood like a rock looking into the eyes of death with resolute determination. At no point of time neither he fell into despair nor lost his hope. He had absolute faith in Almighty. He faced the test of life valiantly and never slumped into hopelessness or desperation. His spirit and his will to live life was so amazingly powerful. that even during the agonizing journey of treatment, Ubaid counseled and inspired other patients to fight the disease with will power and live a positive life. The pious soul departed to heavens on 31st Dec. 2008, but his memories are still afresh in our hearts. Authors hope to learn from Ubaid's example who was his father's greatest joy.

This book is dedicated to loving memories of Syed Ubaid-ur-Rehman.

“This Page is Left Intentionally Blank”

Prof. Anwar Alam
Vice-Chancellor

Sher-e-Kashmir University of
Agricultural Sciences and
Technology-Kashmir
Shalimar, Srinagar, J&K, India

Foreword

Regional and Surgical anatomy of Bovines compiled by Prof. Syed Sajjad Hussain, Dr. Tahseen Lone and Dr. B.A. Moulvi is need based in view of the fact that text books alone can not suffice the requirement of U.G. students. This manuscript shall serve as a reference book to U.G. students of veterinary sciences and field veterinarians. It is aimed to acquaint the veterinary surgeon, in advance, with the knowledge of anatomical structures, he would encounter during the course of surgery on animals. The prior knowledge will make him more confident about the anatomical organ and he can perform surgery without fear and without endangering the life of the patient. This will serve to fill the void between theory and the practice, where a student can independently perform dissections and acquaint himself with the anatomical structure. I compliment authors prof. Seyed Sajjad Hussain, Dr. Tahseen Lone and Dr. B.A. Moulvi for compiling this manuscript where students of veterinary profession can harvest the benefit of hard work and dedicated efforts put by the authors.

(Prof. Anwar Alam)
Vice-Chancellor
SKUAST-K, Shalimar

.

“This Page is Left Intentionally Blank”

Preamble

This manuscript has been compiled for the benefit of veterinary students and veterinary practitioners. Veterinarians can perform more efficiently if they have prior knowledge of the region they are operating upon. There are many books on systemic anatomy of domestic animals, whereas little attention has been paid towards regional/applied antomy.

A surgeon/practicing veterinarian is more concerned with applied/regional anatomy rather than systemic anatomy. Keeping this pressing requirement in view, an endeavour was made to prepare a manuscript that could help veterinary students and practicing field veterinarians to review, before hand, the structures encountered during a particular surgical operation.

The manuscript has been divided into seven chapters and at the end of each chapter common surgical operations, related to the chapter, with respect to anatomical considerations have been described.

One would find duplicacies at various places in this maunscirpt. This was unavoidable because there are many structures that are not confined to a single region e.g. vagus nerve which originates from brain in "The Head" region and extends through the cervical region or "The neck", The Thorax to "The Abdomen". During dissection, where ever it is visible, it needs some description. This way reader can see description in the region he is studying and has not to refer any particular region for this purpose. This Manuscript will not only be useful to the students, but this shall pave a way for field veterinary surgeons to perform surgical operations in animals with more certainty and with prior knowledge of surgical anatomy.

Acknowledgement

We express our whole hearted gratitude to Prof. A. Ahmad, the then Vice-chancellor, SKUAST-K (J & K) for providing the facilities needed to prepare this book.

We extend our deepest appreciation and thanks to Dr. Ab. Rashid (Rtd. director Research, SKUAST -J), the then Dean F.V.Sc and A.H., Shuhama, for his inspiration and constant encouragement. The book was conceived years ago and its publication is an acknowledgement of his efforts for development of an academic character.

We are indebted to Late Prof. M.A. Dar (Ex Vice-Chancellor SKUAST-J&K), the then Director Extension Education, SKUAST (J&K) for providing the services of an artist, Mr. Sadhu. The pains taking job of preparing illustrations, by Mr. Sadhu is greatly appreciated. Mr. Aftab (Artist) assisted in preparing many of the illustrations and his work is greatly appreciated. Both artists turned out to be remarkable and the talent speaks in illustration of the text. They dedicated themselves for may months to this project driven by a feeling of personal responsibilities that every piece meets with our satisfaction.

We generously acknowledge the critical analysis, counsel and suggestions from Dr. M. M. S. Zaman specialist in Veterinary Surgery and Dr. Masrat Khan and Dr. M.A. Baba specialist in veterinary Anatomy.

We thankfully acknowledge Mrs. Nasreen Malik, for making healthy suggestions during preparation of the manuscript.

Our deepest appreciation stand due to Mrs. Lali Mir (ACT) and Mr. Shafqat (Sr. Assistant) for their patience and assistance in typing of the manuscript.

We appreciate the inputs of Dr. Masood. S. Mir, Associate Professor cum- Senior Scientist (Pathology) and Mr. Mir Qaisar Ahmad (PA to DRI) for preparation of the manuscript and checks and rechecks of edited manuscripts and proofs. Both contributed their time and expertise most generously.

The International Book Distributing Co. deserves great credit for the high degree of excellence attained in the publication of this book.

Last but not least, we express deep sense of gratitude to our family member for their patience and constant encouragement during the course of preparation of this book.

S.S. Hussain
T. Lone
B. A. Moulvi

“This Page is Left Intentionally Blank”

Contents

“This Page is Left Intentionally Blank”

Chapter 1

The Head

DISSECTION : Incise and remove the skin from one side of the head taking care not to disturb the small superficial muscles which lie immediately underneath the skin, and appreciate the superficial and deep fascia of the head.

The superficial fascia is blended with the periosteum of the nasal and frontal bones and forms a continuous cover except at the nostrils and opening of the mouth. The **cutaneous muscle** is interposed between the sheaths of the superficial fascia and its **facial part** or **panniculus** is well developed being thicker in the intermaxillary space, over the buccinator and temporal muscles as well as on the nasal and frontal regions, forms a remarkably thick and expansive sheet and is termed as **Frontalis muscle.** A few fibres from the facial cutaneus muscle reach the angle of the lips and help in the retraction of the angle of the mouth. These fibres are termed as **retractor anguli oris.**

The deep fascia covers the buccinator, masseter and temporal muscles ad is attached to facial, parietal and frontal crests besides zygomatic arch.

After clearing the fascia, the following superficial structures of the head are revealed in lateral view. Fig. 1.1.

Masseter muscle : It is a short, strong, somewhat quadrilateral muscle situated on the external face of the horizontal ramus of the mandible.

Temporal Muscle : It is situated in the temporal fossa and is poorly developed.

Angularis oculi vein : It is the terminal branch of the facial vein which courses along the medial angle of the eye, toward

the frontal region.

Levator nasolabialis muscle : It is seen as an extensive but thin muscle covering the external surface of the nasal region.

Malaris muscle : It is a broad muscle spreading below the lower eyelid over the masseter and buccinator muscles with which it is blended.

Levator labii superioris : It is situated at anterolateral aspect of the face and extends from facial tuberosity to the muzzle.

Depressor labii superioris : It is a small, fusiform muscle, situated below the zygomaticus muscle, extending from facial tuberosity to the middle of the muzzle.

Zygomaticus muscle : It is a small, narrow but strong muscle situated on the side of the face and runs from zygomatic arch to the upper lip.

Orbicularis oris muscle : It is a sphincter muscle around the anterior opening of the mouth.

Incisivus mandibularis muscle : It is poorly developed, situated as a small fascicle in the mandibular lip.

Buccinator muscle : It is broad and flat and forms the main muscular tissue of the cheek, covering the lateral wall of the mouth.

Dorsal buccal branch of facial nerve (VII) : It courses from facial nerve, appears on rostral margin of the parotid gland and crosses the external surface of masseter muscle.

Parotid salivary gland : It is situated on the side of the face, immediately below and in front of external ear in a space between posterior border of vertical ramus of the mandiable and the wing of atlas.

Parotid lymph node : It is a flat, oval node lying immediately ventral to temporomandibular joint and is partially covered by parotid gland.

Transverse facial artery : It runs on the lateral surface of the masseter muscle, and is dorsal to facial nerve. It arises ventral

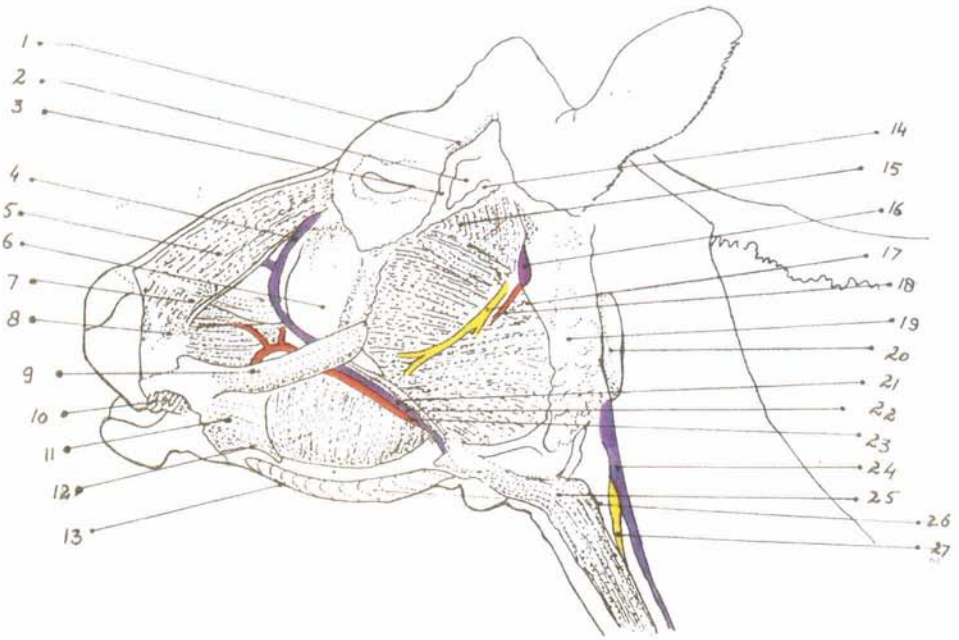

Fig. 1.1 : 1. Temporal line 2. Temporalis muscle; 3. Zygmaticofrontal process; 4. angularis vein. 5. Levator nasolabialis muscle; 6. Malaris muscle; 7 Levator labii maxillaris muscle; 8 Depressor labii maxillaris muscle; 9. Zygomaticus muscle; 10. Orbicularis oris muscle; 11. Depressor angulioris muscle; 12. Buccinator muscle; 13. Body of mandible; 14. Zygomatic arch; 15. Masseter muscle 16. Parotid lymph node; 17. Facial nerve VII (dorsal buccal branch); 18. Transverse facial artery; 19. Parotid salivary gland; 20. Mandibular salivary gland; 21. parotid duct; 22. facial vein; 23. facial artery; 24. external jugular vein; 25. sternomandibularis muscle; 26. Mylohyoideus muscle; 27. Spinal accessory nerve XI (ventral branch).

to the articulation of the mandible and supplies the masseter muscle.

Temporal line: The temporal line is formed by external frontal crest. It is a demarcation between bone and temporal fossa.

Zygomatic arch : It is formed by frontal process of zygomatic bone, which turns dorsad and caudad and joins the zygomatic process of the frontal bone. The temporal process of zygomatic bone continues caudally and is overlaped by the zygomatic process of the temporal bone, completing the zygomatic arch.

Ventral branch of accessory nerve (XI) : The external branch of accessory nerve divides into dorsal and ventral branches at the level of the wing of atlas. The ventral branch supplies the sternomastoideus, stermozygomaticus, cleidomastoideus and cleidooccipitalis muscles.

Subamxillary salivary gland: It is irregulary oval and extends from fossa atlantis to the intermaxillary space.

Facial artery : It is the terminal branch of linguofacial trunk. After crossing the ventral border of the molar part of the mandible it courses dorsally, accompanying the corresponding vein and paroted duct. It ascends along the rostral border of the masseter muscle with the preceding structures.

N.B. The vascular notch in the ventral border of the body of the mandible lodges the external maxillary artery (facial artery), external maixillary vein (linguofacial vein) and Stenson's duct. However, in sheep and goat, it contains only facial vein. In these species the transverse facial artery is large and the parotid duct crosses the surface of the masseter muscle.

DISSECTION : The levator labii superioris muscle is pushed down to expose the infraorbital foramen. Other related superficial structures are also observed.

Fig. 1.2.

Caninus (dilator naris lateralis) muscle : It is situated between the two portions of levator nasolabialis muscle. It terminates by means of two or three thin tendons in the lateral wing of

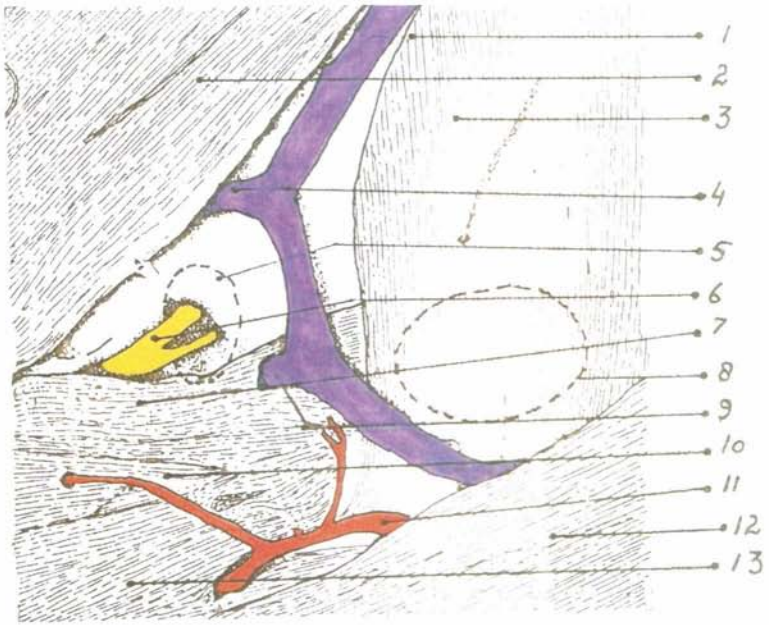

Fig. 1.2 : 1. angularis oculi vein; 2. Levator nasolabialis muscle; 3. malaris muscle; 4. dorsal nasal vein; 5. infraobital foramen; 6. infraorbital nerve (max. V); 7. levator labii maxillaris muscle; 8. location of facial tuberosity; 9. labial maxillary vein; 10. caninus muscle; 11. facial artery; 12. zygomatic muscle; 13. depressor labii maxillaris muscle.

nostril.

Infraorbital foramen : It is situated dorsal to the first cheek tooth. It is often double in number.

Dorsal nasal vein: It is a branch of facial vein going to the bridge of nose.

Facial tuberosity: It is situated on the lateral surface of the maxilla placed dorsal to the third and fourth cheek teeth.

Infraorbital nerve (max. V): The maxillary nerve after it penetrates infraoribital canal is continued as infraorbital nerve and after it emerges through the infraorbital foramen, divides

into dorsal and ventral group of branches. These groups lie under the cover of the depressor labii maxillaris, the caninus and levator labii maxillaris muscles.

DISSECTION: Cut a hole in the depressor labii inferioris muscle to outline the mental foramen. The other superficial structures related to the mental foramen are also revealed. Fig. 1.3.

Mental foramen: It is the external opening of mandibular canal, which is situated at the junction of incisive and molar parts on the lateral surface of mandible.

Mental nerve (mand. V): The mandibular alveolar nerve leaves the mental foramen as the mental nerve. It is distributed in the mental region and adjacent area and ramifies in the lower lip and chin.

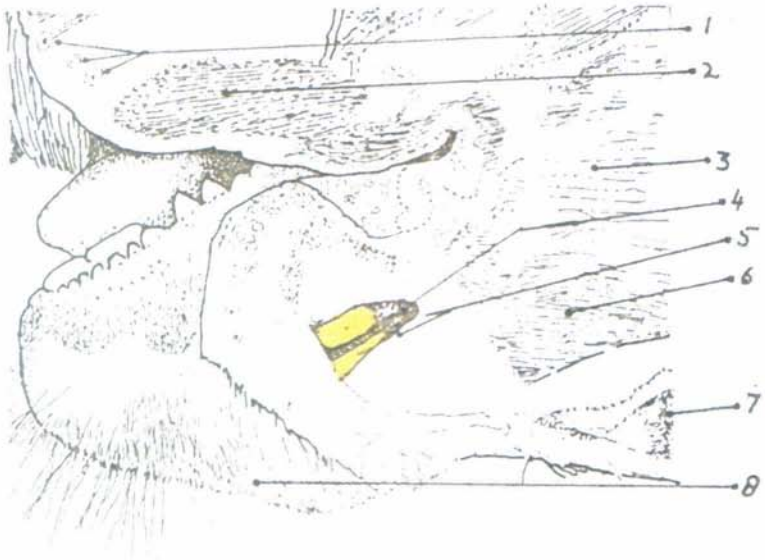

Fig. 1.3 : 1. sections through roots of tactile hairs; 2. orbicularis oris muscle; 3. depressor anguli oris muscle; 4. mental foramen; 5. mental nerve (mand. V); 6. depressor labii mandibularis muscle; 7. mylohyoideus muscle; 8. mentum.

Depressor labii mandibularis muscle: It is a thin muscle layer originating beneath the masseter muscle at the caudal portion of the cheek. It is the most ventral of the facial muscles.

Mylohyoideus muscle: It is thick and an extensive muscle. It acts as a girdle and suspends the tongue between the rami of the mandible.

DISSECTION: The parotid gland is dissected from the ventral end, reflected and removed at the base of external ear. The following structures lying deep to the gland are exposed. Fig. 1.4.

Superficial temporal artery: It is the last branch of the external carotid artery which passes upwards under the parotid gland, behind posterior border of vertical ramus of mandible and reaches the base of horn core.

Obliquus capitis anterior muscle: It lies on the lateral aspect of occipitoatlantal articulation.

Occipitohyoideus muscle: It passes along the posterior border of great cornu, parallel to the vertical ramus of the mandible above the temporomaxillary articulation.

External maxillary vein: It passes along the inferior border of mandible and extends under the zygomaticus muscle.

Mandibular salivary gland: A distinctly lobulated, somewhat oval gland, extends from fossa atlantis to the intermaxillary space. Its pendulous ventral end is easily palpable in the intermandibular space.

Digastric branch of facial nerve (VII): It emerges from ventral edge of the facial nerve at the stylomastoid foramen. It traverses the structure of the occipitohyoideus muscle, leaving it at its ventral margin, and ramifies in the caudal belly of the digastricus muscle.

Stylohyoideus nerve (VII): This branch emerges from the ventral aspect of the facial nerve distal to the digastric branch. It courses on the caudal wall of the caudal auricular artery and penetrates the stylohoideus muscle.

Sternomandibularis muscle: The superficial part of sternocephalicus muscle is known as sternomandibularis, which is inserted on the rostral border of the masseter muscle, the ramus of the mandible and the buccal fascia. It arises from the manubrium of the sternum and first costal cartilage.

Mandibular lymph nodes: They are situated between the sternocephalicus muscle and the ventral part of mandibular salivary gland.

External carotid artery: It is the direct continuation of the common carotid artery which courses on the deep surface of

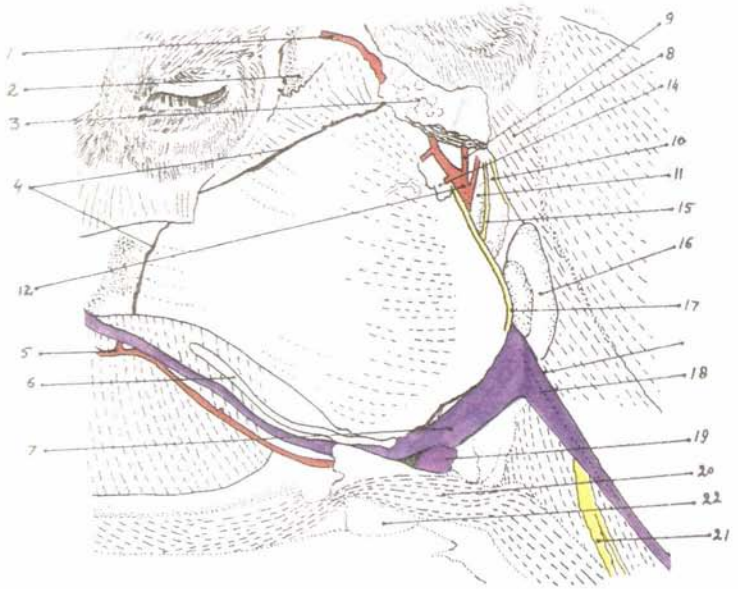

Fig. 1.4 : 1. Superficial temporal artery; 2. Temporalis muscle; 3. parotid salivary gland; 4. Incision through origins of masseter muscle; 5. facial artery; 6. parotid duct. 7. linguofacial vein; 8. obliquus capitis cranialis muscle; 9. caudal auricular artery; 10. digastricus nerve (VII). 11. occipitohyoideus muscle; 12. external carotid artery; 13. angle of stylohyoid bone; 14. maxillary vein; 15. stylohyoideus nerve (VII); 16. mandibular salivary gland; 17. facial nerve VII (ventral buccal branch); 18. external jugular vein; 19. mandibular lymph node; 20. sternomandibularis muscle; 21. spinal accessory nerve XI (ventral branch); 22. mandibular salivary gland (ventral extremity).

caudal belly of the digastricus muscle.

Caudal auricular artery: It is given off by the external carotid artery following the origin of the linguofacial trunk, in the neighbourhood of the angle of the stylohyoid bone.

External jugular vein : It represents the terminal division of the cranial vena cava. It reaches the jugular groove between the scalenus medius, sternohyoideus and sternothyroideus muscles. The superficially situated vein progresses craniad in the jugular groove and, in the upper third of the neck, it crosses the lateral surface of the omohyoideus muscle.

At this site it is accessible for intravenous injection. It divides into the linguofacial and maxillary veins ventral to the wing of atlas.

Maxillaris vein : It is one of the terminal branches of the external jugular vein. It arises caudoventral to the parotid gland land reaches the medial surface of the gland.

DISSECTION : Incise the origin of the masseter muscle. Dissect and reflect the muscle downwards, to expose the upper parts of the depressor labii inferioris and the buccinator muscles. Saw the mandible just below the zygomatic arch. Remove the mandible after cutting muscle fibres from it. With the help of a chisel and hammer remove the part of the upper extremity of the ramus consisting of the coronoid process and the section of the vertical ramus below the coronoid process. Now chip off remaining part of the upper extremity of the malar, maxillary protuberance and lacrimal bulla. Removal of these structures will expose most of the lateral face of the medial and the lateral pterygoid muscles, besides the other structures lying medial to mandible. Fig. 1.5.

Medial pterygoideus muscle : It is fan shaped, comparatively small and weak muscle than masseter to which it resembles. It is situated on medial surface of the vertical ramus of the mandible.

Lateral pterygoideus muscle : It is a triangular muscle which is flattened transversely. It presents an extensive origin in the

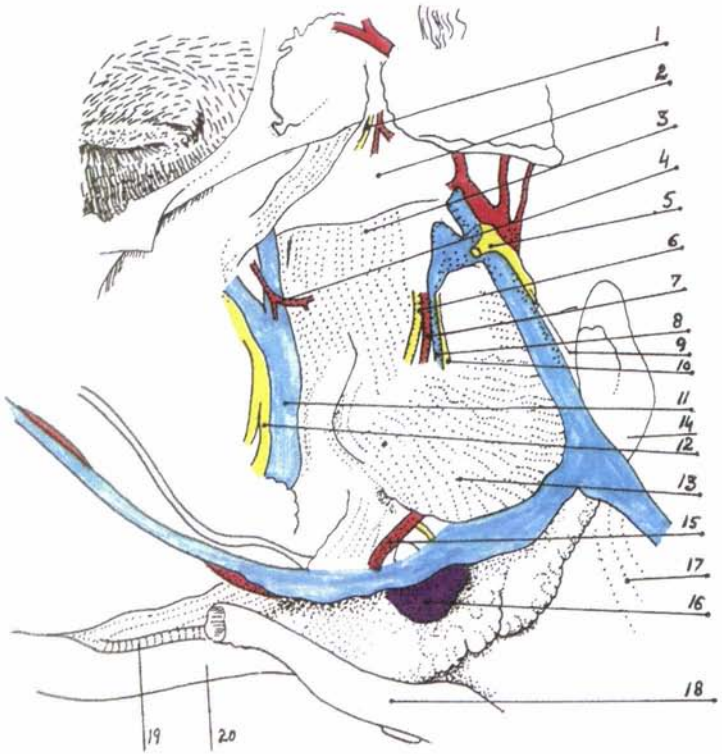

Fig. 1.5 : 1. massetr nerve (mand V); 2. remains of mandibular ramus; 3. pterygoideus laterlis muscle; 4. buccal artery; 5. facial nerve VII (dorsal buccal branch); 6. alveolamandibular nerve (mand. V) 7. aloveolar mandibular artery; 8. alveolar mandibular vein; 9. facial nerve VII (ventral buccal branch); 10. mylohyoideus nerve 11. deep facial vein, 12. buccal nerve (mand. V); 13. pterygoideus medialis muscle; 14. mandibular salivary gland; 15. facial artery; 16. mandibular lymph node; 17. sternomastoideus muscle; 18. sternomandibularis muscle (cut and displaced); 19. cut insertion of digastricus muscle; 20. mylohyoideus muscle.

pterygopalatine fossa, where it is partly covered by pterygoideus medialis muscle. It is placed on the inside of the temporomaxillary articulation.

Mylohyoideus nerve : It is situated in the intermaxillary space and runs along the medial surface of the horizontal ramus of

mandible.

Deep facial vein : It leaves facial vein at the rostral border of the masseter muscle. It forms deep facial plexus ventral to malar tuberosity.

Masseteric nerve (Mand. V): It courses lateral and rostral to the temporomandibular articulation and furnishes the deep temporal nerve to the temporalis muscle. Finally, it reaches the deep surface of the masseter muscle in which it is distributed.

Dorsal buccal branch of facial nerve (VII): It passes around the ventral border of the parotid lymph node, and crosses the masseter muscle in company with the transverse facial vessels and nerve branches. At rostral margin of the masseter muscle, it is joined by the communicating twig from the ventral buccal branch, forming an intricate plexus.

Mandibular alveolar nerve (mand.V): It is the other terminal branch of the mandibular nerve, courses ventrorostrally on the upper surface of the pterygoideus medialis muscle and penetrates the mandibular foramen.

Ventral buccal nerve (facial. VII) : It courses first under the parotid gland and then on the lateral surface of the masseter muscle. At the rostral border of masseter muscle, it gives off communicating twig to the dorsal buccal branch. It supplies the depressor labii mandibularis and buccinator muscles.

Buccal nerve (mand. V): It passes through the dorsal margin of the pterygoideus lateralis muscle and then over the maxillary artery. At the lateral surface of the buccinator muscle, it crosses the large buccal vein and gives off fine twigs to the mucous membrane and glands of the cheek region. Finally, it dips between the buccinator and depressor labii mandibularis muscles supplying the buccal gland and oral mucosa.

Alveolaris mandibularis artery : It arises in a rostro–lateral direction from the first part of the maxillary artery. It runs towards the mandibular foramen through which it enters the mandibular canal.

Alveolaris mandibularis vein : It enter the mandibular canal and then divides like the artery of the same name. It also gives off the mental vein which links up with the veins of the chin region.

DISSECTION : Dissectout the lateral part of pterygoideus

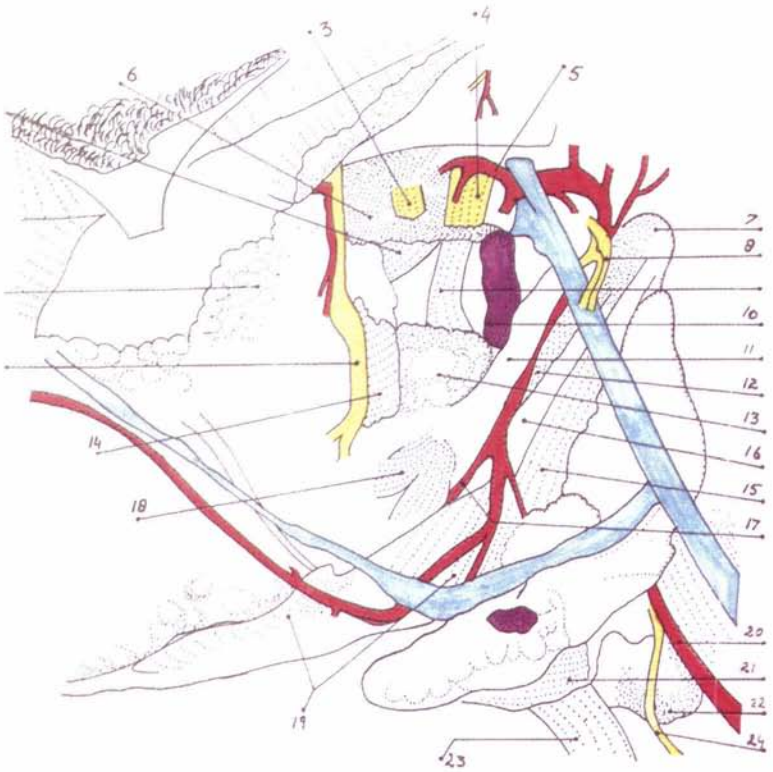

Fig. 1.6 : 1. dorsal buccal glands; 2. buccal nerve (mand. V); 3. lingual nerve (mand.V); 4. alveolar mandibular nerve (mand.V) 5. maxillary artery; 6. cut surface of pterygoideus muscle; 7. angle of stylohyoid bone; 8. facial nerve VII; 9. tensor veli palatinie muscle; 10. medial retropharyngeal lymph node; 11. stylohyoid bone; 12. digastricus muscle; 13. palatine tonsil; 14. cut edge of palatopharyngeus et pterygopharyngeus muscles; 15. stylohyoideus muscle; 16. digastricus muscle (intermediate tendon); 17. lingual artery; 18. hyoglossus muscle; 19. digastricus muscle; 20. common carotid artery; 21. sternohyoideus et omohyoideus muscles; 22. thyroid gland; 23. sternothyroideus muscle; 24. cervical nerve I (ventral branch).

externus muscle. Cut the origin of the medial part from the pterygoid process and palatine crest and reflect it downwards. The sternocephalicus and brachiocephalicus muscles have to be entirely cut away. The muscular wall of the pharynx, rostral to the stylohyoid bone has to be partly removed in order to expose the palatine tonsil. Besides, the structures lying deep to the pterygoid muscle are also revealed.

Fig. 1.6.

Medial retropharyngeus lymph nodes : The medial group of retropharyngeal lymph nodes lie against the pharynx.

Digastricus muscle : It is situated on the inner face of mandible in the intermaxillary space and extends form the posterior part of the paramastoid process. Bellies are short and thick. The intermediate tendon is round and thick. The rostral bellies are connected beneath the root of the tongue and are much larger. The caudal belly is covered by mandibular gland and lies between the hyoid bone and stylohyoideus muscle.

Hyoglossus muscle: It arises from the basihyoid, lingual process and the thyrohyoid of hyoid bone. It is wide, flat and lies lateral to the base of tongue.

Lingualis artery: It orginates at the level of truncus medialis muscle, runs along the posterior border of the great cornu of the hyoid bone, and supplies muscles of the tongue.

Stylohyoideus muscle : It is situated at the proximal extremity of great cornu of hyoid bone. It is a ribbon like muscle.

Thyroid gland: It is a large ductless gland attached to the upper extremity of trachea. The two lobes are connected by an isthmus.

Stylohyoid bone : The stylohyoids are narrow, except at all the ends. The dorsal end of each stylohyoid bone divides to form an angle.

Facial nerve (VII): It arises from the lateral aspect of the medulla oblongata and in company with the vestibulocochlear nerve, reaches the internal acoustic meatus of the temporal bone, where it enters the facial canal.

Tensor veli palatini muscle : It originates mainly from the cartilage of the auditory tube with lesser attachment to the adjacent parts of the temporal bone.

Levator veli palatini muscle : It originates from the tympanic part of the temporal bone, passes ventrally, caudal to the auditory tube and runs parallel to tensor veli.

Palatine tonsil : On the lateral wall near the attachement of soft palate is the opening of the tonsillary sinus, which leads into palatine tonsil. The bean shaped tonsil is concealed in the wall of pharynx.

Palatopharyngeus muscle : It has three parts; longitudinal, oblique and transverse. The dorsal border of longitudinal part is continuous over the dorsal surface of the tonsil with the pterygopalatinus muscle.

Pterygopharyngeus muscle : It arises mainly from the hamulus of the pterygoid bone. It passes caudally, lateral to the levator palatine veli and dorsolateral surface of palatine tonsil.

Common carotid artery: Arising from the bicarotid trunk on the ventral surface of trachea, it ascends in the neck along with vagosympathetic trunk and small jugular vein, enclosed in the carotid sheath. It is related dorsally to the cervical part of vegosympathetic trunk and ventrally to the recurrent laryngeal nerve and the truncus trachealis.

N.B. By displacing the mandibular gland, the lateral retropharyngeal lymph nodes which lie in retromadibular fossa near the atlantal fossa are exposed and their position relative of the stylohyoid bone can be compared with that of the medial node.

DISSECTION: The hyoid bones (stylohyoid and epihyoid) have been removed. Reflect the linguofacial artery, the caudal and middle constrictor muscles of the pharynx. Now, remove part of the hyoid apparatus to expose the caudal part of the stylopharyngeal muscle and dorsal edge of thyroid cartilage. Besides, hyoid apparatus, pharynx and larynx are also revealed.

Fig. 1.7.

Longus capitis muscle : It is the continuation of longus colli and connects entire ventral surface of the cervical vertebral column to the base of the skull.

Stylopharyngeus muscle: It is a narrow strap like muscle which lies on the lateral wall of the pharynx rostral to the stylohyoid bone.

Laryngeal part of pharynx: It is dorsal and lateral to the larynx and ventral to the palatopharyngeal arch.

Thyrohyoid bone : It extends caudad and dorsad from lateral parts of basihyoid bone. Caudal end has cartilaginous prolongation.

Thyrohyoideus muscle : It is a thin, paired, triangular, strap like muscle caudally attached to thyroid cartilage ad laterally to omohyoideus muscle and mandibular salivary gland.

Cricothyroideus muscle: It is a paired muscle. The muscle fibres originate on either side in the caudal border and lateral surface of cricoid cartilage.

Geniohyoideus muscle : It lies on ventral surface of the tongue, deep to the mylohyoideus muscle.

Ceratohyoideus muscle : It is a small triangular muscle that lies in the space between the thyroid and ceratohyoid bones.

Ventral branch of cervical nerve II: It furnishes the longus capitis and connects with the dorsal branch of the accessory nerve as well as the ventral branches of the first and third cervical nerves. After pursuing between the cleidomastoidus and cleido-occipitalis muscles, it divides into the great auricular and transverse cervical nerves.

Cranial laryngeal nerve (X): The vagus nerve at the level of the middle of the atlas gives off the cranial laryngeal nerve, which descends on the lateral side of the larynx.

Caudal laryngeal nerve (X): The recurrent laryngeal nerve terminates as the caudal laryngeal and is the motor nerve to all the intrinsic muscles of larynx except the cricothyroideus.

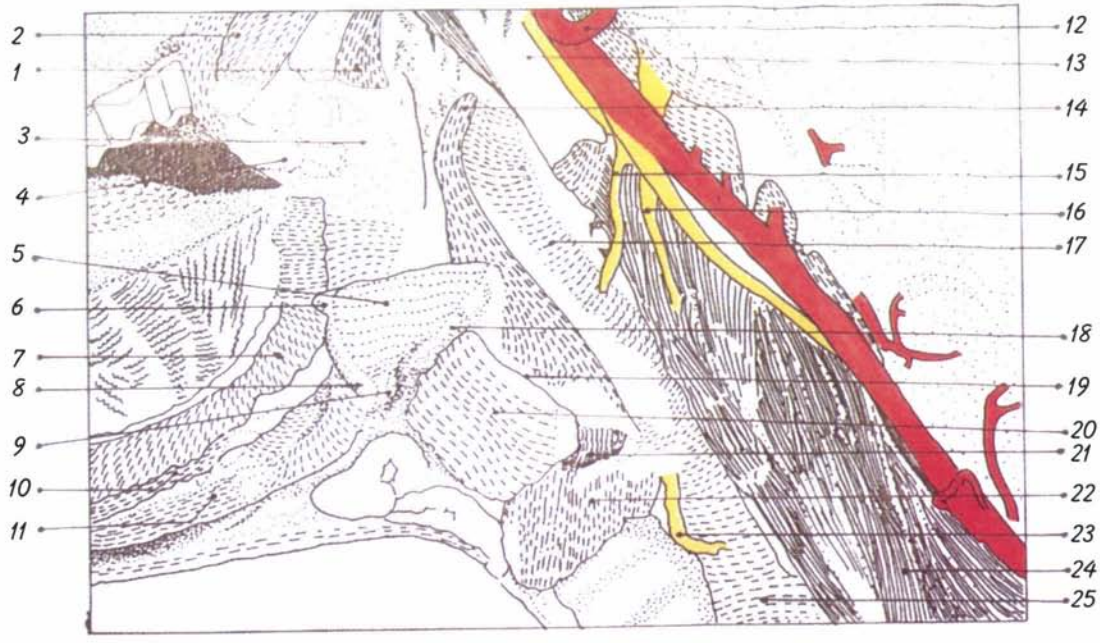

Fig. 1.7 : 1. Levator veli palatini muscle; 2. Tensor veli palatini muscle; 3. Palatine tonsil; 4. Pharyngeal salivary gland; 5. Ceratohyoid palatini muscle; 6 Stylohyoid and epihyoid bones (removed); 7. Hyoglossus muscle (cut edge) 8. Ceratohyoid bone; 9. Basihyoid bone. 10. Genioglossus muscle; 11. Geniohyoideus muscle; 12. Linguofacial trunk (reflectec); 13. Longus captitsi muscle; 14. Stylopharyngeus muscle; 15. Cranial laryngeal nerve (X); 16. Cervical nerve II (ventral branch); 17. Laryngeal part of pharynx; 18. Thyrohyoid bone; 19. Lamina of thyroid cartilage; 20. thyrohyoideus muscle; 21. Sternothyroideus muscle (insertion); 22. cricothyroideus muscle; 23. Caudal laryngeal nerve (X); 24. Longus colli muscle; 25. Oesophagus.

Genioglossus muscle: It is a flat muscle and lies parallel to the median plane. It originates in the angle of the chin, from the medial surface of the mandible, just caudal to the symphysis.

Longus colli muscle: It lies on the ventral surface of the cervical and first five to six thoracic vertebrae. It has thoracic and cervical portions. Both powerful muscles lie in a v-shaped form on ventral side of the bodies of the vertebrae and the transverse processes.

DISSECTION : The skin has been cut and removed form right side of the head including the corneal region. The following superficial structures of head and corneal region are revealed in lateral view.

Fig. 1.8.

Infratrochlear nerve (ophthalmic V): It is a branch of ophthalmic nerve. It ascends along the medial surface of rectus medialis muscle and after reaching the orbital rim near the medial canthus, it courses caudomedially in orbicularis oculi and frontalis muscels. It innervates upper eye lid, frontal region and base of the horn.

Frontalis muscle: It is a cutaneius muscle of head region which is closely adherent to the skin, and lies between the skin and frontal bone.

Dorsal nasal vein: It is a branch of facial vein, going to the bridge of the nose.

Infraorbitalis nerve (max.V) at infraorbital foramen: It is a branch of maxillary nerve, coursing in the infraorbital canal and supplying to the first molar tooth.

Facial artery: It arises from truncus linguofacialis. Its initial course is along the medial aspect of the ventral border of the mandible and it then turns to the lateral surface of lower jaw. It follows the cranial border of masseter muscle in an area dorsocaudal to the infra-orbital foramen.

Labialis maxillaris artery: It arises from the facial artery at the alveolar border of the maxillary bone and ramifies in the upper lip and the muzzle.

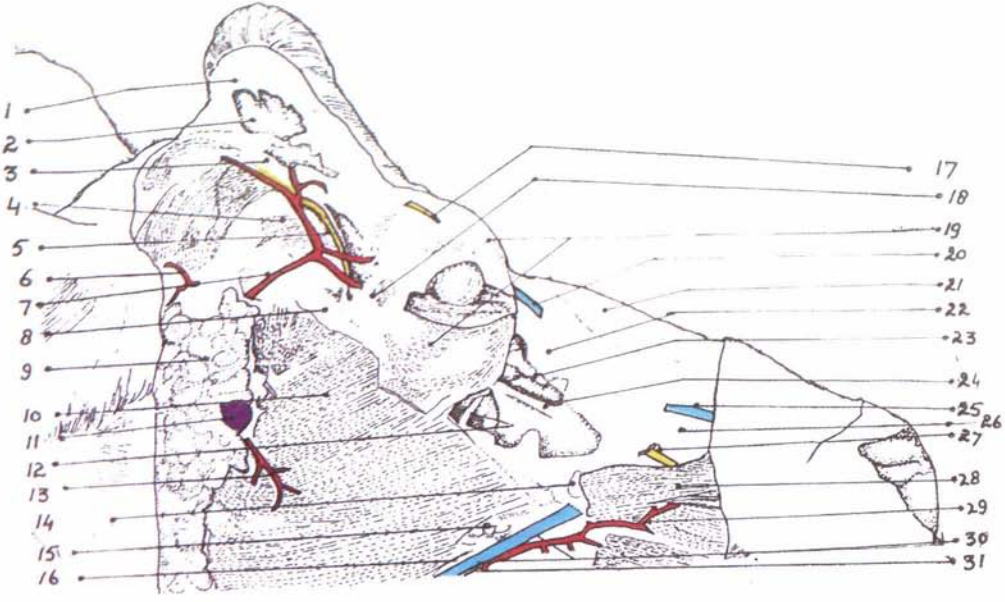

Fig. 1.8 : 1. Intercornual protuberance; 2. caudal frontal sinus; 3. frontal bone (temporal line); 4. temporalis muscle; 5. zygomaticotemporal nerve (max. V); 6. rostral auricular artery; 7. superficial temporal artery; 8. zygomatic arch; 9. parotid salivary gland; 10. masseter muscle; 11; parotid lymph node; 12. maxillary sinus; 13. transverse facial artery; 14. facial tuberosity; 15. dorsal buccal gland; 16. parotid duct; 17. infraorbital nerve (oph. V); 18. zygomaticofrontal process; 19. orbicularis oculi muscle; 20. frontal vein; 21. nasal bone; 22. lacrimal bone; 23. maxillary sinus (palatine extension); 24. infraorbital canal; 25 dorsal nasal vein; 26. maxilla; 27. infraorbital nerve (max. V) at infaorbital foramen; 28. levator labii maxillaris muscle; 29. maxillary labial artery; 30. facial vein. 31. facial artery.

Facial vein: It is the terminal branch of the linguofacial vien which goes to the face. It leaves the mandibulaer space through ventral border of the body of mandible. It runs caudal to the facial artery. On facial surface it follows the cranial border of the masseter muscle dorsally.

Infraorbital canal: It is located at the dorsal edge of inner plate of maxilla and forms the floor of maxillary sinus. It starts at the maxillary foramen and then extends dorsomedial to the roots of molar teeth and terminates at infraorbital foramen.

Zygomaticofrontal process: It is a process which forms a bridge between the squamous part of the frontal and zygomatic process of the temporal bones.

Intercornual protuberance (Frontal and parietal bones): The rostral border of parietal bone join the frontal bone at the corneal suture (parietofrontal suture).

Caudal frontal sinus: It comprises of that portion of the frontal sinus, which lies caudal to the orbits.

Zygomaticotemporalis nerve (max. V): It is the first branch of ophthalmic nerve. It originates form the lateral side of the ophthalmic nerve at the exit of foramen orbitorotundum. It crosses the retro-orbital fat, passes under the frontoscutularis muscle and supplies skin of temporal region.

Auricularis rostralis artery: It arises from superficial temporal artery, reaches the base of ear and supplies external auditory meatus and muscles of scutulum.

Dorsal buccal glands: They are arranged in three group and are yellow in colour, extending from angle of the mouth to the maxillary tuberosity, underlying the buccinator muscle.

Maxillary sinus: It is excavated chiefly in the maxilla, lacrimal and zygomatic bones. It is not divided by any septum.

DISSECTION: The skin has been removed from the dorsolateral side of the face to expose the maxillary and frontal paranasal sinuses in the cranial view.

Fig. 1.9.

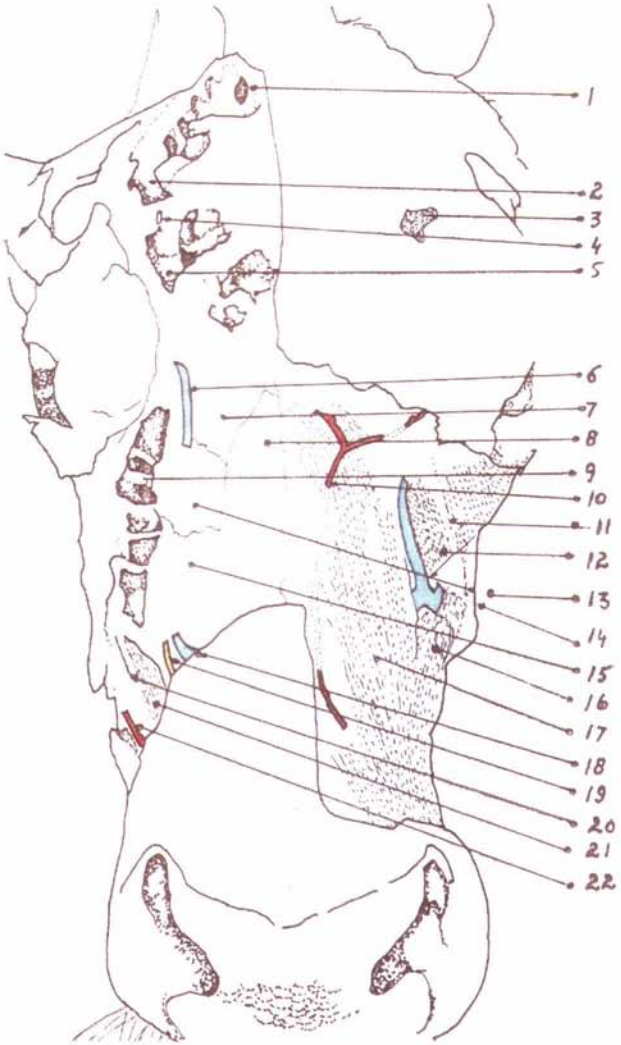

Fig. 1.9 : 1. caudal frontal sinus (extension into intercrnual prominence); 2. caudal frontal sinus in corneal region; 3. position of left supraorbital foramen; 4. marker in supraorbital foramen; 5. rostral frontal sinus; 6. frontal vein; 7. frontal bone; 8. nasal bone; 9. position of nasolacrimal duct; 10. dorsal nasal artery; 11. malaris muscle; 12. angularis oculi vein; 13. lacrimal bone. 14. facial vein; 15. maxilla; 16. levator labii maxillaris muscle; 17. levator nasolabialis muscle; 18. dorsal nasal vein; 19. infraorbital nerve (max. V). 20 facial tuberosity; 21. levator labii maxillaris muscle; 22. maxillary labial artery.

Extension of caudal frontal sinus into intercornual prominence: It lies caudal to the orbits and has three diverticuli. Its cornual diverticulum occupies the cornual process.

Position of left supraorbital foramen: The supraorbital foramen is located somewhat medial to the root of zygomatic process, forming the external orifice of the supraorbital canal. It is in the course of supraorbital groove, which marks the course of frontal vein.

Rostral limit of caudal frontal sinus: It leads the caudal frontal sinus into an ethmoidal meatus.

Rostral frontal sinus: It lies rostral to the caudal frontal sinus between the orbits.

Position of nasolacrimal duct: The nasal surface of body of maxilla is concave dorsoventrally. Its dorsal part is crossed obliquely and ventrally by a shallow lacrimal groove containing the nasolacirmal duct. the caudal part of the lacrimal groove forms the lacrimal canal.

Dorsalis nasi artery: It is a branch of facial artery, which arises from the malaris artery and runs beyond the rostral end of the nasal bone.

DISSECTION: Incise and remove the skin from the cornual and surrounding region, taking care to keep frontalis muscle intact. Cut the frontalis muscle at zygomaticotemporal region to bring to view the deep structures as well as the following superficial structures of the cornual region. Fig. 1.10.

Cervicoscutularis muscle: It is a thin flat muscle, inserted to the caudal part of dorsal surface of the scutiform cartilage.

Scutiform cartilage: It is a small, irregularly quadrilateral, boot shaped cartilaginous plate located at the base of ear on its rostromedial aspect.

Cornualis artery: It is a branch of superficial temporal artery and runs along the linea temporalis to the base of the horn.

Scutuloauricularis muscle: It arises from the dorsal surface of

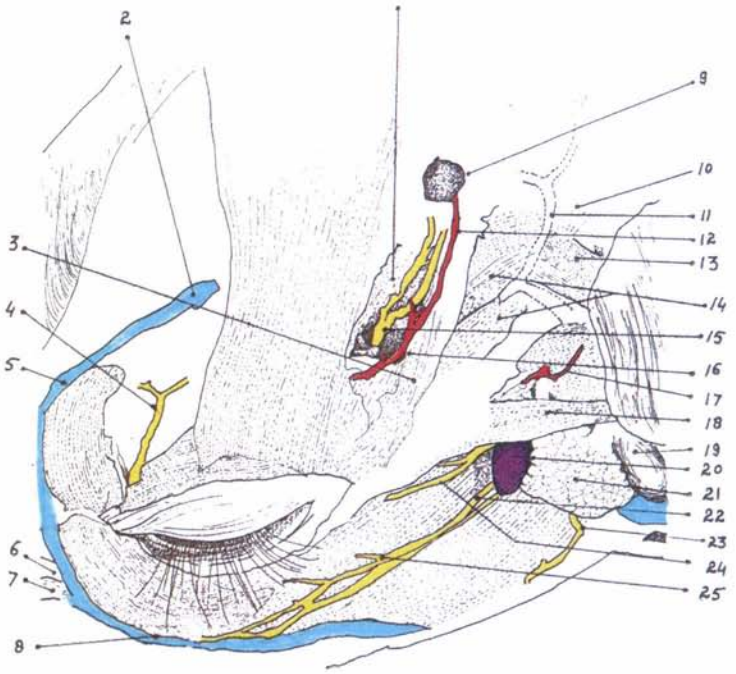

Fig. 1.10 : 1. frontal bone (temporal line); 2. frontal vein; 3. frontalis muscle; 4; infratrochlear nerve (oph. V). 5. angularis oculi vein; 6. dorsal nasal vein; 7. levator labii maxillaris muscle; 8. facial vein; 9. skin of horn bud; 10. cervicoscutularis muscle; 11. scutiform cartilage; 12. cornual artery; 13. scutuloauricularis muscle; 14. frontosutularis muscle; 15. zygomaticotemporalis nerve (max. V) 16. superficial temporal artery; 17. rostral auricular artery; 18. zygomaticoauricularis muscle; 19. mandibular salivary gland; 20. parotid lymph node; 21. parotid salivary gland; 22. auriculotemporalis nerve; 23. facial nerve VII (ventral buccal branch); 24 auriculopalpebral nerve (VII); 25 facial nerve VII (dorsal buccal branch).

suctiform cartilage and its fibres are directed straight towards the auricular cartilage.

Frontoscutularis muscle: It arises from frontal crest and is inserted on the dorsal surface of scutiform cartilage.

Zygomaticoauricularis muscle: It arises from zygomatic arch, courses caudal to the eye and is inserted alongwith partidoauicularis muscle.

Auriculotemporalis nerve (mand. V): It arises from ventral

border of pterygoideus lateralis muscles and courses around the caudal border of vertical mandibular ramus and divides at the deep surface of parotid glad into facial and auricular nerves.

Auriculopalpebralis nerve (VII): It is a branch of facial nerve and courses dorsal to superficial temporal vein. Its fibres innervate auricular muscles, i.e. orbicularis oculi, frontalis and levator angularis oculi muscles.

Frontalis vein at supraorbital foramen: It is a branch of facial vein which courses on caudal part of forehead along the border of the orbit.

Angularis oculi vein: It is the terminal branch of facial vein and courses along the medial angle of the eye.

SURGICAL ANATOMY FOR COMMON SURGICAL AFFECTIONS OF HEAD REGION

TREPHINING OF FRONTAL SINUS:

(A) Anatomical location: A very large, segmented sinus involving nearly whole of the frontal bone and a sizeable part of the caudal wall of cranium, extending into the cornual processes in horned animals.

(B) Site for surgical approach:

(i) Through the horn, about half an inch above its base exposing the extended portion of the sinus in the horn core.

(ii) Immediately above the line joining the upper parts of the orbital cavities or inner side of the supraorbital fissure.

(C) Structures encountered: Skin, cutaneus muscle, deep fascia blended with periosteum, lamina externa of frontal bone, finally mucous membrane of frontal sinus, zugomaticotemporal nerve and temporal superficial artery.

TREPHINING OF MAXILLARY SINUS:

(A) Anatomical location: A non-segmented sinus carved mainly in the maxilla, lacrimal and zygomatic bones. In

equines it is divided by a septum.

(B) Site for surgical approach: Just above the maxillary protuberance or above facial tuberosity in adults. In younger animals, a higher site about the width of two fingers above facial tuberosity has been recommended.

(C) Structures encountered: Skin, malaris, deep fascia fused with periosteum, lamina externa of superior maxilla and mucous membrane of maxillary sinus, dorsal nasal artery from malar artery.

DEHORNING:

(A) Anatomical location: Cornua or horns enclose the horn processes of the frontal bones, with the basis cornus (root or base of horn) being continuous with the surrounding epidermis.

(B) Site for surgical approach: The recommended site lies immediately below the base of the horn.

(C) Structures encountered: Skin, epikeras (a zone of transitional epidermis from which horn grows), deep fascia blended with periosteum, corium and horn core (cornual process), cornual artery, rami cornuales nerve and zygomaticotemporalis nerve (max.V).

EXTIRPATION OF EYE BALL:

(A) Anatomical location: The eye ball rests in the orbit having comparatively complete bony covering with roof of the orbit formed by the frontal bone extending ventrad on the medial wall. The floor of the orbit is formed by the projection of lacrimal bulla, while lacrimal bone itself forms the anterior margin of the orbit.

(B) Site for surgical approach: Immediately along the bony rim of the orbit.

(C) Structures encountered: Ocular conjuctiva, four recti muscles (dorsal, ventral, lateral and medial) two oblique muscles (dorsal and ventral) and one retractor namely retractor oculi muscle and fat pad, optic, oculomotor, trochlear and abducent nerves and ciliary blood vessels.

LIGATION OF STENSONS'S DUCT:

(A) Anatomical location: From the base of parotid gland commence a duct, the parotid duct or Stenson's duct which runs medial to the ventral border of horizontal ramus of mandible for a distance, and then turns round its rim to the side of the face in company with the external maxillary artery and vein, and ends by opening into the mouth.

(B) Site for surgical approach:

(i) An inch above the border of horizontal ramus of the lower jaw and half an inch just in front of the anterior border of the masseter muscle.

(ii) An inch behind the posterior border of the vertical ramus of the mandible, at the level of the tendon of the sternomandibularis muscle where the duct can be felt by careful palpation with the finger.

(C) Structures encountered: Skin, superficial and deep fascia, submaxillary artery, submaxillary vein, parotid (Stenson's) duct and branches of inferior buccal nerve.

OPERATION FOR REMOVAL OF *COENURUS CEREBRALIS* CYST (operation for gid)

(A) Anatomical location: The dorsal aspect of the brain, which is situated in the caudal part of the skull. The posterior and dorsal walls of cranium are formed by the occipital, parietal, interparietal and frontal bones. Laterally formed by the temporal bones and ventrally by sphenoid bone. Anteriorly it is bounded by ethmoid bone.

(B) Site for surgical approach: The site is about two centimeter above the line connecting the upper margins of the bony orbits and one centimeter lateral to the median plane.

(C) Structures encountered: Skin, cutaneous (frontalis) muscle, temporalis muscle, deep fascia blended with perosteum, frontal bone, frontal sinus and cranial duramater. The palpebral nerve lies superficially and perpendicular to the site for surgical approach.

N.B. The skull is suitably constituted to protect the brain and other delicate organs placed within. To prevent the effect of the impact on the brain, the frontal sinus is interposed between the two tables of the frontal bone. Circumstances that prevent fracture of skull are due to the elasticity provided by sutural cartilage and number of elastic arches. Fractures of the basilar part of the occipital and sphenoid are more probably due to their weakening by the perforation by large number of foramina. Frontal and nasal bones are mostly involved in fractures. Cancer of horn is a condition which affects the base of the horn and extends into frontal sinus.

Chapter 2

The Neck

DISSECTION: Make a vertical incision along the caudal border of the scapula upto axilla region and extend the incision cranially on the midventral line upto intermandibular space. Extend this incision upwards upto the base of the ear. Reflect the skin from lateral aspect of the neck. The superficial structures of the neck present in the lateral view are observed. Fig. 2.1.

Sternomastoideus muscle: It is a deeper part of the sternocephalicus muscle. It is about twice as wide as the mandibular part and inserts on mastoid part of the temporal bone alongwith cleidomastoideous and longus capitis muscles.

Common carotid artery: It arises from the bicarotid trunk on the ventral surface of trachea. It ascends in the neck accompanying the vegosympathetic trunk and the small internal jugular vein inside the carotid sheath.

Sternomandibularis muscle: It is a superficial division of sternocephalicus muscle. It arises from the manubrium sterni to the ramus of the mandible and fascia covering the buccinator muscle.

Cephalic vein: It is a superficial vein (the internal subcutaneous vein of the fore-arm). It joins the external jugular vein about two and a half centimeter in front of its termination. It joins external jugular vein at brachiocephalic plexus, and passes on the dorsal aspect of anterior superficial pectoral muscle.

Trapezius muscle (cervical part): It is a thin and triangular muscle, closely adherent to insertion of omotransversarius muscle. It is inserted on scapular spine. The trapezius muscle extends along the dorsal median line from the level of the atlas

to about the end of the thoracic region, and covers a part of shoulder. The muscle fibres of cervical part are directed downwards and backwards, while those on the neck are directed downwards and forwards.

The tendon of the cervical part of trapezius muscle is dissected and removed to reveal the supraspinatus muscle which occupies the supraspinatus fossa of scapula and extends upto humerus. Cut across the brachiocephalicus at about middle of the neck. Dissect the upper portion and reflect it upwards and forwards. Dissect the lower portion to the level of the shoulder joint and reflect it downwards. This exposes omotransversarius and parts of splenius, serratus cervicis, omohyoideus and scalenus muscles.

Omotransversarius muscle: It is situated at the lateral surface of neck. Caudal part lies between brachiocephalicus and cervical part of trapezius muscles.

Deltoideus muscle (scapular part): The deltoideus muscle is divided into acromial part which is spindle shaped, and a scapular part which is flattened. The muscles are placed one above the other at distal part of scapula and are inserted at deltoid tuberosity of humerus.

Cutaneous antebrachii caudalis nerve: It is a branch of ulnar nerve, which is detached proximal to the point of elbow and furnishes branches to dorsomedial aspect of carpus, midocaudal aspect of middle and caudal aspect of forearm.

Brachiocephalicus muscle: It extednds from head, along side of the neck to the arm. It is divided into cleodooccipitalis (dorsal) and cleidotemporalis (ventral). The two parts are separable only in head region.

Cleidomastoideus muscle: It is a smaller and deeper part of the brachiocephalicus muscle. It is situated on the inferior border of cleidooccipitalis muscle.

Cleidoocccipitalis muscle: It is the dorsal part of brachiocephlicus muscle and arises from anterior part of ligamentum nuchae and extends upto humerus.

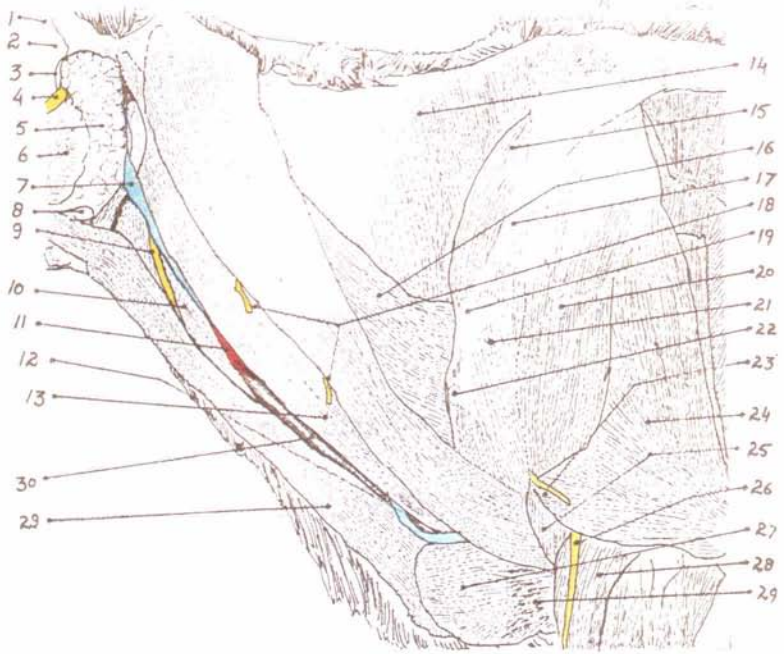

Fig. 2.1 : 1. wing of atlas; 2. cleidooccipitalis muscle; 3. parotid lymph node; 4. facial nerve VII (dorsal buccal branch); 5. parotid salivary gland; 6. masseter muscle; 7. external jugular vein; 8. parotid duct; 9. spinal accessory nerve XI (ventral branch); 10. sternomastoideus muscle; 11. common carotid artery; 12. cephalic vein; 13. cleidomastoideus muscle; 14. trapezius muscle (cervical part); 15. supraspinatus muscle; 16. omotransversarius muscle; 17. spine of scapula; 18. cervical nerves (ventral branches); 19. acromion; 20. deltoideus muscle (scapular part); 21. deltoideus muscle (acromial part); 22. humerus (major tuberosity); 23. cranial cutaneous antebrachial nerve; 24. triceps brachii (lateral head); 25. brachialis muscle; 26. lateral cutaneous antebrachial nerve; 27. pectoralis descendens muscle; 28. extensor carpi radialis muscle; 29. pectoralis transversus muscle; 30. sternomandibularis muscle; 31. jugular groove.

Cut the deltoideus at its insertion and remove it, the triceps brachii muscle is revealed.

Triceps brachii (lateral head): It is a quadrilateral muscle situated obliquely in the neck of humerus upto the olecranon process.

Cut the origin of the lateral head of triceps muscle to reveal the following structures.

Brachialis muscle: It is lodged in the musculospiral groove of the humerus. As it follows the direction of groove, it covers parts of the posterior, lateral and anterior surfaces of the shaft of the humerus.

Cutaneous antebrachii lateralis nerve: It is a superficial branch of the radial nerve. After emerging between brachialis and extensor carpi radialis muscles at craniodistal border of the lateral head of triceps branchii muscle, it gives cutaneous antebrachii caudalis nerve to lateral aspect of the arm.

Pectoralis descendens muscle: It is anterior superficial pectoral muscle, slightly rounded, extending from manubrium sterni to anteroventral part of the arm. It forms the brisket of the animal; and lies superficial to the cranial border of the pectoralis transversus muscle.

Pectoralis transversus muscle: It is thin pale coloured flat muscle, extending caudally to the sixth sternebra.

DISSECTION: An elliptical incision is made, omotrnsversarius muscle is sectioned parallel to the cranial border of scapula and removed. The superficial cervical lymph nodes deep to the omotransversarius muscle are exposed in the cranial border of the supraspinatus muscle in the lateral view. Fig. 2.2.

Infraspinatus muscle : It is a powerful, heavily tendinous infiltrated muscle which fill the entire infaspinatus fossa.

Accessory superficial cervical lymph nodes: Below the trpezius and omotransversarius muscles, usually at the cranial border of the supraspinatus muscle, there are five to ten nodes, which are visible through the muscle as they are dark red.

Superficial cervical lymph node: This node can be palpated at the cranial border of the supraspinatus muscle where it is covered by the brachiocephalicus and omotransversarius muscles.

External jugular vein: It is second branch of brachiocephalic vein. It represents the terminal division of anterior vena cava. External jugular vein reaches the jugular groove between the

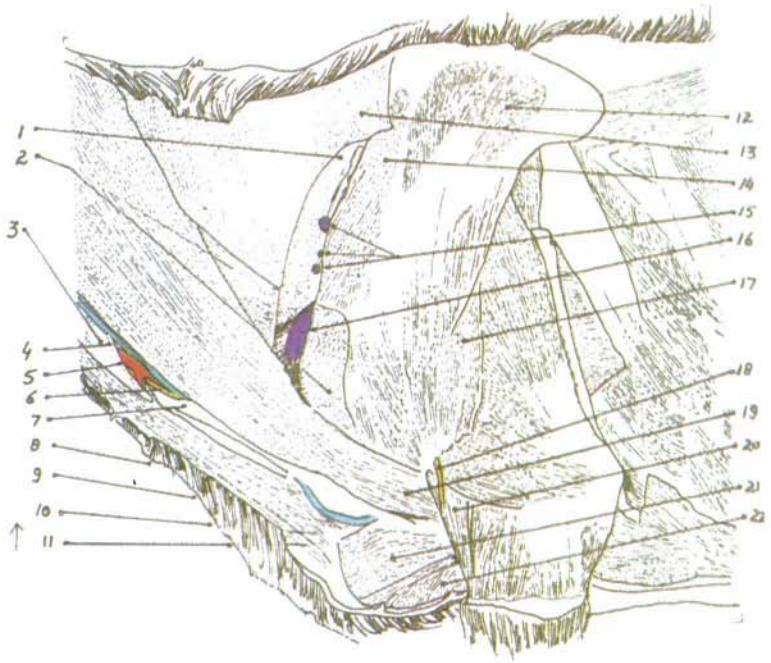

Fig. 2.2 : 1. serratus ventralis cervicis muscle; 2. omotransversarius muscle; 3. sternomastoideus muscle; 4. external jugular vein; 5. common carotid artery; 6. vagosympathetic trunk; 7. oesophagus; 8. cephalic vein; 9. thymus; 10. sternomandibularis muscle; 11. sternothyrohyoideus muscle; 12. infraspinatus muscle; 13. trapezius muscle (cervical part); 14. supraspinauts muscle; 15. accessory superficial cervical lymph node; 16. superficial cervical lymph nodes; 17. deltoideus muscle; 18. cranial cutaneous antebrachial nerve (axillary nerve); 19. brachiocephalicus muscle (cleidobrachialis muscle); 20. brachialis muscle; 21. pectoralis descendens muscle; 22. pectoralis transverses muscle.

scalenus medius, sternohyoideus and sternothyroideus muscle. In lower third it is covered by cutaneus colli muscle.

Common carotid artery: It arises from bicarotid trunk, ventral to trachea at the level of seventh cervical vertebra. Each of the common carotid arteries is related dorsally to the cervical part of vagus and sympathetic nerves and ventrally to recurrent laryngeal nerve.

DISSECTION: The brachiocephlicus and sternocephlicus muscles have been cut. Now cut the trapezius along its origin and reflect it downwards to reveal muscles of neck. The carotid

sheath is also dissected to reveal its contents. Fig. 2.3.

Rhomboidus cervicis muscle: It arises on the nuchal ligament from the second cervical to the fifth thoracic vertebrae. Cervical part of this muscle arises from ligamentum nuchae and thoracic spines of first three or four thoracic vertebrae.

Splenius muscle: It is a triangular flat muscle which lies on the lateral surface of the neck dorsal to the level of the cervical vertebrae.

Longissimus capitis et atlentis muscle: It is placed between the splenius and complexus muscles. It extends from second thoracic vertebra to the wing of atlas.

Brachial plexus (cranial part): It is in the form of a large, thick, wide, flat fasciculus of nerves, and is placed between the thoracic wall and medial face of shoulder. It arises form last three or four cervical and first one or two thoracic nerves. Besides muscles and skin of forelimb, it supplies also to the trunk and the neck.

Scalenus ventralis muscle: It extends from third to seventh cervical vertebrae and inserts on the ventrolateral aspect of first rib. It is darker in colour than scalenus dorsalis.

Intertransversarii ventrales cervicis (atlantal part): It is located between the ventral parts of the transverse processes of cervical vertebrae. The fibres unite to form a long muscle, whose cranial attachment extends to the lateral border of the atlas.

Sternohyoideus muscle: It is a strap like long muscle placed on the ventral surface of the trachea and is fused laterally in the caudal third of the neck with sternothyroideus muscle.

Thymus: It is situated in the anterior part of the chest. It occupies the greater part of the anterior mediastinum and divides at thoracic inlet into two branches. These extend along the traechea and oesophagus in the neck, and terminate at the thyroid gland. They are related externally to the sternocephalicus and sternothyrohyoideus muscles and external jugular vein, and internally to trachea, oesophagus common

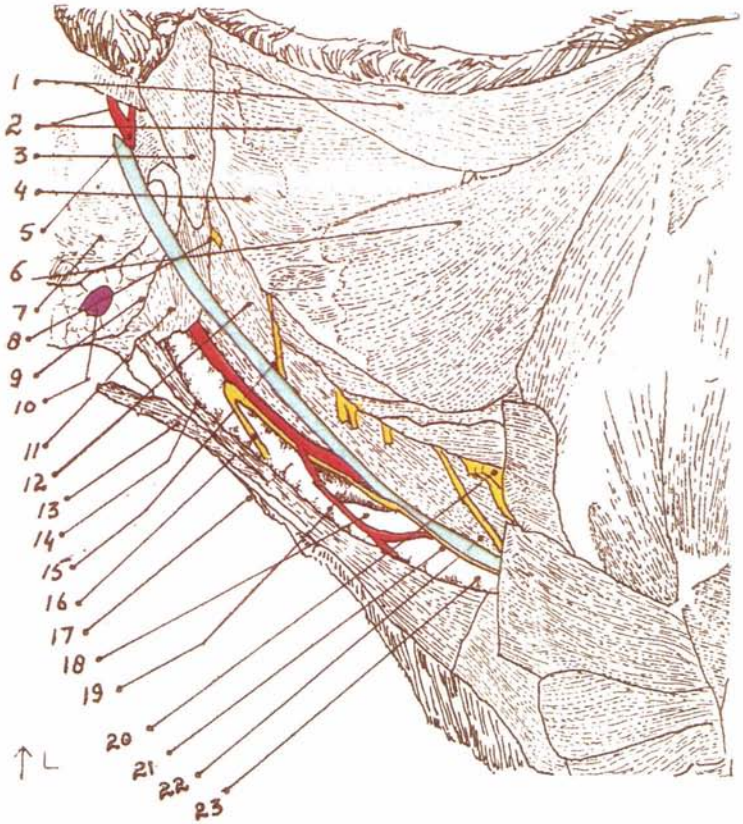

Fig. 2.3 : 1. rhomboideus cervicis muscle; 2. splenius muscle; 3. cleidooccipitalis mscle; 4. longissimus capitis et atlantis muscle; 5. superficial temporal artery; 6. serratus ventralis cervicis muscle; 7. pterygoideus medialis muscle; 8. cervical nerve III (vental branch); 9. mandibular salivary gland; 10. mandibular lymph node; 11. sternomastoideus muscle. 12. intertransversarii ventrales cervicis muscle (atlantal prat); 13. sternohyoideus muscle; 14. sternothyroideus muscle; 15. cervical nerve IV (ventral branch); 16. cervical nerve I (ventral branch); 17. thymus (cranial part). 18. vagosympathetic trunk; 19. oesophagus. 20. brachial plexus (cranial part); 21. cervical nerve VI (ventral branch);. 22. scalenus ventralis muscle; 13. thymus (caudal part).

carotid artery and common cord of the vagus and sympathetic nerves.

Vagosympathetic trunk: In the retropharyngeal region vagus nerve passes caudomedial to common carotid artery where it

is joined by sympathetic trunk. The two nerves continue along the dorsal aspect of the common carotid artery in a common sheath forming a vagosympathetic trunk. The two nerves separate at the root of the neck.

Ventral branch of cervical nerve (IV): The cervical nerve (IV) leaves the vertebral canal through the intervertebral foramen between the third and fourth cervical vertebrae. The ventral branch emerges through the intertransversarii cervicis running ventral to the muscle. It gives muscular branches to the longissimus capitis et atlantis, longus capitis, longus colli, splenius and brachiocephalicus muscles.

Ventral branch of cervical nerve (VI): This nerve is large and contributes to the formation of the brachial plexus as well as the phrenic nerve. Its cutaneous branches inervate the skin of the shoulder and pectoral regions.

Ventral branch of cervical nerve (I): The ventral branch emerges through the alar foramen, where it receives a communicating branch from the cranial cervical ganglion of the sympathetic.

DISSECTION: Incise and remove the dorsal scalenus muscle and dissect the fascia holding the thymus. The cranial and caudal parts of thoracic thymus can be appreciated. Besides, other structures of the neck are also revealed in the lateral view. Fig. 2.4

Ventral branch of cervical nerve (I): The ventral branch passes out through the alar foramen of the atlas. It descends across the rectus capitis ventralis muscle and spinal accessory nerve, curves forward towards the superior face of trachea at about the level of thyroid gland and divides into anterior and posterior branches.

Left lobe of thyroid gland: It is situated on left side of the upper extremity of the trachea, connected to right lobe by an isthmus.

Cranial part of thymus: It is situated at the cranial end of the jugular groove, just cudal to oesophagus and above the cranial end of sternothyroideus muscle.

Sternothyrohyoideus muscle: It is situated on ventral surface of trachea.

Longissimus cervicis muscle: It is a thin tendinous muscle covered on its external side by the longissimus thoracis and serratus ventralis cervicis muscles. It originates from first to seventh thoracic vertebrae.

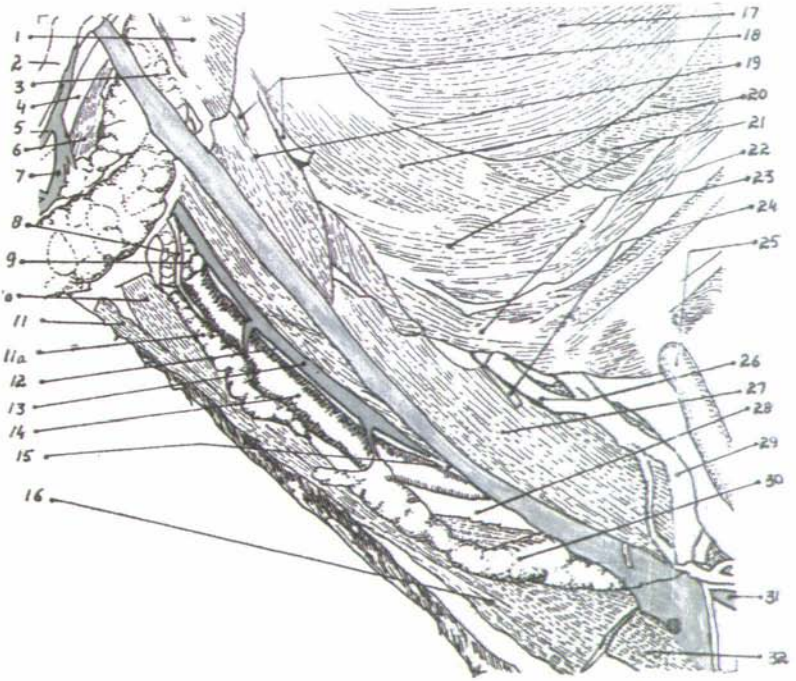

Fig. 2.4 : 1. omotransversarius muscle; 2. stylohyoid bone; 3. mandibular salivary gland 4. tendon of digastricus muscle; 5. lingual artery; 6. stylohyoideus muscle; 7. facial artery; 8. cervical nerve I (ventral branch); 9. thyroid gland (left lobe); 10. sternothyroidus muscle; 11. sternohyoideus muscle; 11a. thymus (caudal part); 12. vagosympathetic trunk. 13. common carotid artery; 14. oesophagus; 15. carotid sheath (external part); 16. sternothyrohyoideus muscle; 17. splenius muscle; 18. cervical nerve III; 19. intertransversarii ventralis cervicis muscle (atlantal part). 20. logissimus capitis et atlantis muscle; 21. longissimus cervicis muscle; 22. itertansversarii cervicis muscle; 23. iliocostalis muscle; 24. phrenic nerve; 25. first rib; 26. brachial plexus; 27. scalenus ventralis muscle; 28. trachea; 29.suprascapular et subscapular nerve; 30. thymus (caudal part); 31. axillary artery; 32. sternomandibularis muscle.

Iliocostalis muscle: The iliocostalis thoracis ends in a glistening tendon at the first rib and on the transverse process of the seventh cervical vertebra. Iliocostalis cervicis potion of the iliocostalis is not present in rumunants.

Phrenic nerve: It arises from the root of fifth, sixth and seventh cervical spinal nerves and runs down on the external face of the scalenus ventralis muscle.

Cervical nerve (III): The superior branch supplies intertransversalis, semispinalis and complexus muscles. The inferior branch passes through the intertransversalis muscle and supplies the longus colli, rectus capitis ventralis, brachiocephalicus and splenius muscles.

Cervical nerve (VII): The inferior branch of seventh cervical nerve forms the brachial plexus and gives off a fine twig to form one of the roots of the phrenic nerve.

Trachea: It runs from larynx down the middle of the lower part of the neck, enters the thorax and ends by splitting into three bronchi.

Suprascapualris et subscapualris nerve: It emerges from anterior part of the bracheal plexus, and passes outwards in the space between subscapularis and supraspinatus muscles. it winds rounds the anterior border of scapula and gains the supraspinatus fossa.

Caudal part of thymus: It is related externally to the sternocephalicus and sternothyroideus muscles and external jugular vein, and internally to trachea, oesophagus, common carotid artery and common vagosympathetic trunk.

DISSECTION: Dissect and remove the mandibular gland. Cut the ear at its base and remove it. Also remove the external jugular vein and the strap muscles of the neck. The nerves, arteries, veins and visceral organs of the neck are revealed in lateral view. Fig. 2.5.

Pharyngeal branch of vagus nerve: It arises from the vagus at the level of the atlantooccipital articulation and supplies the pharynx.

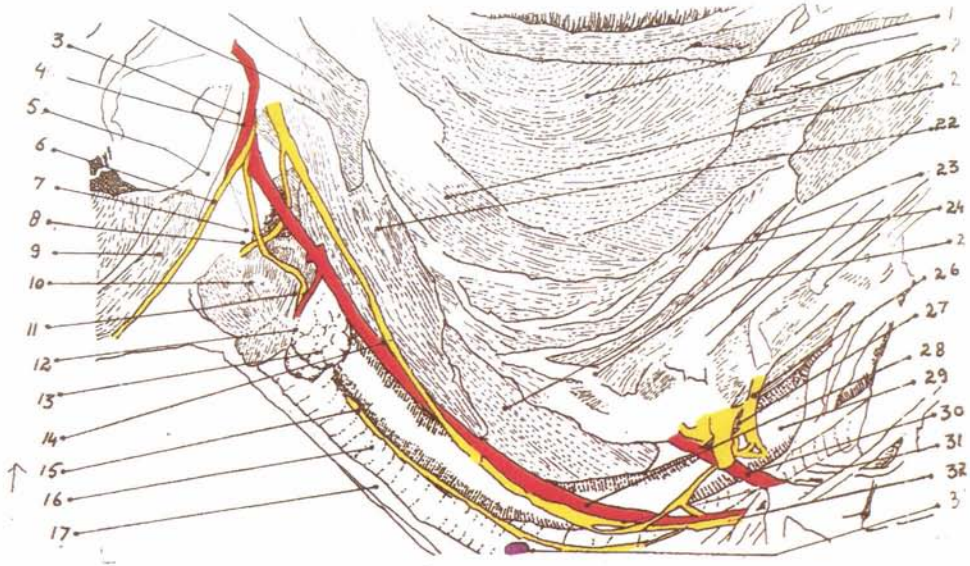

Fig. 2.5 : 1. omotransversarius muscle; 2. external carotid artery; 3. stylohyoid bone; 4. longus capitis muscle; 5. vagus nerve x (pharyngeal branch); 6. hypoglossal nerve XII; 7. cranial laryngeal nerve; 8. cricopharyngeus et thyropharyngeus muscle; 9. styloglossus muscle; 10. thyrohyoideus muscle; 11. cranial thyroid artery; 12. cricothyroideus muscle; 13. thyroid gland; 14. vagosympathetic trunk; 15. recurrent laryngeal nerve (X); 16; trachea; 17. sternothyroideus muscle; 18. rhombiodeus cervicis muscle; 19. splenius muscle; 20. semispinalis capitis muscle; 21. longissimus capitis et atlantis muscle; 22. inter-transversarii ventralis cervicis muscle (atlantal part); 23. iliocostalis muscle; 24. longissimus cervicis muscle; 25. longus colli muscle; 26. cervicothoracic ganglion; 27. vertebral nerve; 28. common carotid artery; 29. oesophagus; 30. costovertebral trunk; 31. vagus nerve X; 32. sympathetic trunk; 33. deep medial cervical lymph node.

Hypoglossal nerve (XII): After it arises from medulla oblongata, it courses and follows the vagus, becomes superficial, related to mandibular lymph node and gland and penetrates between mylohyoideus and hyoglossus muscles.

Cranial laryngeal nerve (X): It emerges caudal to the pharyngeal branch, descends by the side of the pharynx, gives off the external branch and continues as internal branch. The external branch terminates in cricothyroideus muscle. The internal branch penetrates larynx after dividing into cranial and caudal branches.

Cricopharyngeus et thyropharyngeus muscle: It is a narrow muscle that originates from a small area on the cricoid cartilage, caudal to the cricothyroid articulation.

Cricothyroideus muscle: It is a paired muscle, which extends from cricoid cartilage to the thyroid cartilage. It is related laterally to the omohyoideus and rostral end of the sternothyroideus muscles.

Recurrent laryngeal nerve: It leaves the vagus at the aortic arch. The left nerve arises, as the vagus crosses aorta, and courses cranially between oesophagus and trachea. The right nerve originates behind subclavian artery and courses on the ventrolateral surface of trachea.

Semispinalis capitis muscle: It is the largest muscle placed dorsal to the cervical vertebrae. It arise as far cauded as the ninth or tenth thoracic vertebra.

Longissimus capitis et atlantis muscle: It presents two narrow bands which extend along the cervical vertebrae just dorsal to articular processes.

Intertransversarii ventrales cervicis muscle (atlantal part): These are small muscles located between the transverse processes of cervical, thoracic and lumbar vertebrae and are better developed in cervical region.

Longus colli muscle: It lies on the ventral surface of the cervical and first five to six thoracic vertebrae. It consists of a thoracic portion and a cervical portion. In cervical region it is bounded

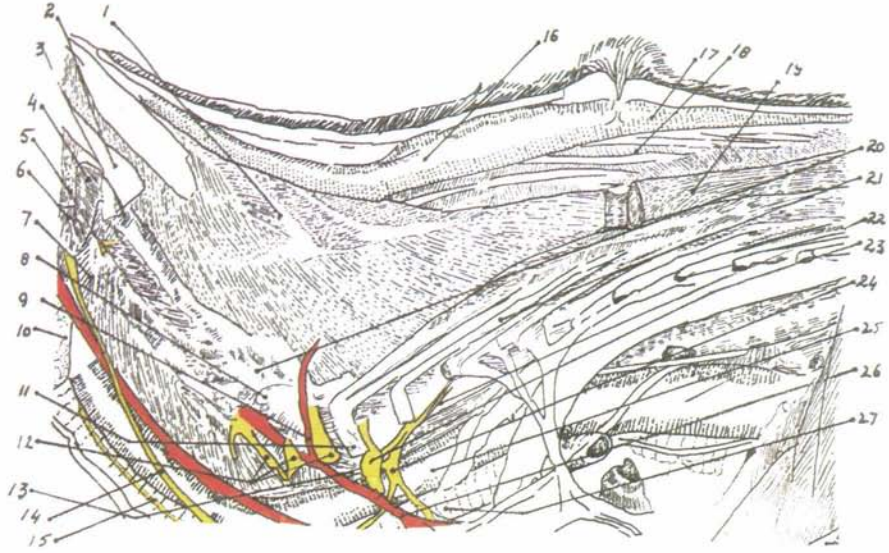

Fig. 2.6 : 1. semispinalis capitis muscle; 2. longissimus capitis muscle; 3. longissimus atlantis muscle; 4. omotransversarius muscle; 5. cervical nerve III; 6. intertransversarii ventralis cervicis muscle (atlantal part); 7. longus colli muscle; 8; cranial articular process of C.7; 9. deep cervical artery; 10. thyroid gland; 11. first rib; 12. cervical nerves VI to VIII; 13. vertebral nerve; 14; vagosympathetic trunk; 15. recurrent laryngeal nerve (X); 16. ligamentum nuchae (funicular part); 17. supraspinous ligament; 18. spinalis et semispinalis muscle (thoracic and cervical parts); 19. longissimus thoracis muscle; 20. remains of intertransversarii cervicis muscle; 21. iliocostalis thoracis muscle; 22. sympathetic trunk; 23. thoracic nerves I and II; 24. cervicothoracic ganglion; 25. oesophagus; 26. costocervical trunk; 27. trachea.

laterally by scaleni and longus capitis muscles and dorsally by transverse processes of cervical vertebrae except atlas.

Cervicothoracicum (stellate) ganglion: It lies on the ventrolateral surface of the longus colli muscle, ventral to the costovertebral junction of first rib and first intercostals space. It is formed by the caudal cervical ad first one or two thoracic sympathetic chain ganglia.

Dorsal intercostals arteries: These supply the body of vertebrae, give branches to the ventral region and the intervertebral region of the vertebrae.

Costocervical trunk: This is the lateral branch of intercostalis dorsalis artery and forms the segmental vessel of cervical region.

DISSCETION: Cut the insertion of splenius and rhomboideus muscles and remove them. It will expose the nuchal ligament and epaxial muscle of neck in lateral view. Fig. 2.6.

Ligamentum nuchae (funicular part): It is a dorsal part and consists of two divisions. It extends from first spine (thoracic), proceeds forwards being closely associated with fellow of apposite side to be inserted on the external occipital protuberance.

Supraspinous ligament: It extends from the sacrum to the occipital bone, attaching to the summit of the vertebral spines. It consists of yellow elastc tissue. It has two parts, lumbodorsal and cervical (ligamentum nuchae).

Spinalis et semispinalis thoracis et cervicis (deep group of erector spinae) muscles: It caps the longissimus thoracis muscle. It can be seen distinctly separating from the longissimus at the level of the first lumbar vertebra. It froms quite a thick mass which extends cranially as far as the third cervical vertebra. Dorsally it is covered by subcutaneous fascia and the nuchal ligament.

Iliocostalis thoracis (lateral column of erector spinae) muscles: It has its origin by means of individual tendons which arise from the first three or four transverse processes of the lumbar

vertebae. They course cramially and in the region of the third to fifth thoracic ribs, they form a large bundle to terminate in common with the tendons of longissimus cervicis on the transverse process of seventh cervical vertebra.

Longissimus capitis et atlantis muscle: It presents two narrow bands which extend along the cervical vertebrae just dorsal to the articular processes.

Cervical nerve (VIII): The inferior branch of the eighth cervical nerve enters into the formation of the brachial plexus. The eighth cervical nerve emerges through the inervertebral foramen between the last cervical and the first thoracic vertebrae.

DISSECTION: Cut remove the semispinalis capitis muscle, the following structures including the nuchal ligament and the deep epaxial muscle of the neck are revealed. Fig 2.7.

Rectus capitis dorsalis major muscle: It originates from spine of axis and inserts at occipital bone near the occipital protuberance. It is bounded dorsally by the funicular part of nuchal ligament and semispinalis capitis, and ventrally by rectus capitis dorsalis minor and atlantoaxial joint.

Rectus capitis dorsalis minor muscle: It is a small muscle which lies under rectus capitis dorsalis major. It is located between the atlas and the occipital bone.

Obliquus capitis cranialis muscle: It is short, strong quadrilateral muscle which fills the space between the atlas and the occipital bone and is covered by the aponeurosis of the splenius and brachiocephalicus muscles.

Obliquus capitis caudalis muscle: It is thick, quadrilateral muscle that lies on the dorsolateral aspect of the atlas and axis.

Longissimus thoracis muscle: It occupies the angle formed by the spines of the thoracic and lumbar vertebrae.

Multifidus cervicis muscle: It is composed of series of muscles on the dorsal surface of the arches of the last five cervical vertebrae and the transverse process of the first thoracic vertabra. It is present in each intervertebral joint except, the

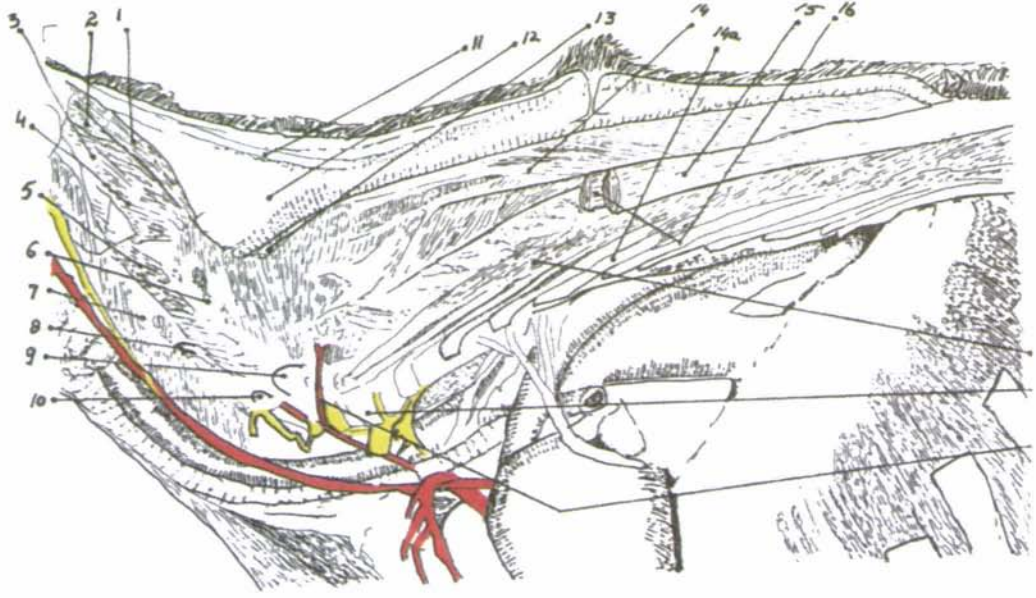

Fig. 2.7 : 1. rectus capits dorsalis major muscle; 2. rectus capitis dorsalis minor muscle; 3. obliquus capitis cranialis muscle; 4. obliquus capits caudalis muscle; 5. longissimus atlantis muscle; 6. multifidus cervicis muscle; 7. longus colli muscle; 8. ventral transverse process of C.5; 9. cranial articular process of C.7; 10. lateral transverse process of C.6; 11. ligamentum nuchae (funicular part); 12. cranial lamellar part; 13. caudal lamellar part; 14. spinalis et semispinalis; 14a. iliocostalis muscle; 15. longissimus thoracis muscle; 16. semispinalis capitis muscle; 17. multifidus thoracis muscle; 18. first rib; 19. deep cervical artery.

articulation between atlas and axis.

Multifidus thoracis muscles: These are series of small segmented muscles, each of which lie along the sides of the vertebral spines from the sacrum to the neck.

DISSECTION: The epaxial muscles of the neck are cut and removed, and the elastic nuchal ligament is revealed fully. Fig. 2.8.

Interspinous ligaments: These are narrow elastic bands which fill up the interspinous space and are attached in front to the posterior border and behind to the anterior border of supraspinous processes of the vertebrae.

Interspinales muscle: It extends from the cervical to the sacral vertebrae. The muscles are largely tendinous through out the length of vertebral column. The fibres extend between the contiguous spines of the vertebrae.

Vertebral artery: It arises from the subclavian artery on the left side and brachiocephalic trunk on the right. It begins opposite the first intercostals space and passes dorsally and cranially. On left it crosses the oesophagus and on right the trachea. It emerges from the thoracic inlet and passes along the longus colli muscle medially and scalenus medius muscle laterally.

DISSECTION: Cut and remove the entire epaxial musculature and observe the cervical vertebrae, vertebral artery and ligamentum nuchae in lateral view. Fig. 2.9.

Funicular part of ligamentum nuchae (dorsal part): In the region of neck the funicular part consists of two divisions. It extends from spine (thoracic), proceeds forwards being closely associated with fellow of opposite side to be inserted on the external occipital protuberance.

Paired cranial lamellar part of ligamentum nuchae: It springs from broad funicular part and consists of cranial and caudal divisions. The cranial division is double and thin and is inserted on the supraspinous processes of second, third and fourth cervical vertebrae.

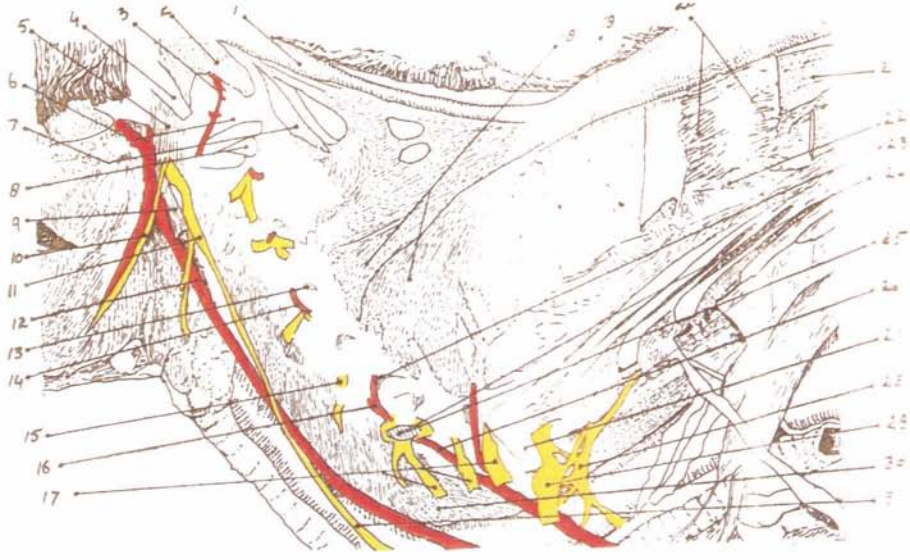

Fig. 2.8 : 1. ligamentum nuchae (funicular part); 2. rectus capitis dorsalis minor muscle; 3. vertebral artery; 4. longissimus capitis muscle; 5. occipitohyoideus muscle; 6. dorsal arch of axis; 7. rectus capitis dorsalis major; 8. dens of axis; 9. longus capitis muscle; 10. hypoglossus nerve XII; 11. vagus nerve X; 12. common carotid artery; 13. synovial joint cavity C.3 and C.4; 14. vertebral artery C.3. 15. cervical nerve V. 16. vertebral artery in intervertebral space C.5 and C.6; 17; cervical nerves VI and VIII; 18. ligamentum nuchae (cranial and caudal lamellar part); 19. interspinous ligaments; 20. interspinales muscle; 21. spinalis et semispinalis muscle; 22. multifidus thoracis muscle; 23. synovial joint cavity C.5 and C.6; 24. deep cervical artery; 25. lateral transverse process of C.6.; 25. sympathetic trunk; 26. vertebral artery; 27. first rib; 28. cervicothoracic ganglion; 29. thoracic I nerve; 30. longus colli muscle; 31. vagosympathetic trunk.

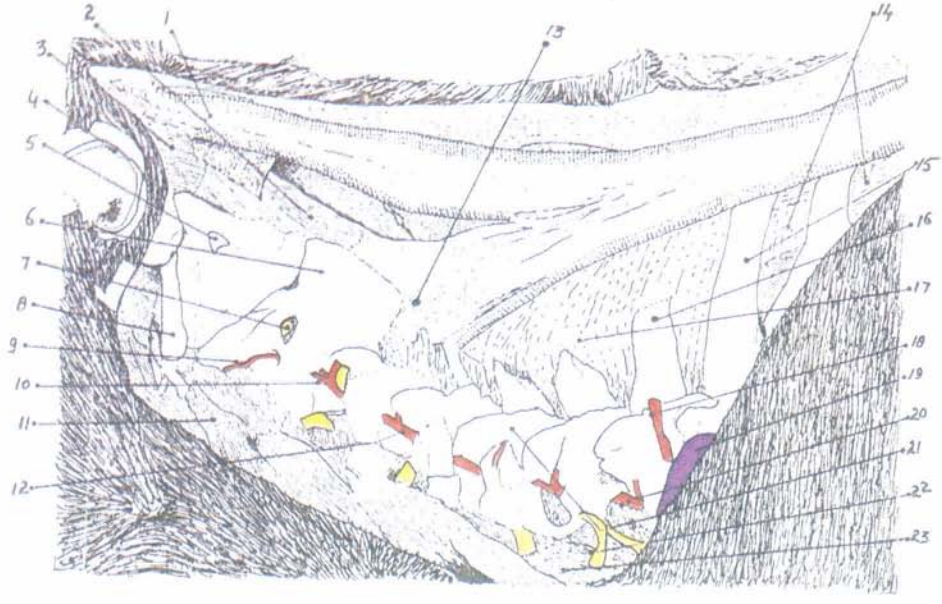

Fig. 2.9 : 1. ligamentum nuchae (funicular part); 2. rectus capitis dorsalis major muscle; 3. rectus capitis dorsalis minor muscle; 4. auricular cartilage; 5. lateral vertebral and alar foramina of atlas (opening); 6. dorsal spinous process of axis; 7. cervical nerve II; 8. wing of atlas; 9. vertebral artery; 10. vertebral artery entering intervertebral foramen between axis and C.3; 11. longus capitis muscle; 12. vertebral artery (dorsal and ventral muscular branches); 13. ligamentum nuchae (paired cranial lamellar part); 14. interspinous ligaments; 15. dorsal spinous process of thoracic I; 16. dorsal spinous process of C.7; 17. ligamentum nuchae (single caudal lamellar part); 18. deep cervical artery; 19. superficial cervical lymph node; 20. vertebral artery at C.6; 21. lateral transverse processes of C.5 and C.6; 22. cervical nerve VI; 23. longus colli muscle.

Single caudal lamellar part of the ligamentum nuchae: The posterior division which is single starts from the anterior border of the supraspinous process of the first thoracic vertebra and is inserted on the supraspinous processes of the fifth, sixth and seventh cervical vertebrae.

SURGICAL ANATOMY FOR COMMON SURGICAL AFFECTIONS OF NECK REGION

OESOPHAGOTOMY

(A) **Anatomical location:** Oesophagus is a direct continuation of the pharynx and extends from the latter in the form of a muscular tube upto the cardia of the stomach. it is about 90 to 105 cm long. In the anterior third of the neck, oesophagus lies dorsal to the trachea in the groove formed by the longus colli muscles. From the level of the third to the sixth cervical vertebrae, the oesophagus is present on the left side of trachea medial to the jugular groove. The cervical part is in association with carotid artery, internal jugular vein, thymus and cervical lymph node. The lateral surface (cervical part) is covered by the sternomastoideus, cleidomastoideus, omohyoideus and scalenus muscles.

(B) **Site for surgical approach:** At the level of the obstruction (in the neck region) between jugular vein and sternomandibular muscle.

(C) **Structures encountered:** Skin, superficial and deep fascia, thick muscular wall of oesophagus covered on the outside by a loose fibrous tissue and lined by mucous membrane. Besides carotid artery, vagosympathetic trunk and recurrent laryngeal nerve are located deep in this region.

TRACHEOTOMY:

(A) **Anatomical location:** Trachea is a cartilaginous flexible tube composed of a number of incomplete rings whose circumference is completed by a strip of muscle, held to each other by a fibrous membrane. It runs from larynx down to the middle of the lower part of the neck, enters the thorax and ends by splitting into three bronchi.

(B) Site for surgical approach: The trachea is most superficial at about the junction of the upper and middle third of neck and this area can be determined by palpation.

(C) Structures encountered:

(i) In temporary tracheotomy: Skin, superficial and deep fascia, tracheal annular ligament placed between two rings, mucous membrane (pseudostratified).

(ii) In permanent tracheotomy: Same as above but in addition one complete and two partial tracheal rings are cut.

LARYNGOTOMY

(A) Anatomical location: Larynx is ventrally located caudal to the ramus of the mandible and it extends caudad to the level of the second cervical vertebra. It is related cranially to the pharynx, dorsally to the entrance into the oesophagus, laterally to the constrictor muscle of pharynx, omohyoideus and sternomandibularis muscles, rostral border of the thyroid gland and the linguofacial vein, and ventrally to the sternohyoideus muscle.

(B) Site for surgical approach: Just behind and middle of a line joining the angles of the jaws to level of second or third tracheal ring.

(C) Structures encountered: Skin, superficial and deep fascia, sternothyrohyoideus muscle, cricothyroid ligament, underlying mucous membrane.

“This Page is Left Intentionally Blank”

Chapter 3

The Forelimb

DISSECTION: The skin covering the pectoral region has already been dissected and reflected upwards. After reflection of the skin the region should be cleared off the omobrachial and brachial fascia. While clearing the fascia, note a large cephalic vein crossing obliquely upwards and inwards in the groove formed between the pectoralis descendens and brachiocephalicus muscels. The superficial structures of scapular, brachial and antebrachial regions are observed in lateral view. Fig. 3.1.

Trapezius muscle (thoracic part): It is thicker, less extensive and continuous with the cervical part. It extends along the dorsal median line from the atlas to the twelfth thoracic vertebra. The fibres of this part are directed downwards and forwards.

Cut the tendon of cervical part of trapezius muscle to reveal supraspinatus muscle: It is situated at supraspinatus fossa of scapula. At the neck of the scapula it divides into two branches which are fleshy in superficial part while deeper parts are tendinous.

Deltoideus muscle: It lies at scapulohumeral angle, partly on triceps brachii muscle and partly on infraspinatus and teres minor muscles.

Brachiocephalicus muscle: It is placed on the lower side of neck extending from head to craniolateral aspect of arm. The ventral branches of cervical spinal verves emerge between the two parts of this muscle.

Brachial muscle: It is situated in the musculospiral groove of humerus. It is a thick and fleshy muscle which crosses biceps brachii muscle obliquely.

Pectoralis descendens muscle: It is a part of superficial pectoral muscle. It extends from first sternebra to medial surface of humerus. It is closely blended with pectoralis transversus. Pectoralis descendens muscle is darker in colour.

Pectoralis transversus muscle: It is a deeper part of superficial pectoral muscle. It extends from fourth to sixth sternebra and blends with cutaneous trunci on the medial aspect of forearm. It is a thin and flat muscle.

Latissimus dorsi muscle: It is a thin, flat and triangular muscle covering the lateral surface of thorax. The fibres are vertical in direction at the cranial part of muscle, but become oblique dorsocaudally.

Triceps brachii muscle: It is one of the massive muscles located between the caudal border of scapula and humerus. It has three heads i.e. long, medial and lateral which are separated by fat deposits. The long head is the largest.

Tensor fascia antebrachii muscle: It is a long slender muscle, which lies medial to long head of triceps brachii muscle.

Triceps brachii muscle (lateral head): The lateral head is broad and flat and lies on the lateral surface of olecranon. The axillary nerve and circumflex humeral artery pass between the long and the lateral heads.

Deep digital flexor muscle (ulnar head): It extends from proximal end of ulna to flexor tubercle of distal phalanx of third and fourth digits.

Cranial cutaneous antebrachial nerve (of axillary nerve): It emerges between the acromial and scapular parts of the deltoideus muscle. During its course in the arm it releases cutaneous twigs, and cutanei brachii lateralis cranialis nerve to innervate the proximal part of the lateral aspect of the arm.

DISSECTION: Separate the limb from the body by cutting the origin of the rhomboideus muscle. The muscles that attach the limb to the head, neck and trunk have all been cut. The parts of these muscles, still maintained with the limb, may now be identified. Secure the limb to the sling, by passing a string through the cartilage of scapula. The deep fascia of the arm on the medial face of the shoulder may now be removed.

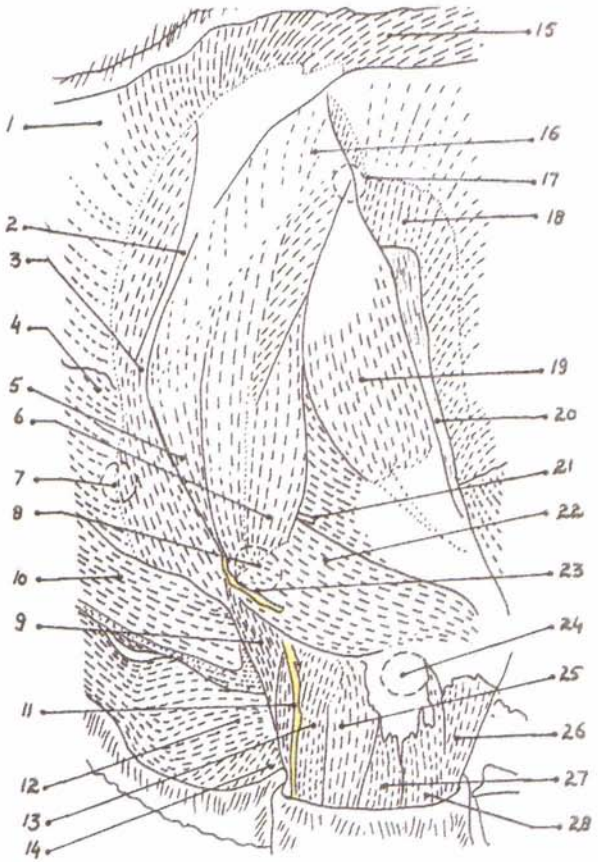

Fig. 3.1 : 1. trapezius muscle (cervical part); 2. scapular spine; 3. acromion, 4. omotransversarius muscle; 5. deltoideus muscle (acromial part); 6. deltoideus muscle (scapular part); 7. humerus (major tuberosity); 8. deltoid tuberosity of humerus (position); 9. brachialis muscle; 10. brachiocephalicus muscle; 11. lateral cutaneous antebrachial nerve (radial nerve. Superficial branch); 12. pectoralis descendens muscle; 13. extensor carpi radialis muscle; 14. pectoralis transversus muscle; 15. trapezius muscle (thoracic part); 16. omobrachial fascia; 17. scapula (caudal angle); 18. latissimus dorsi muscle; 19. triceps brachii muscle (long head); 20. tensor fasciae antebrachii muscle; 21. cutaneous brachii lateral cranial nerve (axillary nerve); 22. triceps brachii muscle (lateral head); 23. cranial cutaneous antebrachial nerve (axillary nerve); 24. humerus (lateral epicondyle); 25. extensor digitorum comunis muscle; 26. flexor digitorum profundus muscle (ulnar head); 27. extensor digitorum laterlis muscle; 28. extensor carpi ulnaris muscle.

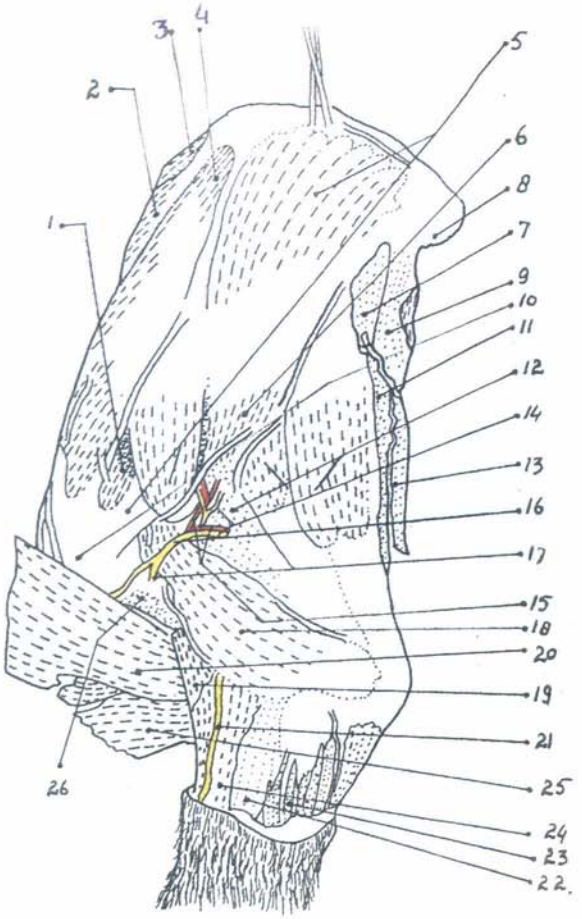

Fig. 3.2 : 1. deltoideus muscle (acromial part, origin); 2. serratus ventralis cervicis muscle; 3. rhomboideus muscle; 4. supraspinatus muscle; 5. infraspinatus muscle (including its tendon of insertion); 6. deltoideus muscle (scapular part); 7. teres major muscle; 8. scapula (caudal angle); 9. serratus ventralis thoracis muscle; 10. humerus (major tuberosity); 11. tensor fasciae antebrachii muscle; 12. triceps brachii muscle (long head); 13. latissimus dorsi muscle; 14. cranial lateral cutaneous brachial nerves (axillary nerve); 15. caudal circumflex humeral artery and vein; 16. axillary nerve; 18. cranial cutaneous antebrachial nerve; 18. triceps brachii muscle (lateral head); 19. brachialis muscle; 20. brachiocephalicus muscle; 21. lateral cutaneous antebrachial nerve (radial nerve, superficial branch); 22. extensor digitorum communis muscle; 23. extensor digitorum lateralis muscle; 24. extensor carpi radialis muscle; 25. pectorialis descendens muscle; 26. deltoideus muscle (insertion on deltoid tuberosity).

Remove the acromial part of the deltoideus muscle and incise its scapular part. The muscles of scapular, brachial and antebrachial regions in detached limb are revealed in lateral view. Fig. 3.2.

Infraspinatus muscle: It fills the infraspinatus fossa. It is heavily tendinous muscle having tendinous insertion on medial surface and caudal part of greater tubercle of the humerus.

Terse major muscle: It lies on the medial surface of triceps brachii muscle. It is a spindle shaped muscle with tapering ends and is widest at the level of shoulder joint.

Serratus ventralis thoracis muscle: It is a thin, flat muscle covered by aponeurosis. The cranial half of lateral thoracic wall is covered by this muscle. The ventral border of the muscle is serrated, presenting six digitations.

Axillary nerve: It derives its fibres from seventh and eighth cervical roots of the brachial plexus. It is caudal to shoulder joint and passes between subscapular artery and subscapularis muscle.

Deltoideus muscle (acromial part): The origin of the acromial part is in the form of a wide, flattened tendon. The fleshy portion of this muscle is shorter but thicker and wider then the scapular part.

Deltoideus muscle (scapular part): The scapular part is partly aponeurotic and partly fleshy. It is mostly inserted to the fascia covering the triceps brachii muscle.

Serratus ventralis cervicis muscle: The serratus ventralis is a large fleshy muscle. The cervical part is placed on the lateral side of neck and partly on lateral wall of thorax. It is inserted on triangular area of the antero-superior part of the ventral surface of scapula.

Rhomboideus cervicis muscle: The cervical part is thick and is inserted to the medial surface of the cartilage of scapula.

Triceps brachii muscle (long head): It is the largest and longest of the three divisions, and can be seen from both the lateral and medial aspect of the shoulder and arm.

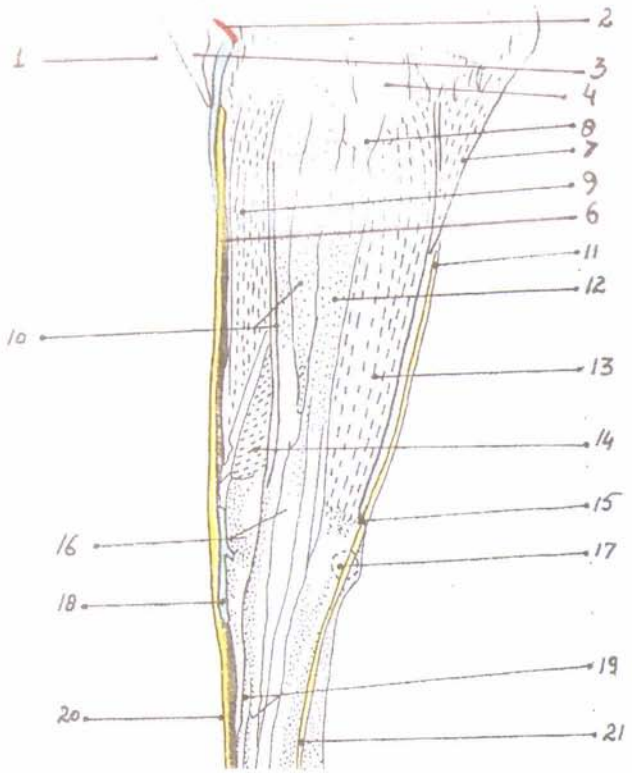

Fig. 3.3 : 1. pectoralis descendens muscle; 2. superficial cervical artery (deltoid brach); 3. brachialis muscle; 4. humerus (lateral epicondyle); 5. cephalic vein; 6. lateral cutaneous antebrachila nerve (radial nerve); 7. flexor digitorum profunds muscle (ulnar head); 8 radius (lateral tuberosity); 9. extensor carpi redialis muscle; 10. extensor digitorum communis muscle; 11. ulnar nerve; 12. extensor digitorum lateralis muscle; 13. extensor carpi ulnaris muscle; 14. abductor digiti I longus muscle; 15; ulanr nerve (palmar branch); 16. radius (distal end); 17. accessory carpal bone; 18. accessory cephalic vein; 19; position of metcarpal tuberosity; 20. radial nerve (superficial branch); 21. ulnar nerve (dosal branch).

DISSECTION: The skin of the upper part of forearm has already been removed. Now, dissect and remove the skin from the lower half of the forearm and manus. While doing so, observe the cutaneous branch of radial nerve, which is placed

subcutaneously and accompanied by vein passing down the anteromedial aspect of the forearm to the metacarpal region. While removing the skin on the inside of the forearm, appreciate the disposition of cephalic vein which is also appreciate the disposition of cephalic vein which is also subcutaneous. Remove the deep fascia covering the muscles of forearm. Care should be taken not to destroy the tendon of extensor carpi obliquus muscle which crosses the tendon of extensor carpi radialis muscle above the carpus. Remove the dense antebrachial fascia entirely. The ulnar nerve runs superficially between the extensor carpi ulnaris and flexor carpi ulnaris muscles. The superficial muscles and nerves of the antebrachium and carpus in lateral view are observed. Fig. 3.3.

Deep digital flexor muscle (ulnar head): It has three heads viz. radial, humeral and ulnar. Ulnar head is fleshy, triangular and short. It is situated at proximal end of ulna.

Extensor carpi radialis muscle: It is present on the cranial surface of radius. At its origin, it is triangular, near the middle of radius it is oval and at radiocarpal joint, it becomes a flat tendon.

Common digital extensor muscle: It is a complex muscle comprising of two distinct bellies viz. lateral and medial which converge at the distal ends of both radius and ulna. They are held together by a layer of deep carpal fascia. The lateral belly has two heads, a superficial and a deep one. Medial belly is thick and triangular in shape.

Lateral digital extersir muscle: It is situated in the middle of the lateral surface of the forearm.

Extesor carpi ulnaris muscle (ulnaris lateralis): It lies on the posteroexternal aspect of the forearm behind the lateral digital extensor muscle. Morphologically it is an extensor but functionally it belongs to the flexor group.

Abductor digit I longus muscle: It corsses obliquely across the dorsal surface of the carpus.

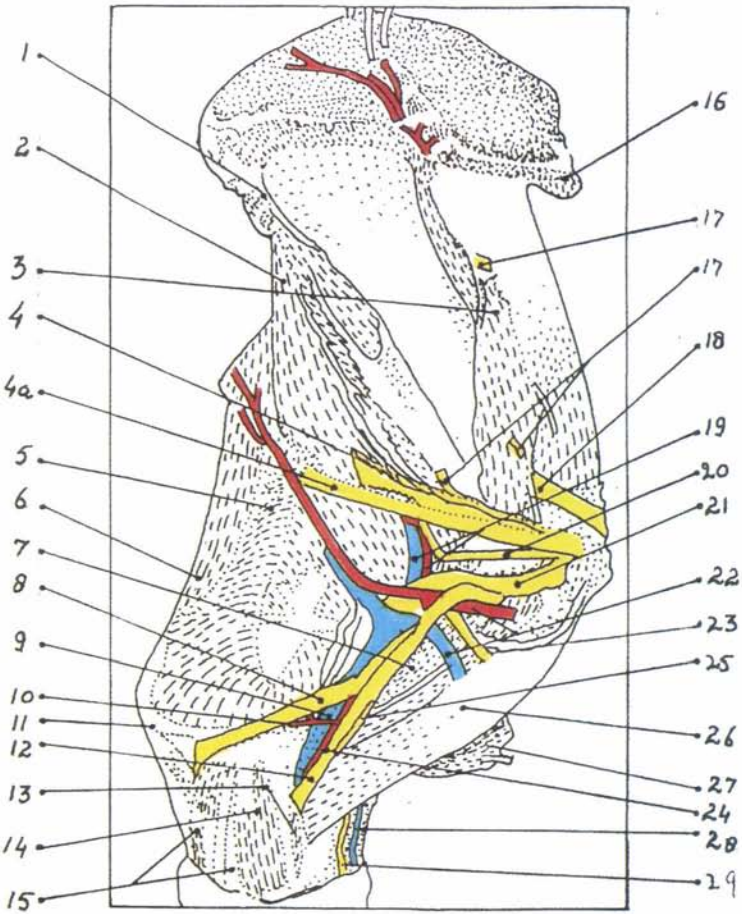

Fig. 3.4 : 1. serratus ventralis thoracis muscle; 2. teres major muscle; 3. subscapularis mscle; 4. axillary nerve; 4. thoracodorsal nerve; 5. triceps brachii muscle (long head); 6. tensor faciae antebrachii muscle; 7. coracobrachialis muscle; 8. ulnar nerve; 9. brachial vein; 10. collateral ulnar artery; 11. flexor carpi ulnaris muscle (ulnar head); 12. median nerve; 13. pronater teres muscle; 14. flexor carpi radialis muscle; 15. flexor carpi ulnaris muscle; 16. serratus ventralis cervicis muscle; 17. subscapular nerve; 18. suprascapular nerve; 19. subscapular artery and vein; 20. axillary nerve; 21. radial nerve; 22. axillary artery and vein; 23. musculocutaneous nerve; 24. brachial artery; 25. distal muscular branch of 23; 26. biceps brachii muscle; 27; pectorlis descendens muscle; 28. cephalic vein; 29. medial cutaneous antebrachial nerve (musculocutaneous nerve).

Ulnar nerve (palmar branch): Palmar nerve is a branch of ulnar nerve. It descends along the superficial digital flexor muscle and gives a deep branch to the interosseous muscle distal to the carpus. Its superficial branch receives a communicating branch from median nerve thus forming palmar common digital nerve IV.

Accessory cephalic vein: It arises from cephalic vein in the lower third of forearm coursing distally to medial border of the tendon of extensor carpi radialis muscle. At middle of metacarpus it turns to dorsal surface alongwith extensor tendons.

Ulnar nerve (dorsal branch): It emerges between the tendons of flexor carpi ulnaris and ulnaris lateralis muscles.

Radial nerve (superficial branch): It emerges between brachialis and extensor carpi radialis muscles and contiues distally on craniomedial aspect of forearm.

N.B. The group of muscle of the forearm and maus consists of extensors and flexors. The extensors of the carpus and the digit occupy the anterior and external aspects of the region, while flexors occupy the posterior aspect. The medial aspect of forearm is not occupied by muscles except at its proximal third. Hence, medial surface of radius is mostly subcutaneous.

DISSECTION: After cutting away the muscles that join the limb to the trunk the serratus ventralis muscle is reflected and removed from its insertion at superoposterior part of ventral surface of scapula and from cartilage of scapula at medial face. Care is taken not to injure the structures beneath. At middle distal part of scapula the pectoral ascendens, pectoral descendens and pectoral transversus muscles are dissected out and removed alongwith both the remnants of brachiocephlicus muscle. It reveals the muscles, vessels and nerves of the scapular, branchial and antebrachial regions in medial view. Fig. 3.4.

Subscapular nerve: It derives its fibres form the ventral braches of sixth and seventh cervical nerves and it innervates the subscapular muscle.

Suprascapular nerve: It is derived from sixth and seventh components of the brachial plexus. The nerve passes across the lateral face of the plexus to the interstices between the

supraspinatus and subscapularis muscles furnishing the former muscle and the infraspinatus muscle.

Subscapular artery: It is a branch of axillary artery and is almost as large as the brachial artery. The vessel passes dorsocaudally between the subscapularis and teres major muscle and continues along the caudal border of scapula.

Subscapular vein: It arises from axillary vein. It courses between subscapularis and teres major muscles to the medial surface of long head of biceps brachii muscle and reaches the caudal border of scapula.

Biceps brachii muscle: It is a long fusiform muscle, situated in front of the humerus, extending from tuber scapula to the radial tuberosity and ulna by two branches of the tendon of insertion. The muscle is thick in the middle.

Medial cutaneous antebrachial nerve (musculocutaneous nerve): It passes between the brachialis and biceps brachii muscles and emerges between the latter muscle and the brachiocephalicus muscles. It innervates fascia and skin of the craniomedial and cranial aspect to the forearm.

Subscapularis muscle: It consists of three parts having a common tendon of insertion on the lesser tubercle of humerus. It is a flat muscle outlining the costal surface of scapula.

Thoracodorsal nerve: The nerve derives its fibres chiefly from the ventral branches of the seventh and eighth cervical nerves. It is distributed mainly to the latissimus dorsi muscle.

Coracobrachialis muscle: It is flat and lies on the medial surface of the shoulder joint and arm. It crosses the shoulder joint obliquely to terminate on the medial side of the humerus.

Radial nerve: It arises from ventral branches of seventh and eighth cervical and first thoracic nerves. It courses between teres major and long as well as medial heads of triceps brachii muscles.

Axillary artery: It is the continuation of the subclavian artery near the interval between the subscapularis and teres major muscles. It divides into the subscapularis and brachial arteries.

Musculocutaneous nerve: It derives its fibres from sixth, seventh and eighth cervical components of brachial plexus. It forms a loop with median nerve.

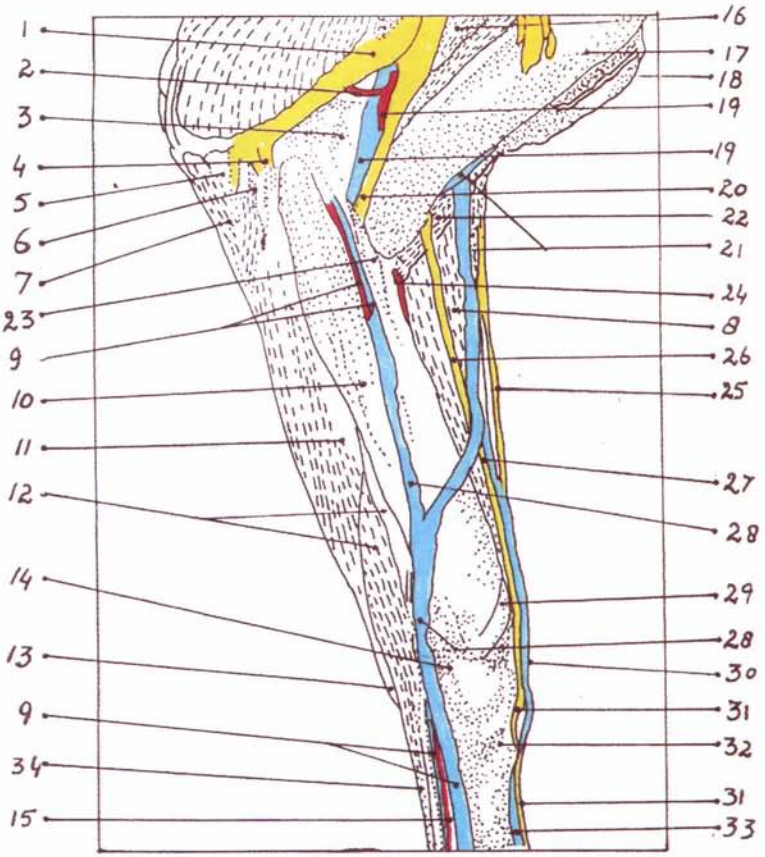

Fig. 3.5 : 1. ulnar nerve; 2. ulnar collateral artery; 3. humerus; 4. caudal cutaneus antebrachial nerve (ulnar nerve); 5. flexor digitorum profudus muscle (ulnar head); 6. flexor carpi ulnaris muscle (humeral head); 7. flexor carpi ulnaris muscle (ulnar head); 8. extensor carpi radialis muscle; 9. median artery and vein; 10. flexor carpi radialis muscle; 11. flexor carpi ulnaris muscle; 12. flexor digitorum superficialis muscle (superficial part); 13. accessory carpal bone (position); 14. flexor retinaculum; 15. flexor digitorum profundus muscle; 16. coracobrachilis muscle; 17. biceps brachii muscle; 18. pectoralis descendens muscle; 19. brachial artery and vein; 20. median nerve; 21. cephalic vein; 22. brachialis muscle; 23. pronater teres muscle; 24. transverse cubital artery; 25. lateral cutaneous antebrachial nerve (radial nerve); 26. medial cutaneous antebrachial nerve (muscular cutaneous nerve); 27. accessory cephalic vein; 28; radial vein; 29. abductor digiti I logus mscle; 30. radial artery; 31. radial nerve (superficial branch); 32. metacarpal bone; 33. common dorsal digital vein III. 34. flexor digitorum superficialis muscle.

Axillary vein: It arises from subclavian vein at cranial border of first rib and runs medially towards the shoulder joint.

Brachial artery: It is the continuation of the axillary artery in the arm after the subscapualris artery is given off. It courses distally following the median nerve and at the flexor surface of the elbow joint it passes beneath the tendons of insertion of the biceps brachii and pronator teres muscles. Distal to elbow joint, it continues as median artery.

Brachial vein: It is an upward continuation of media vein after it divides into two at the level of the lower part of the medial condyle of humerus. The two roots of brachial vein ascend for a short distance after its origin. These two roots unite to form a single brachial vein which terminates below and behind the level of shoulder joint and is continued as an axillary vein.

Median nerve: It derives its fibres from ventral branches of eighth cervical and first and second thoracic nerves. It courses distally in the arm. Near its origin it is in common sheath with ulnar nerve.

Pronater teres muscle: It is a small, narrow muscle lying on the medial aspect of the elbow joint.

Flexor carpi ulnaris muscle: It is situated behind flexor carpi radialis muscle on the posteromedial aspect of the forearm.

Flexor carpi radialis muscle: It is situated on the posteromedial aspect of the forearm.

DESSECTION: After clearing the fascia from medial aspect of the antebrachium and carpus, the proximal ends of the ular, median and radial nerves are cut and reflected downwards to reveal the muscles, vessels and nerves present on medial aspect of antebrachial region. Fig. 3.5.

Caudal cutaneous antebrachial nerve (ulnar nerve): It is detached from ulnar nerve slightly proximal to elbow and after dividing invariably furnishes to dorsomedial aspect of middle two third and caudal aspect of proximal third of the forearm.

Brachial artery: It is the continuation of the axillary artery in

the arm after the subscapular artery is given off. It courses distally following the median nerve and at flexor surface of the elbow joint it passes benath the tendons of insertion of the biceps brachii and pronator teres muscles. After giving off common interosseous artery distal to elbow joint it continues as the median artery.

Median nerve: It crosses the medial surface of the axilllary artery and forms a loop with the musclocutaneous nerve in the axillary region.

Cephlic vein: It is superficial vein and is placed in the forearm. It passes subcutaneously, first between the extensor carpi radialis muscle ad the radius and afterwards on the anteromedial and anterior aspects of the forearm, in continuation with the radial nerve.

Lateral cutaneous antebrachial verve (radial nerve): It is a branch of cranial cutaneous anterachial nerve. It arises as a cutaneous twig from this nerve and innervates the cranial proximal part of the lateral aspect of the arm.

Accessory cephalic vein: It arises in the lower third of the forearm and follows distally the medial border of the tendon of extensor carpi radialis muscle. At about the middle of the metacarpus, it attains the dorsal surface in the proximity of the tendons of extensor muscles.

Tendon of long abductor muscle of first digit: It is thin and flat tendon lying deeply to the other members of the extensor group. It courses obliquely across the dorsal surface of the carpus.

Radial artery: It leaves the median artery near the middle of the forearm and extends distally along the mediopalmar aspect of the carpus.

Radial nerve (superficialis): The superficial branch of radial nerve emerges between the brachialis and extensor carpi radialis muscles. Near craniodistal border the lateral head of the triceps brachii muscle it gives cutaneous antebrachii lateralis branch. It releases few twigs to innervate the craniolateral aspect of the capusule of the elbow joint.

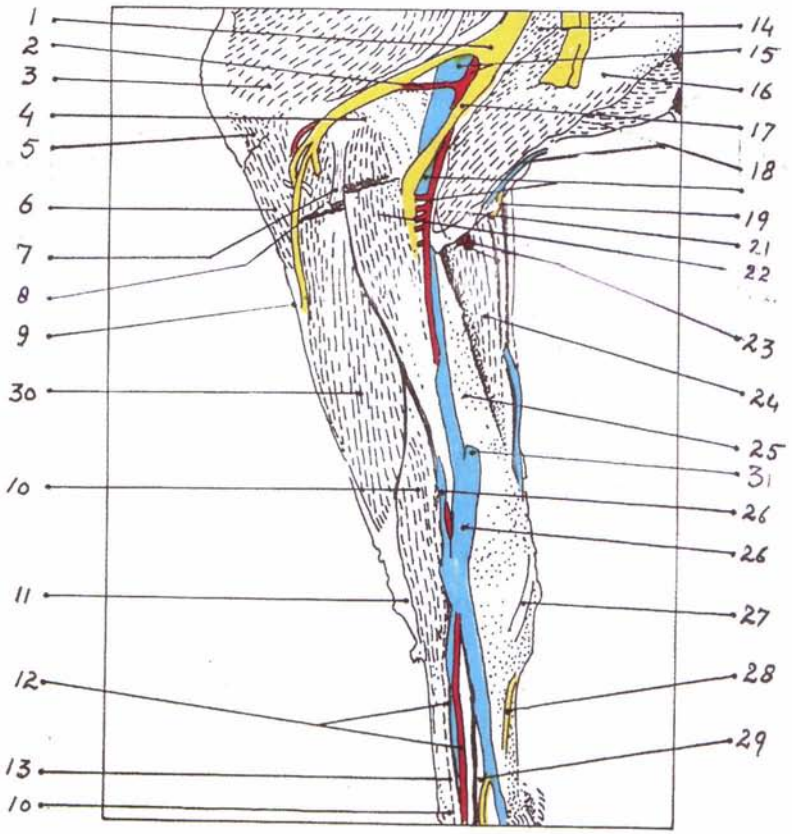

Fig. 3.6 : 1. ulnar nerve; 2. ulnar collateral artery; 3. triceps brachii muscle (long head); 4. medial epicondyle of humerus; 5. flexor carpi ulnaris muscle (ulnar head); 6. flexor digitorum profundus muscle (ulnar head); 7. flexor carpi ulnaris muscle (humeral head); 8. flexor digitoum superficialis muscle; 9; flexor carpi radialis; 10. flexor digitorum superficialis muscle (superficial part); 11. accessory carpal bone; 12. median artery and vein; 13. flexor digitorum superficilis muscle (deep part); 14. coracobrachialis muscle; 15. brachial artery and vein; 16. biceps brachii muscle; 17. median nerve; 18; cephalic vein; 19. medial cutaneous antebrachial nerve; 20. common interosseous artery; 21. brachilis muscle; 22. biceps brachii (laceratus fibrosus); 23. transverse cubital artery; 24. extensor carpi radialis muscle; 25. radius; 26. radial artery and vein; 27. abductor digiti I longus muscle (insertion on metacarpal III); 28. common dorsal digital nerve II; 29; interosseus muscle (suspensory ligament); 30. flexor carpi ulnaris muscle; 31. cephalic vein.

Common dorsal vein of third digit: At about the middle of the metacarpus, the accessory cephalic vein becomes the common dorsal vein of third digit. Few branches arise from the lateral saphenous vein which course to the superficial plantar arch half way down the metacarpus and forks into common dorsal digital vein of digits II and III.

Ulnar nerve: It derives its fibres from ventral branches of the eighth cervical and first and second thoracic nerves. It descends over the medial face of the axillary artery in company with median nerve. At middle third of the arm, it inclines caudally and crosses the medial face.

Collateral ulnar artery: It arises from the caudal aspect of the brachial artery slightly proximal to the level of the olecranon tuber of the ulna.

Flexor carpi ulnaris muscle (humeral and ulnar heads): It is a thin and flat muscle derived from two origins which partially cover the remainder of the flexor group. It lies superficially on the caudomedial aspect of the forearm. The humeral head arises from medial epicondyle of the humerus and the ulnar head from caudal and medial surfaces of the olecranon. Both the heads insert in common with the tendon of insertion of ulnaris lateralis into proximal border and lateral surface of accessory carpal bone.

Flexor digital muscle (superficial part): It is blended at its origin with the flexor carpi ulnaris. It is divided into two bellies, superficial and deep and terminates on tendons at the distal part of forearm. Superficial tendon passes over the flexor retinaculum. It perforates the metacarpal fascia and joins the deep tendon about the middle of metacarpus.

Median vein: It is formed by the union of radial and ulnar veins. It passes under the pronater teres muscle and infront of median artery divides into two branches, which are continued at lower medial condyle of humerus as the brachial veins.

Deep digital flexor muscle: It consists of three heads, radial, humeral and ulnar. The humeral is largest, the radial is the deepest and ulnar the most lateral.

Flexor retinaculum (transverse ligament): It is thick and strong extending from accessory carpal bone and its distal ligament forming the palmar boundary of the carpal canal. It has superficial and deep thicker layers. The superficial tendon of superficial digital flexor muscle passes between the two layers.

DISSECTION: The humeral head of extensor carpi radialis muscle which orginates from epicondyloid crest of humerus is severed and removed. The components originating from radial fossa are revealed in lateral view. Fig. 3.6.

Common digital extensor muscle: It is more complex extensor consisting of two distinct bellies. Both heads converge at about the middle of forearm.

Lateral digital extensor muscle: It is caudal most muscle functioning as extensor. It courses along the middle of the lateral surface of the forearm.

Ulnar nerve (dorsal branch): It emerges between the tendons of flexor carpi ulnaris and ulnaris lateralis muscles.

DISSECTION: The flexor carpi radialis and flexor carpi ulnaris muscles are severed immediately to their humeral origin. Muscles, vessels and nerves of the antebrachium, carpus, besides the cubital region are revealed in medial view. Fig. 3.7

Musculocutaneous nerve: It derives its fibres form the sixth, seventh and eighth cervical components of the brachial plexus. It crosses the lateral face of the axillary artery and joins the median nerve to form a loop (ansa axillaris) ventral to the vessel. It gives muscular branches to the coracobrachialis and biceps brachii muscles near the shoulder and continues in the limb alongwith median nerve.

Transverse cubital artery: It leaves the brachial artery proximal to the trochlea of the humerus. It immediately bends laterally and supplies elbow joint. Besides, it gives vessels to brachialis, brachiocephalicus, pectoralis descendens and biceps brachii muscles.

Biceps brachii muscle (laceratus fibrosus): Laceratus fibrosus

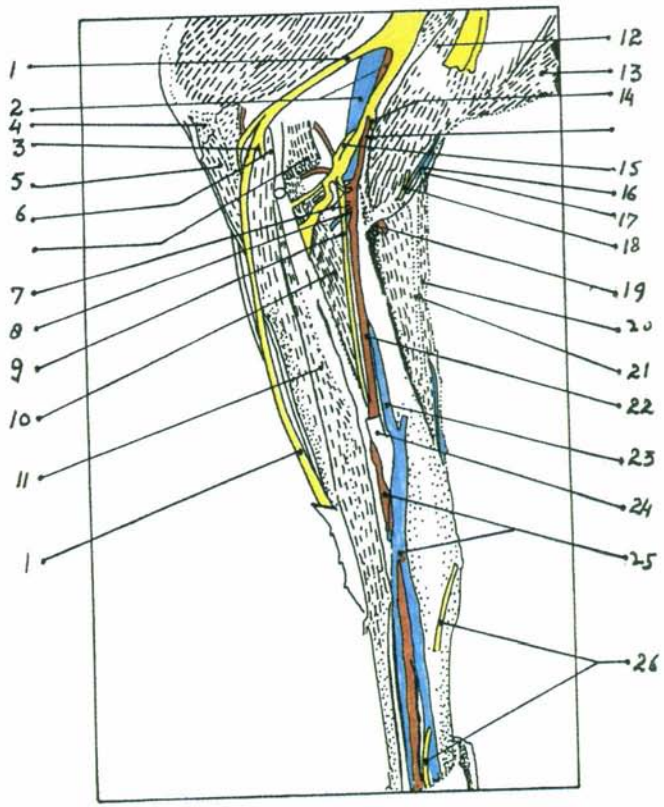

Fig. 3.7 : 1. ulnar nerve; 2. brachial artery and vein; 3. caudal cutaneous antebrachial nerve (ulnar nerve); 4. flexor carpi ulnaris muscle (ulnar head); 5. flexor digitorum profundus muscle (ulnar head); 6. flexor carpi ulnaris muscle (humeral head); 7. common interosseous artery and vein; 8. median artery (muscular branch); 9. media nerve; 10. flexor digitorum profundus muscle (humeral head); 11.flexor digitorum superficialis (superficial part); 12. biceps brachii muscle; 13. brachiocephalicus muscle; 14. musculocutaneous nerve; 15. muscular branch of 9; 16. cephalic vein; 17. brachialis muscle; 18. medial cutaneous antebrachial nerve; 19. transverse cubital artery; 20. extensor carpi radialis muscle; 21. biceps brachii muscle (laceratus fibrosus); 22. median artery; 23. radial vein; 24. flexor carpi radialis; 25. radialis artery; 26. common dorsal digital nerve II (radial nerve, superficial branch).

is specialized form of deep fascia by which biceps brachii muscle inserts to the metacarpal bone. It radiates out in the antebrachial fascia.

Common dorsal nerve of II digit (superficial branch of radial nerve): During its course, it supplies the medial accessory digit (second digit) and then continues on the abaxial side of the third digit.

Flexor carpi ulnaris muscle: It is a wide, thin and flat muscle having two origins which partially cover the rest of the flexor group. Its ulnar head arises form caudal surface of olecranon, and the humeral head arises from medial epicondyle of humerus. Both heads insert on proximal border and lateral surface of accessory carpal bone.

Flexor carpi radialis muscle: It lies on the caudomedial surface of the forearm arising from medial epicondle of humerus and ends on the mediopalmar surface of the base of large metacarpal bone.

Deep digital flexor muscle (ulnar head): The ulnar head is fleshy, triangular ad short. It arises from medial, caudal and lateral surface of proximal end of ulna and courses on the lateral surface of the humeral head of the muscle to insert at the distal phalanx of third and fourth digits.

Common interosseous artery: It arises as the last branch of the brachial artery before this becomes median artery distal to the elbow joint at the level of the proximal interosseous space of the forearm.

Common interosseous vein: It arises from brachial vein in the proximal region of the interosseous space of the forearm. It gives recurrens ulanris branch.

Superficial digital flexor muscle: It is somewhat blended at its origin (pars superficialis) with flexor carpi ulnaris muscle. It is divided into two bellies, superficial and deep, terminating on tendons at the distal part of the forearm. The superficial tendon passes over the flexor retinaculum, perforates the metacarpal fascia and joins the deep tendon at about the middle of the metacarpus.

Ulna (lateral styloid process): Ulna projects to the level of the radius which forms the part of the facet for ulnar carpal bone. This projection is known as styloid process of ulna.

Accessory carpal bone: It is short, thick and rounded bone. It articulates with ulnar carpal bone on its posterior aspect.

Common dorsal vein of III digit: Cranial ramus of lateral saphenous vein divides at distal half of metacarpus into common digital veins III and IV.

DISSECTION: After dissecting and removing the fascia from the dorsal aspect of the carpal and metacarpal regions, the following structures are revealed in dorsal view. Fig. 3.8.

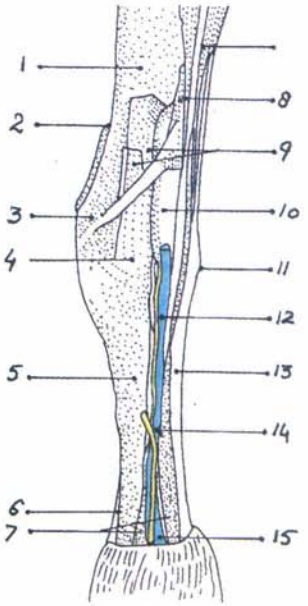

Fig. 3.8 : 1. radius; 22. flexor carpi radialis muscle; 3. radius (medial styloid process); 4. metacarpal tuberosity; 5. fused metacarpal bone III, IV; 6. interosseous muscle; 7. extensor digitorm communis muscle; 8. abductor digiti I longus muscle; 9. extensor carpi radialis mscle; 10. ulna (lateral styloid process); 11. accessory carpal bone; 112. accessory cephalic vein; 13. extensor digitorum lateralis muscle; 14. common dorsal digital nerve III (radial nerve, superficial branch); 15. common dorsal digital vein III.

Flexor carpi radialis muscle: The muscle is inserted at the rough obtuse eminence on the anterointernal part of the proximal extremity of the large metacarpal bone.

Common digital extensor muscle: The tendon of this muscle, on passing over the metacarpophalangeal articulation, divides into two branches, and both of them terminate on the extensor process of the corresponding third phalanx.

Long abductor muscle for digit: It is inserted on the mediopalmar surface of the proximal extremity of large metacarpal bone.

Interosseous muscle (suspensory): It is a complex muscle composed of both fleshy and tendinous tissue. It lies in a groove on the palmar surface of the metacarpal bone.

Lateral digital extensor muscle: It lies in the caudal most portion of the forearm extending on caudolateral surface of ulna. It inserts by axial tendon to proximal extremity of fourth digit and by abaxial tendon to parietal surface of distal phalanx of fourth digit.

DISSECTION: After dissecting and clearing the fascia from the palmar aspect of the carpal and metacarpal regions, following structures are revealed in palmar view. Fig. 3.9.

Extensor carpi ulnaris muscle (insertion): It is inserted in the lateral half of the dorsal part of the accessory carpal bone, lateral to the insertion of flexor carpi ulnaris muscle and a roughened small elevation on the lateral aspect of the proximal extremity of large metacarpal bone.

Dorsal common digital nerve IV (dorsal branch of ulnar nerve): The dorsal branch emerges between the tendons of the flexor carpi ulnaris and ulnaris lateralis muscles. It courses caudally along the dorsolateral aspect of the metacarpus and continues as the dorsal common digital nerve IV. It gives branches near fetlock to fifth digit (lateral accessory digit).

Median artery: It is a distal continuation of the branchial artery following the origin of the common interosseus artery. it descends along the medial aspect of the caudal surface of the

radius, accompanying the median nerve, passes through the carpal canal beneath the flexor retinaculum to the metacarpal region. It gives collaterals to the biceps brachii, pronater teres, brachialis and extensor carpi redialis muscles.

Flexor carpi radialis muscle (insertion): It is inserted to the base of large metacarpal bone.

Flexor carpi ulnaris muscle (insertion): It is inserted on the accessory carpal bone alongwith the caudal tendon of ulanris lateralis muscle.

Cut edge of flexor retinaculum (volar annular ligament): It is thick and strong extending from accessory carpal bone and the bone's distal ligament to the medial collateral carpal ligament and forms the palmar boundary of the carpal canal.

Palmar common digital artery III: It is formed by the median artery and the anastomotic brach from the deep distal palmar arch. It continues distally between the accessory digits along the palmar aspect of the fetlock joint.

Palmar common digital nerve II: The medial branch of the median nerve divides into palmar common digital nerve II and palmar digital nerve III.

Palmar axial digital nerve: The medial branch of the median nerve divides into palmar axial digital nerve III and palmar common digital nerve II, III and IV palmar axial digital nerves unite in the interdigital space to separate again immediately. Plamar axial digital nerve III descends along the mediopalmar aspect of fetlock, supplies medial accessory digit and courses along the axial surface of thrid digit.

Palmar common digital nerve III: In bovine the palmar digital nerve III and IV together form palmar common digital nerve III. While passing in the inter-digital space, they separate again immediately.

Plamar common digital vein III: It is the terminal continuation of the median vein. It is connected by a robust vein interdigitalis III with the dorsal common vein of same number.

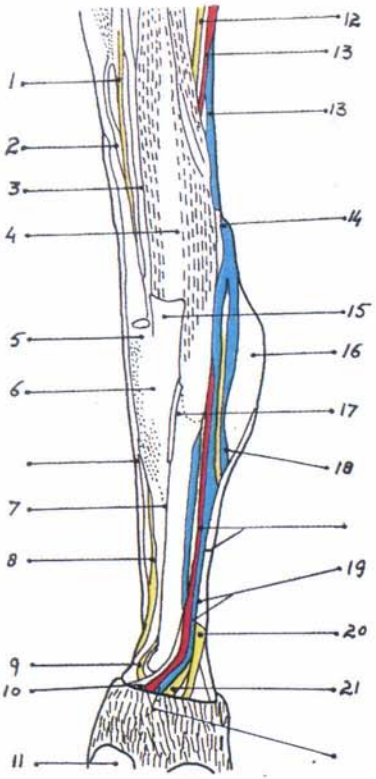

Fig. 3.9 : 1. ulnar nerve; 2. extensor digitorum lateralis muscle; 3. flexor carpi ulnaris muscle (ulnar head); 4. flexor digitorum superficialis muscle (superficial part); 5. extensor carpi ulnaris (insertion); 6. accessory carpal bone; 7. accessory metacarpal ligament; 8; common dorsal digital nerve IV (ulnar nerve, dorsal branch); 9. common palmar digital nerve IV; (ulnar nerve, palmar branch); 10. median nerve (communicating branch); 11. digit V (lateral dew claw); 12. median nerve; 13. median artery and vein; 14. flexor carpi radialis muscle (insertion); 15. flexor carpi ulnaris muscle (insertion); 16. radius (medial styloid process). 17. flexor retinaculum; 18. radial vein; 19. common palmar digital artery and vein III; 20. common palmar digital nerve II (media nerve); 21. axial palmar digital nerve (common palmar digital nerve III).

DISSECTION: After removing skin and fascia from medial aspect of carpal and metacarpal regions, the following structures are revealed in medial view. Fig. 3.10.

Radial vein: It arises from the medain vein half way down the forearm. Accompanied by the radial artery, it courses beneath the fascia, towards the carpus. Distal to the carpus the radial vein divides into deep palmar arch and superficial palmar ramus, which, terminates distally in the median vein.

Radial vein (anstomotic branch): The radial branch unites with cephalic vein proximal to the carpus and anastomoses at about the same level with caudal interosseous vein.

Common digital extensor muscle: It arises by two heads from the lateral epicondyle of the humerus and the ulna. The heads fuse at about the middle of the forearm, and terminate soon on a tendon which passes forward over the carpus and metacarpus. At fetlock joint it divides into two branches, each of which is inserted into the extensor process of the corresponding third phalanx.

Radial bone: It is relatively short and broad. It is somewhat oblique, the distal end being nearer the median plane than the proximal.

Flexor carpi radialis muscle: It is inserted on the palmar surface of base of the large metacarpal bone.

Extensor carpi radialis muscle: It is inserted on the metacarpal tuberosity by means of broad flat tendon.

Proximal extremity of metacarpal bone: The proximal end bears two slightly concave facets for articulation with the bones of lower row of the carpus.

Metacarpal bone III: It is small metacarpal bone, which is rounded rod about one and a half inch in length, and lies against the proximal part of the lateral border of the large metacarpal bone.

DISSECTION: The fore limb is held and sawn sagitally. The saw passes through the axis of the fourth digit and then through the axis of the limb in metacarpal, carpal and antebrachial regions and reveals the bones and muscles of the manus as seen in sagittal section. Fig. 3.11.

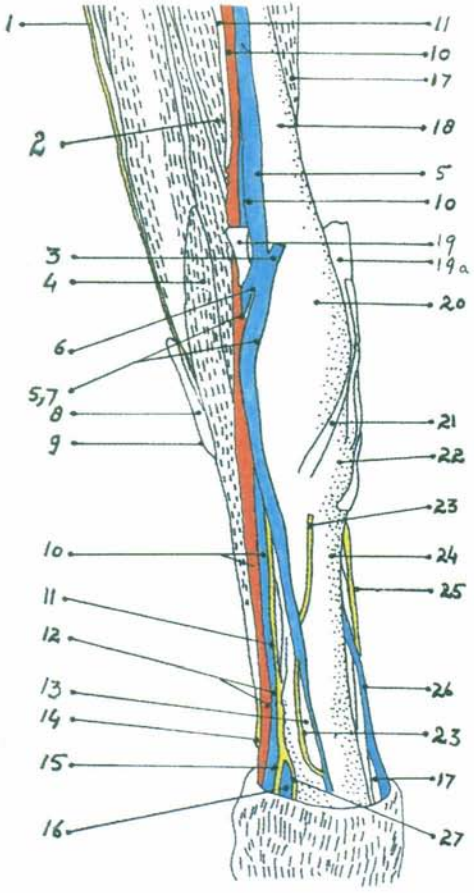

Fig. 3.10 : 1. ulnar verve; 2. flexor digitorum profundus muscle (humeral head); 3. cephalic vein; 4. flexor digitorum superficialis muscle (superficial part); 5. radial vein; 6. anastomotic branch of 5; 7. radial artery; 8. flexor carpi ulnaris muscle; 9. accessory carpal bone; 10. median artry and vein; 11. median nerve; 12. common palmar digital artery and vein III; 13. interosseous muscle; 14. communicating branch of 11; 15. axial palmar digital nerve (median nerve); 16. common palmar digital vein II; 17. extensor digitorum communis muscle; 18. radius; 19. flexor carpi radialis muscle (tendon of insertion); 19a. extensor carpi radialis muscle (tendon of insertion); 20. radius (medial styloid process); 21. abductor digiti I longus muscle; 22. metacarpal bone (proximal extremity); 23. common dorsal digital nerve II (radial nerve); 24. metacarpal bone III; 25. common dorsal digital nerve III (radial nerve); 26. dorsal common digital vein III; 27. common palmar digital nerve II (median nerve).

Tendon in carpal canal: The palmar surface is slightly convex and alongwith the accessory carpal bone forms carpal groove, rendered smooth by palmar ligament. This is converted into carpal canal for the flexor tendons by flexor retinaculum which stretches across from the accessory carpal bone to the medial side.

Metacarpal bones: There is a large metacarpal bone and a small metacarpal bone is placed lateral to the large metacarpal bone.

Proximal sesamoid bones: These are two in number and articulate on the dorsal aspect of each half of the head of the large metacarpal bone.

Distal sesamoid bones: Each digit has one or each limb has two sesamoid bones which are short and their ends are slightly narrow than the middle of the bone.

Carpal bones:

(i) Intermediate: This is less regular in shape and its long axis is directed obliquely backwards and medially. It is constricted in the middle and wider behind than in front.

(ii) Accessory: It is short, thick and rounded. It articulates with the ulnar carpal bone only.

(iii) Fourth: It is a small quadrilateral bone.

Superficial digital flexor muscle (manica flexoria): Manica flexoria is a tublar structure composed primarily of the tendon of the flexor digitorum superficialis muscle with the interosseous. It lodges the deep tendons of flexor digitorum profundus muscle.

Lateral digital extensor muscle: The muscle is inserted through an axial tendon to the dorsal surface of the proximal extremity of the middle phalanx of the fourth digit.

Common digital extensor muscle: It inserts at extensor process of the distal phalanges of the third and fourth digits, through a thin tendinous sheet to the parietal surface of the distal phalanx of the third digit.

Extensor process of distal phalanx: On its articular surface of

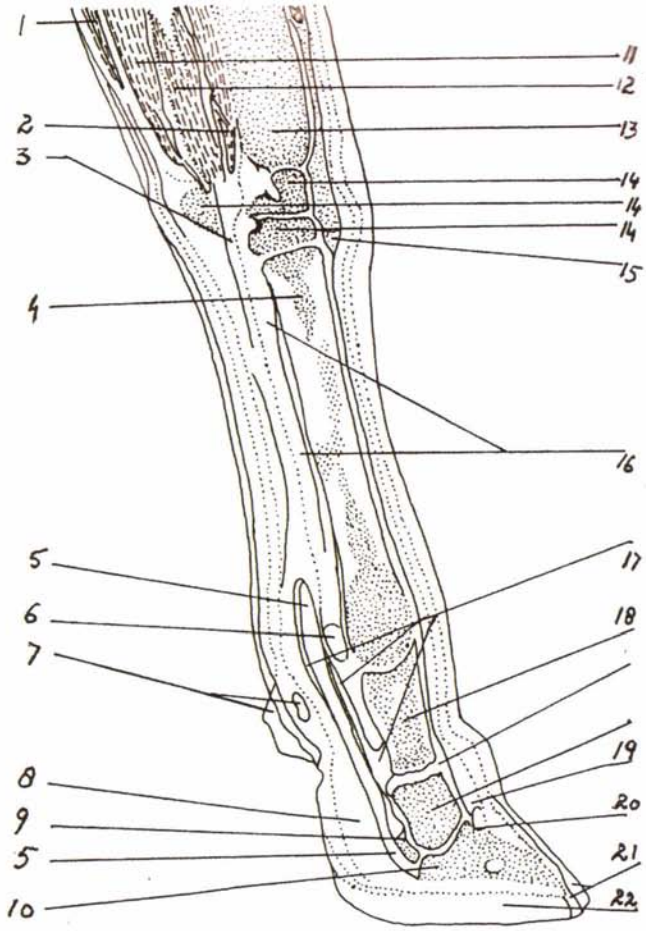

Fig. 3.11 : 1. extensor carpi ulnaris muscle; 2. flexor digitorum profundus muscle (humeral head); 3. flexor digitorum profundus muscle; (tendon in carpal canal); 4. metacarpal bone; 5. flexor digitorum profundus muscle; 6. proximal sesamoid bone; 7. bone and hoof of digit V; 8. digital cushion; 9. distal sesamoid bone; 10. flexor tubercle; 11. flexor digitorum superficialis muscle (superficial part); 12. flexor digitorum superficialis muscle (deep part); 13. radius; 14; carpal bones (intermediate; accessory and fourth); 15. extensor carpi radialis muscle (insertion); 16. interosseous muscle; 17. flexor digitorum superficialis muscle (manica flexoria); 18. proximal phalanx; 19. extensor digitorum communis muscle; 20. distal phalanx (extensor process); 21; hoof wall; 22. sole of hoof.

the proximal border, it bears a central eminence called the extensor process to which common digital extensor tendon is attached.

Wall of hoof: It is defined as part of the hoof which is visible when the foot is placed on the ground. The term foot is here in popular sense i.e. to designate the hoof and the structures enclosed whithin it.

Sole of hoof: The sole constitutes the greater part of the ground surface of the hoof.

Digital cushion: It is underlying part of frog which is wider in its posterior part. It consists of relatively soft horn and together with the underlying digital cushion, forms a very effective and well- sprung cushing mechanism.

Flexor tubercle: The deep digital flexor is inserted to the flexor tubercle of the distal phalanx of the third and fourth digits.

DISSECTION: The pectoralis descendens, pectoralis ascendens and pectoralis transversus are dissected and removed. The left rib cage and the serratus ventralis muscle have also been removed. The medial view reveals muscles and nerves of the axillary and brachial regions. Fig. 3.12.

Axillary nerve (its course near shoulder): It gives collaterals to the teres major, teres minor, deltoideus muscles and caudal part of subscapular nerve.

Thoracodoral nerve: It derives its fibres chiefly from the ventral branch of the seventh and eighth cervical nerves. It is distributed mainly to the latissimus dorsi muscle.

Axillary nerve: It derives its fibres from seventh and eighth cervical roots of brachial plexus. It passes laterally between subscapular artery and subscapularis muscle.

Pectoralis ascendens muscle: Caudal deep pectoral is a large muscle whose fibres are usually directed longitudinally along the ventral thoracic wall. It is covered in the most part by pectoralis superficialis muscle.

Cranial humeral circumflex artery: It arises as the last branch

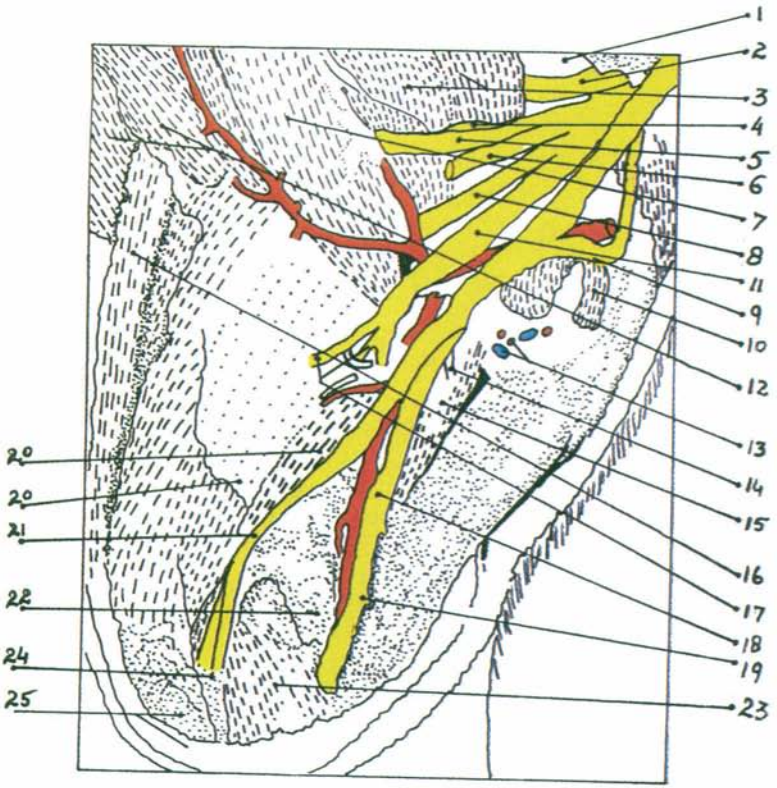

Fig. 3.12 : 1. supraspinatus muscle; 2. suprascapular nerve; 3. subscapularis muscle; 4. subscapular nerve; 5. nerve to teres major muscle (axillary nerve); 6. thoracodorsal nerve; 7. teres major muscle; 8. axillary nerve; 9. musculocutaneous nerve (ansa axillaries); 10. pectoralis ascendens muscle; 11. radial nerve; 12. latissimus dorsi muscle; 13. cranial circumflex humeral artery and vein; 14. musculocutaneous nerve (proximal muscular branch); 15. coracobrachialis muscle; 16. tensor fascia antebrachii muscle; 17. muscular branches of 11; 18. median nerve; 19. musculocutaneous nerve (distal mscular branch); 20 triceps brachii muscle (medial and long heads); 21. ulnar nerve; 22. elbow joint (capsule); 23. flexor carpi radialis muscle; 24. flexor carpi ulnaris mscle (humeral head); 25. antebrachial fascia.

of the axillary artery and courses between the two parts of coracobranchialis, supplies humerus, biceps brachii and shoulder joint.

Cranial humeral circumflex vein: It arises from subscapular vein and courses medially over the cranial part of humerus to

anastomose with its caudal branch. It mainly drains the biceps brachii, coracobrachialis and nearby muscles.

Tensor fasciae antebrachii muscle: It is slender and lies along the caudal border of scapula. It extends from caudal angle of scapula to the medial side of olecranon.

Musculocutaneous nerve (muscularis distalis branch): It arises within distal half of the arm and close to the insertion of the coracobrachialis on the humerus. The musculocutaneous nerve separates as the distal muscular branch which supplies the brachial and continues as the medial cutaneous antebrachial nerve.

Capsule of elbow joint: The joint capsule is extremely thin caudally, where it forms a pouch in the olecranon fossa. Cranially it is strengthened by oblique fibres, and on each side it fuses with the collateral ligament.

Musculocutaneous nerve (proximal branch): Two msculocutaneous nerve gives muscular branch to the coracobrachialis and biceps brachii muscles near the shoulder by means of its proximal muscular branch. It continues distally in the limb and accompanies the median nerve.

SURGICAL ANATOMY FOR COMMON SURGICAL AFFECTIONS OF THORACIC LIMB

AMPUTATION OF LIMB

(A) **Anatomical location:** The medial aspect of radius is placed subcutaneously in the middle of forearm region. The dorsolateral group of muscles placed superficially in mediolateral sequence are extensor carpi redialis, medial digital extensor, common digital extensor and lateral digital extensor muscles. The extensor carpi obliquus muscle is deeply situated. The volar medial group of muscles comprises of flexor carpi radialis, flexor carpi ulnaris, ulnaris lateralis superficially and two heads of superficial digital flexor, humeral, radial and ulnar heads of deep digital flexor deeply. The dorsal interosseous artery and

radial nerve supply the lateral group of muscles while the median artery along with median and ulnar nerves supplies the volar group of muscles.

(B) Site for surgical approach: The operation may be performed from the elbow joint or at the junction of the upper and middle third of the radius, a point above and well clear of the lesion to ensure operating on normal tissue.

(C) Structures encountered: Skin, superficial and deep fascia, tendons of radial, lateral, common and medial extensor muscles, perosteum, bone superficial and deep parts of suspensory ligament, tendons of superficial and deep digital flexors, flexor carpi radialis, flexor carpi ulnaris and ulnaris lateralis muscles, median artry, radial artery, caudal interosseous artery, cephalic vein, accessory cephalic vein, ulnar collateral vein, ulnar vein, iterosseous vein, radial nerve, ulnar nerve and musclocutaneus nerve.

Chapter **4**

The Thorax

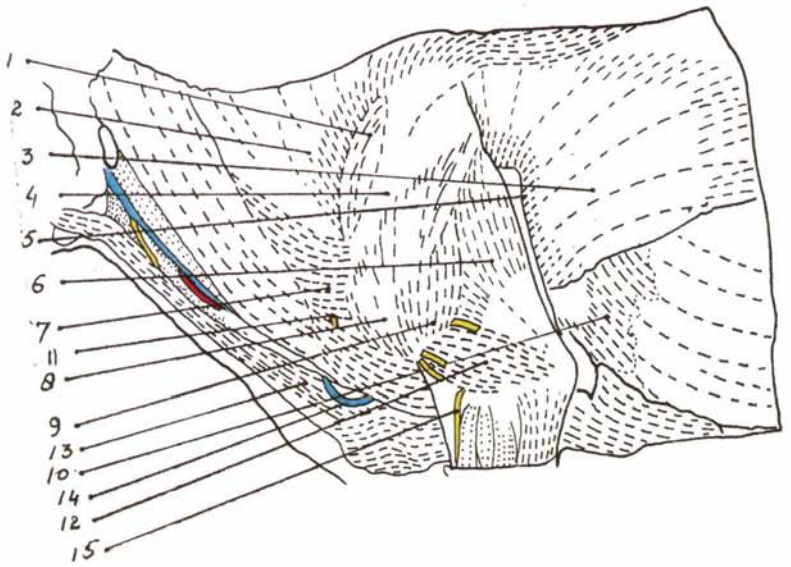

Fig. 4.1 : 1. supraspinatus muscle; 2. trapezius muscle (cervical part); 3. latissimus dorsi muscle; 4. scapular spine; 5. tensor fasciae antebrachii muscle; 6. triceps brachii muscle (long head); 7. omotaransversarius muscle; 8. deltoideus muscle (acromial part); 9. deltoideus muscle (scapular part); 10. serratus ventralis muscle; 11. dorsal supraclavicular nerve (C. IV); 12. triceps brachii muscle (lateral head); 13. sternocephalicus muscle; 14. cephalic vein; 15. cutaneous latral antebrachial nerve.

DISSECTION: The opposite side of the subject is taken for the study of the superficial muscles of thorax. The skin and fascia of neck, scapulohumeral region and trunk, and the cutaneous muscles of the scapulohumeral and abdominal regions are removed. The superficial structures of the neck, shoulder and thorax are revealed in lateral view. Fig. 4.1.

Trapezius muscle (thoracic part): It extends from spines of all thoracic vertebrae and thoracolumbar fascia to the spine of scapula by means of an aponeurotic sheath.

Latissimus dorsi muscle: It is a fan shaped muscle which is situated on lateral aspect of chest wall extending from ninth to twelfth rib.

Longissimus thoracis muscle: It is lies in the angle formed by spines of thoracic vertebrae and the ribs.

Serratus dorsalis caudalis muscle: This is a thin elongated, quadrilateral muscle which is situated at the caudal end of last three ribs. The fibres of this muscle are directed ventrally overlapping one another. It lies covered by latissimus dorsi muscle.

Levator costarum muscles: These constitute a series of ten to twelve small flat, triangular musculotendinous fasciculi which occupy the part of the intercostal spaces. Fibres are directed downwards and backwards.

Teres major muscle: It covers and lies over the serratus ventralis thoracis muscle.

External intercostal muscles: These are situated in the intercostal spaces extending from levatores costarum muscle to sternal extremity of the ribs. Their fibres are directed downwards and backwards.

DISSECTION: Cut the latissimus dorsi muscle parallel to the tenth rib and extend the incision upto tenth thoracic vertebra. Cut its aponeurotic origin from this point to the hump and reflect its muscular portion forwards. It reveals left thoracic wall besides the following structures in lateral view. Fig. 4.2.

Triceps brachii muscle (long head): It is the largest and longest head of the triceps brachii muscle, and arises on caudal border of scapula and inserts by means of a strong tendon over lateral and caudal part of olecranon. It is present on both the lateral nd medial aspect of shoulder and arm.

N.B. The caudal border of the triceps muscle is the cranial limit of the area of auscultation and percussion.

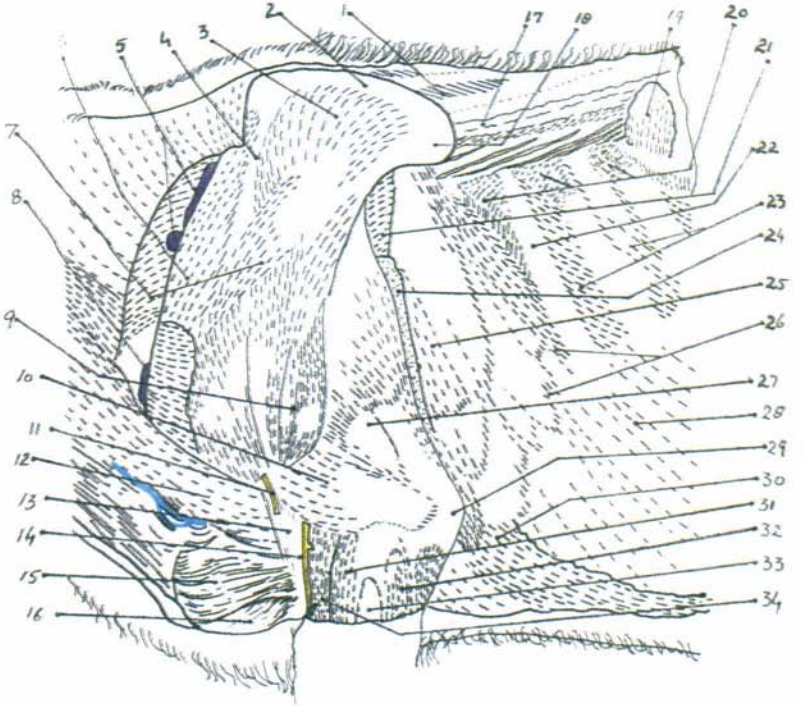

Fig. 4.2 : 1. spinalis et semispinalis thoracis muscle; 2. scapular cartilage; 3. infraspinatus muscle; 4. scapular spine (tuberosity); 5. superficial accessory cervical lymph nodes; 6. supraspinatus muscle; 7; deltoideus muscle (acromial part); 8. superficial eervical lymph node; 9. deltoideus muscle (scapular part); 10. triceps brachii muscle (lateral head); 11. cranial cutaneous antebrachial nerve; 12 brachiocephalicus muscle; 13. brachialis muscle; 14. lateral cutaneus antebrachial nerve; 15. pectoralis descedens muscle; 16. pectoralis transversus muscle; 17. longissimus thoracis muscle; 18. scapula (caudal angle); 19. serratus dorsalis caudalis muscle; 20. levatores costarum muscles; 21. teres major muscle; 22. rib 9; 23. intercostals externi mscles; 24. tensor fasciae antebrachii muscle; 25. latissimus dorsi muscle; 26. serratus ventralis thoracis muscle; 27. triceps brachii muscle; 28. obliquus externus abdominis muscle; 29. olecranon; 30. pectoralis ascedens muscle; 31. common digital extensor muscle; 32. extensor carpi ulnaris muscle; 33. lateral digital extensor muscle; 34. extensor carpi radialis muscle.

Obliquus externus abdominis muscle: This is the largest of the abdominal muscles and is irregularly triangular in shape. It extends from lateral surface of last eight ribs and ends on tuber coxae, prepubic tendon and linea alba. It is mostly aponeurotic and the direction of its fibres is horizontal in the paralumbar region.

Pectoralis ascendens muscle: It is a part of deep pectoral muscle, having fibres directed longitudinally. It is situated beneath the superficial pectoral muscle, extending from the median raphe along the ventral surface of sternum to the tubercles of the humerus.

Common digital extensor muscle: It has two distinct bellies, medial and lateral. Lateral belly has two heads while, medial belly has its tendon inserted on the extensor process of chief digt alongwith the tendon of lateral belly. This muscle lies in front of lateral digital extensor muscle.

Extensor carpi ulnaris muscle (ulnaris laterlis): It is a long strap like muscles lying on the craniolateral aspect of the forearm.

Lateral digital extensor muscle: It is situated over the ulna just in front of ulnaris lateralis on the lateral side of the forearm.

Extensor carpi radials muscle: It is the largest muscle of the extensor group. throughout its course it lies upon the cranial surface of radius.

DISSECTION: The muscles that attach the forelimb to the neck and trunk are cut, and the limb is separated from the body. A part of the vental serratus muscle is also removed. The trapezius and a portion of the latissimus dorsi muscle in fornt of tenth rib have been removed alongwith the limb. The remaining portion of latissimus dorsi muscle lying behind the level of the tenth rib may also be dissected and removed. The long thoracic and lateral thoracic nerves are exposed besides other structures in lateral view. Fig. 4.3.

Thoracic nerve (dorsalis cutanei lateralis): The lateral branches run laterad, under the longissimus thoracis muscle and emerge between this muscle and iliocostalis muscle. After passing through the latissimus dorsi muscle and thoracolumbar fascia they ramify as dorsal cutaneous nerve under the skin of thorax.

Iliocostalis thoracis muscle: This is a long, segmental muscle extending across the ribs in contact with the lateral surface of longissimus thoracis muscle and ends in a glistening tendon at the first rib and on the transverse process of seventh cervical vertebra.

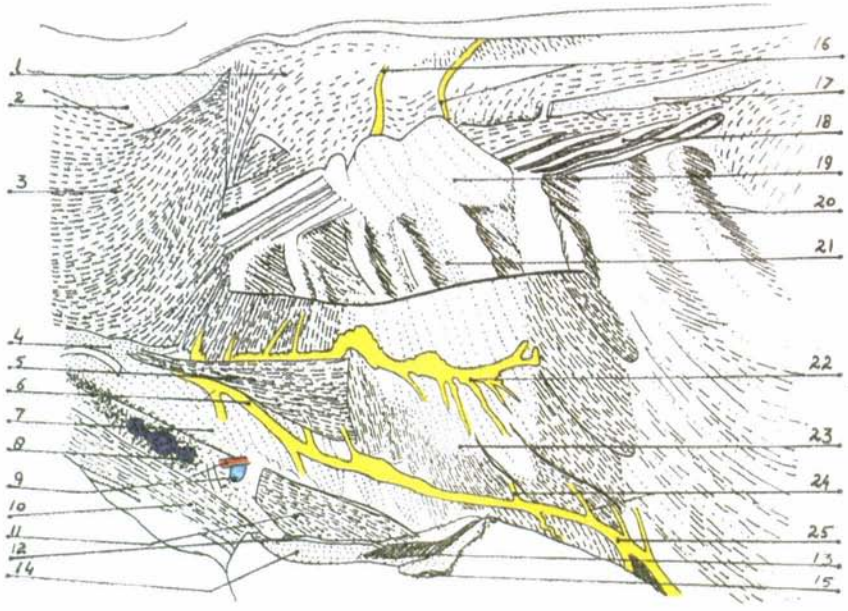

Fig. 4.3 : 1. deep thoracolumbar fascia; 2. rhomboideus cervicis muscle; 3. serratus ventralis cervicis muscle; 4. intertransversarii muscle; 5. scalenus dorsalis muscle; 6. brachial plexus; 7. scalenus ventralis muscle; 8. deep caudal cervical lymph nodes; 9. axillary artery and vein; 10. sterno-cephalicus muscle; 11. rectus thoracis muscle; 12. subclavius muscle; 13. pectoralis ascendens muscle; 14. pectoralis descendens muscle; 15. pectoralis transversus muscle; 16. thoracic nerve (dorsal lateral cutaneous branches); 17. longissimus thoracis muscle; 18. iliocostlis thoracis muscle; 19. serratus dorsalis cranialis muscle; 20. levatores costarum muscles; 21. Intercostals externi muscles; 22. long thoracic nerve; 23. serratus ventralis thoracis muscle; 24. intercostals nerves (lteral cutaeous branches); 25. lateral thoracic nerve.

Serratus dorsalis cranialis muscle: It is situated on dorsolateral aspect and cranial border of fifth to ninth ribs. This muscle lies covered by serratus ventralis thoracis and latissimus dorsi muscles.

External intercostal muscles: These muscles arise at the caudal border of the preceding ribs and insert on the cranial border of the succeeding ribs.

Long thoracic nerve: This nerve receives its fibres from seventh to eighth cervical components of brachial plexus and courses laterally between scaleni muscles. It is distributed to the serratus ventralis thoracis muscle.

Serratus ventralis thoracis muscle: It is a powerful muscle. It receives its name from the serrated ventral edges of this muscle. It covers the cranial half of lateral thoracic wall and is covered by an aponeurosis which gives it a pearly appearance.

Intercostal nerves (cutaneous lateralis branches): These are sensory nerves which join the lateral thoracic nerve of branchial plexus, supply the cutaneous omborachialis muscle, skin in lateral thoracic wall, cutaneous trunci muscle and ventral abdominal region.

Deep thoracolumbar fascia: It closely adheres to the muscles covering thoracolumbar region. It gives origin to serratus dorsalis, iliocostalis, lumber part of obliquus abdominis externus, transversus abdominis and retractor costae muscles. Longissimus dorsi muscle covers the lateral edge of the fascia. This lateral edge attaches the fascia of ribs and transverse processes of lumber vertebrae. **Dorsoscapular ligament** formed by the deep fascia attaches the scapula to the spines of third to fifth thoracic vertebrae.

Intertransversarii muscle: These muscles are found lying between transverse processes of vertebrae and are best developed in cervical region.

Scalenus ventralis muscle: It extends from transverse processes of third to seventh cervical vertebrae to the first rib. This muscle is traversed by roots of brachial plexus breaking the surface of muscle into many bundles.

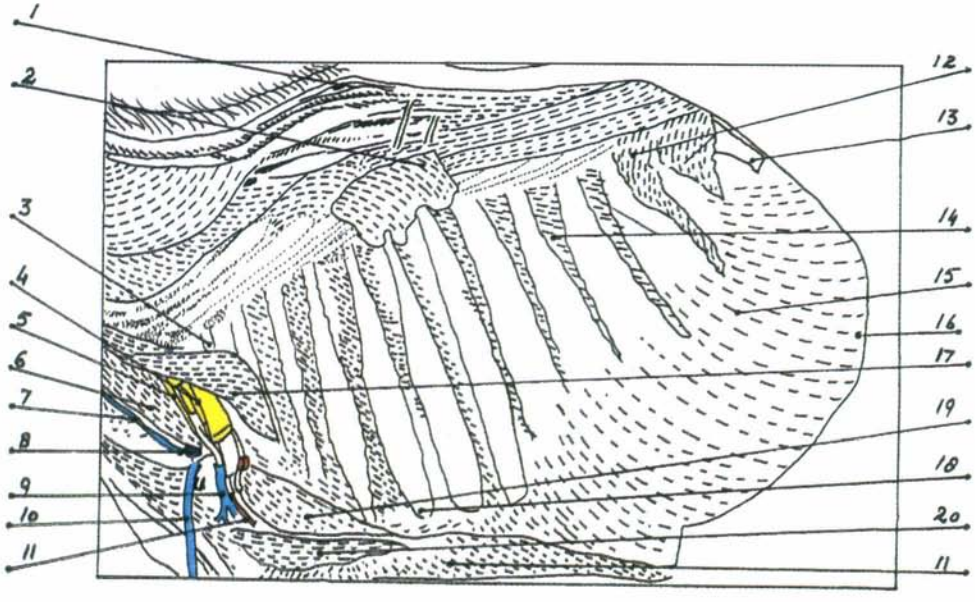

Fig. 4.4 : 1. trapezius muscle (thoracic part); 2. serratus dorsalis cranialis muscle; 3. rib 1; 4. brachial plexus; 5. phrenic nerve. 6. scalenus ventralis muscle; 7. external jugular vein; 8. deep caudal cervical lymph nodes; 9. axillarty vein; 10. cephalic vein; 11. external thoracic artery; 12. serratus dorsalis caudalis muscle; 13. rib 13; 14. intercostalis externi muscles; 15. obliquus externus abdominis muscle (covered by yellow abdominal tunic); 16. costal arch; 17. scalenus dorsalis muscle; 18. rib 5 (costochondral junction); 19. rectus thoracis muscle; 20 pectoralis transversus muscle; 21. pectoralis ascendens muscle.

Scalenus dorsalis muscle: This muscle is placed from fourth to sixth transverse processes of cervical vertebrae to the fourth rib. It is a fusiform bundle which blends with the ventral part at the first rib.

Caudal deep cervical lymph nodes: These lymph nodes lie immediately in fornt of first rib close against each side of the trachea.

Axillary artery: It arises from subclavian artery beyond first rib in axillary space and continues ventral to medial scalenus muscle. It runs between thoracic wall and pactoral limb to reach flexor aspect of shoulder joint, where it divides into **subscapular** and **brachial arteries** near the interval between subscapularis and teres major muscles.

Rectus thoracis muscle: It is situated in the caudoventral aspect of first rib. It is quadrilateral in shape and lies covered by deep pectoral muscle.

Subclavian muscle: It is a small, round bundle of fleshy muscle which arises from ventral end of first rib and is inserted on deep face of brchiocephlicus muscle.

DISSECTION: Cut the serratus thoracis and serratus cervicis muscles from their origin. Now cut across and remove the sections of each of them below their dorsal end. The rhomboideus muscle has been cut from its origin and removed with the limb. The rib cage and muscles of the left thoracic wall are revealed. Fig. 4.4

Phrenic nerve: It is a motor nerve to the diaphragm, formed by ventral branches of fifth, sixth and seventh cervical nerves. Roots from sixth and seventh course ventrally to scalenus medius muscle on its superficial face. Phrenic nerve connects the cervicothoracic ganglion after running a short course.

Cephalic vein: It arises from external jugular vein. It follows the border of brachiocephalicus muscle. In the region of forearm it continues in subcutaneous position medial to extensor carpi radialis muscle.

Axillary vein: Arises at the cranial border of first rib from subclavian vein and runs medial to axillary artery towards the shoulder joint.

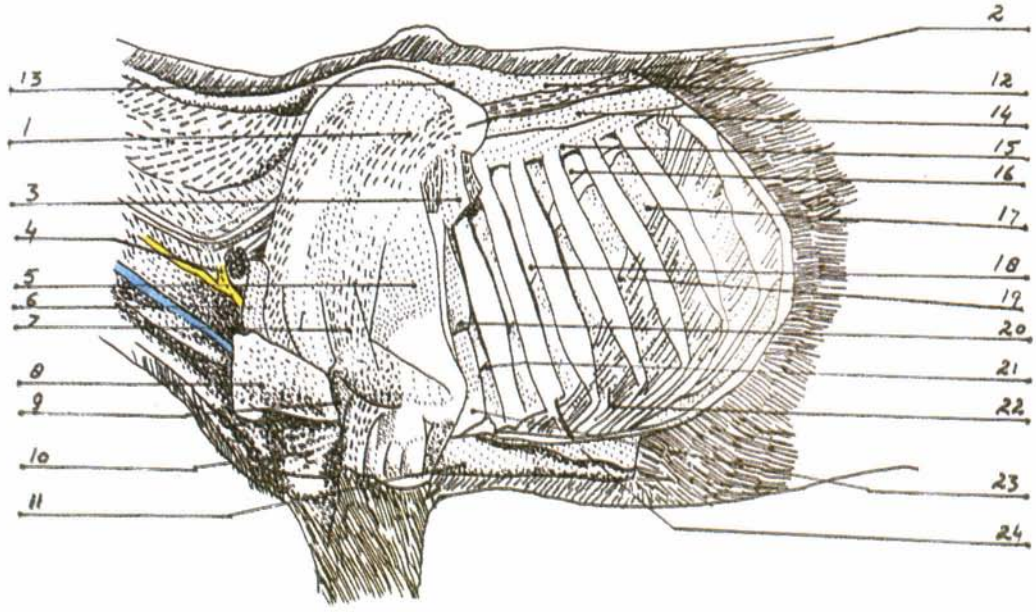

Fig. 4.5 : 1. infraspinatus muscle; 2. scapula (caudal angle); 3. serratus ventralis thoracis muscle; 4. brachial plexus; 5. triceps brachii muscle; 6. omotransversarius muscle; 7. deltoideus muscle; 8. brachiocephalicus muscle; 9. brachialis muscle; 10. pectoralis descendens muscle; 11. pectoralis ascendens muscle; 12. spinalis et semispinalis thoracis muscles; 13. scapula (dorsal border); 14; longissimus thoracis muscle; 15. iliocostalis thorcis muscle; 16. diaphragm (central tendon); 17. diaphragm (costal part); 18. left lung (caudal lobe); 19. line of pleural reflection; 20. latissimus dorsi muscle; 21. left lung (caudal border); 22. intercostalis interni muscle; 23. rib 6; 24. obliquus externus abdominis muscle.

External thoracic artery: It is a large artery which originates from axillary artery at the level of first rib and supplies mainly the pectoral muscles and also gives braches to biceps brachii and brchiocephalicus muscles.

Costochondral junction: It is the junction between the ventral end of the ribs (second to eleventh) with the costal cartilages.

Yellow abdominal tunic: It is a deep fascia which forms the abdominal tunic. It is placed along the lateral walls and floor of the abdomen. It is blended with aponeurosis of obliquus externus abdominis muscle.

DISSECTION: A portion of the thoracic cavity is displayed after the forelimb has been replaced. It shows the relationship between thoracic and appendicular structures. It depicts the restricted region avalible in the standing animal for pulmonary auscultation. It also reveals the following structures. Fig. 4.5.

Spinalis et semispinalis thoracis muscle: It covers the longissimus thoracis muscle and is separated from it at the first lumbar vertebra.

Dorsal border of scapula: It is cartilaginous and is coverd by trapezius muscle.

Line of pleural reflection: Right pleural sac extends beyond first rib on the deep face of scalenus muscle while left sac does not go beyond the first rib. The diaphragmatic part is reflected upto eighth costochondral junction, from where it goes upwards ventrally along the curve of eleventh to twelfth rib to end near the vertebral end.

Left lung (basal or caudal border): The caudal border separates the diaphragmatic surface from medial and costal surfaces. The part of the border that separates the diaphragmatic surface from costal surface is thin and sharp. It is formed by the diaphragmatic lobe of left lung.

DISSECTION: Saw through the ribs from third to eighth close to their costal junctions leaving first, third and sixth ribs and their associated parts intact and those parts that do not enclose the pleural cavity. The thoracic viscera in situ are revealed in the left lateral view. 4.6.

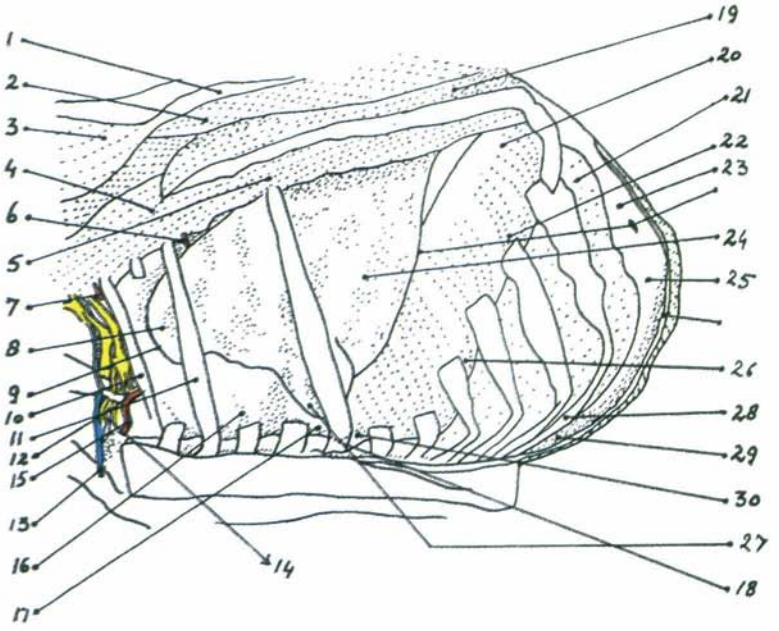

Fig. 4.6 : 1. ligamentum nuchae; 2. spinalis et semispinalis thoracis muscle; 3. splenius muscle; 4. longissimus cervicis muscle; 5. iliocostalis thoracis muscle; 6. dorsal intercostal artery III; 7. dorsal scapular artery; 8. left lung (cranial border); 9. cranial part of cranial lobe; 10. rib 1; 11. rib 3; 12. axillary artery; 13. cephalic vein; 14. cranial pectoral nerves; 15. external thoracic artery; 16. pericardium; 17. costomediastinal recess; 18. costochondral junction (rib 6); 19. longissimus thoracis muscle; 20. diaphragm (central tendon); 21. intercostalis interni muscle; 22. diaphragm (costal part); 23. rib 13; 24. left lung (caudal lobe grooved by ribs); 25. obliquus internus abdominis muscle; 26. costodiaphragmatic recess; 27. left lung (caudal part of cranial lobe); 28costal arch; 29. transversus abdominis muscle; 30. diapharagm (sternal part).

Internal intercostal muscles: These muscles are situated under external intercostal muscles. Their fibres are directed from cranial border of succeeding rib to the caudal border of the preceding rib. These muscles occupy the intercostals spaces and extend into interchondral spaces.

Left lung (cudal lobe grooved by rib): This is the diaphragmatic lobe of the left lung having costal impression on its costal surface.

Obliquus internus abdominis muscle (Dorsal part): It is situated beneath obliquus externus abdominis muscle and its

fleshy portion is fasciculated. This muscle extends from tuber coxae to the caudal border of last rib where the muscle gets intermingled with the fibres of retractor costae.

Letf lung, cranial lobe (caudal part): It is the apical lobe of the left lung and forms the boundary of cardiac notch cranially.

Costal arch: The costal cartilages of sternal ribs articulate with the sternum, while those of asternal ribs overlap and are attached to each another by elastic tissue to form the costal arch.

Transversus abdominis muscle: It lies on the deep face of rectus abdominis and obliquus internus abdominis muscles. It begins as an aponeurosis from the deep lumbar fascia. and thus indirectly from first five lumbar transverse processes and as fleshy muscle from medial surface of false ribs.

Diaphragm (sternal part): The sternal part of the diaphragm is attached to the xiphoid cartilage on it upper surface.

Cephalic vein: It is the superficial and the internal subcutaneous vein of the forearm. It follows the border of brachiocephlicus muscle.

Cranial pectoral nerve: This is one of the branches of the pectoral nerve formed by seventh and eighth cervical components of the brachial plexus. It supplies all the pectoral muscles except pectoralis ascendens.

DISSECTION: Sling the body in the natural position and remove the left forelimb. Remove the muscles covering the ribs and the intercostal muscles. Disarticualate the chondrosternal articulations and saw through second to sixth rib at their upper extremities, and remove them. Note the cardiac notch of the left lung and the large extent of the left part of the external face of the pericardium lying against the chest wall. Raise the cardiac lobe of the left lung and reflect it outwards and upwards. The thoracic vessels, nerves, lymph nodes and other structures are observed in left lateral view. Fig. 4.7.

Thoracic aorta: The aortic arch enclosed within its mediastinum reachs the vertebral column somewhat to the left of the midline at the level of fifth, sixth or seventh thoracic vertebra and continues caudally ventral to the column as descending aorta. Within the thoracic cavity it is known as the thoracic aorta.

Bronchoesophageal artery (oesophageal branch): It is a large branch of thoracic aorta. It follows dorsal face of oesophagus to the oesophageal hiatus. It supplies oesophagus, caudal mediastinal lymph node and sends few branches to pericardium.

Bronchoesophageal artery (bronchial branch): It arises from the thoracic aorta. It is single at its origin but divides at the tracheal bifurcation.

Tracheobronchialis medius lymph node: It is a small lymph node which is situated at the bifurcation of trachea.

Vagus nerve (ventral branch): Each vagus nerve passes ventromedial to the subclavian artery. The right vagus nerve passes caudally, crossing obliquely the lateral surface of the brachiocephalic artery and the right face of trachea. Reaching the dorsal surface of the latter near the bifurcation, it divides into dorsal and ventral branches. The left vagus nerve passes caudally on the lateral surface of subclavian artery. It continues caudally on the left face of the aorta, inclines to the dorsal surface of the left bronchus, and divides into dorsal and ventral branches. The dorsal and ventral branches unite with the corresponding branches of opposite side forming dorsal and ventral vagal trunks at the level of eighth thoracic vertebra and just caudal to the base of heart respectively. These pass caudally in the caudal mediastinum dorsal and ventral to the oesophagus respectively, innervating this structure and continuing into the abdominal cavity through the hiatus oesophagus. Samll branches pass from the vagus nerve to pulmonary vessels, bronchi, oesophagus and trachea. Direct branches form the dorsal and ventral vagal branches and trunks ramify on oesophagus other braches of the thoracic vagi include the recurrent laryngeal, caudal vagal, cardiac, bronchial and oesophageal nerves.

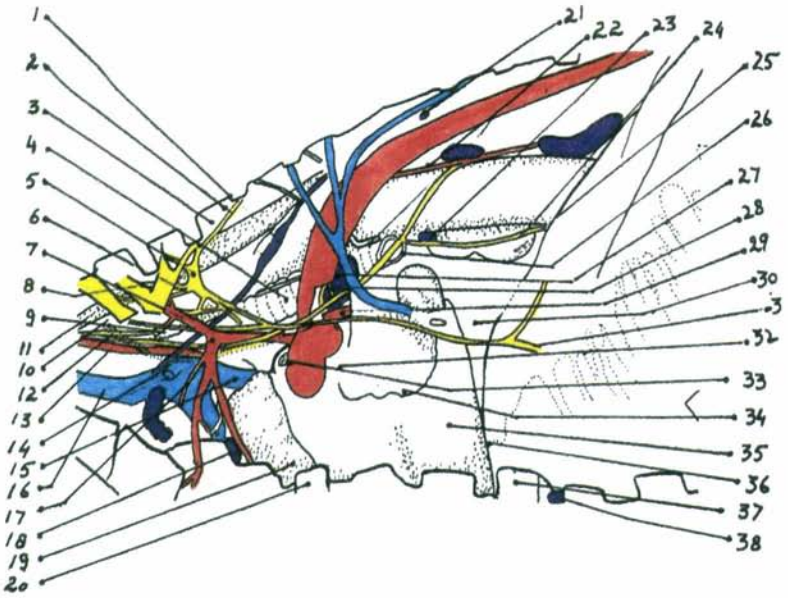

Fig. 4.7 : 1. thoracic duct; 2. sympathetic trunk; 3. ligamentum arteriosum; 4. trachea; 5.cervicothoracic ganglion; 6. rami communicantes; 7. costocervical trunk; 8. vertebral nerve; 9. medial cervical ganglion; 10. oesophagus; 11. longus colli muscle; 12. vagus nerve X; 13. common carotid artery; 14. left subclavian artery and vein; 15. anterior vena cave; 16. external jugular vein; 17. superficial cervical artery; 18. cranial sternal lymph node; 19. rigt lung (cranial lobe); 20. rib 3; 21. thoracic aortic lymph node; 22. broncho-oesophageal artery (caudal oesophageal and bronchialis branches); 23. medial tracheobronchialis lymph node; 24. vagal trunk X (ventral branch); 25. right lung (accessory lobe); 26. left principal bronchus; 27. left tracheobronchialis lymph node; 28. recurrent laryngeal nerve (X); 29. pulmonary trunk; 30. caudal mediastinal pleura; 31. phrenic nerve; 32. parietal pericardium; 33. pericardial cavity; 34. left auricle; 25. left ventricle; 36. phrenicopericardial attachment; 37. rib 6; 38. caudal sternal lymph node.

Right lung (accessory lobe): It is pyramidal in shape and its apex is directed towards the hilus of the lung.

Left principal bronchus: It passes laterally from the tracheal bifurcation and enters the left lung at its hilus.

Recurrent laryngeal nerve (vagus): Its left division arises from the base of the heart, at the point where the vagus nerve is about to cross the aortic arch.

Pulmonary artery: Right and left pulmonary arteries arise from bifurcation of the pulmonary trunk ventral to tracheal bifurcation and enter the corresponding lung alongwith the bronchi. Inside the lungs the pulmonary arteries divide, following the principal bronchi. The right pulmonary artery has four secondary (lobar) branches, whicle the left artery has only two.

Pericardial cavity: The cavity between parietal and visceral parts of the serous pericardium is the pericardial cavity and contains a small quantity of serous fluid, the **liquor pericardii.**

Parietal pericardium (cut): The pericardium is the fibroserous sac which encloses the heart and, in part, the great vessels connected with it. The **fibrous layer** (pericardium fibrosum) is relatively thin but strong and inelastic. It is firmly attached ventrally to the middle of the caudal half of the thoracic surface of the sternum by the strong sternopericardiac ligament. The **serous layer** (pericardium serosum) is surrounded by the fibrous pericardium. It is smooth and glistening and contains a small amount of clear serous fluid, in the pericardial cavity. It may be regarded consisting of two parts, parietal and visceral. Parietal part lines the fibrous layer and the visceral part covers the heart and part of great vessels and is thus also know as **epicardium.** Two parts of the serous pericardium are contiuous with each other at the line of reflection on great vessels.

Left auricle: It is larger than the right auricate. It is situated at left posterior part of the base of heart, behind the arterial trunks and above the left ventricle.

Caudal sternal lymph nodes: They lie beneath the transversus thoracis muscle.

Thoracic duct: It arises from cisterna chyli at aortic hiatus and it traverses the diaphragm lateral to the right crus. Its diameter is 2-4 mm in calves and 6-10mm in adult cattle. Left part of thoracic duct runs to the left of trachea and oesophagus. The duct ends a few millimeters to two centimeters anterior to the cranial border of the first rib.

Sympathetic trunk: The cord which forms the thoracic portion

of the sympathetic system extends backwards from the inferior of posterior cervical ganglion to the crura of the diaphragm.

Ligamentum arteriosum: It is a fibrous band connecting the pulmonary trunk with the descending aorta.

Cervicothoracic ganglion (stllate ganglion): It lies on ventrolateral surface of longus colli muscle, ventral to first costovertebral junction or first rib. It is formed by caudal cervical and first one or two thoracic sympathetic chain ganglia.

Rami communicantes: The ganglia of the sympathetic trunk are in connection with the cerebrospinal nerves by the rami communicates, which are of two kinds, white and gray. The white kind is derived from the spinal nerves and ganglia and consists largely of medullated fibres. The second variety, the gray type is derived from the sympathetic ganglia and is gray in colour and consists chiefly of nonmedullated fibres.

Vertebral nerve: The vertebral nerve is the extension of rami communicantes, upto the second cervical spinal nerve.

Middle cervical ganglia: They lie cranial to vertebral ganglion and are scattered along the cervical trunk.

Longus colli muscle: It is a long muscle extending from ventral surface of cervical and first six thoracic vertebrae. It is a powerful v-shaped muscle situated on ventral aspect of vertebral bodies. Thoracic part inserts on bodies and transverse processes of seventh cervical vertebra.

Subclavian artery: It is a branch of brachiocephalic artery. Its branches are costocervical trunk, superficial cervical, internal thoracic and axillary arteries.

Subclavian vein: It arises at thoracic inlet from the anterior vena cava. It curves laterally round the cranial border of the first rib and continues caudally as axillary vein.

External jugular vein: It is formed behind the upper part of vertical ramus of mandible by the union of superficial temporal and external maxillary veins. It is lodged in parotid gland and then it courses in the furrow formed by lower border of

brachiocephalicus and upper border of sternomandibularis, muscles.

Superficial cervical artery: It is the branch of subclavian artery and arises at the thoracic entrance to run in the cranial direction.

Cranial sternal lymph node: This lymph node is located in first intercostal space near cranial border of transversus thoracis muscle.

DISSECTION: The postion of the left auriculoventricular and pulmonary heart valves are observed after a part of pulmonary trunk has been removed to depict the pulmonary valves at the orifice of pulmonary trunk. Besides ventral side of left auriculoventricular valve is also made visible after cutting the edge of left auricle. The other structures visible on this side are also observed by cutting away the valves from fibrous auriculoventricular ring. Fig. 4.8.

Recurrent nerve: It leaves the vagus within the thorax. It passes caudad to right subclavian artery and then moves cranially on the ventrolateral surface of the trachea.

Caudal sternal lymph nodes: They lie covered by transverse thoracis muscle and vary in size, number and arrangement. Some of the lymph nodes are present on the transverse thoracis muscle along the course of the internal thoracic vein.

Brachiocephalic trunk: It arises from the convexity of the aortic arch within the pericardium at the level of fourth rib. It runs cranially and dorsally in the cranial mediastinum. ventral to trachea. Opposite the first rib, it gives off right subclavian artery and continues as bicarotid trunk. The left subclavian artery arises at a higher level.

Anterior vena cava: It lies in anterior mediastinum. It is formed at thoracic inlet by union of right and left common jugular and axillary veins. It opens at the level of fourth rib in the sinus venosum of the right auricle.

Left tracheobronchial lymph node: This lymph node lies in the angle between aortic arch and left division of pulmonary artery.

Pulmonary trunk: It is short vessel of large caliber and arises from conus arteriosus at feft anterior portion of the base of

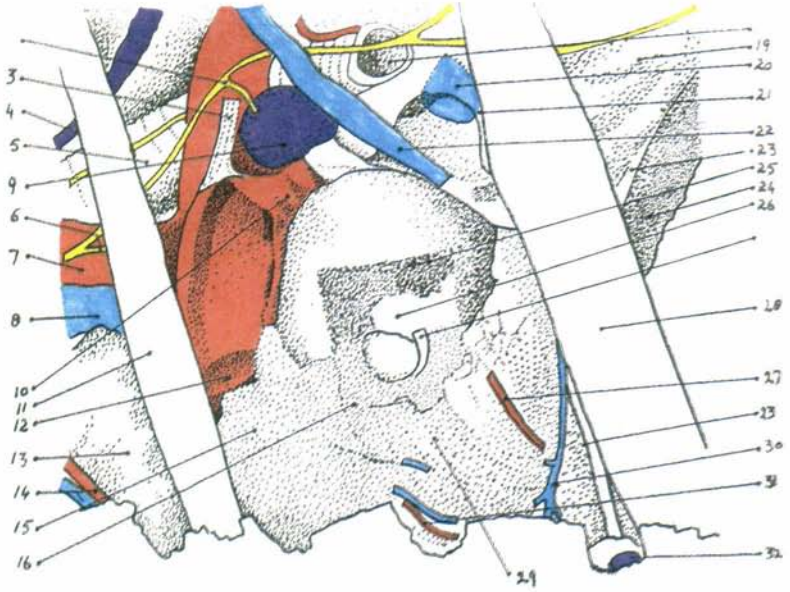

Fig. 4.8 : 1. broncho-oesophageal artery (bronchial branch); 2. recurrent laryngeal nerve; 3. ligametum arteriosum; 4. thoracic duct; 5. trachea; 6. vagus nerve X (cranial cardiac branches); 7. brachiocephalic turnk; 8. anterior vena cava; 9. left tracheobronchial lymph node; 10. pulmonary trunk; 11. rib 3; 12. pulmonary trunk (orifice); 13. right lung (cranial lobe); 14. internal thoracic artery and vein; 15; right ventricle (conus arteriosus); 16. coronary groove (adipose tissue); 17 vagal trunk X (dorsal branch); 18. left principal bronchus; 19. right lung (accessory lobe); 20. right pulmonary vein; 21. atrium; 22. left azygos vein; 23. diaphragm; 24. liver; 25. left atrium (auricle); 26. parietal cusp of left AV valve; 27. left coronay artery; 28. rib 6; 29. left ventricle; 30 caudal cardiac vein; 31. paraconal interventricular groove (emerging vessels); 32; caudal sternal lymph node.

right ventricle. On passing a finger from right ventricle into the artery there is the presence of three cusps which are thin and transparent and called **semilunar valves.**

Opening of pulmonary artery: It opens to the left and above the right auriculoventricular orifice opposite third intercostal space. It occupies the summit of conus arteriosus present at the left anterior portion.

Internal thoracic vein: It is a satellite vein of internal thoracic artery and opens into anterior vena cava just at its formation.

Conus arteriosus of right ventricle: It is a conical projection of the left anterior part of the base of left ventricle.

Coronary groove filled with adipose tissue: This groove runs around the base of the ventricles and is covered by adipose tissue called subepicardial fat. The blood vessels passing in the groove are also covered by this fat.

Vagus (pars dorsalis): Vagus gives parasympathetic innervation to cardiac blood vessels, muscles and conducting system of heart besides other visceral structures.

Rigth lung: It is two times larger than the left one. Its costal surface bears the impression of ribs. The cranial mediastinal part of this lung has a deep cardiac impression.

Accessory lobe (right lung): It is pyramidal in shape. Near the attachment of its lateral surface with the medial surface of diaphragmatic lobe, there is a groove formed by caudal vena cave.

Pulmonary vein from right lung: Pulmonary veins open on the posterior and right side of the sinus by means of four orifices.

Left auricle (cut edge): the opening of pulmonary veins into the auricle of left atrium is exposed by cutting at the border of sinus venosus and ventricles. Left atrium has an appendix and a sinus which is towards the inerauricular septum.

Left azygous vein: It arises from the coronary sinus and runs dorsal to left atrium. It further courses round the pulmonary veins, to the left of pulmonary artery and dorsal to aorta. It terminates in the caudal half of thorax.

Auricle of left atrium (cut edge): It is less spacious than the right auricle and its border lies in contact with the pulmonary trunk. The wall where the veins open through the ostia venarum pulmonarum lacks muscle pillars.

Parietal cusps of left auriculoventricular valve (cut away from fibrous A.V ring): The valves originate at the fibrous ring. The parietal valve is smaller of the two valves of the left atrioventricular aperture.

Valves cut away from left atrioventricular ring: After making a flap to see the left ventricle, cut away the moderator band and observe the atrioventricular opening having two valves, one larger and other smaller.

Left coronary artery (marginis ventricularis sinistra branch): It arises from left posterior sinus of aorta and passes between pulmonary artery and right face of left auricular appendix. On reaching the auriculoventricular groove it divides into vertical and transverse branches. Vertical branch runs in left longitudinal groove.

Caudal cardiac vein: It runs in the groove formed by intermediate and diaphragmatic lobe of right lung and opens into posterior part of sinus venosus of right atrium.

Paraconal interventricular groove (emergence of vessels): It is present near the fourth rib and receives the direct branch of left coronary artery. It courses in the paraconal interventricular groove.

DISSECTION: After removing the forelimb, the rib cage is also cut away except the sixth rib. The right lung is removed and the following structures in the right lateral view are observed. Fig. 4.9.

Axillary artery: It is a continuation of subclavian artery after it gives the superficial cervical artery. It courses in the axillary space beyond the first rib.

Internal thoracic artery: It arises opposite to deltoid branch at the level of first rib and is the branch of subclavian artery.

Middle mediastinal lymph node: It is situated on the right or dorsal aspect of the aortic arch and may extend to the right face of the oesophagus. The number varies from one to five.

Oesophagus. It courses on right of the aortic arch and then passes straight into mediastinum ventral to aorta before passing through hiatus oesophagi at the level of eighth to ninth intercostal space.

Tracheal bronchus: It arises from the trachea at the level of third rib.

Trachea: It is membranocartilagenous tube which at the level of fifth thoracic vertebra bifurcates into left and right principal bronchi.

Pulmonary vein: It carries oxygenated blood from the lungs to the left atrium of heart. There is one large and two or three small pulmonary veins.

Right auricle: It forms the right cranial part of the base of heart. It consists of sinus venosus cavum having the opening of veins.

Openings into the right auricle are Cranial vena cava, caudal vena cava, coronary sinus and vein, foramina venarum minimarum and opening of vena cardis parvae which are conceled in pectinate muscle.

Right ventricle: It is right cranial part of ventricular mass and forms almost all of the cranial border of the heart, but does not reach the apex, which is formed entirely by the left ventricle. Its left part forms conus arteriosus at the summit of which is the pulmonary opening.

Reticulum: The lesser curvature of reticulum faces to right and is connected with omasum.

DISSECTION: Saw the rib cage and remove the right thoracic wall. Remove the thoracic viscera. The medial view of axilla is revealed. The thoracic surface of the diaphragm is also revealed in oblique craniolateral view besides, other structures. Fig. 4.10.

Transversus thoracis muscle: It lies on the inside of thoracic cavity covering the sternum and is placed medial to costal cartilage.

Aortic thoracic artery in aortic hiatus: It lies just ventral to last thoracic vertebra between the crura of the diaphragm.

Diaphragm (lumbar part; right crus surrounding oesophageal hiatus): It has two crura (right and left), formed of two muscular pillars arising from ventral surface of lumbar vertebrae. Right crus attaches to ventral surface of first four vertebrae by ventral longitudinal ligament on both the sides. The two parts of right

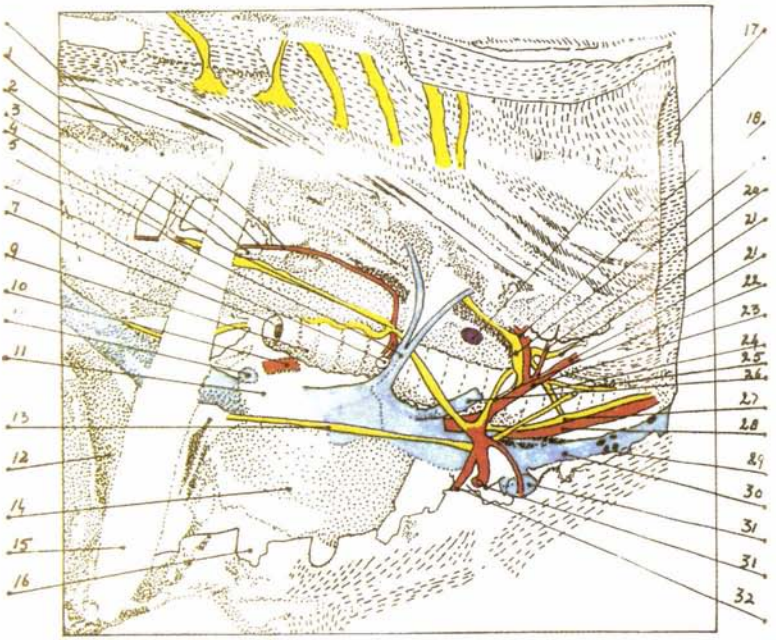

Fig. 4.9 : 1. broncho-oesophageal artery (broncheal and oesophageal branches); 2. medial mediastinal lymph node; 3. thoracic aorta; 4. vagal nerve X; 5. oesophagus; 6. right azygos vein; 7. right principal bronchus; 8. tracheal bronchus; 9. trachea; 10. pulmonary artery and vein; 11 right atrium; 12 reticulum; 13. phrenic nerve; 14 pericardium; 15 rib 6; 16 right ventricle; 17. cranial mediastinal lymph node; 18. suprema intercostal artery; 19. cervicothoracic ganglion; 20. dorsal scapular artery; 21. vertebral nerve and artery; 22. caudal ansa subclavia; 23. costocervical trunk; 24. cranial ansa subclavia; 25. recurrent laryngeal nerve; 26. costocervical vein; 27. vagus nerve; 28. common carotid artery; 29. caudal deep cervical lymph nodes; 30. external jugular vein; 31. axillary vein and artery; 32. internal thoracic artery and vein.

crus circumscribe the oesophageal hiatus and unite ventrally.

Diaphragm (costal part): It begins at dorsal third of twelfth rib, passes ventrally to the ventral one third of tenth rib and one fourth of ninth rib, to extend along the eighth costal cartilage to the base of xiphoid cartilage.

Diaphragm (central tendon): Central tendinous part forms the dome of the diaphragm which is tendinous in nature. The convexity of the dome faces the thorax. Thus the thoracic surface

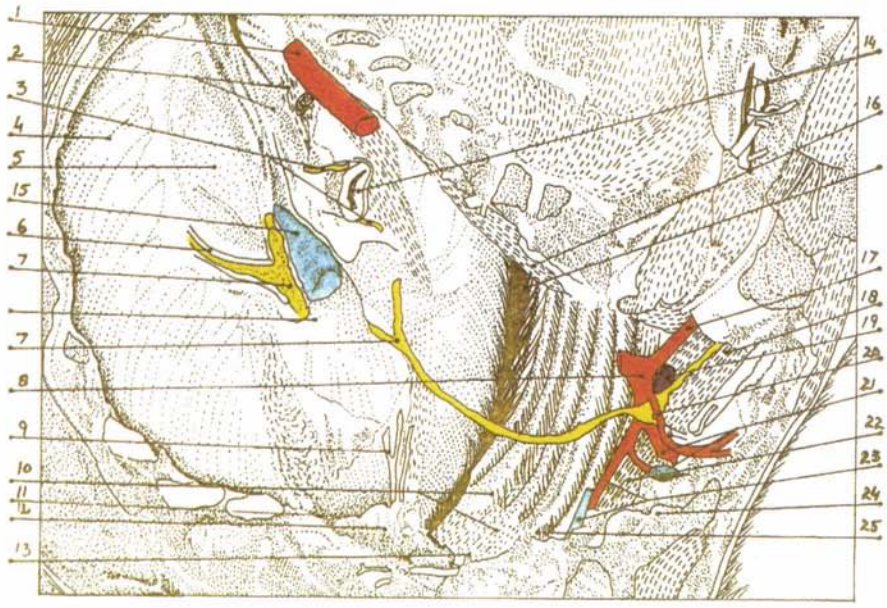

Fig. 4.10 : 1. thoracic aorta; 2. diaphragm (lumbar part, right crus); 3. vagus nerve X; 4. diaphragm (costal part); 5. diaphragm (central tedon); 6. cranial phrenic vein; 7. phrenic nerve (right and left); 8. left subclavian artery; 9. ventral mediastinal pleura (cut); 10. costochondral junction of rib 5,6; 11. diaphragm (sternal part); 12. sternopericardiac attachment (cut); 13. costomediastinal pleural recess (caudal part); 14. oesophagus; 15. caudal vena cava; 16. longus colli muscle; 17. costocervical trunk; 18. scalenus ventralis muscle; 19. deep caudal cervical lymph node; 20. superficial cervical artery; 21. axillary artery and vein; 22. rib 1; 23. internal thoracic artery and vein; 24. sternocephalicus muscle; 25. transversus thoracis muscle.

is convex and covered by thoracic fascia and pleura and abdominal surface is concave and is covered for the most part by transverse fascia and peritoneum. It is composed of radiating fibres.

Cranial phrenic vein: It leaves the caudal vena cave in the vena caval foramen in the tendinous centre of the diaphragm. Each vein gives branches to costal and sternal parts of the diaphragm, i.e. the left and right brances.

Ventral mediastinum pleura: The ventral part of cranial mediastinum is pushed to left by the apical lobe of right lung and lies in contact with left costal pleura.

Sternopericardiac ligament: Thoracic surface of sternum is attached to the pericardium of heart by two tendinous ligaments called sternopercardiac ligament.

Oesophagus in oesophageal hiatus: Oesophagus passes in the oesophageal hiatus at a hand's breadth ventral to eighth thoracic vertebra towards the left of the median plane.

Posterior vena cava in foramen vena cavae: It lies towards right and ventral to oesophageal hiatus in the median plane of the diaphragm.

Axillary vein: It is a satellite vein of axillary artery and is the continuation of brachial vein. It starts at inner side of arm, lies inferior to shoulder, crosses inferior border of first rib to join jugular vein and forms anterior vena cava.

Sternocephalic muscle: In the thoracic region it arises from manubrium sterni and first costal cartilage.

Sternopericardiac attachement: This is the ligament having right and left parts embedded in the mass of fat. On left side it is attcheded upto the fourth intercostal space.

Costo-mediastinal recess: Mediastinal pleura is related to the mediastinum. It is formed by the reflection of costal and diaphragmatic pleurae. The ventral line of reflection of the costal pleura onto the mediastinum is called the sternal line of pleural reflection and the part of the pleural cavity formed by this

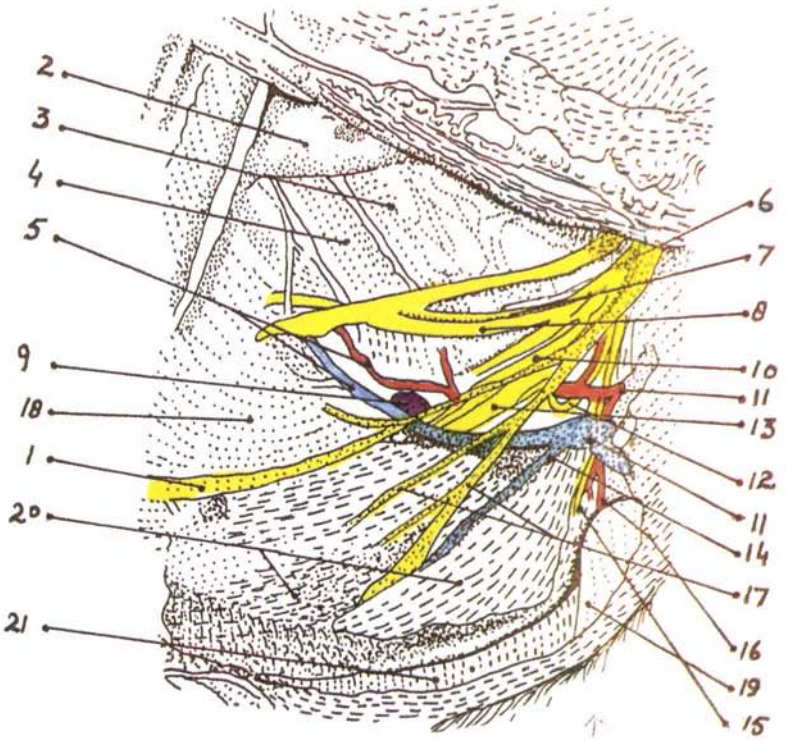

Fig. 4.11 : 1. lateral thoracic nerve; 2. serratus ventralis thoracis muscle; 3. subscapularis muscle; 4. teres major muscle; 5. thoracodorsal artery and vein; 6. subscapular neve; 7. axillary nerve; 8. thoracodorsal nerve; 9. axillary lymph node; 10. radial nerve; 11. axillary artery and vein; 12. msculocutaneous nerve (ansa axillaries); 13. musculocutaneous ulnar and median nerves; 14. external thoracic vein; 15. cranial pectoral nerve; 16. external thoracic artery (deltoid branch); 17. caudal pectoral nerves; 18. latissimus dorsi muscle; 19. pectoralis descendens muscle; 20. pectoralis ascendens muscle; 21. pectoralis transversus muscle.

reflection is known as the costomdiastinal recess.

DISSECTION: After removing the limb and thoracic wall of right side, thoracic viscera too are removed. The dorsal scalenus muscle has also been transected. The brachial plexus, thoracic wall and other structures are revealed in medial view. Fig. 4.11.

Lateral thoracic nerve: It arises from eighth cervical and first two thoracic components of brachial plexus. It innervates the skin on lateral thoracic wall, cutaneous trunci muscles and ventral abdominal region.

Subscapualris muscle: It is a flat muscle which outlines the costal surface of the scapula.

Thoracodorsal artery: It is the first vessel that arises from subscapular artery. It passes on the medial aspect of teres major and alongwith thoracodorsal nerve runs medial to lattissimus dorsi muscle.

Thoracodorsal vein: It orginates from axillary vein and supplies branches to teres major pectoralis profundus and latissimus dorsi muscles and to the skin in the region of lumbodorsal fascia.

Thoracodorsal nerve: It derives its fibres from the ventral branches of seventh and eighth cervical nerves and supplies the latissimus dorsi muscle.

Axillary nerve: It orginates from seventh and eighth cervical roots of brachial plexus. This nerve courses between subscapular artery and subscapularis muscle caudal to shoulder joint. It gives branches to teres major teres minor, deltoideus and caudal part of subscapularis muscle.

Axillary lymph nodes: It is situated medial to pectoralis profundus on lateral face of first intercostal space.

Musculocutaneous (ansa axillaris) nerve: This is the formation of loop of musculocutaneus branch with the median nerve in the axillary region, after crossing the medial face of axillary artery.

Musculocutaneous, ulnaris et median nerve: The median nerve courses with musculocutaneous branch cranially and ulnar nerve caudally. Near its origin the median nerve lies in a common sheath with ulnar and alogwith the musculocutaneous nerve it crosses the cranial border of distal third of the arm.

External thoracic vein: It arises from axillary vein at the level of the first rib. It ramifies in the pectoralis musculature giving a

distal branch to the deep pectoral and a branch between the superficial and the deep parts.

Pectoralis cranialis nerve: This is present in the form of a loop around the axillary artery.

Pectoralis caudalis nerve: This supplies pectoralis ascendens muscle.

DISSECTION: The thoracic region if completely transected, after sawing the bony part at dorsal and ventral parts. It exposes the thoracic surface of diaphragm in cranial view and also reveals the costal and sternal attachments of the diaphragm. Fig. 4.12.

Cranial phrenic vein: It leaves the caudal vena cava in the vena caval foramen of the diaphragm. It gives rise to laterally directed vessels to costal and sternal parts of diaphragm.

Liver (coronary ligament): On the right side the coronary ligament attaches the liver to the diaphragm. It extends from the dorsal connection of the liver to the oesophageal hiatus in the diaphragm.

Bronchoesophageal artery: It arises at the level of seventh thoracic vertebra dorsal to the base of heart and divides into bronchial and oesophageal branches. The two arteries may arise independently from the thoracic aorta. Oesophageal branches supply the intrathoracic part of oesophagus while the bronchial branches course alongwith the bronchial bifurcation.

Right azygos vein: It arises from the anterior vena cava close to the insertion of pericardium. It runs vertically just cranial to tracheal bronchus and continues over the lateral surface of right longus colli muscle to second or third intercostal space.

SURGICAL ANATOMY FOR COMMON SURGICAL AFFECTIONS OF THORACIC REGION

RIB RESECTION

(A) **Antomical location:** The location of the fifth rib may be determined by counting nine ribs forward from the last

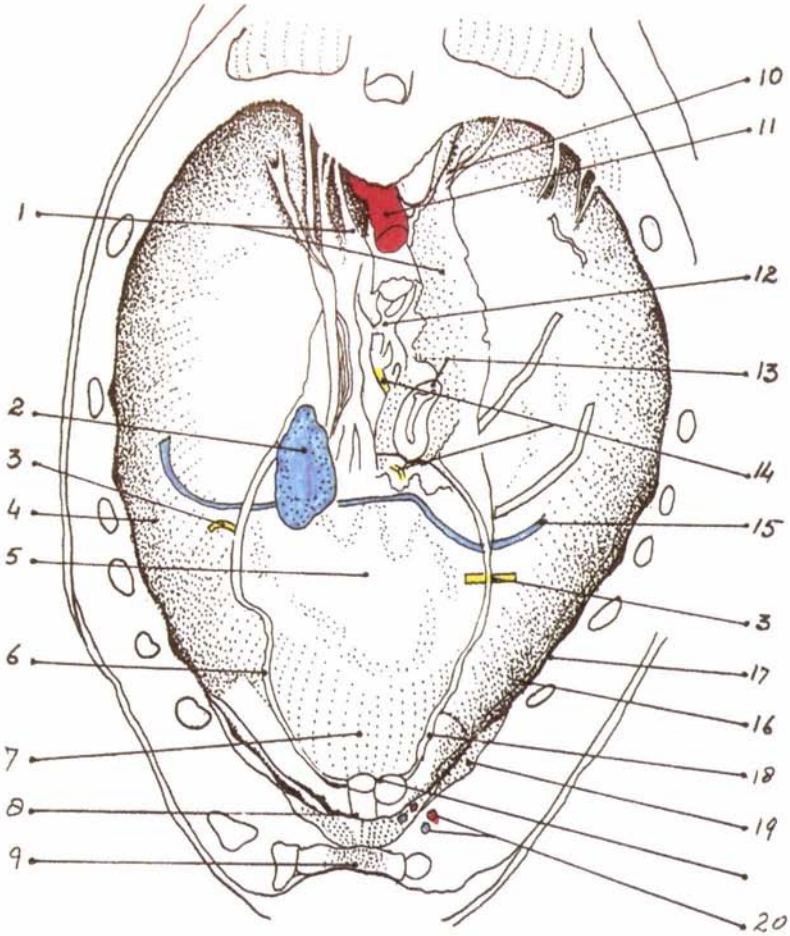

Fig. 4.12 : 1. diaphragm (lumbar part, right crus); 2. caudal vena cava (in caval foramen); 3. right and leaf phrenic nerves; 4. diaphragm (costal part); 5. diaphragm (central tendon); 6. pleural fold of caudal vena cava (cut edge); 7. diaphragm (sternal part); 8. sternopericardiac attachment (cut edge); 9. sixth sternebra and costal cartilages; 10. diaphragm (lumbar part, left crus); 11. thoracic aorta; 12. mediastinal pleura (cut edge); 13. oesophagus in oesophageal hiatus; 14. vagus nerve X; 15. cranial phrenic vein; 16. costodiaphragmatic pleural recess; 17. costal arch; 18. ventral mediastinal pleura (cut edge); 19. trasversus muscle; 20 internal thoracic artery and vein.

rib. The shaft of the rib is elongated, curved and has convex lateral and concave medial surfaces. The cranial and caudal borders are sharp.

(B) **Site for surgical approach:** About four to five inches portion of the distal end of the fifth rib. The site for incision is one inch below the costochondral junction and upward for a distance of six inches.

(C) **Structures encountered:** Skin, fascia, latissimus dorsi, serratus ventralis thoracis, intercostal vein, artery, nerves, periosteum and rib.

PARACENTESIS THORACIS (TAPPING CHEST)

(A) **Anatomical location:** The roof of the thoracic cavity is formed by the dorsal vertebrae and the thoracic muscles, the lateral walls by the ribs and the inercostal muscle, the floor by sternum cartilage of the sternal ribs and the muscles connected with these, and the posterior wall by the diaphragm. The thoracic cavity is in the form of a short, hollow cone, slightly compressed laterally. The cavity contains the lungs, pericardium and heart, thoracic portions of esophagus and trachea, large arterial, venous and lymphatic trunks, nerves, and lymphatic glands and vessels.

(B) **Site for surgical approach:** Right seventh intercostal space above the external thoracic vein about eight to nine inches behind the point of elbow in the same level.

(C) **Structures encountered:** Skin, panniculus carnosus, deep fascia (abdominal tunic), muscular part of obliquus abdominis externus, intercostal muscles and parietal pleura.

DIAPHRAGMATIC HERNIA (DIAPHRAGMATOCELE)

(A) **Anatomical location:** A rupture in the diaphragm through which some of the abdominal organs, usually the small intestines, stomach, perhaps spleen, liver have protruded themselves, so that they become situated actually within the chest cavity.

(B) **Site for surgical approach:** Right lateral thoracotomy is performed by giving 5 cm long cutaneous incision com-

mencing from midway on the sixth rib and extending downwards to its costochondral junction.

(C) **Structures enconuntered:** As dealt under rib resection. In addition there are hernial contents.

LOBECTOMY

(A) **Anatomical location:** The lungs occupy the greater part of the thoracic cavity and are accurately moulded to the chest wall and to other organs contained within it. The right lung is considerably larger than the left, owing to the presence of an extra lobe, the accessory lobe, and also its apical lobe is very much larger than that of the left. Thus left lung has three lobes, and the right one four lobes.

(B) **Site for surgical approach:** The thoracic cavity is entered through the resection of sixth rib, the rib is resected at the site described in rib resection.

(C) **Structures encountered:** As in rib resection, in addition there are parietal pleura, pulmonary artery, vein, bronchus and thin walled vessels of the bronchial tree.

N.B. The apical lobe receives a special small bronchus from the trachea directly. The lungs are firmly anchored in position by their roots to the heart and thrachea, by pleura to a longitudinal septum running vertically from front to back, called the mediastinum. The pulmonary artery, carrying impure blood to the lungs, divides into tow large branches after only short course. Each of these branches enters into the formation of the root of the lungs. The oxygenated blood is carried by larger and longer veins till it eventually leaves the lung by one of the several pulmonary veins.

PERICARDIOTOMY:

(A) **Anatomical location:** Heart lies in the lower portion of the chest cavity between the lungs, but projecting more to the left side than to the right. Its base lies opposite the third to sixth rib inclusive, and its apex lies above the last segment of the sternum. Heart and stomach are only separated from each other by a very small space.

(B) Site for surgical approach: Ventral aspect of the fifth rib on the left side of the thorax. A five to six inches (13 - 15 cm) skin incision is made over the fith rib dorsal to the costochondral junction.

(C) Sturctrues encountered: As in rib resection and in addition these are parietal pleura and pericardium.

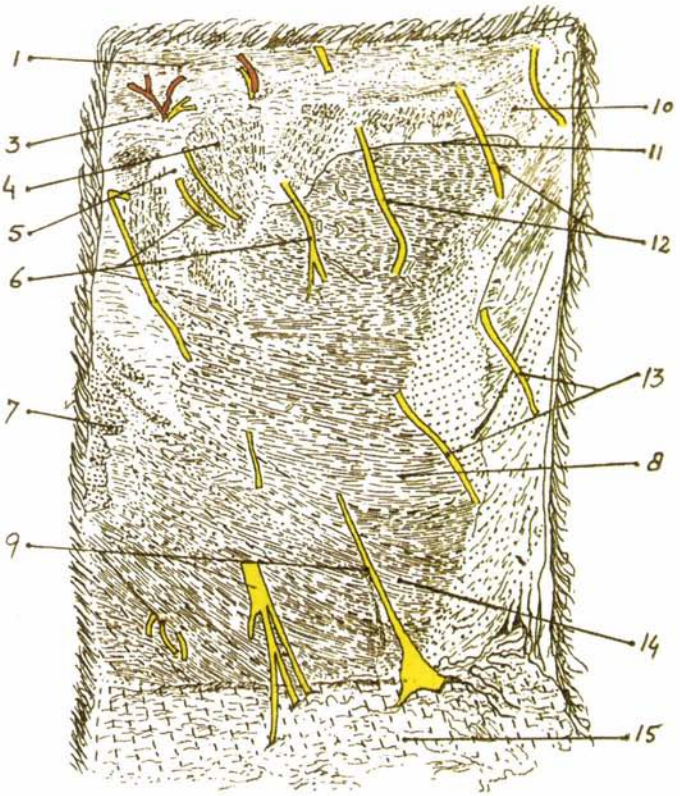

Fig. 5.1 : 1. lumbodorsal fascia; 2. longissimus muscle; 3. thoracic nerve XIII (dorsal medial cutaneous branch); 4. serratus dorsalis caudalis muscle; 5. rib 13; 6. thoracic nerves XI to XIII (dorsal lateral cutaneous branches); 7. serratus ventralis muscle (costal insertions); 8. obliquus externus abdominis muscle; 9. thoracic nerves XI to XIII (ventral lateral cutaneous branches); 10. obliquus internus abdominis muscle; 11. oliquus externus abdominis muscle (dorsal border); 12. lumbales nerves I and II (dorsal lateral cutaneous branches); 13. lumbales nerves I and II (ventral lateral cutaneous branches); 14. obliquus externus abdominis muscle; 15. cutaneous trunci muscle.

“This Page is Left Intentionally Blank”

Chapter 5

The Abdomen

DISSECTION: The skin alongwith the cutaneous muscle covering the ventral and lateral aspect of the trunk has been dissected and reflected ventrally. The cutaneous nerves in superficial fascia besides the following structures are revealed in lateral view. Fig. 5.1.

Lumbar cutaneous lateralis dorsalis nerves: The dorsolateral branches of third lumbar nerve course between internal and external olique muscles of abdomen and innervate the skin.

Lumbar cutaneous lateralis ventralis nerves: The branches of first and second lumbar nerves give medial branches which traverse the transversus abdominis muscle to reach rectus abdominis muscle. They pass between latter and the aponeurosis of oblique muscles of abdomen and supply the skin of ventral abdominal region.

Cutaneous trunci muscle: After the removal of superficial fascia the fleshy panniculus of cutaneous trunci muscle is exposed. It arises from interbrachial fascia on the medial surface of the arm and elbow and the fascia on the lateral aspect of arm and shoulder. It extends as a broad sheet to lateral crest of thigh. Ventrally, it covers the thorax and passes along the midventral line upto umbilicus. It is more developed at umbilicus, stifle and flank regions.

Cutaneous thoracis lateralis ventralis nerves: Ventral branches of eleventh and twelfth thoracic nerves pierce the rectus abdominis muscle, the aponeurotic sheets of oblique muscles of abdomen, and cutaneous trunci muscle. They ramify in the skin cranial to umbilicus.

Thoracic cutanei lateralis dorsalis nerves: These arise from first to fifth thoracic nerves to course and innervate as far ventrally as the infraspinous area.

Serratus dorsalis caudalis muscle: This muscle is poorly developed and lies covered by latissimus dorsi. Its fibres are directed ventrally overlapping one another.

Thirteenth thoracic nerve (cutaneous dorsalis): This branch arises at the level of costochondral junction of last rib and is distributed to skin of the flank slightly ventral to the level of tuber coxae.

Lumbodorsal fascia covering longissimus muscle: It extends the whole length of throracic and lumbar region. The deep part of the fascia forms a covering on the longissimus muscle and passes between the muscle to attach to the lumbar transverse processes and ribs.

DISSECTION: The cutaneous muscles covering the ventral and lateral aspects of the trunk have been removed and the emergence of cutaneous nerves is exposed besides other structures. Fig. 5.2.

Longissimus thoracis muscle: This muscle is lodged in the angle formed by the spines of thoracic vertebrae and the ribs. This muscle has two separate masses and is very fleshy.

Thoracic nerves VII to XI (cutaneous lateralis dorsalis): These are found supplying the serratus dorsalis caudalis muscle, thoracolumbar fascia and ramify in dorsal aspect of the tuber coxae.

Iliocostalis thoracis muscle: It arises from the transverse processes of first three or four lumbar vertebrae and forms a large bundle in the area of third to fifth rib. It terminates as glistening tendon on the first rib and on transverse process of seventh cervical vertebra alongwith the tendon of longissimus cervicis muscle.

Serratus dorsalis cranialis muscle: It has four digitations inserted on fifth to ninth rib when fully developed. It lies

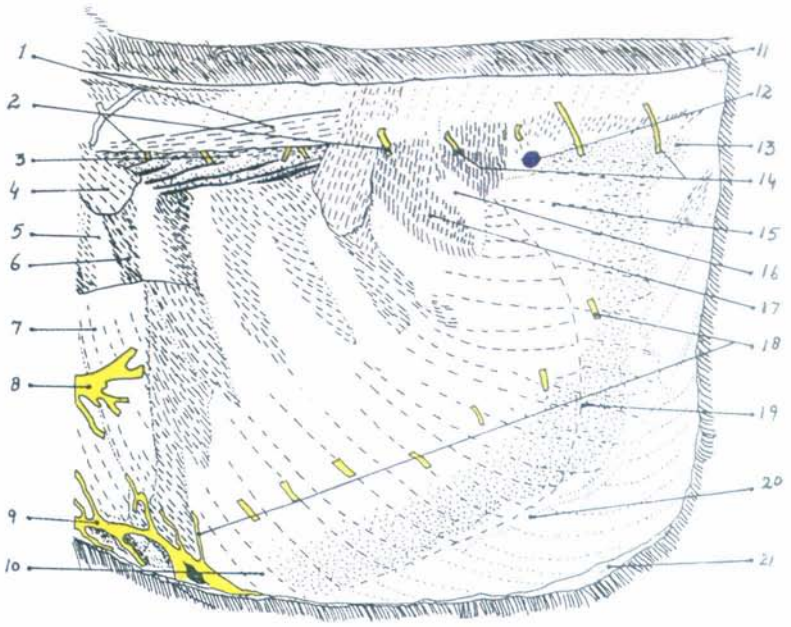

Fig. 5.2: 1. longissimus thoracis muscle; 2. thoracic nerves VII to XI (dorsal lateral cutaneous branches); 3. iliocostalis thoracis muscle; 4. serratus dorsalis cranialis muscle; 5 rib 7; 6. intercostalis externus muscle; 7. serratus ventralis thoracis muscle; 8. long thoracic nerve; 9. lateral thoracic nerve; 10. obliquus externus abdominis muscle; 11. tuber coxae; 12. paralumbar fossa lymph node; 13. obliquus interuns abdominis muscle (lumbo-dorsal fascial origin); 14. spinal nerves Th. XII - L.II (dorsal lateral cutaneous branches); 15. oliquus externus abdominis muscle; 16 rib 13; 17. serratus dorsalis caudalis muscle; 18. spinal nerves Th. VII. - L. I (ventral lateral cutaneous branches); 19. costal arch; 20. obliquus externus abdominis muscle (covered by yellow abdominal tunic); 21. cutaneous trunci muscle.

beneath serratus ventralis thoracis and latissims dorsi muscles.

Serratus ventralis thoracis muscle: The cranial half of the lateral thoracic wall is covered by this muscle. It is attached to caudal angle of the scapula and its cartilage by means of strong aponeurosis. Its caudal portion forms interdigitations with the origin of the obliquus externus abdominis muscle.

Long thoracic nerve: Its derives it fibres from ventral branches of seventh and eighth cervical nerves of the brachial plexus. It courses between scalene muscles and innervates serratus

ventralis thoracis muscle.

Lateral thoracic nerve: It receives branches from first and second thoracic and eighth cervical nerves. It supplies the cutaneous trunci muscle, and the muscles of ventral abdominal region.

Obliquus externus abdominis muscle (cranioventral extermity): It begins at the ventral part of fifth intercostal space and ends on the last rib, dorsal to its middle. In the flank region the fibres are directed horizontally. It is inserted by means of aponeourotic tissue to the coxal tuber, prepublic tendon and linea alba ventrally.

Ilium (tuber coxae): Tuber coxae of the ilium is large and prominent. It forms the point of the hip.

Obliquus internus abdominis muscle (origin): It is situated beneath the obliquus externus abdominis muscle. It originates from the coxal tuber and the deep lumbar fascia at the lateral border of the longissimus lumborum.

Spinal nerves Th. XII to L. II (cutanei laterlis dorsalis branches): The branches of these nerves innervate the skin on dorsal aspect as well as the coxal tuber, besides they also supply the lumbar region, including the area on the lateral abdominal wall.

Obliquus externus abdominis muscle (caudodorsal extremity): The caudodorsal extremity of this muscle is directed horizontally and its fleshy portion extends only upto the fourth lumbar vertebra, after which it is tendinous and ends on tuber coxae.

Yellow abdominal tunic (covering obliquus externus abdominis muscle): Yellow abdominal tunic covers the obliquus externus abdominis muscle. This elastic tunic extends over ribs to which it is attached. Its fibres are woven with the fibres of aponeurosis of external and internal abdominal muscles.

DISSECTION: A flap of skin has been removed from the right lateral and ventral aspects of the trunk to reveal cutaneous muscles. Fig. 5.3.

Longissimus lumborum muscle: It occupies the angle formed

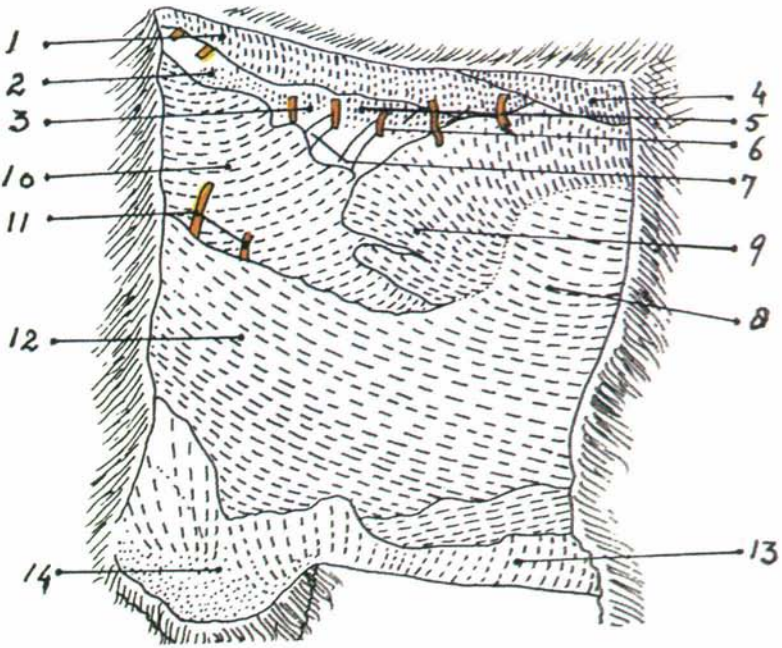

Fig. 5.3 : 1. longissimus lumborum muscle; 2. iliocostalis lumborum muscle; 3. obliquus internus abdominis muscle; 4. trapezius muscle (thoracic part); 5. serratus dorsalis caudalis muscle; 6. spinal nerves (dorsal lateral cutaneous branches); 7. rib13; 8. cutaneous ombrachialis muscle; 9. latissimus dorsi muscle; 10. obliquus externus abdominis muscle; 11. spinal nerves (ventral lateral cutaneous branches); 12. cutaneous trunci muscle; 13. pectoralis ascendens muscle; 14. preputialis cranialis muscle.

by spines of lumbar vertebrae and the lumbar transverse processes. It is distinct from longissimus cervicis and spinalis thoracis muscles. It orignates from cranioventral surface of the ilium and sacrum and from lumbar spines.

Iliocostalis lumborum muscle: It is a well developed, segmented muscle originating by tendinous fibres from the iliac crest as well as from aponeurosis of the longissimus lumborum muscle and the lumbar fascia. At the level of about third or fourth lumbar vertebra It emerges from beneath the thoracolumbar fascia to terminate tendinously at the caudal border of the last rib.

Obliquus internus abdominis muscle: It lies beneath obliqus externus abdominis. it occupies entire flank region from tuber coxae to last rib. Its aponeurosis is divided into two parts - the dorsal part is attached to caudal border of last rib and its cartilage; the other part extends laterally and superficially superficially to the costal arch to become fused with aponeourosis of the obliquus externus abdominis muscle. Its fibres are directed downwards, forwards and inwards.

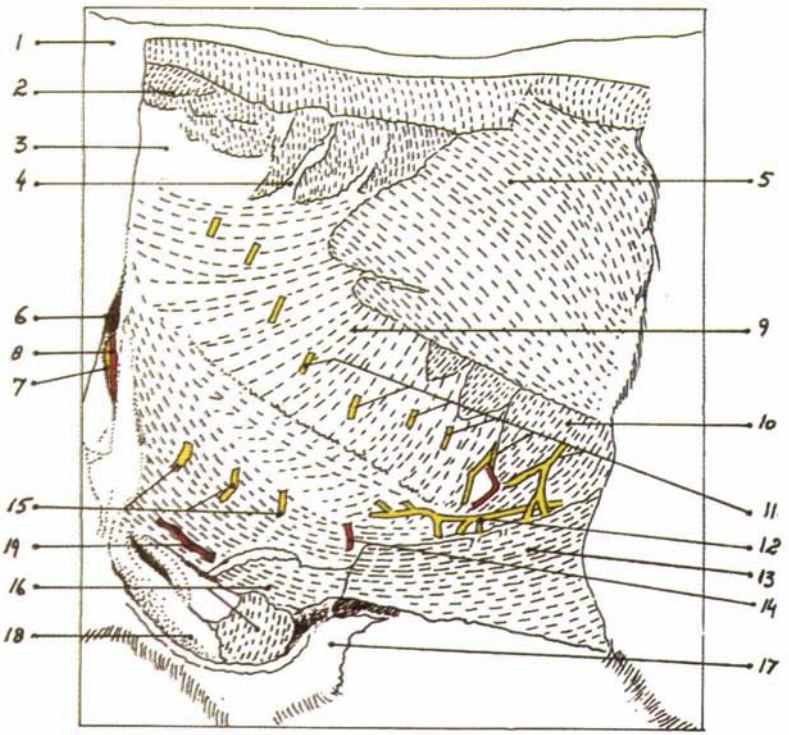

Fig. 5.4 : 1. Tuber coxae; 2. obliquus internus abdominis muscle; 3. obliquus externus abdominis muscle; 4. rib 13; 5. latissimus dorsi muscle; 6. subiliacus lymph node; 7. lateral fermoral cutaneous nerve (L. III. IV); 8. deep circumflex iliac artery (superficial caudal branch); 9. obliquus externus abdominis muscle (covered by abdominal tunic); 10. serratus ventralis thoracis muscle 11. spinal nerves (lateral ventral cutaneous branches); 12. lateral thoracic nerve; 13. pectoralis ascedens muscle; 14. cranial epigastric artery (at milk well); 15. spinal nerves (medial ventral cutaneous branches); 16. preputialis crannialis muscle; 17. umbilicus; 18. prepuce; 19. epigastric caudalis artery.

Cutaneous omobrachialis muscle: It is found covering the shoulder and the arm. The fibres are directed vertically which in the caudal region are in an oblique fashion and continue with cutaneous trunci muscle.

Latissimus dorsi muscle: It covers the lateral surface of thorax and is blended with thoracolumbar fascia. It is flat. thin and triangular in shape.

Obliquus externus abdominis muscle: It is the largest of all the abdominal muscles and is irregularly triangular in shape. Its fibres are directed downwards and backwards, but are less oblique at the upper part of the flank.

Pectoralis ascendens muscle: It is a large muscle having its fibres directed longitudinally along the ventral thoracic wall.

Preputialis cranialis muscle: It is a cutaneous muscle having its origin from fascia which is slightly caudal to xiphiod cartilage. The fibres of the muscle converge over the preputial orifice.

DISSECTION: The lateral cutaneous muscles have been dissected and removed to expose the cranial muscles of the prepuce. Their origins from tenth and eleventh ribs are covered by the latissimus dorsi muscle, however, interdigitations with serratus ventralis muscle at seventh, eighth and ninth ribs are revealed, besides the obliquus externus abdominis muscle in right lateral view. Fig. 5.4.

Subiliacus lymph node: It is situated on the aponeurosis of the obliquus externus abdominis muscle. It is usually flattened in shape and elongated in outline.

Lateral cutaneous femoral nerve: It is formed by the fibres from ventral branches of third and fourth lumbar nerves. It passes caudally between psoas muscle and across the surface of peritoneum to the cranial border of tuber coxae. Along with deep circumflex artery it perforates the obliquus externus abdominis muscle and extends on deep face of the subiliac lymph node to reach the skin in the region of thigh.

Deep circumflex iliac artery (caudalis, superficialis branch): It originates from external iliac artery and may arise from the

angle at the origin of external iliac artery. It crosses the inner lumbar muscles ventrally and perforates the transverse abdominis dividing into cranial and caudal branches. Caudal ramus gives superficial branch and perforates the external oblique abdominal muscle in a lateral direction and meets cutaneous femoris lateralis nerve to course to tensor fascia lata muscle and stifle fold.

Cranial epigastric (artery at the "milk well"): It is the second terminal branch of the internal thoracic artery. It perforates the diaphragm and runs a paramedian course towards the pelvis. It ramifies in the ventral abdominal wall through lateral, medial and even segmentally arranged branches. At the level of umbilicus the diverging terminal branches make contact with those of the caudal epigastric artery.

Umbilicus: It is distinctly visible in the median ventral line in a transverse plane jus near the ventral end of the last rib. It is a cicatrix slightly caudal to middle of linea alba and indicates the position of umbilical opening of the fetus.

Prepuce: It is a double invagination of th skin which contains and covers the free or the prescrotal portion of the penis when not erect. It is reflected inferiorly and laterally to form the preputial orifice while dorsally it becomes continuous with the skin of the abdominal wall. The preputial orifice lies about five centimeters caudal to umbilicus.

Caudal epigastric artery: It arises at the caudal border of annulus inguinalis profundus from pudendoepigastric trunk, which in turn originates from deep femoral artery. In the region of internal inguinal ring it vascularises the internal oblique abdominal and rectus abdominis muscles. At the level of umbilicus its diverging terminal branches link with those of cranial epigastric artery.

DISSECTION: Remove the mscular and aponeurotic part of the two oblique abdominal muscles at the flank and median line. Cut and reflect the rectus abdominis muscle towards the linea alba. The aponeurosis of the tansverse abdominis muscle, rectus sheath and the nerves which form the medial lamina

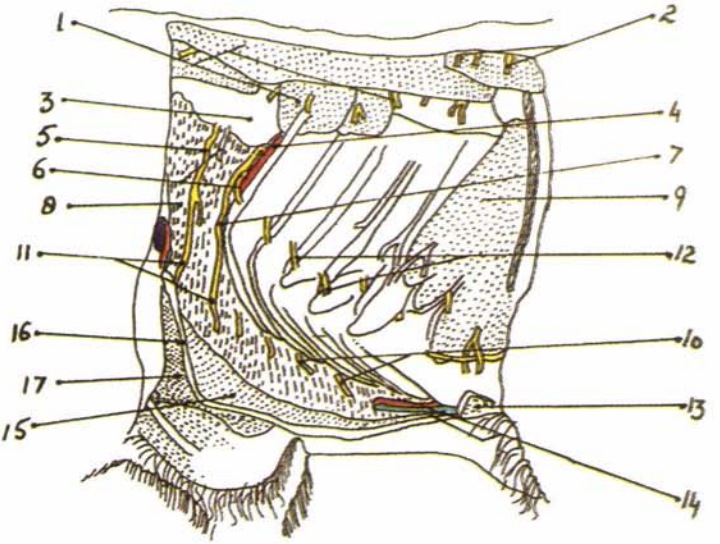

Fig. 5.5 : 1. thoracic et lumbales nerves (dorsal lateral cutaneous brances): 2. thoracic nerves (dorsal medial cutaneous branches): 3. transversus abdominis muscle; 4. costoabdominal nerve (Th. XIII); 5. lumbalis nerve (ventral branch); 6. costoabdominal dorsal artery; 7; Th. XIII and L.I. (ventral lateral cutaneous branches); 8. transversus abdominis muscle; 9. serratus ventralis thoracis muscle; 10. intercostal nerves X, Xi (lateral cutaneous branches); 11. Th. XIII and L.I. (ventral medial cutaneous branches); 12. intercostalis nerves X, XI (ventral cutaneous branches); 13. pectoralis ascendens muscle; 14; epigastric cranialis artery and vein (cranial to the milk well); 15 rectus abdominis muscle (lamina interna); 16. rectus abdominis muscle; 17. rectus abdominis muscle (lamina externa).

of the abdominal wall are revealed in right lateral view. Fig. 5.5.

Aponeurotic origin of transversus abdominis muscle: It appears as a muscular sheet on the deep face of obliquus internus abdominis and rectus abdominis muscle. In lumbar region it is aponeourotic from first five lumbar transverse processes.

Costoabdominal nerve: It is the ventral branch of the last thoracic nerve. It descends along the caudal border of the last rib, being covered by the obliquus internus abdominis muscle. It is divided into lateral and medial branches which are distributed to the cutaneous trunci muscle and skin, and to ventral abdominal wall respectively.

Ventral lumbar nerves: The first and second lumbar nerves come out independently through the respective foramina and innervate the lateral and ventral abdominal wall. The ventral branch of the third lumbar nerve ends in the skin of flank and the ventral branch of the fourth reaches the skin of thigh. The ventral branches of the fifth and sixth lumbar nerves after leaving the abdominal cavity through obturator foramen, split into several muscular branches for the abductor, pectineus, gracilis, obturatorius externus muscles including its intrapelvic part.

Cutanei lateralis ventrales branches of nerves of Th. XIII and L.I: The first lumbar nerve has a lateral branch, which pieries the aponeurotic origin of transversus abdominis muscles crosses the oblique muscles to innervate the skin on lateral abdominal wall. The lateral ventral branch of thirteenth thoracic nerve pierces the external and internal oblique abdominal muscles and is distributed to the cutaneous trunci muscle and the skin.

Intercostales X, XI nerves (cutanei laterale branches): Lateral cutaneous branches of the intercostal nerves give rise to intercostobrachial nerves.

Cutanei mediales ventrales of Th. XIII and L.I: The fibres from these branches innervate the fascia and skin of the ventral abdominal wall besides prepuce and preputial membrane.

Cranial epigastic vein (cut just cranial to "milk well"): It arises from internal thoracic vein near the diaphragm which it pierces and gains access to the ventral wall of the abdomen. Here it ramifies alongwith the corresponding artery and usually anastomoses through its terminal branches with those of the caudal epigastric vein.

DISSECTION: The muscles situated caudal to the costal arch are dissected and displaced in order to reveal, in lateral view, the course of a typical segmental nerve and its cutaneous branches supplying the trunk. Fig. 5.6.

Thirteenth thoracic nerve: It divides into dorsal and ventral branches. The dorsal branch is smaller than the ventral one. The dorsal branch of thirteenth thoracic nerve emerges at about the level of costochondral junction of the last rib and is distributed to the skin of the flank slightly ventral to the level

of the tuber coxae. The ventral branch, called the **costoabdominal nerve** descends along the caudal border of the last rib under obliquus internus abdominis muscle. Near the ventral end of the last rib it divides into lateral and medial branches. The lateral branch pierces the oblique abdominal muscles and is distributed to the cutaneous trunci muscle and the skin as cutaneous lateralis branch. The medial branch courses between obliquus internus abdominis and tranversus abdominis muscles, finally entering rectus abdominis muscle. some of its branches innervate the fascia and skin of the ventral abdominal wall as cutaneous ventralis branch. A distinct branch innervates the preputial membrane and preputial orifice. This branch together with the corresponding branches of I and II lumbar nerves is called as **cranial preputial nerve.**

First lumbar nerve: It divides into dorsal and ventral branches. The ventral branch of first lumbar nerve is known as Iliohypogastic nerve. The dorsal branch accompanied by a branch of corresponding lumbar artery courses between the longissimus lumborum and the fasicia on the surface of intertransversarii lumborum muscle. This course is initially along the caudal border of the transverse process of the first lumbar vertebra and then passes over the lateral edge of the transverse process of second lumbar vertebra. It emerges between logissimus lumborum and the iliocostalis muscles and innervates the skin of the lumbar region including some area of the lateral abdominal wall. The ventral branch passes laterally between itertransversarii lumborum and psoas muscles. Close to its emergence it gives branches to psoas and quadratus lumborum muscles. The nerve passes under the iliocostalis lumborum muscle and on the peritoneal surface divides into lateral and medial branches. The lateral branch courses between abdominal muscles to end in the skin of lateral abdominal wall. The medial branch passes through transverse abdominis to rectus abdominis muscles and finally is distributed in the skin of ventral abdominal wall. It gives a distinct branch to be distributed to the preputial orifice and the preputial membrane. This branch together with the corresponding branch of thirteenth thoracic and second lumbar nerves, is designated as **cranial preputial nerve.**

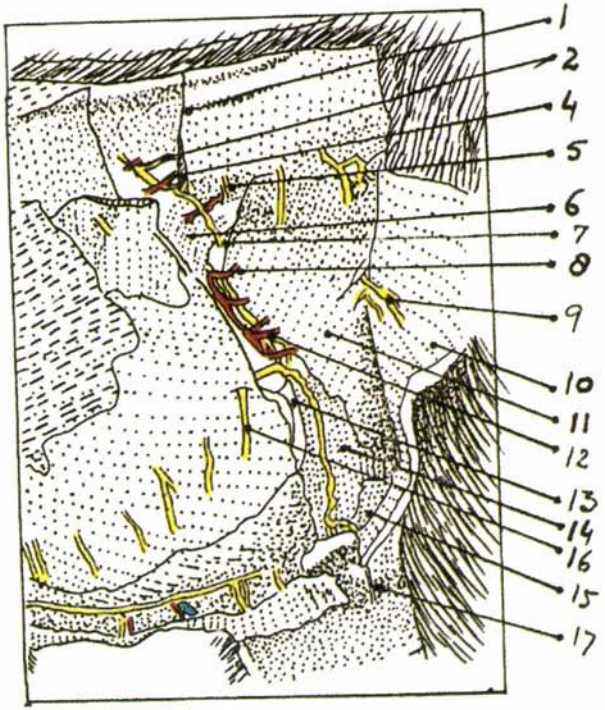

Fig. 5.6 : 1. longissimus muscle; 2. thoracic nerve XIII; 3. vertebral canal; 4. dorsalis branch (muscular branch to epaxial muscles); 5. lumbalis nerve (dorsal lateral cutaneous branch); 6. retractor costae muscle; 7. thoracic nerve XIII (dorsal lateral cutaneous branch); 8. costoabdominal nerve (ventral branch); 9. lumbalis nerve (ventral muscular branch); 10. obliquus externus abdominis muscle; 11. obliquus internus abdominis muscle; 12. dorsal costoabdominal artery; 13. rib 13; 14. transversus abdominis muscle; 15. rectus abdominis muscle; 16. thoracic nerve XIII (ventral lateral cutaneous branch); 17. thoracic nerve (ventral medial cutaneous branch).

Retractor costae muscle: It is a thin muscle which is placed in the angle formed by the last rib and the ends of the lumbar transverse processes. Fibres are inserted on the caudal border of the vertebral end of the last rib.

Dorsal costoabdominal artery: The dorsal intercostal arteries correspond to the number of thoracic vertebrae and run through intercostal spaces except the last one, which descends caudal to last rib and is therefore not an intercostal artery. it is know as

dorsal costoabdominal artery. It arises from the thoracic aorta.

Transversus abdominis muscle: It is a muscular sheet on the deep face of obliquus internus abdominis muscle. Its lumbar origin is aponeurotic while the costal origin is fleshy. Deeply it is related to the peritoneum, xiphoid cartilage and subserous fat.

Rectus abdominis muscle: This muscle extends from sternum to pubis. It has two parts joined only at the pelvis. Umbilicus is in the plane of third lumbar vertebra in this muscle. There are five tendinous intersections in cranial two third of this muscle which pass at right angles to the muscle fibres and prevent the muscle fibres from spreading laterally. There is, usually a foramen near the second intersection for the passage of the superficial cranial epigastric vein. This foramen is sometimes referred to as "**milk well**".

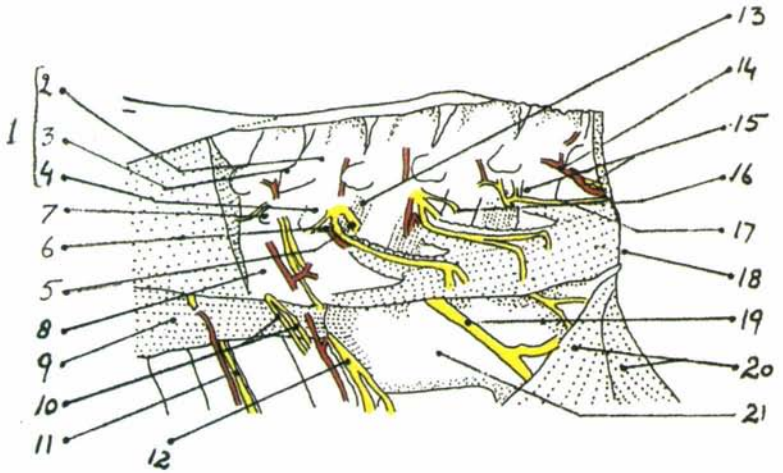

Fig. 5.7 : 1. L.I; 2. dorsal spinous process; 3. mammillary process; 4. transverse process; 5. lumbalis nerve I (ventral branch); 6. lumbalis nerve I (dorsal lateral cutaneous branch); 7. transverse process of Th; 13; 8. rib 13; 9. iliocostalis thoracis muscle; 10. thoracic nerve XII (dorsal lateral cutaneous branch); 11. intercostal nerve (ventral branch); 12. costoabdominal nerve; 13. psoas muscle; 14. lumbalis artery IV (dorsal branch); 15. lumbalis nerve III, IV; 16. lumbalis nerve II (dorsal muscular branches); 17. lumbalis nerve III (dorsal lateral cutaneus branch); 18. iliocostalis lumbalis muscle; 19. lumbalis nerve I (ventral part); 20. obliquus internus muscle; 21. transversus abdominis muscle.

DISSECTION: The muscles of the abdominal wall are dissected and removed. The processes of lumbar vertebrae are exposed and cleaned, in order to demonstrate the thoracic and lumbar nerves of the left paravertebral region. Fig. 5.7.

Intercostal nerves (ventral branches of thoracic nerves): They are much larger than the dorsal branches and are connected with sympathetic trunk by rami communicantes. Cutaneous branches of the cranial intercostals nerves join the branches of the lateral thoracic nerve of the branhial plexus. The **intercostobrachial nerve** arises from this union. These nerves descend in the intercostals spaces with the dorsal intercostal vessels, at first between the intercostal muscles, and further ventrally they are chiefly subpleural.

Psoas muscle: This mscle has minor and major parts. Psoas minor muscle is the most medial of the sublumbar muscles and psoas major muscle is the most lateral of the sublumbar muscles.

Lumbar arteries: They correspond to the number of lumbar vertebrae. They originate from dorsal aorta as segmental vessels except the last one which arises from iliolumbar artery. lateral to the corresponding vertebra these arteries curve to the caudal border of the transverse processes and give a branch to the body of the vertebra. After this branch the arteries give spinal branch for the spinal canal and cord, dorsal branch which courses through the musculature of the back, ending in the skin of the back as cutaneous branch. The main trunks of the lumbar arteries suppy the dorsally directed branches to the trunk muscles and ventrally directed branches to inner lumbar muscles. Also, first and second lumbar nerves give phrenic branch to diaphragm and suprarenal branch to adrenal gland respectively.

Lumbar nerve II, dorsalis (muscular branch to epaxial muscle): This is small branch and is distributed to the muscles and skin of the loin and croup.

Lumbar nerves I – III (cutaneous lateralis dorsalis nerves): The first three dorsolateral branches emerge through thoracolumbar fascia at the level of tuber coxae.

These supply the lumbar region including an area on the lateral abdominal wall.

DISSECTION: The rib cage and the diaphragm on lateral wall of the trunk are removed. The stomach has been slightly inflated to imitate its shape and position in life. The abdominal viscera in left lateral view are revealed. Fig. 5.8.

Thoracic aorta: It lies within the pericardium to the point of attachment of the ligamentum arteriosum an is enclosed with the pulmonary trunk in prolongation of the epicardium. Beyond this lies between the two pleural sacs.

Bronchoesophageal artery (oesophageal branch): Oesophageal artery arises from the beginning part of the thoracic aorta just caudal to aortic arch. It divides into cranial and caudal branches. Cranial branch courses along the right face of the oesophagus. Caudal branch follows the dorsal surface of the oesophagus caudally to the oesophageal hiatus.

Dorsal vagus: Dorsal vagus receives a branch from ventral trunk and gives a branch to celiac plexus. Its fibres follow the branches of cranial mesenteric artery to the intestine.

Left ventricle: It sends blood through aorta through systemic circulation to whole body. Its muscular walls are two to three times thicker than the outer wall of right ventricle. The capacity of the left ventricle is less than the right although its cavity reaches down to the apex.

Tensor fascia lata: It makes up the cranial edge of the thigh. This muscle is triangular in shape with its apex at the coxal tuber. The fibres radiate from the coxal tuber in a fan like maner.

DISSECTION: The right lung has been removed. A small portion of the liver extends into the left half of abdomen. The spleen is also removed. The abdominal viscera can be observed in lateral view from slightly cranial angle. Fig. 5.9.

Left atrium: Left atrium is less spacious. The border of its auricle is in contact with the pulmonary trunk and is notched in similar manner to that of the right atrium. It receives blood from pulmonary veins.

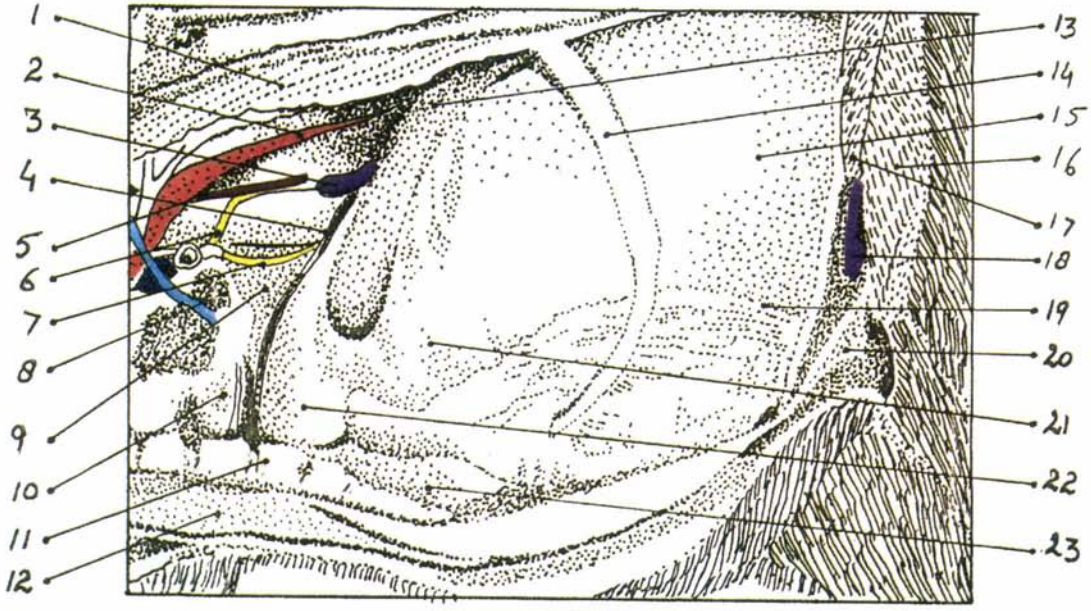

Fig. 5.8 : 1. iliocostalis thoracis muscle; 2. thoracic aorta; 3. caudal mediastinal lymph node; 4. diaphragm; 5. broncho-oesophageal artery (oesopheageal branch); 6. vagal trunk X (dorsal branch); 7. vagal trunk X (ventral branch); 8. left atrium; 9. right lung (accessory lobe); 10. left ventricle; 11. rib 6; 12. pectoralis ascandeins muscle; 13. spleen; 14. rib 13; 15. rumen (dorsal sac); 16. tensor fasiae latae muscle; 7. obliquus internus abdominis muscle; 18. subiliac lymph node; 19. great omentum (superficial leaf); 20. obliquus externus abdominis muscle; 21. rumen (atrium) 22. reticulum; 23. abomasum.

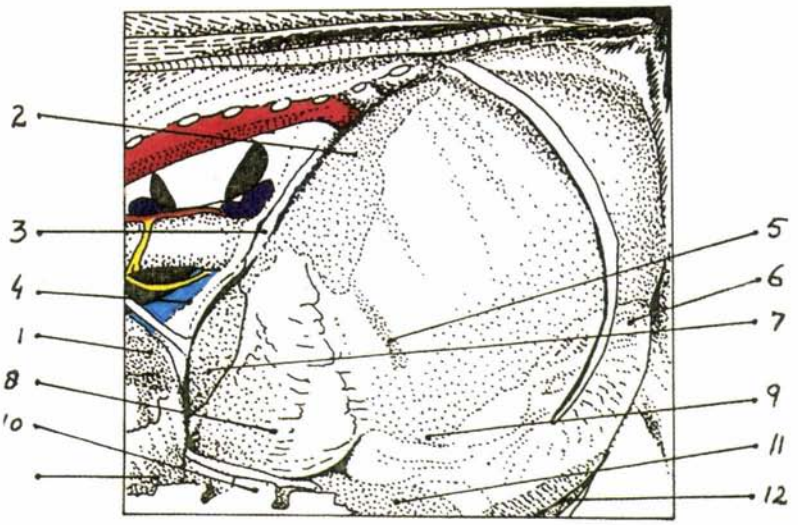

Fig. 5.9 : 1. left atrium; 2. spleen (attaced to dorsal sac of rumen); 3. diaphragm (lumbar part, right crus); 4. posterior vena cava (at caval foramen); 5. ruminoreticular groove; 6. rumen (ventral sac covered by superficial leaf of great omentum); 7. liver (left lobe); 8. reticulum; 9. rumen (atrium); 10. rib 6; 11. abomasums; 12. abdominal muscle (cut edges).

Diaphragm, lumbar part, (right crus at oesophageal hiatus): This part of the diaphragm is muscular and the right crus circumscribes the oesophageal hiatus before joining the tendinous part.

Caudal vena cave (at caval foramen): It runs in the plica vena cavae through the right pleural cavity to foramen vena cavae in the tendinous centre of the diaphragm.

Ruminoreticular groove: External demarcation between the ruminal atrium and reticulum is ruminoreticular groove. Ventrally this groove is deep on the parietal surface but dorsally it is not distinct.

Reticulum: It is the most cranial and smallest of the four compartments of the ruminant stmach. It is located between sixth and seventh or eighth rib. Most of its part lies on the left of median plane.

DISSECTION: The dorsolateral part of the rumen is removed whereas the dorsal part is stitched to the abdominal roof. The ventral part of ruminal atrium is also removed. It reveals the relationship of the abomasum, reticulum and rumen to the left abdominal wall. The interior of rumen and reticulum are revealed in left lateral view. Fig. 5.10.

Caudal mediastinal lymph nodes: They are located in the caudal mediastinum, caudal to the aortic arch along the dorsal and lateral faces of the oesophagus.

Ruminoreticular fold (cut edge): The cranial end of the cavity of the rumen is the ruminoreticular orifice bounded by ruminoreticular fold which corresponds to the ruminoreticular groove on the outside.

Lips of the reticular groove: The lips are formed by the left and right sides of the groove. The groove is twisted by 180 degrees so that the thickened edges of the lips first project caudally and then cranially.

Reticuloomasal orifice: It is situated in the lesser curvature of the reticulum to the right of the median plane. It is limited ventrally and on the sides by the lips and dorsally by the fundus of the groove.

Cavity of the reticulum: Mucous membrane is raised into folds which encloses four, five or six sided cells forming a network of folds which gives the shape of honey comb. The name of reticulum was suggested by this network of folds.

Cavity of the rumen (dorsal sac): The right and left longitudinal grooves on the outer side of rumen correspond to right and left longitudinal pillars respectively and divide the cavity of rumen into dorsal and ventral sacs. The dorsal sac is demarcated caudally from caudodorsal blind sac by dorsal coronary pillar which corresponds to the dorsal coronary groove seen externally.

Iliopsoas muscle: These are two muscles, psoas major and iliacus muscles, which are intimately adherent to each other in ruminants forming iliopsoas muscle. Psoas major muscle

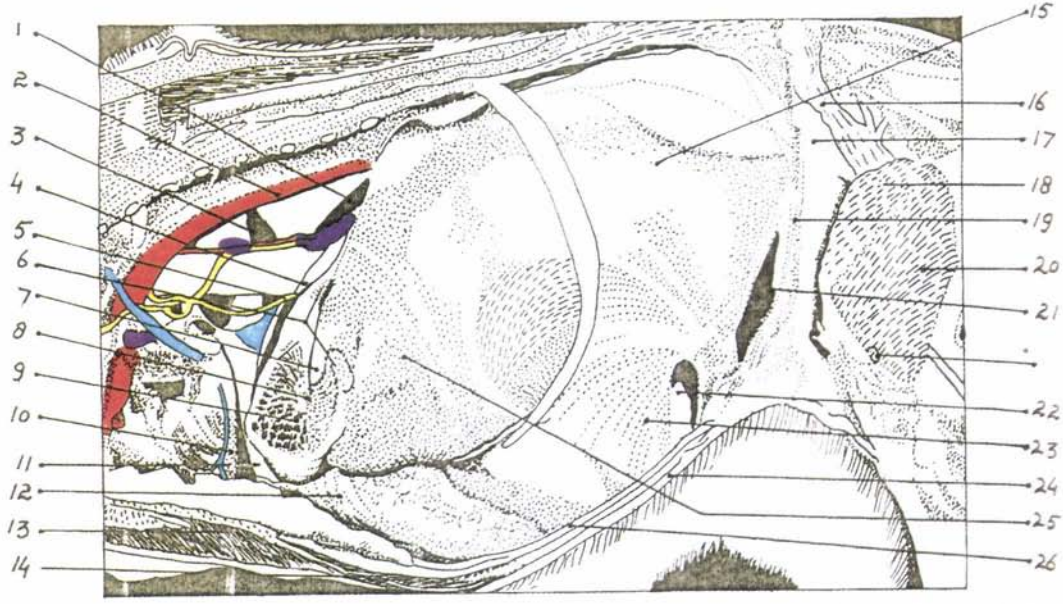

Fig. 5.10 : 1. caudal mediastial lymph node; 2. thoracic aorta; 3. vagal trunk X (dorsal branch); 4. diaphragm (right crus); 5. vagal trunkx (ventral branch); 6. ruminoreticular fold; 7. reticular groove (lips); 8. reticulo-omasal orifice; 9. cavity of reticulum; 10. left ventricle; 11. diaphragm (sternal part); 12. abomasums; 13. pectoralis ascendens muscle; 14. obliquus externus abdominis muscle; 15. cavity of rumen (dorsal sac); 16. iliopsoas muscle; 17. obliquus externus abdominis muscle (covered by yellow abdominal tunic); 18. rectus femoris muscle; 19. obliquus internus abdominis muscle; 20. vastus lateralis muscle; 21. cavity of rumen (dorsal blind sac); 22. cavity of rumen (ventral blind sac); 23. cavity of rumen (ventral sac); 24. cutaneous trunci muscle; 25. cavity of rumen (atrium); 26. obliquus interms abdominis muscle.

originates form vertebral ends of last two ribs and ventrolateral aspect of bodies and ventral surface of transverse processes of all lumbar vertebrae. Iliacus muscle originates from the body of sixth lumbar vertebra and ventrolateral surface of ilium. Both the muscles get inserted on the lesser trochanter of femur.

Rectus femoris muscle: It arises as a tendon from os coxae and extends till cranial surfaceof patella. Laterally rectus femoris has gluteus profundus and vastus lateralis muscles.

Vastus lateralis muscle: It makes up the lateral mass of the thigh cranial to the femur. It arises from greater trochanter and extends till lateral patella and gives shape to the thigh.

Cavity of rumen (dorsal blind sac): The posterior extremity of the rumen extends upto pubis and is divided into caudodorsal and caudoventral blind sacs by a deep transverse caudal groove externally, which corresponds to caudal pillar internally. The caudodorsal blind sac is marked off from rest of the dorsal sac of rumen on each side by dorsal coronary groove corresponding internally to dorsal coronary pillar.

Cavity of rumen (atrium): The cranial extremity of rumen is divided ventrally into two sacs. The dorsal one is known as atrium runminis. It is continous caudally with the dorsal sac of the rumen and cranially with the reticulum. Ruminoreticular groove froms the line of demarcatin between reticulum and the atrium. Internally the mucous membrane of the atrium ruminis is thickly studded with large papillae which are largest in this region and in blind sacs of rumen.

DISSECTION: The entire rumen has been cut and removed. The right diaphragmatic crus is held in place by a fine wire. The arteries and veins of the abdominal viscera are revealed in left lateral view. Fig. 5.11.

Pancreas (left lobe): It is enclosed in the dorsal attachment of the greater omentum. Its dorsal surface forms medioventral wall of epiploic foramen. The dorsal surface is also related to celiac, hepatic and cranial mesenteric arteries and the splenic vein.

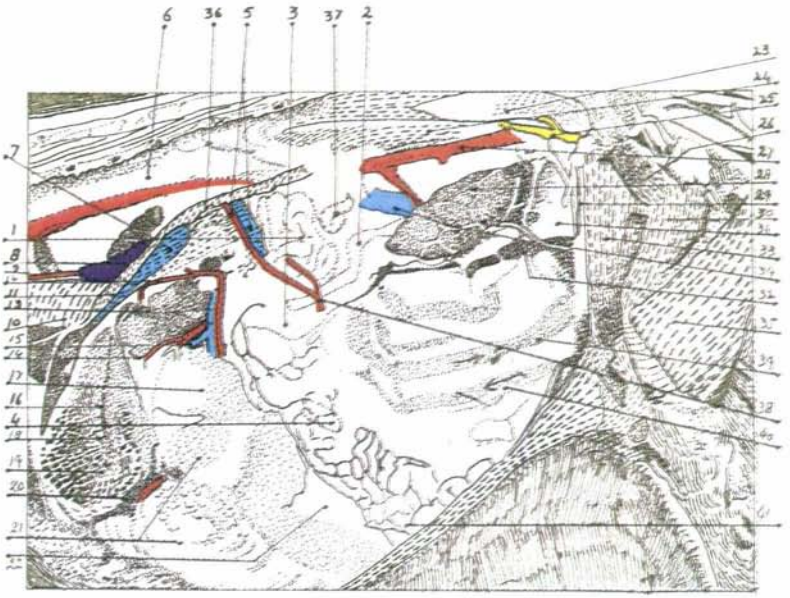

Fig. 5.11 : 1. pancreas (left lobe); 2. descending colon; 3. ascending duodenum; 4. jejunum; 5. lienalis artery and vein; 6. thoracic aorta; 7. posterior vena cava; 8. caudal mediastinal lymph node; 9. broncho-oesophageal artery (oesophageal branch); 10. oesophagus; 11. diaphragm (right crus); 12. reticular artery; 13. left ruminal artery and vein; 14. accessory reticular artery; 15. left gastroepiploic artery and vein; 16. reticular groove; 17. omasum; 18. reticulo-omasal orifice; 19. reticulum 20. left gastroepiploic artery; 21. abomasum; 22. great omentum (deep leaf); 23. psoas major muscle; 24. psoas minor muscle; 25. lumbales nerves III, IV (ventral branches); 26. iliopsoas muscle; 27. abdominal aorta; 28 left kidney; 29. obliquus internus abdominis muscle; 30 rectus fermoris muscle; 31. descending colon; 32. ureter; 33. obliquus externus abdominis muscle; 34. left renal artery and vein; 35. vastus lateralis muscle; 36. diaphragm (left crus); 37. left suprarenal gland; 38. right ruminal artery; 39. first centripetal loop of ansa spiralis; 40 last centrifugal loop of ansa spiralis of ascending colon; 41 ileum.

Descending colon: It runs caudally dorsal to the ascending duodenum and inclines to the right under the right kidney. it forms a slight sigmoid flexure near the pelvic inlet and joins the rectum.

Ascending duodenum: Ascending duodenum is attac;hed to descending colon by duodenocolic ligament and to proximal and distal loops of the ascending colon and to descending colon

by the adhesions present around the root of the mesentery.

Jejunum: It froms coils arranged in a festoon. Before it joins the ileum, it is prolonged by a "U" shaped series of loops on an extension of the mesentery. Jejunum lies in the supraomental recess on the right side of rumen.

Lienalis (splenic) artery: It is the largest branch of the celiac artery. It passes cranially and to the left across the dorsal curvature of the rumen and enters the hilus of the spleen.

Lienalis (splenic) vein: Near the body of pancreas the portal vein gives off large lienalis vein accompanying the corresponding artery.

Reticular artery: It arises from the left ruminal artery, passes over the dorsal curvature of rumen and turns ventrally in the ruminoreticular groove in which it is covered by a layer of muscle. it follows the groove from left to right side.

Left ruminal artery: This originates from splenic or left gastric artery. It runs ventrally on the right surface of the rumen to cranial groove and then to left longitudinal groove.

N.B. Accessory reticular artery is present only in small ruminants and arises from left gastric artery after the origin of left gastroepiploic artery. It supplies right wall of omasum and right and cranial wall of reticulum upto cardia.

Left gastroepiploic vein: Left gastroepiploic vein arises from lienalis vein after giving left gastric vein.

Abdominal aorta: It is a part of descending aorta which enters the abdominal cavity after traversing the aortic hiatus of the diaphragm. This is related dorsally to lumbar vertebrae, ventral longitudinal ligament and left psoas minor muscle. In aortic hiatus it is related to cisterna chyli.

Left kidney: Dorsal surface is convex and presents on its craniolateral part the hilus, which opens on lateral side. Its ventral surface is related to intestine and its third surface is flattended which is related to rumen and called the ruminal surfrace.

Ureter (left): It begins at the ventral part of the hilus of the kidney, comes to the dorsal side by curving over the lateral aspect of kidney and crosses the median plane to run caudally on the left side.

Left renal artery: This arises from the ventral aspect of abdominal aorta between the second and third lumbar vertebrae, slightly caudal to the corresponding right artery. It runs cranially and ventrally and enters the kidney at the hilus.

Left suprarenal (adrenal) gland: Left suprarenal gland is placed on the midline just caudal to the cranial mesenteric artery and on the medial face of the caudal vena cava. It is roughly "C" shaped and is situated 5-8 cm, cranial to the left kidney.

Right ruminal artery: This is the largest artery of the rumen and arises from splenic artery. It passes in the right longitudinal and caudal grooves giving off collateral branches.

First centripetal gyrus of spiral loop (ansa spiralis) of colon: The proximal loop turns medially round the caudodorsal border of the mesentery and runs cranially on the left side of the mesentery. It turns ventrally and is continued by the first centripetal gyrus of the spiral loop.

Last centrifugal gyrus of spiral loop (ansa spiralis) of colon: It is related to the rest of the colon and separated from jejunum by cranial mesenteric artery and mesenteric lymph nodes. From the last centrifugal gyrus, distal loop proceeds dorsally and caudally on the proximal loop.

Ileum: It is the terminal part of small intestine from the ileocecal fold to ileocecal orifice. It enters the junction of cecum and colon obliquely on the medial surface.

DISSECTION: The rib cage of right side is cut and removed. The diaphragm is removed. The abdominal viscera are exposed and viewed more cranially. The umbilical notch for the round ligament is also visible and other structures are revealed in right lateral view. Fig. 5.12.

Liver: Liver is placed to the right of the median plane. Its long axis is directed cranioventrally, extending from right kidney at the last rib to ventral third of sixth intercostals space.

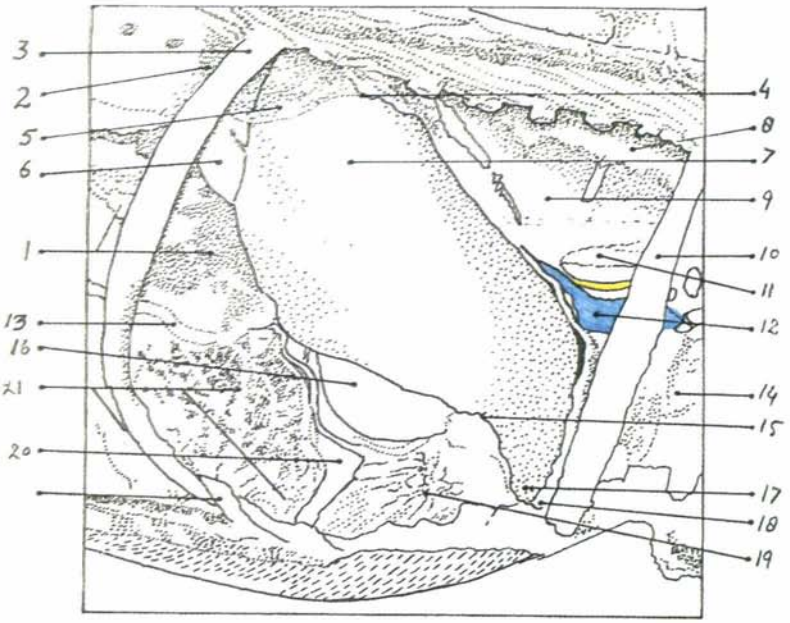

Fig 5.12 : 1. pancreas (right lobe); 2. right kidney; 3. rib 13; 4. liver (coronary ligament); 5. liver (right triangular ligament); 6. liver (caudate process); 7. liver (right lobe); 8. thoracic aorta; 9. caudal mediastinum (dorsal part); 10 rib 6; 11. oesophagus; 12. posterior vena cava; 13. descending duodenum; 14. heart in pericardium; 15. liver (umbilical notach); 16. gall bladder; 17. liver (left lobe); 18. diaphragm; 19. lesser omentum; 20. abomasum; 21. great omentum (superficial leaf).

Coronary ligament: Coronary ligament attaches the liver to the diaphragm on a line from the right triangular ligament along the right side of the vena cava and around the ventral margin of foramen vena cavae to the left triangular ligament.

Right triangular ligament: Attaches the caudolateral angle of the right lobe of liver to dorsal abdominal wall.

Caudate process (liver): It is one of the two processes of the caudate lobe. It is a larger process which extends to the right, covering much of the visceral surface of the right lobe and bearing part of the renal impression.

Umbilical notch: It lies on the ventral border of liver and is the

site for the attachment of round ligament which is the remnant of ductus venosus formed durig foetal life.

Gall bladder: It is partly in contact with the visceral surface of the liver but largely against the abdominal wall at the ventral part of tenth or eleventh rib.

Liver (left lobe): It is the ventral part of the liver directed cranioventrally and separated from caudate and quadrate lobes by a line from the notch for round ligament to esophageal impression on visceral surface, and the line of attachment of the falciform ligament on diaphragmatic surface.

DISSECTION: The liver is removed, after it has been separated from the adherent caudal vena cava. The abdominal viscera and other structures are observed in right lateral view. Fig. 5.13.

Right kidney: It has an elongated elliptical outline and is flattened dorsoventrally. It lies ventral to last rib and transverse processes of first two or three lumbar vertebrae. Dorsal surface is rounded and the hilus is on the ventral surface. Cranial extremity occupies the renal impression of the liver. This kidney is palpable through paralumbar fossa.

Celiac artery: It arises from the posterior aorta and sometimes by a common trunk with the cranial mesenteric artery. It passes ventrally and curves cranially between the rumen and pancreas on the left, and right crus of the diaphragm and caudal vena cava on the right.

Hepatic lymph nodes: They are present in, and ventral to portal fissure and lie covered with the pancreas. They may be ten to twenty in number.

Ascending colon (proximal loop): This is the first part of the ascending colon and begins as the direct continuation of the cecum at the ileocecal orifice and runs forward 5-10 cms. opposite the ventral part of the last two ribs. It is distally continuous with spiral loop of ascending colon.

Pancreatic notch: The junction between larger right lobe and smaller left lobe of pancreas is called the body. Opposite to the

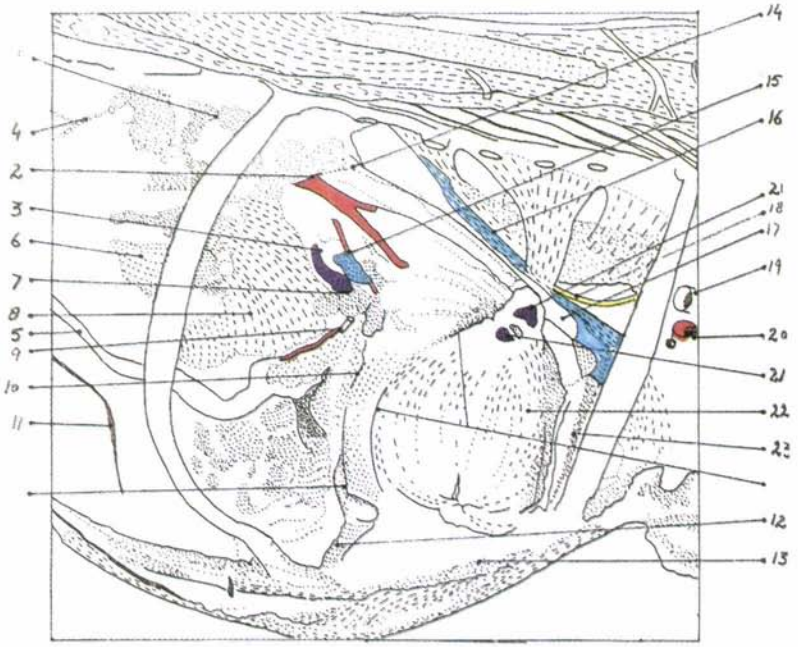

Fig. 5.13 : 1. right kidney; 2. cocliac artery; 3. hepatic lymph node; 4. peritoncum; 5. descending duodenum; 6. ascending colon (ansa proximalis); 7. pancreatic notch; 8. pancreas (right lobe); 9. bile duct; 10. duodenum (ansa sigmoidea cranial part); 11. great omentum (superficial leaf); 12. abomasum; 13. lesser omentum; 14. posterior vena cava; 15. portal vein; 16. diaphragm; 17. caval hiatus of diaphragm 18. vagal trank X (ventral branch); 19. right principal bronchus; 20. right pulmonary artery; 21. omasal lymph node; 22. omasum (covered by lesser omentum); 23. diaphragm.

body is a deep pancreatic notch, through which pass the cranial mesenteric artery and the portal vein.

Pancreas (right lobe): It extends caudally along the descending duodenum and is enclosed in the layers of mesoduodenum.

Bile duct: Smaller bile ducts accompany the branches of portal vein. They unite to form **right** and **left hepatic ducts**. The union of hepatic ducts result into the formation of **common hepatic duct** which gives off the cystic duct and continues as **(common) bile duct**. This enters the duodenum at the second sigmoid flexor.

Duodenum (cranial part): It begins at the pylorus and passes dorsally to the visceral surface of liver where it forms an 'S' – shaped curve.

Ansa sigmoidea: The 'S' – shaped curve formed by the cranial part of duodenum is referred to as ansa sigmoidea.

Ventral vagal trunk: The ventral trunk of vagus is continued ventrally, and to the right from oesophagus to the parietal side of the neck of the omasum.

Right principal bronchus: It passes caudolaterally from the bifurcation of the trachea and enters the right lung at the hilus.

Right pulmonary artery: It is longer and a little wider than the left one. It arises from the bifurcation of the pulmonary trunk ventral to tracheal bifurcation. Inside the lung it divides following the prinicipal bronchus. It has four secondary (lobar) branches in the lung.

Omasal lymph nodes: They lie on the the omasum along the course of the left gastric vessels.

DISSECTION: The entire rumen has been cut and removed. The omasal groove, normally vertical in the living animal is oblique in the present dissection due to the standing position of the animal. The abdominal viscera with parts of the colon exposed and the omasum opened are revealed in right lateral view. Fig. 5.14.

Ascending duodenum: It passes cranially and terminates at the duodenojejunal flexure on the left side of the cranial mesenteric artery.

Descending duodenum: Descending part runs dorsocaudally to tuber coxae where it is continued by caudal flexure. The descending part of the duodenum and caudal flexure are attached dorsally to the mesoduodenum. Descending part is attached ventrally to the superficial wall of the omental bursa.

Cranial mesenteric vein: This is the stoutest of the terminal branches of the portal vein and it follows the course of cranial mesenteric artery and its branches. It gives off jejunal, ileal and ileocolic veins and collateral branches all of which, with their

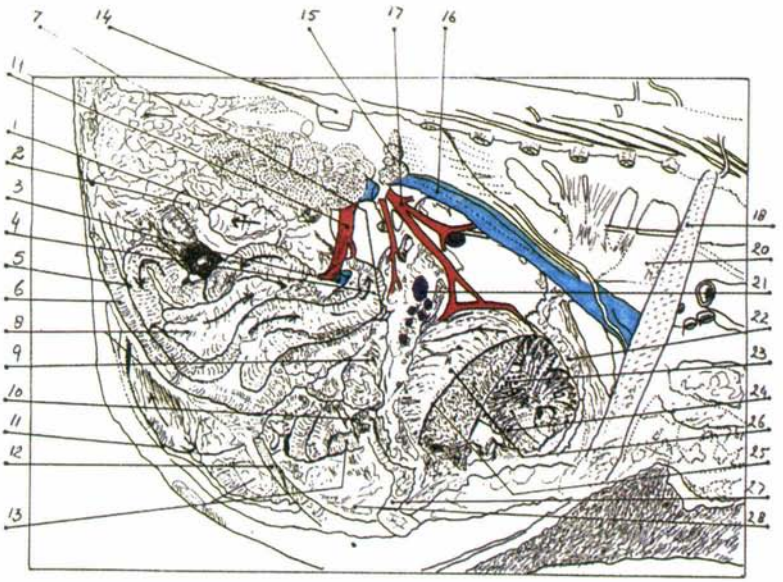

Fig. 5.14 : 1. descending colon; 2. ascending duodenum; 3. cranial mesenteric vein; 4. transverse colon; 5. ascending colon (ansa distalis); 6. duodenum (descending part); 7. bile duct; 8. ascending colon (ansa proximalis); 9. duodenum (ansa sigmoidea); 10. duodenum (cranial part); 11. great omentum (superficial and deep leaves); 12. costal cartilage of rib 13; 13. small intestine in supraomental recess; 14. rib 13; 15. right suprarenal gland; 16. posterior vena cava; 17. coeliac artery; 18. rib 6; 19. cranial mesenteric artery; 20. oesophagus; 21. omasal lymph node. 22. reticulum; 23. omasal groove distal to reticulo-omasal orifice; 24. omasal pillar (omasoabomasal orifice); 25. omasal wall; 26. lesser omentum; 27. abomasum; 28. great omentum (superficial leaf).

branches, accompany the corresponding arteries.

Transverse colon: It passes from right to left around the cranial surface of the cranial mesenteric artery and is continued by the descending colon.

Ascending colon (distal loop): This part of the ascending colon proceeds from the last centrifugal gyrus dorsally and caudally on the proximal loop. It turns around the caudal border from left to right side of the mesentery and runs cranially on the right side medial to proximal loop.

Duodenum (cranial part): The cranial part of the duodenum is

exposed when the peritoneal cavity is opened from right side. It is attached along its cranial surface to leser omentum and along its caudal surface to superficial wall of omental bursa.

Superficial and deep leaves of great omentum: Deep wall of omentum is secondarily fused with the superficial wall along the descending duodenum. It passes ventrally around the intestine and dorsally to its attachment in the right longitudinal groove of rumen. Along the caudal free fold of greater omentum, the superficial and deep walls are continuous.

Right suprarenal (adrenal) gland: Right adrenal gland is roughly "Y" shaped. It lies aginst the medial surface at the cranial end of the right kidney. Medial surface of the gland is flattened and is in close apposition with the right crus of the diaphragm.

Caudal vena cava: It arises from the caudal part of sinus venosus of the right atrium. It creates a sulcus on the diaphragmatic surface of liver and follows the aorta in a caudal direction along the lumbar vertebral column. Finally, it divides into two common iliacs at sixth or seventh lumbar vertebra.

Celiae artery: It is the first visceral branch arising at the level of first lumbar vertebra and leaves the ventral wall of the abdominal aorta. It gives initially unpaired caudal phrenic artery. It gives branches to stomach, liver, spleen, pancreas and first part of duodenum.

Cranial mesenteric artery: This artery arises caudal to celiac artery as an unpaired second visceral branch from the ventral wall of abdominal aorta. It arises at the level of second lumbar vertebra, and immediately enters the cranial mesentery forming the root of the mesentery.

Omasal groove distal to reticuloomasal orifice: Omasal groove is the second part of the gastric groove. It passes from reticulum to abomasum and opens on its right at the caudodorsal side. At reticuloomasal orifice, the laminae become low, thick folds and papillae increase in length to become unguiculiform papillae.

Omasal pillar at omasoabomasal orifice: These are formed by convergence of circular muscle fibres from the sides of omsaum.

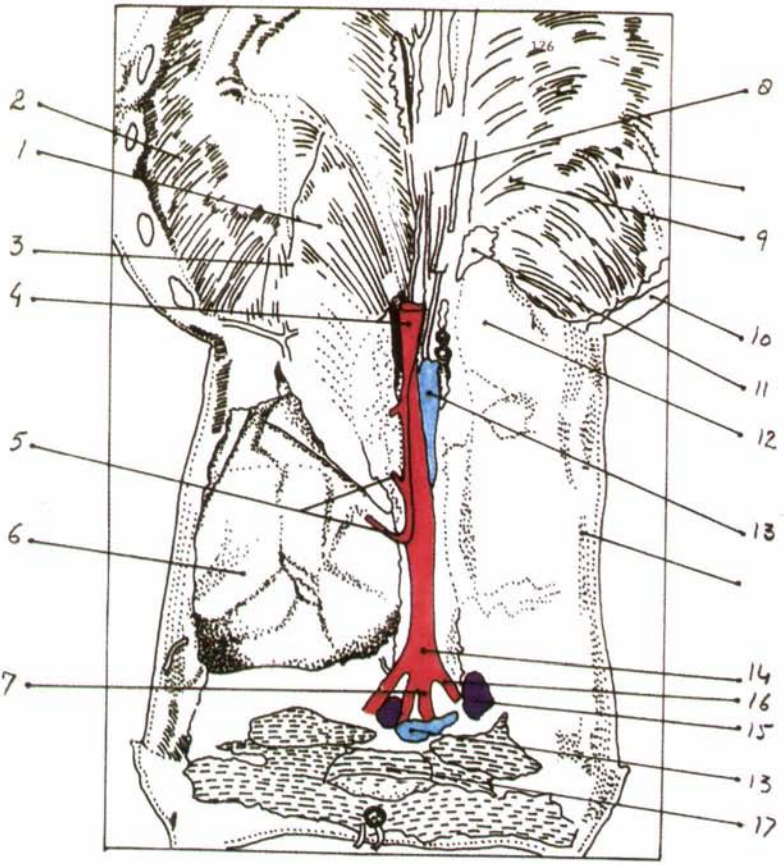

Fig. 5.15 : 1. diaphragm (lumbar part, left crus); 2. diaphragm (costal part); 3. diaphragm (lumbocostal arch); 4. aorta (at aortic hiatus); 5. lumbalis artery; 6. rumen (dorsal sac); 7. internal iliac artery; 8. diaphragm (lumbar part, right crus); 9. diaphragm (central tendon); 10, costal arch, 11, liver (caudate process); 12. right kidney (perirenal fat); 13. posterior vena cava; 14. median sacral artery; 15. median iliac lymph node; 16. external iliac artery; 17. sacral centrum.

Cavity of omasum: There are laminae of three orders. The largest of these have convex attached edges and thick concave free edges, second order has shorter laminae and third order still shorter. In addition, there is a series of very low folds or lines.

Lesser omentum: It extends from the lesser curvature of stomach to the liver on the right ateral position.

Greater omentum (superficial leaf): The superficial leaf or wall passes, ventral to the deep wall and ventral sac of the rumen. It is also attached to the left longitudinal groove of the rumen.

DISSECTION: The vertebral colum and ribs are sawn and removed. The thoracic viscera and caudal vena cava have been removed. The parietal peritoneum has been partially removed and the lumbar attachments of diaphragm are cut. The following abdominal structures are revealed in dorsal view. Fig. 5.15.

Diaphragm (lumbocostal arch): The margin of diaphragm is free for a short distance from the lumbar attachment to the last rib. The opening that can be seen beneath the last rib and its vertebra is referred to as the lumbocostal arch.

Aorta (cut at aortic hiatus): It enters the diaphragm at aortic hiatus after which aorta is called abdominal aorta. Aorta lies to the left of the caudal vena cava. It is in contact with thoracic duct and dorsally to inner lumbar muscles.

Internal iliac artery: Arises from the bifurcation of abdominal aorta ventral to seventh lumbar vertebra. It passes over the medial surface of the iliopsoas muscle into the pelvic cavity. Its collateral and terminal branches are umbilical, iliolumbar, cranial gluteal, urogenital, caudal gluteal, internal pudendal arteries and obturator branches.

Perirenal adipose tissue enclosing right kidney: Kidneys are embedded in a large amount of parierenal fat termed the adipose capsule.

Median sacral artery: After the origin of internal iliac arteries, abdominal aorta continues as median sacral artery. It runs ventral to sacrum from the last lumbar vertebra and in the region of caudal vertebrae it further continues as median caudal artery.

Internal iliac lymph nodes: Are present on each side of the terminal part of abdominal aorta at the level of the origin of deep circumflex iliac artery.

External iliac artery: It is a stout vessel which arises from abdominal aorta ventral to the body of sixth lumbar vertebra. Initially it courses ventrally over the inner lumbar musculature,

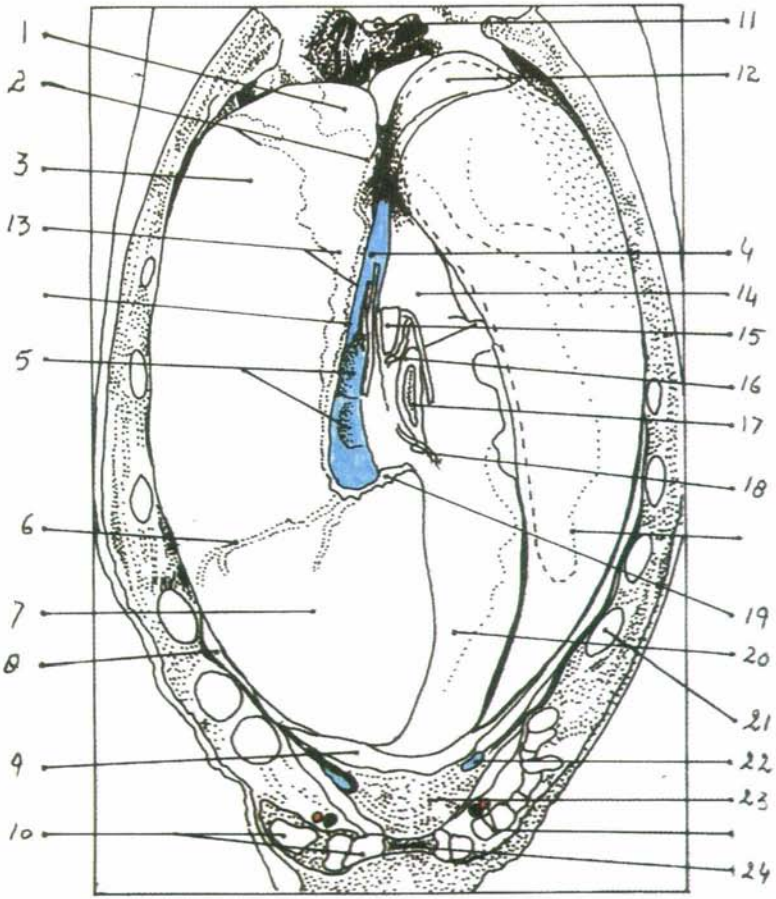

Fig 5.16 : 1. liver (caudate process); 2. liver (coronary ligament bordering area nuda); 3. liver (right lobe); 4. posterior vena cava in liver; 5. hepatic vein entering posterior vena cava; 6. falciform ligament; 7. liver (left lobe); 8. diaphragm (costal part); 9. diaphragm (sternal part); 10. costal cartilage of ribs 7,8; 11. abdominal aorta near iliac bifurcation; 12. spleen (diaphragmatic attachment); 13. coronary ligament; 14. atrium of rumen; 15. diaphragm (lumbar part, right crus); 16. vagal trunk X (dorsal branch); 17. oesophagus in oesophageal hiatus; 18. vagal trunk X (ventral branch); 19. left triangular ligament of liver; 20. reticulum; 21. rib; 22. musculophrenic vein; 23. transversus thoracis muscle; 24. sterum.

lies craniomedial to the body of the ilium and medial to iliace fascia. It becomes femoral aratery on entering the femoral canal.

Sacral centrum: Sacral centrum is formed by the base of the

anterior exteremity of the first sacral vertebra. The body is flattened anteriorly from above downwards and presents a transversely elongated convex surface for articulation with the posterior extremity of the body of last lumbar vertebra.

DISSECTION: The body of the animal is transversely severed at thoracoabdominal demarcation. Both left and right sides of the thorax are removed. The diaphragm is also removed and the following structures are revealed in cranial view. Fig. 5.16.

Liver (right lobe): The right lobe is demarcated by a line from the gall bladder fossa through the porta to the sulcus vena cavae. It is a short and thick lobe.

Caudal vena cava in liver: As the caudal vena cava enters the abdominal cavity it runs dorsally between the right crus of diaphragm and the liver. In doing so, it creates an impression, the sulcus vena cavae on the diaphragmatic surface of liver.

Falciform ligament: Faliciform ligament is attached on the diaphragmatic surface of liver along a line from oesophageal impression to the notch for the round ligament. It attaches the liver to diaphragm.

Abdominal aorta (cut near iliac bifurcation): At the sacral promontory the abdominal aorta divides into stout left and right internal iliac arteries and a median sacral artery.

Spleen (diaphragmatic attachment): A narrow triangular elongated area on the parietal surface of spleen has no peritoneal covering and is directly attached to diaphragm.

Left triangular ligament at oesophageal impression of liver: This ligament extends from oesophageal impression to the diaphragm and ventral to oesophageal hiatus.

Musculophrenic vein: The musculophrenic vein arises from the internal thoracic vein near the diaphragm. During its course through costal part of diaphragm, the musculophrenic vein gives off ventral intercostal veins.

Internal thoracic artery: It leaves the subclavian artery medial to first rib. It dips at about the level of third sternebra on the

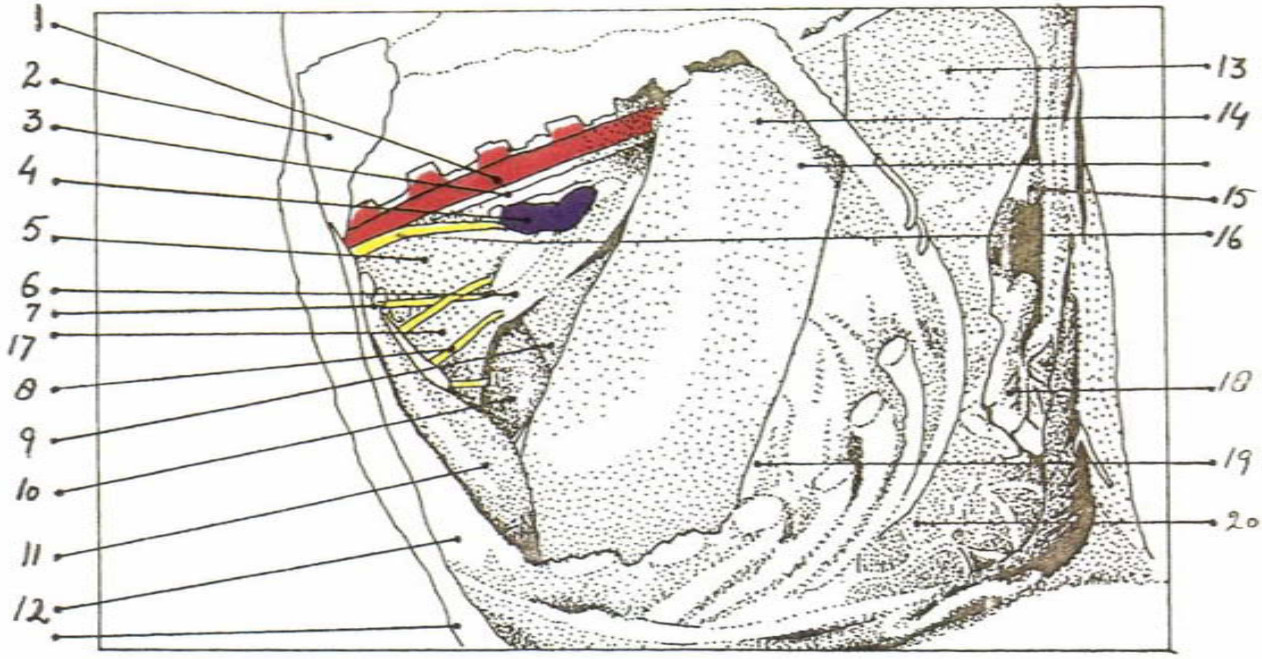

Fig. 5.17 : 1. thoracic aorta; 2. scapular cartilage; 3. dorsocaudal mediastinum; 4. caudal medastinal lymph node; 5. oesophagus; 6. diaphragm (right crus); 7. vagal trunk X (ventral branch); 8. phrenic nerve; 9. rumen (atrium); 10. reticulum; 11; left lung (cranial lobe); 12. rib 6; 13. rumen (dorsal sac); 14. spleen; 15. left kidney; 16. vagal trunk X (dorsal branch); 17. right lung (accessory lobe); 18. small intestine (caudal to supraomental recess); 19. abomasum; 20 omental bursa.

floor of the thorax into transversus thoracis muscle and reaches the diaphragm.

DISSECTION: The rib cage is removed on left lateral side. The diaphragm and caudal lobe of the left lung have been rermoved. The following structures are revealed in left lateral view. Fig. 5.17.

Left lung (cranial lobe): It is the apical lobe, having two parts, smaller, pointed, cranially directed apical portion and a larger, three sided, ventrally directed cardiac part. Medial surface of the apical lobe has a cardiac impression.

Spleen: Spleen is elongated, elliptical organ with thin extremities and is rounded in shape. Dorsal extremity lies ventral to last two ribs in the left hypogastric region. Ventral extremity is opposite to eighth or ninth rib. Pariental surface is convex, related to diaphragm and the visceral surface is related to rumen. Hilus is on visceral surface near the cranial border.

Right lung (accessory lobe covered by mediastinum): The part of caudal medastinum ventral to esophagus is pushed to the left by accessory lobe of right lung. This lobe is pyramidal in shape, with slightly concave base forming part of diaphragmatic surface of lung. Its apex is directed towards hilus.

Small intestine (lying caudal to supraometal recess): Greater omentum has attachment to rumen on left and through duodenum and mesoduodenum to dorsal abdominal wall on right. Omentum forms a sling ventral to intestine, between these two supports and opens caudally. This recess is called supraomental recess.

Omental bursa: Omental bursa is the cavity enclosed by two omenta, ie., the visceral surface of stomach and part of visceral surface of liver.

DISSECTION: The abdominal wall, ribs, diaphragm and caudal lobe of the right lung have been removed. The vessels, lymph nodes and nerves of the caudal mediastinum are revealed in right lateral view. Fig. 5.18.

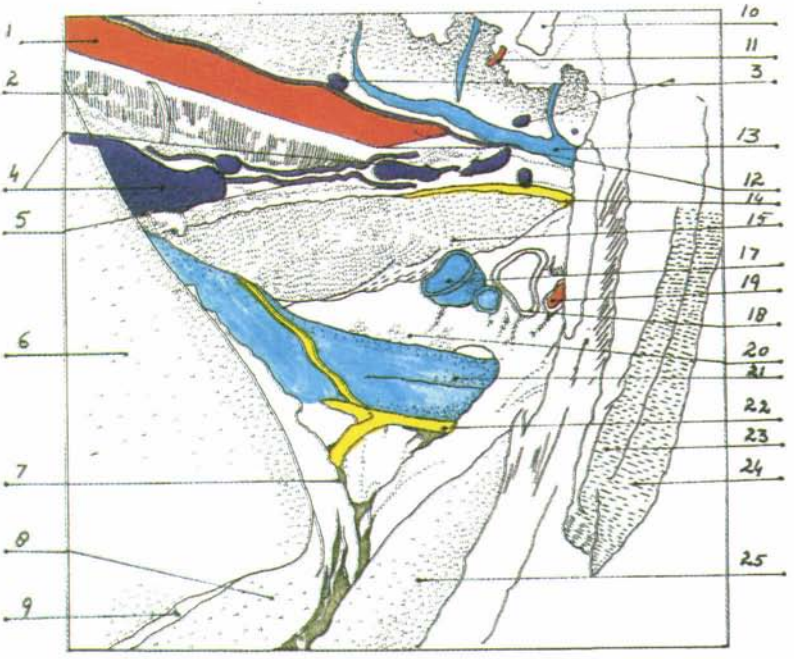

Fig. 5.18 : 1. thoracic aorta; 2. dorsal caudal mediastinum; 3. thoracic aortic lymph nodes; 4. caudal mediastinal lymph nodes; 5. vasa efferentia lymphatica (joining thoracic duct); 6. liver (right lobe); 7. cranial phrenic vein; 8. liver (left lobe); 9. falciform ligament (attachmet to diaphragmatic surface); 10. rib 8; 11. dorsal intercostal artery VIII; 12. thoracic duct; 13. right azygos vein; 14. vagal trunk X (dorsal branch); 15. oesophagus; 16. right lung (caudal lobe); 17. pulmonary vein; 18. bronchus; 19. pulmonary artery; 20. right lung (accessory lobe); 21. posterior vena cava; 22. phrenic nerve; 23. latissimus dorsi muscle; 24. cutaneous trunci muscle; 25. right lung (middle lobe).

Thoracic aorta: It starts between the third and sixth thoracic vertebrae. From its dorsal wall arise dorsal intercostal arteries which are segmentally distributed to both sides of the thorax. It gives off dorsal costoabdominal artery to the border of last rib and bronchoesophageal artey arises dorsal to the base of heart from the thoracic aorta.

Thoracic aortic lymph nodes: Are situated between the dorsal wall of aorta and bodies of fifth to thirteenth thoracic vertebrae. On left side most of the nodes lie ventral while some are dorsal

to left azygos vein. On right side they are situated along the dorsal wall of thoracic duct.

Vasa efferentia lymphatica (running to join the thoracic duct): These are the various lymphatic branches from different organs which open into thoracic duct.

Cranial phrenic vein (in cut surface of diaphragm): It leaves the caudal vena cava in the vena caval foramen of the tendinous centre of the diaphragm. Each cranial phrenic vein gives rise to laterally directed vessels to costal and sternal parts of diaphragm.

Dorsal intercostal arteries: These arteries arise from the thoracic aorta. They supply the bodies of thoracic vertebrae, vertebral canal, muscles of trunk and thoracic wall supported by the ribs.

Thoracic duct: Thoracic duct traverses the diaphragm lateral to the right crus. It remains single throughout its course but in exceptional cases divides into two parallel vessels of equal caliber. The fusion of the latter two vessels or the transition of single trunk from right to left side occur at the level of fifth thoracic vertebra. Its diameter is 2-4 mm in calves and 6-10 mm in adult cattle. Left part of thoracic duct runs to the left of trachea and oesophagus and medial to large blood vessel. Duct ends a few millimetes to 2 cm anterior to the cranial border of first rib. The last part of the duct may have an ampulla like dilatation but invariably there is a constriction for the last 1-3 mm. The terminal orifice has one or two valves and a venous valve often lies across the opening. There is usually a connecting branch from the terminal part of throracic duct to the right jugular trunk, running past the ventral surface of the jungular vein.

Right azygos vein: It arises from that part of cranial vena cava which lies close to the insertion of the pericardium and still contains heart muscle tissue. After passing through aortic hiatus it terminates in one of the first lumbar veins.

Oesophagus: It crosses the right face of aortic arch, then passes straight back in the caudal mediastinum ventral to aorta, and through oesophageal hiatus. At eighth or ninth intercostal space it enters the abdominal cavity.

Right lung, caudal lobe (diaphragmatic lobe): It is the largest lobe and is caudal in postion. Attached to its medial surface just caudal to the hilus, is th accessory lobe.

Pulmonary veins: They carry arterial blood from lungs to the left atrium of the heart. They arise from roof of left atrium, ventral to the hilus of lung. They are more than one in number, one large and two or three small pulmonary veins. These run alongwith the branches of pulmonary arteries in lung.

Right lung (accessory lobe): It is pyramidal in shape having concave base, and apex is directed towards the hilus. Plica vena cava lies between the accessory and diaphragmatic lobes.

Right lung: Its base or diaphragmatic surface is related to convex thoracic surface of diaphragm. Its apex lies cranial to heart and pericardium, right and ventral to trachea and great vessels.

DISSECTION: The liver has been removed and the abomasum has been displaced ventrally to reveal the following abdominal structures in right lateral view. Fig. 5.19.

Left gastric artery: It arises from celiac artery. It passes over the cranioventral surface of atrium of rumen givin left gastroepiploic artery dorsal to the omasum. It meets right gastric artery near the pylorus.

Hepatic artery: It is a branch of celiac artery. It supplies to liver and gives pancreatic and cystic branches and then continues as gastroduodenal artery.

Portal vein: The veins arising from spleen, stomach, small intestine and part of large intestine are all joined to form the portal vein. The portal vein is connected to caudal vena cava through the hepatic capillary system and hepatic veins. After coming out at hepatic porta, it runs in the edge of hepatoduodenal ligament. It traverses the pancreatic notch and gains the portal fissure of the liver.

Hepatic artery (right branch): Right branch arises together with the cystic artery. It is smaller than the left and supplies right lobe and caudate process of liver.

Cranial pancreaticoduodenal artery: It is a limb of gastroduodenal artery. It runs in mesoduodenum along the cranial and descending parts of the duodenum and is then embedded in the right lobe of pancreas.

Omental bursa (in its caudal recess): Caudal recess of omental bursa is formed by movement of greater curvature of stomach to the left. As a result cavity between dorsal mesogastrium and visceral surface of stomach expands resulting into a recess.

Right gastroepiploic artery: It is one of the terminal limbs of the gastroduodenal artery. It runs close to greater curvature of stomach to the cranial part of pylorus and then along the greater curvature of the abomasum.

Pylorus: It is one of the interior openings of abomasum into the duodenum. It is small and round and communicates with duodenum.

Ventral abomasal lymph nodes: These may be one to four nodes situated on the ventral border or near the greater curvature of abomasum or in greater omentum. These lymph nodes are mainly present at pyloric part.

Superficial leaf of great omentum: From descending duodenum the superficial wall passes ventral to deep wall and ventral sac of rumen and gets attached to left longitudinal groove.

Abomasum: This is the true stomach of the ruminants having glandular mucous membrane. This part continues into small intestine. It lies on the abdominal floor and the body lies on the left of median plane. Pyloric part turns right, caudal to the omasum and joins duodenum at ventral end of ninth or tenth intercostal space.

Diaphragm (right crus): Right crus attaches to first four lumbar vertebrae by ventral longitudinal ligament. This crus circumscribes the oesophageal hiatus and then spreads out in the tendinous centre.

Branches of dorsal vagus to celiac plexus: After receiving communicating branch from ventral vagus, it gives large branches to celiac plexus. These branches follow the branches of cranial mesenteric artery to intestine.

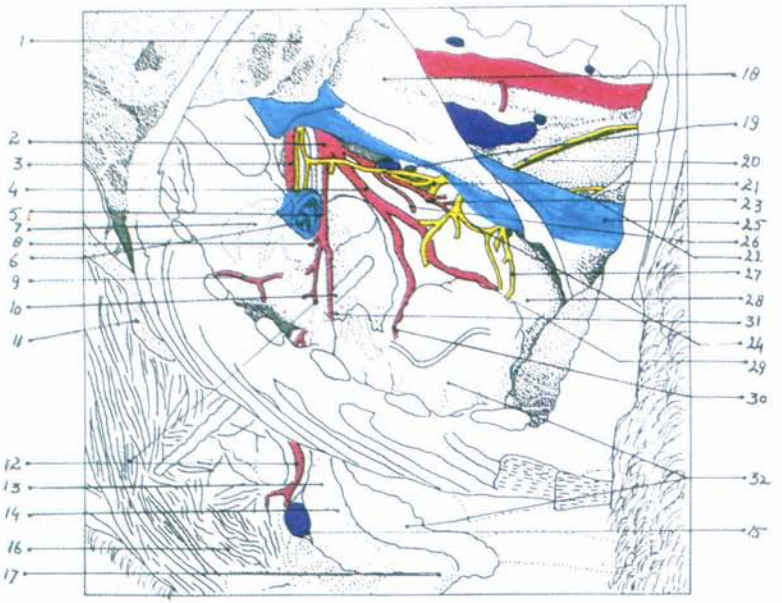

Fig. 5.19: 1. right kidney; 2. celiac artery; 3. cranial mesenteric artery; 4. left gastric artery; 5. hepatic artery; 6. portal vein; 7. pancreas; 8. hepatic artery (right branch); 9. cranial pancreaticoduodenal artery; 10. omental bursa (caudal recess); 11. descending duodenum; 12. right gastroepiploic artery; 13. duodenum (cranial part); 14. pylorus; 15. ventral abomasal lymph node; 16. great omentum (superficial leaf); 17. abomasum; 18. diaphragm (right crus); 19. vagus X (dorsal branches to celiac plexus); 20. vagal trunk X (dorsal branches); 21. vagal trunk X (dorsal ruminal branches); 22. vagal trunk X (ventral branches); 23. reticular artery; 24. stomach (dorsal branches of vagus in lesser curvature); 25. posterior vena cava; 26. left ruminal artery; 27. stomach (ventral branches of vagus in lesser curvature); 28. reticulum; 29. left gastroepiploic artery; 30. left gastric artery; 31. right gastric artery; 32. lesser omentum.

Ruminal branches of dorsal vagus: These branches run obliquely dorsocaudally over the dorsal surface of rumen. Large right ruminal branches pass between the left gastric artery and the rumen to reach the right longitudinal groove.

Ventral vagus: Ventral vagus nerve gives branches to the reticulum ventral to oesophagus. Its first branch, on the left after innervating reticulum, joins the dorsal trunk.

Distribution of dorsal vagus (distribution along lesser curvature of stomach): Dorsal vagal trunk accompanies the left

gastric artery and runs over the dorsaol curvature of the omasum and on the visceral side of the lesser curvature of abomasum upto pyloric part.

Left ruminal artery: It arises mostly from splenic, celiac, or left gastric artery. It runs on right side of the atrium of the rumen to cranial groove after giving reticular branch. It gains the parietal surface and gives a small artery to left longitudinal groove which joins the right ruminal artery.

Distribution of ventral vagus along lesser curvature of stomach: Several strands of the ventral vagus continue in lesser omentum close to parietal surface of the base of omasum and along the lesser curvature of abomasum, innervating omasum and abomasum.

Left gastroepiploic artery: It arises from left gastric artery, gives branches to atrium of rumen, and to omasum and reticulum. It passes through the groove between the reticulum and omasum to reach the greater curvature of abomasum and thus the greater ometum. It runs with pariental sheet of greater omentum and joins right branches.

Left gastric artery: This artery supplies the right wall of the omentum and the right and cranial wall of the reticulum upto the cardia.

Right gastric artery: This artery arises from hepatic artery. It travels along hepatoduodenal ligament from the first part of the duodenum to the pylorus.

Lesser omentum: It extends from the ventral side of oesophagus, along the reticular groove, parietal surface of omasum and lesser curvature of abomasum. Terminal part is attached to cranial part of duodenum forming **hepatoduodenal ligament** which contains bile duct, portal vein and hepatic artery.

SURGICAL ANATOMY FOR COMMON SURGICAL AFFECTIONS OF ABDOMINAL REGION

LAPAROTOMY

(A) Anatomical location: The flank (lactus) is that part of the

lateral wall which is formed only of soft structures. The triangular depression on its dorsal part is termed the paralumbar fossa. This is bounded dorsally by the lateral border of longissimus muscle, ventrally by the dorsal border of the obliquus abdominis internus and rostrally by the posterior border of the last rib.

(B) Site for surgical approach:

(i) Flank incision:

(a) Two to three cm posterior to the last rib for rumenotomy.

(b) Six to eight cm below the transverse processes of lumbar vertebrae on the right flank in between the last rib and the external angle of the ilium for enterotomy.

(c) Twelve to thirteen cm below the transverse processes of lumbar vertebrae and six to seven cm in front of the external angle of the ilium.

(ii) Paramedian incision: Half way between the median line and subcutaneous vein for caesarean section and correction of abomasal displacement.

(iii) Midline incision: Incision is given on the median line either anteriorly between xiphoid and umbilicus or posteriorly between umbilicus and pubis for caesarean section, operation for valvulus, torsion, or incarceration of the intestine.

(A) Structures encountered:

(i) Flank incision: Skin, subcutaneous fascia, obliquus abdominis externus and internus and transverse abdominis muscles, parietal peritoneum, anterior abdominal artery, external thoracic artery, prepubic artery, external thoracic vein, ventral branches of ninth thoracic to third to fourth lumbar spinal nerves.

(ii) and (iii) Paramedian or midline incision: Skin, subcutaneous fascia, obliquus abdominis externus and internus and rectus abdominis muscles, parietal peritoneum, anterior abdominal, external thoracic and prepubic arteries, caudal epigastric superficial artey,

subcutaneous abdominal, external thoracic vein, ventral branch of ninth thoracic to third or fourth lumbar spinal nerves.

RUMENOTOMY

(A) **Anotomical location:** (See laparotomy). The paralumbar fossa, is large and offeres a good avenue for entering the abdominal cavity, the left fossa provides the site of choice for the rumenotomy operation, spaying, and sometimes for the correction of torsion of the uterus.

(B) **Site for surgical approach:** A 7-8 inches (17-20 cm) long vertical skin incision beginning 3-4 inches below the transverse processes of the lumbar vertebrae and equidistance from and parallel to the last rib.

(C) **Structures encountered:** Skin, superficial and deep fascia, obliquus abdominis externus, obliquus abdominis internus, transverse abdominis muscles, tansversalis fascia and parietal layer of peritoneum, wall of the rumen. Subserous connective tissue joins the parietal peritoneum with transversalis fascia and contains variable amout of fat, caudal epipastric superficial, anterior abdominal, external thoracic and prepubic arteries, subcutaneous abdominal vein, external thoracic vein, ventral branches of ninth thoracic to third or fourth lumbar nerves, right and left ruminal arteries, left gastroepilploic artery, portal vein, splenic vein, gastroduodenal vein, dorsal and ventral vagal trunks and sympathetic nerves from celiac plexus.

CORRECTION OF LEFT ABOMASAL DISPLACEMENT

(A) **Anatomical location:** Abomasum is elongated and placed on ventral region. Body is directed backward between ventral ruminal sac and omasum. The terminal pyloric part incline dorsally behind the omentum, the superficial part of greater omentum attaching to the greater curvature while lesser omentum along the lesser curvature.

(B) **Site for surgical approach:** A 18 cm long vertrical incision is made in the flank 20 cm ventral to the lumbar transverse processes and approximately 8-10 cm behind the last

rib.

(C) **Structures enconuntered:** (See ventral approach) skin, superficial and deep fascia, rectus abdominis muscle, oblique abdominal muscles, transverse abdominis muscle, cutaneous trunci muscle, parietal peritoneum, wall of abomasum, external thoracic and prepubic arteries, ninth thoracic to third or fourth lumbar spinal nerves, right and left gastric artery, right and left gastroepiploic artery, portal vein, splenic vein, gastroduodenal vein, dorsal and ventral vagal trunks and sympathetic nerves from celiac plexus.

ENTEROTOMY

(A) **Anatomical location:** Intestines lie almost entirely to the right of the median plane chiefly in contact with the right face of the rumen. It is attaced to the sublumbar region by a common mesentery.

(B) **Site for surgical approach:** Right flank approach. The incision is made more or less vertically in the right paralumbar fossa, corresponding to that made on the left for rumenotomy.

(C) **Structures encountered:** Skin, abdominal fascia abdominal cutaneous muscle, part of the obliquus abdominis externus, obliquus abdominis internus and transversus abdominis muscles, transversalis fascia and pariental layer of peritoneum, omentum, mesentery, wall of intestine, anterior abdominal, external thoracic, prepublic arteries, right gastric and right gastroepiploic arteries, cranial and caudal pancreaticoduodenal, cranial and caudal mesenteric, middle colic artery, ileocolic artery, ninth thoracic to third or fourth lumbar spinal nerves, vagus nerve, sympathetic form celiac, mesenteric and pelvic plexuses.

CAESAREAN OPERATION

(A) **Anatomical location:** The uterus of bovines has body, two horns and a cervix. The horns of the uterus are extensive, curved spirally and their caudal parts are united by fibromuscular tissue with a common peritoneal covering. The spiral cervical canal is tightly closed. The cevix separates

uterus from vagina and has distinct external and internal openings. The endometrium has about hundred uterine caruncles.

(B) Site for surgical approach:

(i) Flank incision: The area extending from flank ventrally to the attachment of udder. An oblique 24 to 30 cm long incision is made starting from lower part of the right flank extending downwards to and above attachment of the udder and parallel to the inferoposterior border of the last rib.

(ii) Laparotomy is carried out through a vertical flank incision in the posterior left paralumbar fossa, extending from just below and cranial to the external angle of the ilium down to the level of the fold of the flank.

(iii) Paralumbar incision: A skin incision, approximately 24 to 30 cm long is made between the median line and subcutaneous abdominal vein.

(C) Structrues encountered: Skin panniculus carnosus, abdominal tunic, aponeurosis of obliquus abdominis externus, aponeurosis of obliquus abdominis internus, rectus abdominis, aponeurosis of transverse abdominis muscle, subserous tissue, parietal peritoneum, serous, musclar and mucous coats of uterus, allantochorionic membrane and amniotic membrane, the uterine artery, the uterine branch of the utero-ovarian artery, a branch for the internal pudic artery, dorsal costoabdominal artery, caudal abdominal artery, ventral costoabdominal vein, cranial epigastric superficial vein (milk vien), caudal epigastrtic superficial vein (cranial mammary vein), ventral branches of lumbar spinal nerves.

CYSTOTOMY

(A) Anatomical location: It differs in form, size and position according to the amount of its contents. When empty and contracted, it is dense piriform mass and lies on the ventral wall of the pelvic cavity at variable distance behind the inlet. When moderately filled, it is ovoid and extends at variable distance along the ventral abdominal wall. The

peritoneal reflection over the bladder extends to a greater extent posteriorly. The anterior broad end is termed vertex, middle part or body (fundus) and posterior narrow extremity, the neck. The middle and lateral peritoneal folds formed by reflection of peritoneum attach bladder with ventral and lateral walls of pelvic cavity. Dorsally it is reflected to terminal parts of ductus deferens, seminal vesicle and porstate in male and uterus and vagina in female.

(B) Site for surgical approach:

(i) Para-anal approach: A 10-15 cm long slightly oblique incision is made commencing from root of the tail and extending ventromedially towards the urethral bend at the ischial arch in between anus and the semimembranosus muscle.

(ii) Suprapubic approach: A cutaneous incision 2 cm lateral to median raphe extending from pubic symphysis towards umbilicus.

(iii) Flank approach: Site for incision is selected at the lower flank region 4-5 cm in from stifle joint.

(C) Structrures encountered:

(i) Skin, muscular layer, ischiocavernous muscle and fibroelastic fascia.

(ii) Structures: Skin, superficial and deep fascia, bulbocavernosus, erector penis and retractor penis muscle.

(iii) Skin, fascia, obliquus abdominis externus, obliquus abdominis internus and transverse abdominis muscle peritoneum, urinary bladder, branches from internal pudic, umbilical and obturator arteries and vein, sympathetic nerves and ventral branches of third and fourth sacral nerves.

UMBILICAL HERNIA

(A) Anatomical location: An umbilical hernia arises due to failure of the linea alba to close around the stalk of umbilical cord. Due to this defect a portion of abdominal viscera will protrude, pushing with it a pouch of peritoneum. The

umbilicus is situated at the mid ventral abdominal wall.

(B) **Site for surgical approach:** Mid ventral abdominal wall (ventral approach). Elliptical incision over the skin of hernial ring.

(C) **Structrues encountered:** Skin, abdominal fascia aponeurosis of abdominal muscles parietal peritoneum, herneal contents, anterior abdominal and external thoracic vein, cranial epigastric superficial vein, ventral branches of ninth thoracic to third lumbar spinal nerves.

VENTRAL HERNIA

(B) **Anatomical location:** It is situated in the lowr flank along the costal arch, or between the last few ribs. The ventral hernias also occur in the abdomen near the midline.

(B) **Site for surgical approach:** The skin is carefully incise along the side of the hernial sac.

(C) **Structures encountered:** Skin, subcutaneous tissues, peritoneum, visceral organs, cranial epigastric artery, ventral costoabdominal branch of cranial epigastric artery, cranial epigastric superficial arteries, cranial epigastric vein, ventral intercostals veins, ventral costoabdominal vein, cranial epigastric superficial ('milk vein' in.female) caudal epigastric vein, caudal epigastric superficial vein (cranial mammary vein) and ventral branches of lumbar spinal nerves.

“This Page is Left Intentionally Blank”

Chapter 6

The Hindlimb

DISSECTION: The two hind limbs are separated by sawing through the lumbar and sacral vertebrae. The skin of the perineum is removed. The male genital organs under the pelvic symphysis are also removed. Now, the symphysis is sawn from the under, and the two parts separated, the pelvic viscera removed and the limb is hooked to the sling. The skin from the gluteal and anterior femoral regions is removed along with the deep gluteal fascia and the fascia latae. Also remove a square piece of deep crural fascia. While clearing the fascia at the lower part of the biceps femoris, care must be taken not to disturb or destroy the soleus, or small muscle lying overlapped by the outer head of gastrocnemius. The following superficial structures of the pelvis and hind limb in lateral view are revealed. Fig. 6.1.

Gluteus medius muscle: The middle gluteus is a thick and fleshy muscle and covers the gluteal surface of the ilium and the lateral wall of pelvis. It is partly covered by biceps femoris and superficial gluteus muscles.

Tensor fascia lata: It is situated on the anterior aspect of the hip and the thigh. It is triangular in form with its base below and apex at the external angle of the ilium.

Vastus lateralis muscle: It is situated on the external side of rectus femoris and is thicker than the vastus medialis. It is large fleshy muscle with an extensive tendinous origin and insertion.

Subiliac (prefemoral) lymph node: It is situated on the aponeurosis of the obliquus externus abdominis muscle, close to the tensor fascia lata.

Fibularis tertius muscle: It is tendinous at both its origin and insertion. It extends from the lateral surface of the stifle to the medial face of the tarsometatarsus.

Tibialis cranialis muscle: It is a thin muscle lying on the craniolateral border of the tibia. It is the deepest of the extensor group of muscles.

Coccygeus muscle: It is a thin and flat muscle which lies between the broad sacrotuberal ligament and the rectum.

Caudal border of sacrotuberous ligament: The caudal border of this ligament is fused with the vertebral head of the semimembranosus muscle.

Gluteobiceps muscle: It is a very expansive muscle situated on the lateral aspect of the hip and thigh, superficial to the gluteus medius. In the thigh region the cranial edge of this long muscle lies just caudal to the femur.

Semimembranosus muscle: It is a long, thick fleshy muscle which lies on the caudal aspect of the rump arising from the area about the ischiatic tuber and coursing distally to insert on the medial surface of the stifle.

Semitendinosus muscle: It is a long, fleshy fusiform muscle, lying on the caudolateral aspect of the rump between the gluteobiceps and semimembranosus.

Gastrocnemius muscle: It is a large, fleshy muscle composed of a medial and lateral head of nearly equal size. Together they form the major fleshy portion of the caudal aspect of the leg.

Fibularis longus muscle: It is a long triangular muscle situated in the most superficial position of the lateral surface of the leg.

Soleus muscle: It is a thin, long, ribbon like muscle lying immediately under the deep fascia of the leg and superficial to the deep digital flexor muscle. It passes downwards along the lateral border of the gastrocnemius.

DISSECTION: The tensor fascia latae is dissected and removed. The gluteobiceps muscle is cut from the ischial origin and removed. The deeper structures of the gluteal and femoral regions are exposed in the lateral aspect. Fig. 6.2.

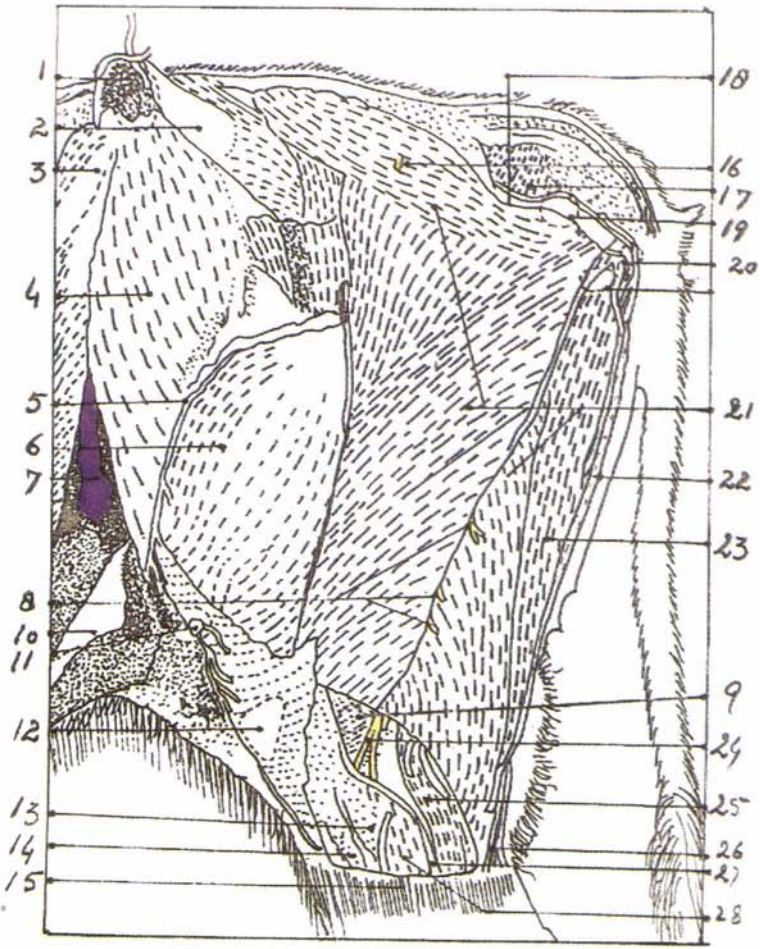

Fig. 6.1 : 1. ilium (tuber coxae); 2. gluteus medius muscle; 3. obliquus internus abdominis muscle; 4. tensor fascia lata muscle; 5. fascia lata (cut edge); 6. vastus lateralis muscle; 7. subiliac lymph node; 8. caudal clunial nerves; 9. tibia (lateral condyle); 10. obliquus externus abdominis muscle (aponeurosis); 11. patella; 12. tibial tuberosity; 13. fibularis tertius muscle; 14. tibialis cranialis muscle; 15. crural fascia (cut edge); 16. medial clunial nerve; 17. coccygeus muscle; 18. sacrotuberal ligament (caudal border); 19. tuber ischii; 20. pudendal nerve (proximal cutaneous branch); 21. gluteobiceps muscle; 22. semimembranosus muscle; 23. semitendinosus muscle; 24. common fibular nerve; 25. gastrocnemius muscle; 26. caudal cutaneous sural nerve (tibial nerve); 27. soleus muscle; 28. fibularis longus muscle.

Sacrocaudalis dorsalis medialis muscle: It lies along the dorsal median aspect of the tail in contact with its fellow from the opposite side. It can be considered to be the caudal extension of the multifidus muscle.

Sacrocuadalis dorsalis lateralis muscle: It lies immediately lateral to sacrocaudalis dorsalis medialis. It is the caudal continuation of the logissimus muscle in the caudal region.

Board sacrotuberous ligament: It is an extensive quadrilateral sheet which completes the lateral pelvic wall. Its dorsal border is attached to border of the sacrum and the transverse processes of the first and second caudal vertebrae. Its ventral border is attached to ischiatic spine and tuber. Between these it bridges over the lateral border of the ischium and completes the lesser ischiatic foramen. The cranial border is concave ad completes the greater ischiatic foramen. The caudal border is fused with the vertebral head of the semimembranosus muscle.

Origin of the gluteobiceps muscle: It orginates from sacral spines, broad sacrotuberal ligament, ischiatic tuber and by a strong tendon to a portion of ischium near the obturator foramen.

Ischiatic nerve (muscular branch): The ischiatic nerve derives its fibres mainly from the ventral branches of the last lumbar and first and second sacral components of the lumbosacral trunk. It courses caudoventrally, passes through the greater ischiatic foramen and comes to lie on the lateral surface of the broad sacrotuberal ligament. Close to its emergence from the pelvic cavity, it gives muscular branches to the gluteobiceps, semimembranosus and semitendinosus muscles.

Gemelli muscles: These are triangular muscles having wide fleshy origin and narrow tendinous insertion. The fibres extend from ventrolateral aspect of ischium to trochanteric fossa of the femur.

Popliteal lymph node: The deep popliteal lymph node is situated deeply in a mass of fat on the gastrocnemius muscle between the biceps fermoris and semitendinosus muscles. Superficial popliteal lymph nodes are absent in bovines.

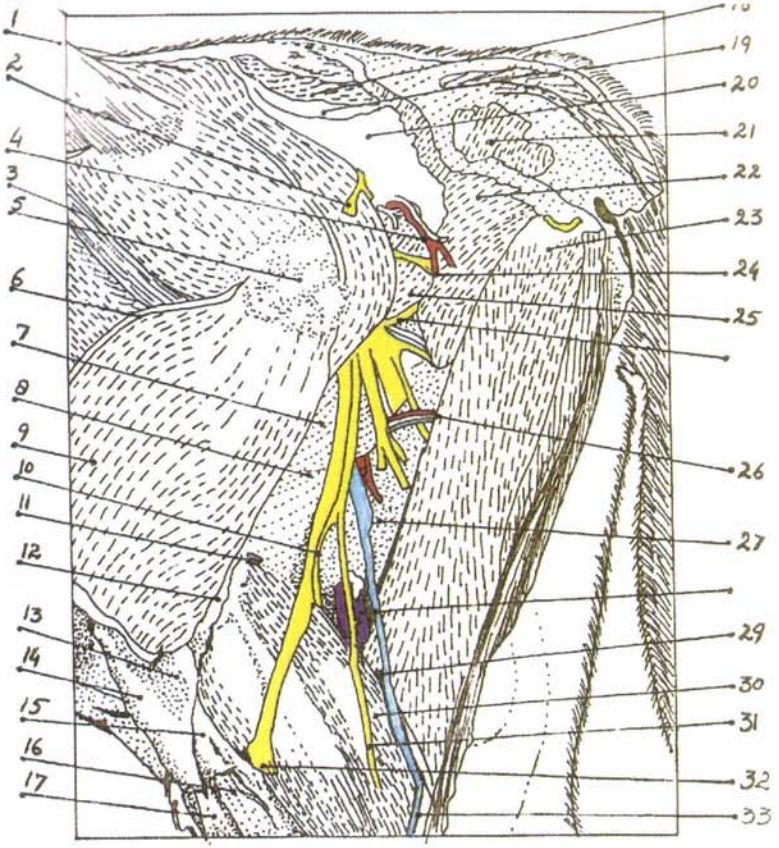

Fig. 6.2 : 1. medial clunial nerves (L.V. and VI); 2. caudal gluteal nerve; 3. iliacus muscle; 4. caudal gluteal artery; 5. femur (greater trochanter); 6. rectus femoris muscle; 7. quadratus femoris muscle; 8. adductor muscle; 9. vastus lateralis muscle; 10. tibialis nerve; 11. distal caudal femoral artery and vein; 12. biceps femoris muscle (insertion); 13. lateral and 14. middle patellar ligaments; 15. lateral tibial condyle; 16. fibularis longus muscle; 17. fibularis tertius muscle; 18. sacrocaudalis dorsalis medialis muscle; 19. sacrocaudalis dorsalis laterlis muscle 20. broad sacrotuberal ligament; 21. coccygeus muscle; 22. gluteobiceps muscle (orgin); 23. semitendinosus muscle; 24. ischiatic nerve (muscular branch); 25. gemilli muscle; 26. medial circumflex femoral artery; 27. semimembranosus muscle; 28. popliteus muscle; 29. distal caudal femoral vein; 30. gastrocnemius muscle (lateral head); 31. caudal cutaneous sural nerve (tibial nerve); 32. common fibular nerve; 33. lateral saphena vein.

Distal caudal femoral vein: It is the last and largest of the branches of the femoral vein, which arises proximal to the head of gastrocnemius muscle. The vein divides into two branches. Caudally directed branch lies between long ischiatic muscle and another over the lateral head of gastrocnemius muscle.

Gastrocnemius muscle (caput laterale): The lateral head arises from the lateral supracondyloid tuberosity and cranial border of latertal epicondhyle of femur.

Cutaneous surae cudalis (tibialis) nerve: It is also known as lateral plantar cutaneous sural nerve which arises from the caudal aspect of the ischiatic nerve in the neighbourhood of the greater trochanter of te femur. It extends distally between the gluteobiceps and lateral head of the gastrocnemius. At about the middle of the leg it appears subcutaneously, coursing over the insertion of gluteobiceps muscle on the calcaneal tuber.

Fibular nerve: The fibular (common peroneal) nerve continues distally and cranially under the gluteobiceps muscle, and later between that muscle and the lateral head of the gastrocnemius muscle. It descends further between the fibularis longus and extensor digitorum lateralis. It divides into superficial and deep branches in the region of the leg.

Lateral saphena vein: It arises from medial circumflex femoral vein between the biceps femoris and semitendinosus muscle. It runs along caudal aspect of gastrocnemius muscle to the gastrocnemius tendon and then moves into a superficial position giving muscular branches to gastrocnemius and a superficial branch, which runs laterally along the common tendon of calcaneus and crosses the plantar surface to lie medial to calcaneus.

Caudal gluteal nerve: It derives its fibres essentially from the ventral branches of the first and second sacral nerves. It runs caudal to the lateral surface of the broad sacrotuberal ligament, and gluteus profundus muscle before dividing into a dorsal and ventral branch.

Iliacus muscle: It is a rounded muscle situated ventrolaterally

to the body of ilium. Iliacus is grooved on its ventral caudal aspect to accommodate the cadual portion of psoas major muscle. Together with the psoas major it makes up the iliopsoas.

Caudal gluteal artery (at lesser ischiatic foramen): It is a large, lateral terminal branch of the internal iliac artery, emerging through the lesser ischiatic notch. This artery furnishes the deep face of the gluteobiceps and gemelli muscles, and external sacral lymph nodes.

Rectus femoris muscle: It originates from the prominent tendons from os coxae proximally and cranial to the acetabulum and is inserted at the base and cranial surface of the patella.

Quadratus fermoris muscle: It is a small muscle lying just ventral to gemelli coursing cranioventrally from ventrolateral edge of the ischium to intertrochanteric crest and the lesser trochanter of the femur.

Adductor muscle: It is thick, fleshy muscle with an extensive origin and insertion. It arises on the midline and inserts on the medial aspect of thigh. It thus acts as a very effective adductor of the limb.

Tibial nerve: Tibial nerve separates from the fibular nerve near the middle of the thigh. It continues between the two heads of the gastrocnemius being related superficially to the popliteal lymph node. Here it gives muscular branches to the popliteus, soleus, flexor digitorum profundus and the lateral head of gastrocnemius muscles. At distal third of the leg, it lies cranial to the common calcaneal tendon.

Insertion of biceps femoris muscle: The anterior part is inserted on the patella, the middle part on the lateral patellar ligament, tibial crest and posterior on the os calcis through fascia lata.

Patellar (straight) ligaments: These are strong bands which attach the patella to the anterior tuberosity of the tibia. The three patellar ligaments are medial, middle and lateral.

(i) Medial patellar ligament: It extends from the medial border of the patellar fibrocartilage and attaches to the anterior

tuberosity of the tibia, medial to the attachment of the middle patellar ligament.

(ii) Middle patellar ligament: It extends from the apex of the patella to the anterior tuberosity of the tibia, being attached between the medial and the lateral patellar ligament. The middle patellar ligament is not sunken as there is no groove on the tuberosity of tibia where it is attached.

(iii) Lateral patellar ligament: It is the largest and most powerful ligament which fuses completely with the tendon of insertion of biceps femoris. The ligament extends from the lateral part of the anterior surface on the patella lto be inserted on the anterior tuberosity of the tibia, lateral to the middle patellar ligament.

DISSECTION: Cut the gluteobiceps at its sacral origin leaving the ischial origin in contact. The origin of middle gluteus and semtiendinosus muscles is also severed, and both of them are removed. It exposes the course of the ischiatic nerve from the greater ischiatic foramen to its termination, besides, other structures are also revealed in left lateral view. Fig. 6.3.

Gluteus medius muscle (cut origin): It originates from posterior surface of the external angle of the ilium, the lateral face of the internal angle of the ilium, upper three fourth of gluteal surface of the ilium, internal to the gluteal line, sacrosciatic ligament, gluteal fascia, and the aponeurosis of the longissimus dorsi upto fourth lumbar vertebra.

Cranial gluteal artery: It arises near the greater ischiatic foramen and is a branch of internal iliac artery and supplies the gluteobiceps muscle.

Cranial gluteal nerve: It derives its fibres chiefly from ventral branches of the sixth lumbar and first sacral nerves. Following a short course it divides into several branches. It innervates the gluteus medius, gluteus profundus and tensor fascia lata muscles.

Gluteus accessorius muscle: The deep smaller head of gluteus medius is called as gluteus accessories muscle. It is a strap like muscle which lies between the main protion of the gluteus

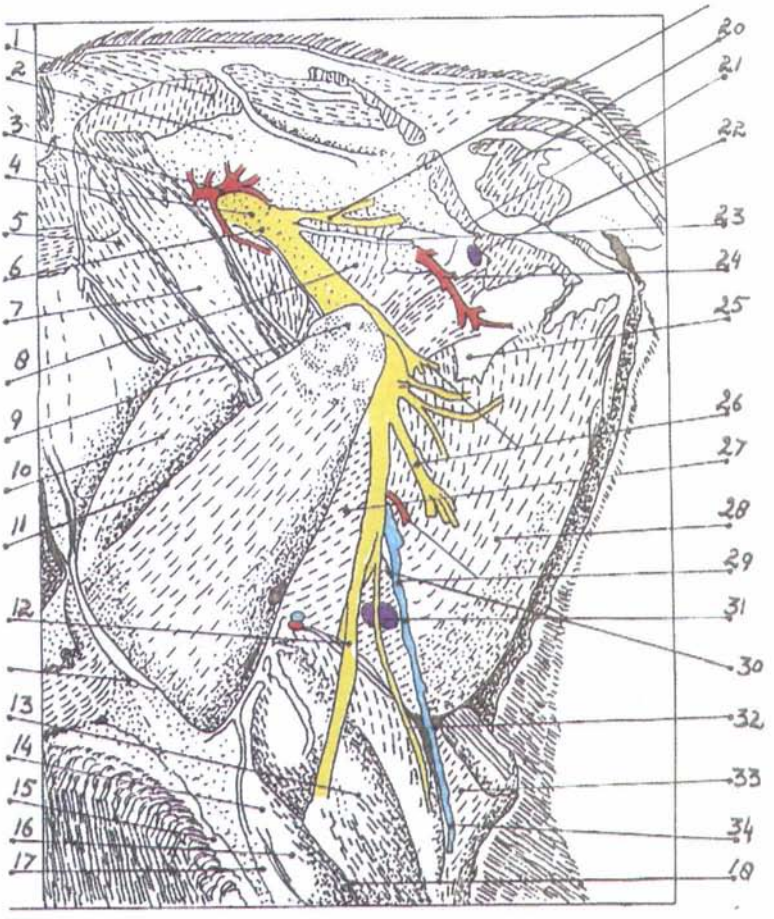

Fig. 6.3 : 1. gluteus medius muscle; 2. broad sacrotuberous ligament; 3. cranial guteal artery; 4. ischiatic nerve; 5. iliacus muscle; 6. cranial gluteal nerve. 7. gluteus accessories muscle; 8. gluteus profundus muscle; 9. greater trochanter of femur; 10. rectus femoris muscle; 11. vastus lateralis muscle; 12. common fibular nerve; 13. gastrocnemius muscle; 14. lateral condyle of tibia; 15. tibial tuberosity; 16. fibularis longus muscle; 17. fibularis tertius muscle; 18. soleus muscle; 19. caudal gluteal nerve; 20. coccygeus muscle; 21. gluteobiceps muscle (origin); 22. ischiatic lymph node; 23. caudal cutaneous femoral nerve; 24. caudal gluteal artery; 25. ischiatic tendon of biceps femoris muscle; 26. ischiatic nerve (muscular branch); 27. adductor muscle; 28. semimembranosus muscle; 29. medial circumflex femoral artery and vein; 30. tibial nerve; 31. popliteal lymph node; 32. caudal cutaneous sural nerve; 33. semitendinosus muscle; 34. lateral saphena vein.

medius and its profundus part. It arises form the crest of the ilium and inserts on the lateral surface of the femur, just distal to greater trochanter.

Gluteus profundus muscle: It is a fan shaped muscle coursing caudoventrally over the hip joint. The origin is a wider base and its insertion on the neck of the femur is the apex.

Vastus lateralis muscle (cut): It originates from the lateral surface of the greater trochanter and a narrow line along the caudolateral face of the femur.

Ischiatic lymph nodes: These are present along the lateral aspect of the broad sacrotuberal ligament. These lie caudal to the sacral tube and dorsal to the lesser ischiatic notch.

Caudal gluteal artery (at leser ischiatic foramen): It is the lateral terminal branch of internal iliac artery. It is the large branch emerging through the lesser ischiatic notch. After passing caudoventrally it furnishes the deep face of gluteobiceps and gemelli muscles and external sacral lymph nodes.

Ischiatic tendon of biceps femoris muscle: It originates from tuber ischii, curved ridge and tuber on the ventral surface of the ischium.

DISSECTION: Remove the skin covering the remaining protion of the hind leg, (tarsal, metatarsal and digital regions). Cut the insertions of the semitendinosus, gracilis, pectineus, adductor, semimembranosus, tensor fascia latae and all the four heads of the quadriceps femoris muscles and remove them. Cut and remove the quadratus femoris muscle at its insertion. Disarticulate the hip joint and suspend the rest of the limb in the natural postion by securing it to the sling. Clean the fascia of the leg, tarsal, metatarsal and digital regions. The following superficial structures of the hind limb in the lateral view can be observed. Fig. 6.4.

Flexor digitorum superficialis muscle: It is well developed, fleshy, fusiform muscle in its proximal two third. It is embedded in the deep surface of the gastrocnemius muscle.

Flexor digitorum profundus muscle: It is a complex muscle having three heads and is lying on the caudolateral surface of

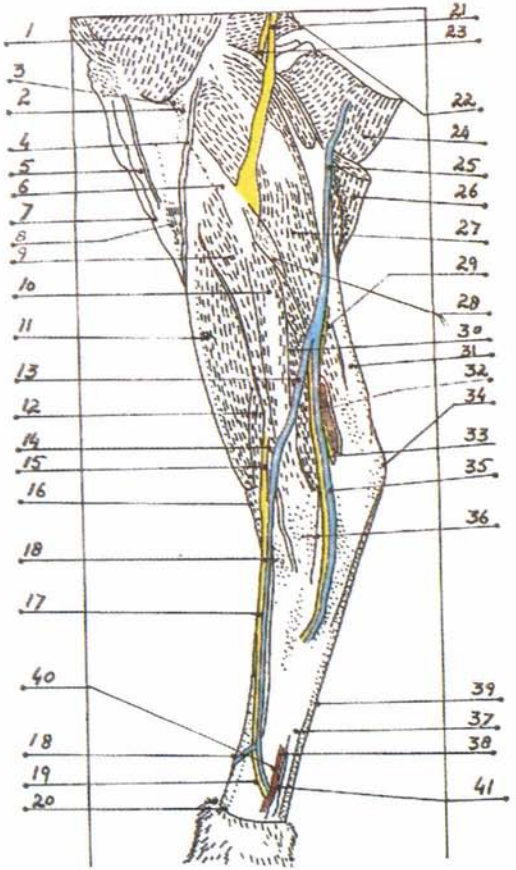

Fig. 6.4 : 1. vastus lateralis muscle; 2. lateral femoropatellar ligament; 3. lateral epicondyle of femur; 4. crural fascia; 5. lateral patellar ligament; 6. lateral collateral ligament; 7. tibial tuberosity; 8. cranial tibial muscle; 9. long fibular muscle; 10. extensor digitorum lateralis muscle; 11. fibularis tertius muscle; 12. extensor digitorum longus muscle; 13. lateral saphena vein (cranial branch); 14. cranial tibial vein; 15. surperficial fibular nerve; 16. proximal extensor retinaculum; 17. common dorsal digital nerve III; 18. common dorsal digital vein III; 19. common dorsal digital nerve IV; 20. extensor digitorum lateralis muscle; 21. common fibular nerve; 22. adductor muscle; 23. tibial nerve; 24. semimembranosus muscle; 25. lateral saphena vein; 26. semitendinosus muscle; 27. gastrocnemius muscle (lateral head); 28. soleus muscle; 29. caudal cutaneous sural nerve; 30. tibialis caudalis muscle; 31. flexor digitorum superficialis muscle; 32. flexor digiti I longus muscle; 33. tibial nerve; 34. calcaneal tuberosity; 35. lateral saphena vein (caudal branch); 36. lateral malleolus of fibula; 37. flexor digitorum profundus muscle; 38. interosseous muscle; 39. flexor digitorum superficialis muscle; 40. common plantar digital artery IV; 41. common dorsal digital vein.

tibia.

Flexor digiti I longus: It is the deep head of the flexor digitorum profundus. It is the largest and has most extensive origin from tibia.

Plantar common digital artery IV: It arises from the superficial plantar arch which is formed shortly before fetlock joint after the medial plantar artery communicates with the distal (deep) plantar arch through an anastomotic branch.

Lateral (femoropatellar) ligament of stifle: It is the largest and most powerful ligament. The lateral patellar ligament fuses completely with the tendon of insertion of the biceps femoris. This ligament extends from the lateral part of the anterior face of patella to be inserted on the anterior tuberosity of the tibia, lateral to the middle patellar ligament.

Tibialis cranialis muscle: It is the deepest of the extensor group. It is a thin muscle lying on the craniolateral aspect of tibia lateral to the cranial border of tibia.

Extensor digitorum longus muscle: It is a complex extensor of the digits. It is a thin, fusiform muscle lying on the craniolateral surface of the leg and lies covered by the fibularis tertius to which it is closely adherent. It lies between the tibialis cranialis and extensor digitorum lateralis and consists of two bellies.

Cranial tibial veins: These are upward continuation of the two anterior deep metatarsal veins. They begin above the tarsus, ascend the leg on either side of the satellite artery and communicate with each other on their way by transverse anastomotic branches. In the lower third of the leg the external anterior tibial vein is joined by a branch from the anterior superficial metarasal vein. In their upwar course vessels are placed almost in vertical position.

Superficial fibular nerve: It is the stronger of the two terminal branches of the ischiatic nerve. It descends distally and about the middle of the leg, crosses gradually the deep face of the fibularis longus muscle and appears between the fibularis tertius, fibualris longus and extensor digitorum lateralis muscles.

Proximal extensor retinaculum: It is thick transverse band at the cochlea of the tibia and is attached to the medial malleolus, and to the dorsal surface of tibia, medial to the lateral malleolus. It is the strongest ligament.

Dorsal common pedal digital nerve III: It is the continuation of superficial fibular nerve beyond the middle of the metatarsus where dosal common (pedal) digital nerve II is given off. At the level of fetlock joint the dorsal common (pedal) nerve III communicates with dorsal metatarsal nerve III and divides into dorsal (axial) proper (pedal) digital nerve III and IV.

Dorsal common digital vein III: Anterior proper digital veins arise from the venous plexuses of the two digits, pass upwards and at about middle of the interdigital space from the anterior (dorsal) common digital vein, which passes upwards in front of interdigital space and continues as anterior superficial metatarsal vein.

Dorsal common digital nerve IV: At variable level on the dorsal surface of the tarsus superficial fibular nerve detaches the dorsal common digital nerve IV. It furnishes twigs to the dorsolateral aspect of the metatarsus and near the fetlock joint it gives branches to the lateral accessory (fifth) digit, and continues as the dorsal proper digital nerve IV.

Extensor digitorum lateralis muscle: It lies on the lateral surface of the leg, between some of the extensors and flexors of the limb.

DISSECTION: Cut and remove a section of fibularis tertius muscle from about the middle to the lower third of its muscular belly leaving the tendon of insertion. The long digital extensor muscle is also transected and removed. The removal of these muscles exposes the cranial tibial muscles, besides other surperficial structures of the hind limb, in caudolatral view. Fig. 6.5.

Tibialis caudalis muscle: It is the superficial head of flexor digitorum profundus. It is a thin, flat muscle, partially adherent to the underlying flexor digit I longus muscle near its origin.

The muscle becomes tendinous at the proximal and distal one half.

Plantar common digital nerve IV: The lateral plantar nerve runs in the groove between the interosseous muscle and flexor tendons. On the plantar aspect of the proximal extremity of the metatarsus it gives off the deep branch to the interosseous muscle and continues further as the **Plantar digital nerve IV.** Near the fetlock joint it gives branches to the plantar aspect of the joint capsule, the accessory digit and extends as the **plantar proper digital nerve IV.**

DISSECTION: Remove the skin on medial aspect of the limb, which has already been detruncated. The fascia is cleaned and the gracilis muscle is cut and removed from its origin. The medial plantar artery, which extends as far as the digit, has been cut short at the hock. The following structures of the hind limb in medial view are revealed. Fig. 6.6.

Pectineus muscle: It is a large fleshy muscle, somewhat triangular in shape. It is massive and single at its origin. Its origin is from the prepubic tendon and the cranial border of the pubis to insert at caudomedial border of the femur.

Vastus medialis muscle: It is one of the divisions of the quadriceps femoris, and originates from the neck of the femur caudally and distally to the middle of the caudal surface of the femur. It inserts on craniomedial surface of the patella, and also on the medial patellar ligament.

Sartorius muscle: It is a strap like muscle extending across the cranial medial surface of the thigh to the stifle.

Gastrocnemius muscle (caput medial): It is a large fleshy muscle having a medial and lateral heads of equal size. The medial head arises from the distalmost portion of the medial supracondyloid tuberosity and the medial epicondyle of the femur. Alongwith the lateral head it inserts on the calcaneal tuber by means of strong tendons.

Medial saphenous vein: It arises at the distal end of the femoral canal from the femoral vein to course alongwith saphenous artery and nerve. At the insertion of semitendinosus it divides

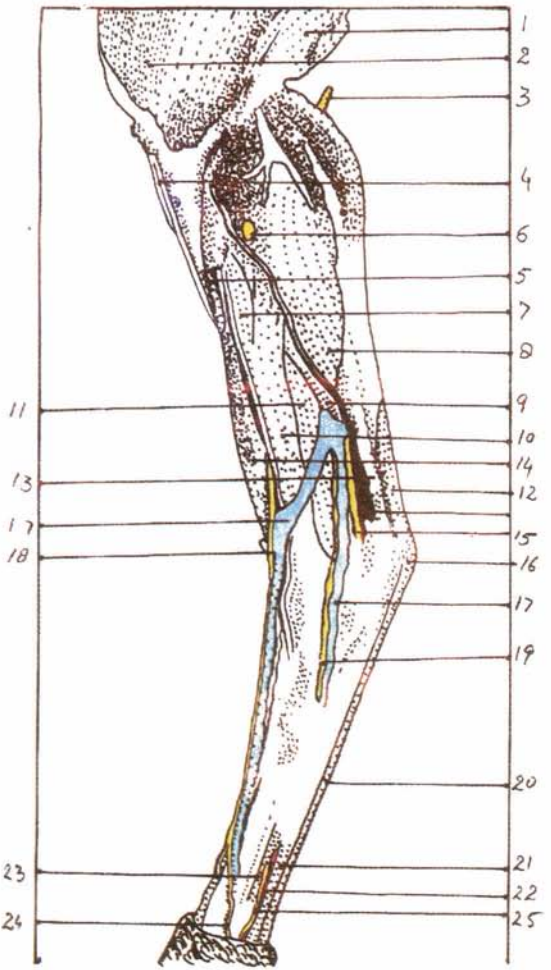

Fig. 6.5 : 1. adductor muscle; 2. vastus lateralis muscle; 3. tibial nerve; 4. lateral patell ligament; 5. tibialis cranialis muscle; 6. common fibular nerve; 7. fibularis longus muscle; 8. gastro nemius muscle (lateral head); 9. tibialis caudalis muscle; 10. extensor digitorum lateralis muscle; 11. flexor digitii longus muscle; 12. flexor digital superficialis muscle; 13. gastrocnemius muscle; 14. tibialis cranialis muscle; 15. tibial nerve 16. calcaneal tuberosity 17. lateral saphena vein (cranial and caudal branches); 18. superficial fibular nerve; 19. cauda cutaneous sural nerve; 20. flexor digitorum superficialis muscle; 21. flexor digitorum superficialis muscle; 22. common planter digital artery IV 23. interosseous muscle; 24. common dorsal digital nerve IV (fibular nerve); 25. common plantar digit nerve IV (tibial nerve).

into a caudal and a cranial ramus but only caudal ramus is developed and drains gracilis and deep digital flexor muscles.

Saphenous artery: It is one of the branches of the femoral artery given off a little below the middle of its course, at the distal end of femoral canal. It becomes superficial by emerging between the sartorius and gracilis, passes down in front of the lateral saphena vein on medial face of leg, where it is placed subcutaneously. It supplies to medial thigh muscles and cutaneous branches to knee and cranial shank region.

Saphenous nerve: It appears along the caudal border of the sartorius, near the distal third on the medial aspect of the thigh.

Flexor digitorum longus muscle: The medial head of flexor digitorum profundus muscle is the flexor digitorum longus muscle. From its fleshy origin on the lateral surface of the tibia, this muscle courses obliquels across the tibla. At distal one third, it tapers to a thin, flat tendon which courses over the medial surface of the hock in a canal in the medial collateral ligament. This tendon joins the larger common tendon at the proximal one fourth of metatarsus.

Medial plantar artery: It arises from the saphena artery just proximal to sustentaculum teli. While descending along the plantaromedial aspect of the tarsus it gives twigs to the fascia and skin on the medial aspect of tarsus, long plantar ligament and the tendon sheath of the flexor digtorum superficialis muscle.

Medial plantar nerve: It originates from tibial nerve at the level of calcaneal tuber. It continues along the medioplantar aspect of the tarsus and lies in the groove between the interosseous muscle and the flexor tendons. Slightly above the fetlock it divides into plantar common digital nerves II and III.

DISSECTION: The proximal extensor retinaculum is cut. The fascia is cleaned from the hock and metatarsal regions. The fibularis tertius muscle has been transected and remove at its lower third. The following structures of the hock and metatarsal regions are revealed in dorsal view. Fig. 6.7.

Deep fibularis nerve: It descends in the groove between the

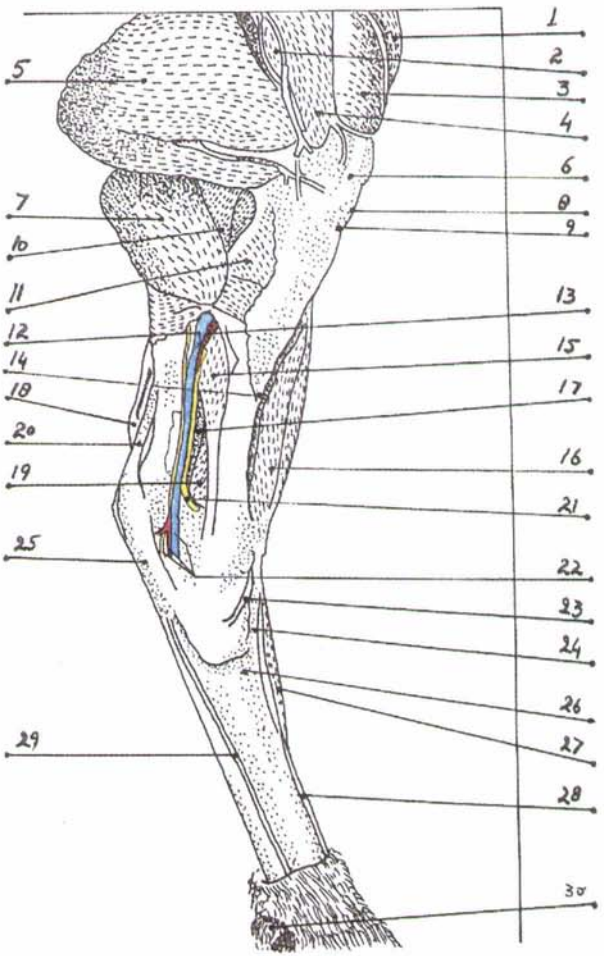

Fig 6.6 : 1. rectus femoris muscle; 2. pectineus muscle; 3. vastus medialis muscle; 4. sartorius muscle; 5. semimembranosus muscle; 6. medial patellar ligament; 7. semitendinosus muscle; 8. tibial tuberosity; 9. tibial crest; 10. gastrocnemius muscle (medial head); 11. popliteus muscle; 12. medial saphena vein; 13. saphena artery and nerve; 14. tibialis cranialis muscle; 15. flexor digiti longus muscle; 16. fibularis tertius muscle; 17. tibialis caudalis muscle; 18. gstrocnemius muscle; 19. flexor digiti I longus muscle; 20. flexor digiti superficialis muscle; 21. tibial nerve; 22. medial plantar artery, vein and nerve; 23. tibialis cranialis muscle; 24. fibularis tertius muscle; 25. long plantar ligament; 26. metatarsal bones II and IV; 27. extensor digitorum brevis muscle; 28. extensor digitorum longus muscle; 29. interosseous muscle; 30. accessory digit II.

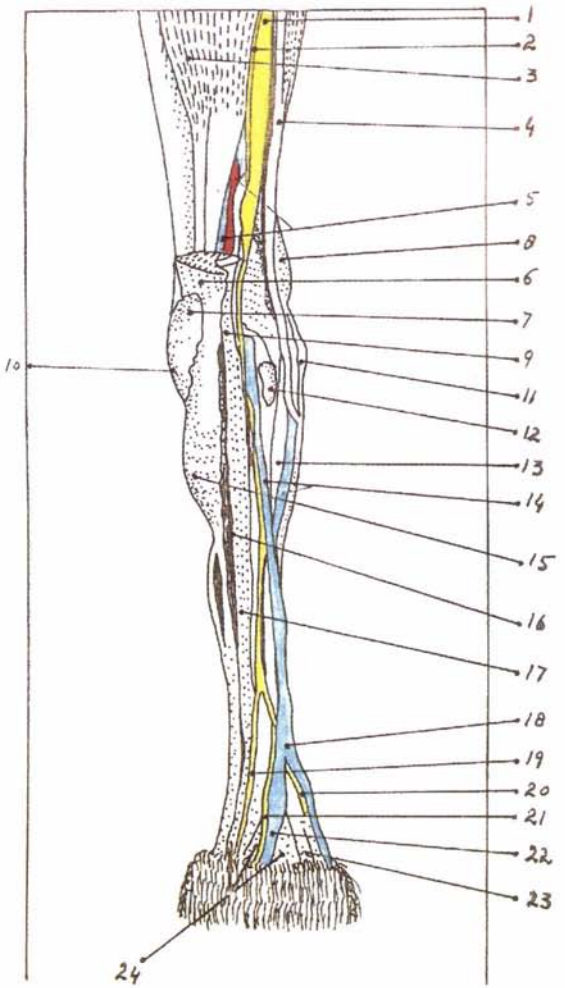

Fig. 6.7 : 1. superficial fibular nerve; 2. deep fibular nerve; 3. tibialis cranialis muscle; 4. tibulairs longus muscle; 5. cranial tibial artery and vein; 6. fibularis tertius muscle; 7. proximal extensor retinaculum; 8. calcaneal tuberosity; 9. extensor digitorum longus muscle; 10. medial malleolus of tibia; 11. lateral malleolus of fibula; 12. sinovial cavity of tarsocrural joint; 13. extensor digitorum lateralis muscle; 14. lateral saphena vein (caudal and cranial branches); 15. distal extensor retinaculum, 16. extensor digitorum brevis muscle; 17. extensor digitorum longus muscle; 18. common dorsal digital vein IV; 19. common dorsal digital nerve II; 20. common dorsal digital nerve IV; 21. common dorsal digital nerve III; 22. common dorsal digital vein III; 23. extensor digitorum lateralis muscle; 24. extensor digitorum longus muscle.

fibularis longus and extensor digitorum lateralis muscles and courses along extensor digitorum longus muscle under the proximal retinaculum. It further continues as dorsal metatarsal nerve III in the metatarsal region.

Cranial tibial artery: It is the continuation of popliteal artery and passes through the interosseous membrane craniolaterally to reach the tibia.

Distal extensor retinaculum: It crosses the dorsal surface of the large metatarsal bone, to whose borders it is attached and is much thinner than the proximal retinaculum. The tendons of extensor digitorum longus, extensor digit III and fibularis tertius muscles pass under the distal retinaculum.

DISSECTION: The fascia has been cleaned from the lower part of the limb, and the tendons are loosened from the fascia. The third fibular and long extensor muscles have been cut and removed. The gastrocnemius muscle has been severed and removed from its both origins. The following structures of the hock and metatarsus are revealed in lateral view. Fig. 6.8.

Lateral plantar nerve: The lateral plantar nerve is a branch of tibial nerve. It passes obliquely laterally beneath long plantar ligament to reach the plantarolateral aspect of tarsus. On the plantar aspect of the proximal extremity of the metatarusus it give off a deep branch and contiues further as the plantar common digital nerve IV.

Flexor digitorum profundus muscle: It is inserted at the flexor tubercle of the distal phalanges of the third and fourth digits.

Dorsal common digital vein IV: The cranial branch of lateral spahenous vein divides at the distal half of the metatarsus into the dorsal common digital veins III & IV. The dorsal common digital vein does not proceed further towards the toe but runs parallel to the corresponding nerve across the lateral surface to the origin of the plantar common digital vein IV.

DISSECTION: The superficial digital flexor muscle has been transected and removed. It reveals the deep digital flexor and

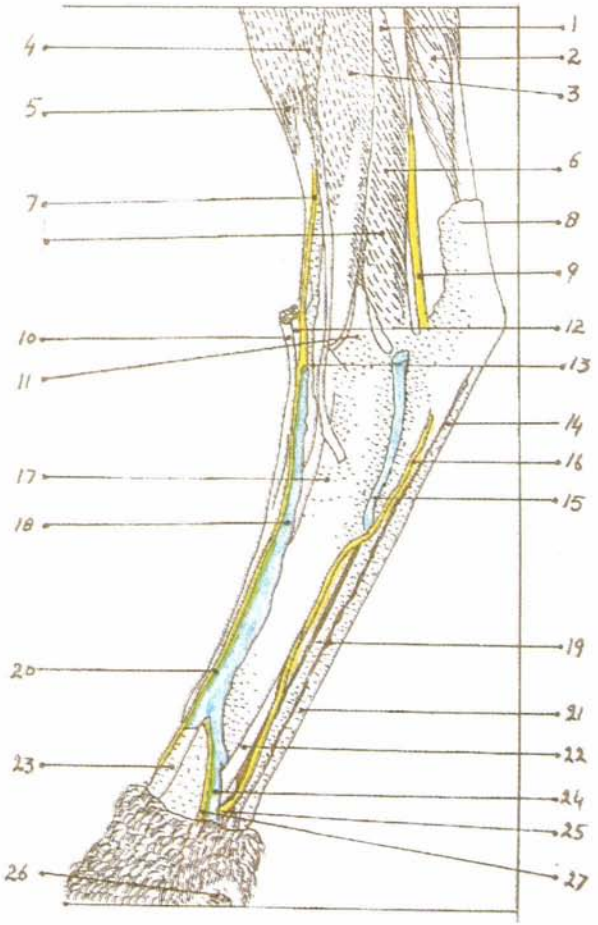

Fig. 6.8 : 1. tibialis caudalis muscle; 2. flexor digitorum superficialis muscle; 3. extensor digitorum lateralis muscle; 4. fibularis longus muscle; 5. tibialis cranialis nerve; 6. flexor digiti longus muscle; 7. superficial fibular nerve; 8. gastrocnemius muscle (lateral head); 9. tibial nerve; 10. fibularis tertious muscle; 11. proximal extensor retinaculum; 12. extensor digitorum longus muscle; 13. later saphena vein (cranial branch); 14. long plantar ligament; 15. lateral saphena vein (caudal branch); 16. lateral plantar nerve; 17. distal extensor retinaculum; 18. common dorsal digital vein III; 19. flexor digitorum profundus muscle; 20. common dorsal digital nerve III; 21. flexor digitorum superficialis muscle; 22. interosseous muscle; 23. extensor digitorum lateralis muscle; 24. common dorsal digital vein IV; 25. common plantar digital nerve I; 26. accessory digit V; 27. common dorsal digital nerve IV.

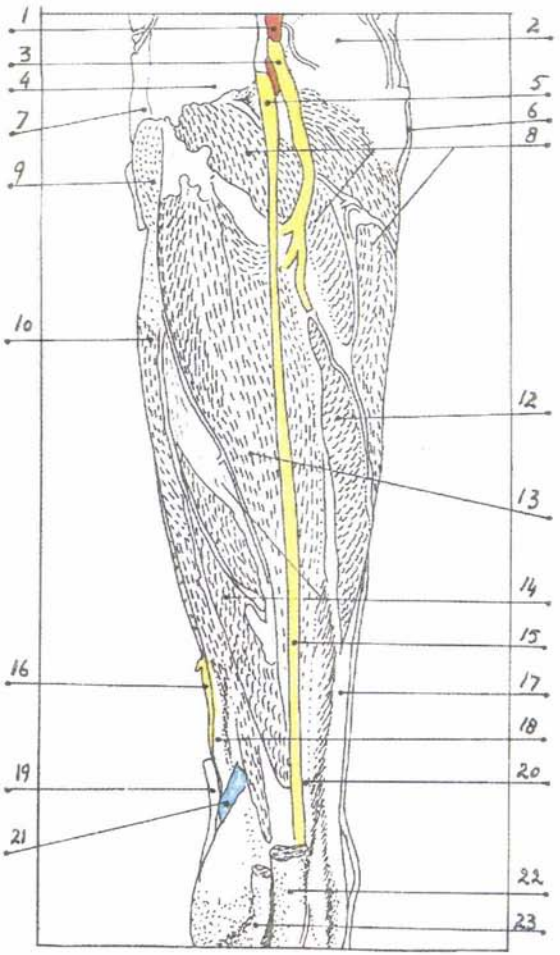

Fig. 6.9: 1. popliteal artery; 2. medial condyle of femur; 3. tibial nerve (muscular branch); 4. lateral condyle of femur; 5. tibial nerve; 6. medial collateral ligament of stifle; 7. lateral collateral ligament of stifle; 8. popliteus muscle; 9. lateral condyle of tibia; 10. extensor digitorum lateralis muscle; 11. Flexor digitorum profundus muscle; 12. flexor digitorum longus muscle; 13. tibialis caudalis muscle; 14. flexor digitilongus muscle; 15. tibial nerve; 16. superficial fibular nerve; 17. tendon of flexor digitorum longus muscle; 18. extensor digitorum lateralis muscle; 19. fibularis longus muscle; 20. tendon of tibialis· caudalis muscle; 21. lateral saphena vein (caudal branch); 22. flexor digitorum superficialis. muscle; 23. gastrocnemius muscle.

the popliteus muscle besides caudal muscles of tibia, in dorsocaudal view. Fig. 6.9.

Popliteal artery: It is the continuation of femoral artey. It runs between the two heads of gastroenemius muscle and then between the tibia and popliteal muscle. Here it gives rise to caudal tibial artery and caudodistal to the lateral condyle of tibia it gives interossea cruris artery. From here it continues as cranial tibial artery.

Tibial nerve: Following its separation from the fibular nerve near the middle of thigh, the tibial nerve continues between the two heads of gastrocnemius muscle. Here it gives muscular branches to the popliteus, soleus, flexor digitorum profundus and the lateral head of gastrocnemius muscles.

Medial collateral ligament of stifle: The medial ligament is less salient as compared to lateral ligament and connects the medial epicondyle to the fibrocartilage on the medial border of patella.

Lateral collateral ligament of stifle: The lateral ligament is more clearly defined and connects the lateral condyle of femur with the lateral border of the patella.

Caudal tibial vein: It arises from popliteal vein on the proximal part of the caudal surface of tibia beneath the popliteus muscle. This vein crosses the caudal surface of this muscle to supply the extensors of tarsal joint and flexors of the toe joint.

DISSECTION: Make a sagittal section through the right pes with the help of a saw. The following structures can be observed after median section in medial view. Fig. 6.10.

Cranial tibial vein: It arises as continuation of popliteal vein at the distal border of popliteus muscle. It passes through the crural interosseous space and runs under cranial tibialis muscle, craniolateral to tibia.

Extensor digitorum brevis muscle: This muscle is very small and inconspicuous and is located on the dorsal surface of tarsus.

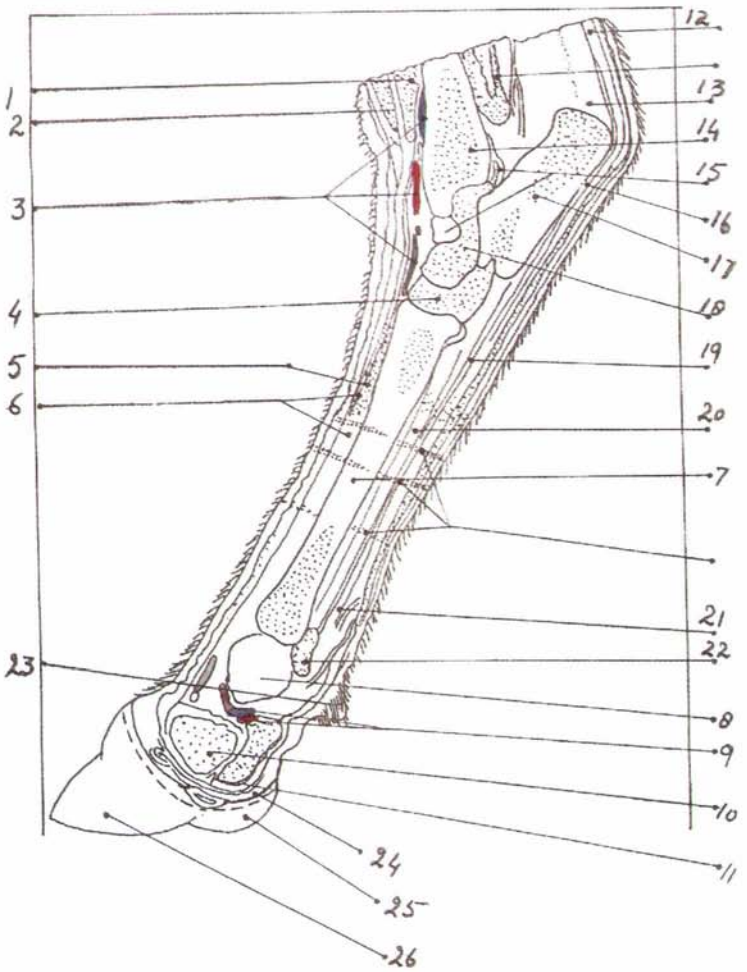

Fig. 6.10 : 1. extensor digitorum longus muscle; 2. fibularis tertius muscle; 3. cranial tibial artery and vein; 4. fused tarsal bones (central and distal IV); 5. extensor ditgitorum brevis muscle; 6. extensor digitorum longus muscle; 7. fused metatarsal bones III and IV; 8. proximal interdigital ligament; 9. interdigital artery and vein III; 10. interdigital adipose tissue; 11. distal interdigital ligament; 12. superficial digital flexor muscle; 13. gastrocnemius muscle; 14. tibia; 15. tarsocrural joint (cavity); 16. long plantar ligament; 17. calcaneus (fibular tarsal bone); 18. talus (tibial tarsal bone); 19. deep digital flexor muscle; 20. interosseous muscle; 21. superficial digital flexor muscle (division); 22. interdigital intersesamoid ligament; 23. digit V; 24. digit IV (axial coronet); 25. bulb of heel; 26. wall of hoof.

Interdigital artery III: The interdigital artery III links the common palmar and dorsal digital arteries.

Distal interdigital ligament: These are also called cruciate ligaments and are in the form of two strong bands which limit the separation of digits. Proximally they bind on the aboxial eminences of the proximal ends of the middle phalanges and cross the deep digital flexor tendon obliquely. They intercross in the interdigital space and are blended together.

Interdigital adipose tissue: This is formed of fibroelastic tissue and fat, and forms the digital pad. Each digital pad receives two suspensory bands from the tubercles at the distal end of corresponding middle phalanx.

Cranial tibialis artery: It is the continuation of the popliteal artery and passes craniolaterally through the interosseous membrane to reach the tibia. In the distal third it comes on the cranial surface and lies medal to the tendon of long extensor of the toes.

N.B. Proximal interdigital ligament is absent is sheep and instead of distal interdigital ligament there is a transverse ligament attached on either side to interdigital surfaces of the middle and distal phalanges and distal sesamoid bone.

SURGICAL ANATOMY FOR COMMON SURGICAL AFFECTIONS OF HINDLIMB

MEDIAL PATELLAR DESMOTOMY

(A) **Anatomical location:** Femoropatellar articulation is formed by the trochlea of femur and the posterior (articular) surface of patella. Extending from the nonariticular surface of patella to the anterior tuberosity of tibia are three patellar ligaments. The patellar ligaments are very strong bands which attach the patella to the tuberosity of the tibia. The lateral patellar ligament extends from the lateral part of the anterior surface of the patella to the lateral part of the tuberosity of the tibia. The middle patellar ligament extends from the front of the apex of the patella to the distal part of the groove on the tuberosity of the tibia. The medial patellar ligament,

distinctly weaker than the others, is attached above to the patellar fibrocartilage, and ends on the tuberosity of the tibia at the medial side of the groove.

(B) **Site for surgical approach:** The medial epicondyle of the tibia is palpated. Extending above the anterior tibial tuberosity a thick band of medial patellar ligament is felt. The line of incision is along the side of this ligament and 1.5 cm anterior to the edge of the medial tibial condyle.

(C) Structures enconuntered: Skin, fascia, medial patellar ligament, aponeurosis of gracilis muscle, saphena artery, medial saphena vein and saphena nerve.

AMPUTATION OF HIND LIMB

(A) **Anatomical location:** In the middle of the leg region the medial surface of the shaft of tibia is subcutaneous. The dorsolateral group of muscles, comprise of peroneus tertius, medial digital extensor, long digital extensor, peroneus longus, lateral digital extensor and the most deeply placed tibialis anterior muscles. The plantar group of muscles is the medial and lateral head of the gastrocnemius, superficial digital flexor and three heads of deep digital flexor muscles. The anterior tibial vessels, superficial and deep peroneal nerves are dorsolaterally situated while the posterior tibial vessels and the tibial nerve are the structures of the plantar aspect.

(B) **Site for surgical approach:** The limb is best amputated below the stifle joint at the junction of upper and middle third of tibia, a point above and well clear of the lesion to ensure operating in normal tissue.

(C) **Structures:** Skin, superficial and deep fascia, tendons of lateral common and medial digital extensors, periosteum, bone, superficial and deep parts of suspensoryligament, tendons of superficial and deep digital flexors, cranial tibial artery, caudal tibial artery, saphena artery, cranial and caudal branches of lateral saphena vein, caudal branch of medial spahena vein, cranial tibial vein, superificial and deep fibular nerves, saphena nerve, tibial nerve, lateral plantar cutaneous sural nerve.

AMPUTATION OF THE DIGIT

(A) Anatomical location: There are two rudimentary and two chief digits for each limb. The hoof (horny covering) conforms to the shape of distal (third) phalanx and shows the three surface; abaxial, interdigital and basal (ground) surfaces. Periople, wall and sole are the three parts of the hoof. The sole is concave and anteriorly placed part of the ground surface, while the prominent bulb of soft, thin horn is on its posterior aspect. The corium of pododerm is the fiborovascualr part that nourishes the hoof. The three phalanges and three sesamoid (two proximal and a distal sesamoid) bones form the bony basis of each of the chief digits. The tendons of the common digital and proper digital extensors are present on the anterior aspect whereas, the superficial and deep digital flexor tendons are on the posterior aspect of the limb.

(B) Site for surgical approach:

(i) Disarticulation at the coronopedal joint. The incision is made below the level of the coronet, thus permitting horn to regenerate in order to protect the stump and to bear the weight.

(ii) Disarticulation at the pastern joint performed directly through the joint.

(iii) Removal of the digit through the middle of the second phalanx.

(iv) Amputation at the level of the first phalanx.

(B) Structures encountered: Skin, superficial and deep fascia, tendons of lateral, common and medial digital extensors, flexor tendons, digital blood vessels and nerves, capsular, collateral, interdigital, cruciate, lateral and median sesamoidean, middle and deep inferior sesamoidean ligaments, proper digital veins, interdigital common vein, dorsal digital vein, dorsal common digital vein plantar veins of proper digits, plantar common digital vien. Plantar arteries of proper digits, intrdigital arteries polmor arteries of prominal pholaure planter arteries for proper digits, propria artery. Medial plantar nerve, plantar proper common digital nerve III, planter and dorsal proper digital nerve IV, dorsal proper digital nerve III and dorsal common digital nerve III.

Chapter 7

The Pelvic Region

DISSECTION: Saw through the pelvic symphysis and remove the wing of the ilium. Remove most of the broad sacrotuberous ligament. The nerves and arteries of the pelvic cavity surrounded by massive adipose tissue besides, other structures are revealed in left lateral pelvic wall. Fig. 7.1.

Sacrotuberal ligament: Sacrotuberal ligament is an extensive quadrilateral sheet which completes the lateral pelvic wall. Its **dorsal border** is attached to the border of the sacrum and transverse processes of the first and second caudal vertebrae. The **ventral border** is attached to the ischiatic spine and tuber. Between these it bridges over the lateral border of the ischium and completes the lesser ischiatic foramen. The **cranial border** is concave, and completes the greater ischiatic foramen. The **caudal border** is fused with the vertebral head of the semimembranosus muscle.

Rectum: It is the terminal part of the bowel extending from pelvic inlet to the anus. It consists of a cranial part largely covered by the peritoneum, and a wider retroperitoneal part, the ampulla recti. A short **Mesorectum** is present near sacral promontory and forms the point (reflection) where parietal and visceral peritoneum are continuous with each other.

Retractor clitoris muscle: It consists of smooth muscle fibres. It originates from second and third or third & fourth caudal vertebrae. It passes around the lateral surface of the rectum, covered by terminal part of levator ani muscle.

Dorsal perineal artery: In males it is one of the terminal branches of urogenital artery and supplies the sphincter ani externus muscle and skin of the perineal region. In females it is the caudal

continuation of the caudal branch of the urogenital artery beyond the retractor clitoris and levator ani muscles. After giving off a branch laterally near the ischiatic tuber, dorsal perineal artery turns ventrally and enters labium as caudal labial artery between constrictor vulvae and retractor clitoris muscles.

Median caudal artery: It is a direct continuation of median sacral artery beyond the first caudal vertebra. It runs along the ventral surface of the entrie length of tail inside the vascular groove enclosed by hemal process. It gives off paired branches at regular intervals.

Vaginalis artery: It is analogous to the prostatic artery of the males. It arises from internal iliac artery in the region of the greater ischiatic notch cranial to the ischiatic spine. On the lateral surface of vagina it divides into cranial and caudal branches, the cranial branch being relatively larger.

Prepubic tendon: It is essentially the tendon of insertion of the two rectus abdominis mscles. It is attached to cranial borders of pubic bones and iliopubic eminences. It is in the form of a thick band with concave lateral borders forming medial boundaries of superficial inguinal ring.

N.B. Rupture of the prepubic tendon occasionally occurs in cow, particularly during gestation, resulting in a relaxation of the abdominal musculature and a concave appearance of the dorsum.

Obturatorius nerve: Obturator nerve receives fibres form ventral branches of fifth and a few branches from fourth and sixth lumbar nerves together with the fibres from femoral nerve. It courses under the peritoneum to the cranial end of obturator foramen and innervates the obturatorius externus muscle, including its intrapelvic part. It also splits into muscular branches for adductor, pectineus and gracilis muscles.

DISSECTION: After the lateral side of the bony pelvis is cut and removed, the adipose tissue of the pelvic wall is also removed together with coccygeal muscles. The pelvic viscera, besides other structures are revealed in lateral view. Fig. 7.2.

Caudal limit of peritoneum (pelvic peritoneum): It is

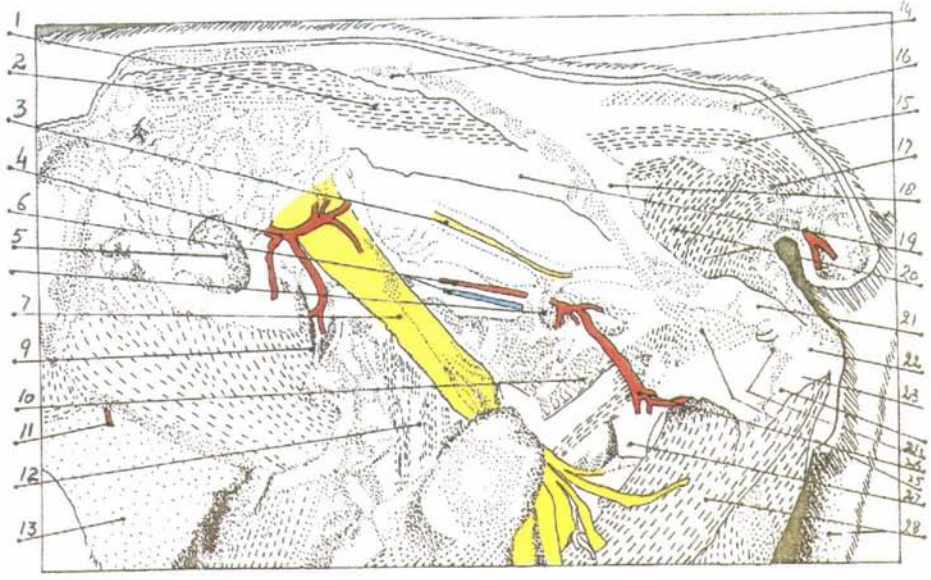

Fig. 7.1: 1. sacrocaudalis dorsalis lateralis muscle; 2. longissimus lumborum muscle; 3. pudendal nerve; 4. cranial gluteal artery; 5. transverse process of sacrum; 6. internal iliac artery and vein; 7. ischiatic nerve; 8. iliac nerve; 9. body of ilium (cut end); 10 gemelli muscles; 11. deep circumflex iliac artery; 12. gluteus profundus muscle; 13. deep fascia covering obliquus externus abdominis muscle; 14. gluteobiceps muscle (line of origin); 15. sacrocaudalis dorsalis lateralis muscle; 16. sacrocaudalis dorsalis medialis muscle; 17. intertransversarii caudae muscles; 18. sacrotuberous ligament (caudal limit); 19. broad sacrotuberous ligament coccygeus muscle; 20. coccygeus muscle; 21. dorsal, 22. ventral and 23. lateral tuberosities of tuber ischium; 24. semitendinosus muscle; 25. biceps femoris muscle; 26. caudal gluteal artery; 27 biceps femoris muscle (origin from ischium); 28. semimembranosus muscle.

continuous cranially with abdominal peritoneum. Caudally it lines the pelvic cavity for a variable distance and is then reflected onto the viscera, and from one organ to ano*ther. Thus cranial (peritoneal) and caudal (retroperitoneal) parts of pelvic cavity can be distinguished. Along the mid-dorsal line it forms a continuation of mesocolon, the mesorectum which attaches the peritoneal part of rectum to the roof.

Ischium (cut edge): It is a large flat bone forming a part of os coxae. With its fellow of opposite side it forms the posterior part of the pevic floor. The anterior border of ischium forms the posterior boundary of obturator foramen.

Obtuatorius externus muscle (intrapelvic part): It is a fan shaped muscle, lying on the ventral surface of ischium and pubis. It converges to the trochanteric fossa and lies beneath the adductor and quadratus femoris muscles.

Pubis (cut edge): It is the smallest of the three parts of os coxae and forms the cranial part of pelvic floor. Its caudal border forms the cranial margin of the obturator foramen.

Obturator foramen: It is the largest foramen of the body situated between pubis and ischium on the floor of the pelvis. It is elliptical in outline, the medial border being sharp

Symphysial tendon: It is a strong plate of tendinous tissue that attaches the suspensory apparatus of udder to the pelvic symphysis. This plate attaches the prepubic tendon to the ventral part of the symphysis.

Internal iliac artery: It arises from abdominal aorta before the sacral promontory, ventral to sixth lumbar vertebra. It passes over the medial surface of the iliopsoas muscle into the pelvic cavity.

Vagina: It is situated in the pelvic cavity between rectum dorsally and urinary bladder ventrally. It is roomy, long and has thick walls.

Deep circumflex iliac artery: It arises from external iliac artery. It crosses the inner lumbar muscles ventrally and divides into cranial and caudal branches after perforating the transverse abdominis muscles.

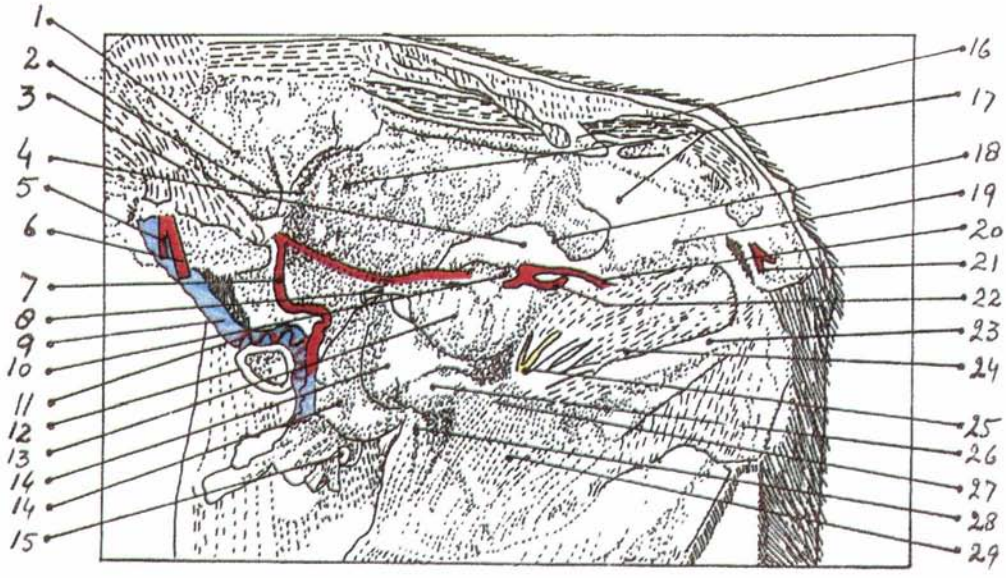

Fig. 7.2: 1. wing of sacrum; 2. internal iliac artery; 3. iliopsoas muscle; 4. vagina; 5. deep circumflex iliac artery; 6. external iliac artery; 7. uterine artery; 8. left ureter; 9. ovarian vein; 10. lateral ligament of bladder; 11. ovarian artery; 12. descending colon; 13. urinary bladder; 14. left and right uterine horns; 15. left ovary with corpus luteum; 16. sacrotuberous ligament (caudal limit); 17. rectum; 18. peritoneum caudal limit; 19. retractor clitoridis muscle; 20. dorsal perineal artey; 21. median caudal artery; 22. vaginal artery; 23. ischium (cut edge); 24. obturatorius exterunus muscle (intrapelvic part); 25. obturator nerve; 26. pubis (cut edge); 27. obturator foramen; 28. prepubic tendon; 29. symphys tendon.

External iliac artery: It arises from the abdominal aorta, as a stout artery at the level of sixth lumbar vertebra. It courses ventrad over the inner lumbar musculature, to the cranial border of pubis, beyond which it descends in the thigh as femoral artery in the femoral canal.

Left ureter: It begins at the ventral part of hilus of kidney, curves the lateral aspect of kidney to dorsal surface, then crosses the median plane and runs caudally on the left side.

Ovarian vein: It is much larger than the overian artery and courses alongwith it in the mesovarium to the ovary. This vein gives rise to tuberius branch to oviduct, and uterinus branch to the uterine horn where the vein of uterus, anastomoses with it.

Lateral ligament of bladder: It stretches form lateral aspect of the bladder to the lateral pelvic wall. In its free edge a round firm band called round ligament of bladder is persent.

Ovarian artery: It arises from the lateral aspect of the abdominal aorta at the level of fourth or fifth lumbar vertebra. This paired artery runs along the dorsal abdominal wall into mesovarium and its right branch corsses the caudal vena cava laterally. This artery becomes contorted as it contiues towards ovary.

Colon (descending part): Descending colon runs caudally dorsal to ascending duodenum, inclines to right under the right kidney and forms a sigmoid flexure near the pelvic inlet to continue as rectum.

Uterine horn (left and right): Horns of the uterus are more extensive than they appear, as the caudal parts are united by connective and muscular tissue. They taper gradually to their junction with the uterine tubes. The free part of the horn curves first ventrally cranially and laterally, and then turns dorsally and caudally forming a spiral coil.

Left ovary with corpus luteum: Ovaries are present near the middle of lateral margin of pelvic inlet cranial to external iliac artery. After rupture of the follicle, a cavity is left which, due to proliferation, enlargement and fatty changes, gets filled up by lutein cells and the structure is called corpus luteum.

Urinary bladder: It has an apex, a body and a neck. It is long, narrow and extends cranially on the abdominal floor. Middle ligament is formed by a triangular median fold of peritoneum which joins it to ventral wall of pelvis and abdomen. **Lateral ligament** comes from lateral aspect of bladder and joins it to the lateral pelvic walls.

DISSECTION: The left bony pelvis is removed. Some of the visceral organs are also removed. The adipose tissue is removed completely. structures of the pelvic inlet, in left lateral view are revealed. Fig. 7.3.

Psoas major muscle: It is the largest and most lateral of the sublumbar muscles.

Psoas minor muscle: It is the most medial of the sublumbar muscles. It is a paried muscle arising at the midline near the body of the last thoracic vertebra and gradually diverging to the psoas tubercle on the body of the ilium.

Umbilical artery: It arises from the ventral surface of the internal iliac artery. It is very large vessel in foetus, after birth its lumen is greatly reduced and its completely obliterated beyond the apex (vertex) of urinary bladder to the umbilicus. It courses along the free border of the lateral ligament of the urinary bladder, and near the apex, it ends abruptly, forming the **round ligament** of the urinary bladder.

Uterine artery: It is the first vessel emerging from the umbilical artery. Uterine artery divides in broad ligament into several branches which diverge and supply the mesometrial border of horn of the same side. Here these vessels form arched anastomoses between one another. Cranially directed branches link with uterine branches of overian and vaginal arteries.

N.B. Normal contour of the uterine vessels is very tortuous which decreases with the onset of pregnancy and the vessel becomes very thick. After third month of pregnancy it is the "Whirring" of this artery that is palpated.

Uterus: It lies almost entirely in the abdominal cavity in adult. It has two horns, a body and cervix (cervical canal). The body and horns are attached to abdominal and pelvic wall by extensive

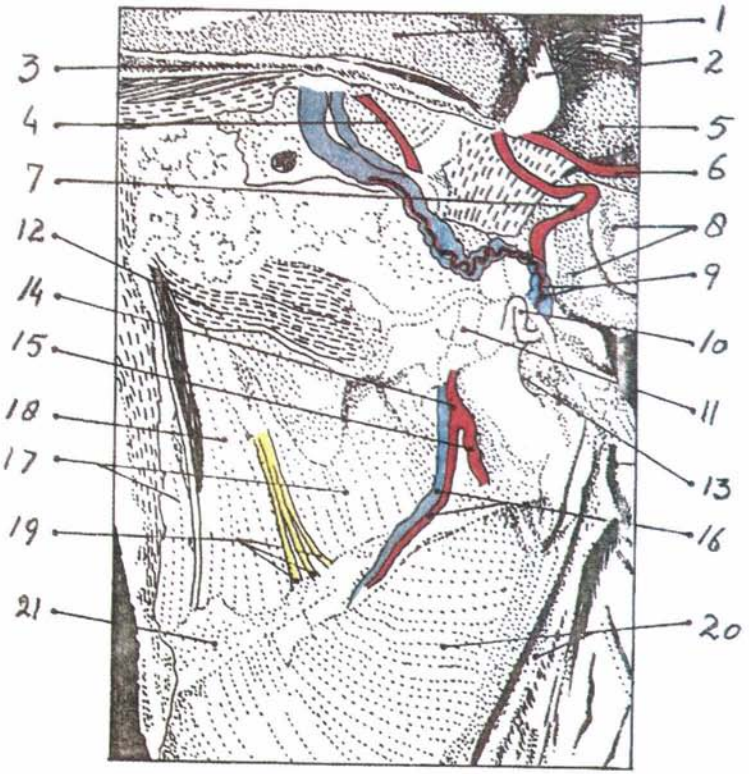

Fig. 7.3 : 1. psoas major muscle; 2. iliacus muscle; 3. psoas minor muscle; 4. deep circumflex iliac artery; 5. rectum; 6. umbilical artery; 7. uterine artery; 8. uterus; 9. left ovarian artery and vein; 10. right uterine horn; 11. right ovary in ovarian bursa; 12. suspensory ligament of right ovary; 13. left ovary; 14. pudendoepigastric trunk; 15. external pudendal artery; 16. caudal epigastric artery and vein; 17. obliquus internus abdominis muscle; 18. transversus abdominis muscle; 19. lumbar nerve II (ventral branch); 20. rectus abdominis muscle; 21. vagina.

peritoneal folds, the **broad ligament of uterus and the round ligament of uterus.**

Suspensory ligament of right ovary (cranial edge of broad ligament): The cranial part of the broad ligament attaches the ovary to the sublumbar region. It is called mesovarium.

Ovary (left): It is essential female reproductive gland in which

the ova are produced. It also conducts the estrous cycle in female animals. It is oval in form and pointed at uterine end. It is situated near the middle of the lateral margin of pelvic inlet cranial to exernal iliac artey in the nonpregnant animals but may be further cranial, especially in cows which have been pregnant.

Pudendoepigastric trunk: It arises from deep femoral artery and supplies the external cremaster muscle.

External pudendal artery: It is the second branch arising from the pudendoepigastric trunk. It passes in the inguinal canal and in the males is accompanied by external cremaster muscle.

Caudal epigastric artery: It arises at the caudal border of internal inguinal ring from pudedoepigastric trunk. It runs forwards, medial to internal inguinal ring and crosses the lateral border of rectus abdominis muscle and then crosses dorsal surface of obliquus internus abdominis muscle which it supplies. It joins the branches of cranial epigastric artery.

Caudal epigastric vein: It arises from pudendoepigastric vein and courses along with the caudal epigastric artery. It runs along the dorsal surface of the rectus abdominis muscle. The caudal epigastric vein gives off cremasteric vein which follows the external cremaster muscle into the sheaths of the testis.

DISSECTION: The tissue covering the right inguinal region is removed. The right inguinal canal and structures traversing it are revealed in left craniolateral view. Fig. 7.4.

External iliac vein: It is a direct continuation of the common iliac and runs along the shaft of ilium to lacuna vasorum passing between the sartorius muscle.

Right ovary: It is oval in shape pointed at uterine end. The ovary is present near the middle of lateral margin of pelvic inlet cranial to external iliac artery.

Right uterine tube (in the wall of ovarian bursa): Uterine tubes are long, somewhat flexuous. Each tube follows course over a pouch formed by a folding over of the free edgs of broad ligament. This pouch is known as ovarian bursa.

Medial circumflex femoral artery (origin): It arises from deep femoral artery cranial to the adductor muscles and runs in these muscles ventral to pelvic floor to the long ischiaitic muscles.

Parietal peritoneum (cut edge): The layer of peritoneum which lines the abdominal cavity is know as parietal peritoneum. Its external surface is rough while internal surface is lined by a layer of mesothelial cells.

Obliquus externus abdominis muscle (pelvic tendon or inguinal ligament): The caudolateral wall of inguinal canal is formed by a portion of the aponeurosis of the obliquus externus abdominis muscle reinforced by iliac fascia, referred to as inguinal ligament.

Borders of superficial inguinal ring: Boundaries of the superficial inguinal ring are medial and lateral crura formed by a slit in the obliquus externus abdominis muscle.

Origin of femoral artery: Femoral artery originates from the external iliac artery after it enters the lacuna vasorum.

Vasa afferentia to iliofemoral lymph node from superficial lymph nodes: These vessels are not well established, however, afferents come from adjacent part of peritoneum and abdominal muscles.

Deep femoral vein: It arises from external iliac vein proximal to femoral canal. Along with its artery it passes between pectineus and iliopsoas muscles to adductor muscles, thereafter giving off, in a caudal direction and distal to the hip joint, the medial circumflex femoral vein.

Pudendoepigastric vein: It arises from external iliac vein shortly before the latter enters the femoral canal.

Obliquus internus abdominis muscle: It is situated beneath the obliquus externus abdominis muscle. Its fibres are directed ventrad, craniad and mediad. It is trianagualr in shape with the base caudad. It occupies entire flank region from the coxal tuber to the last rib, where it is intermingled with fibres of retractor costae muscle.

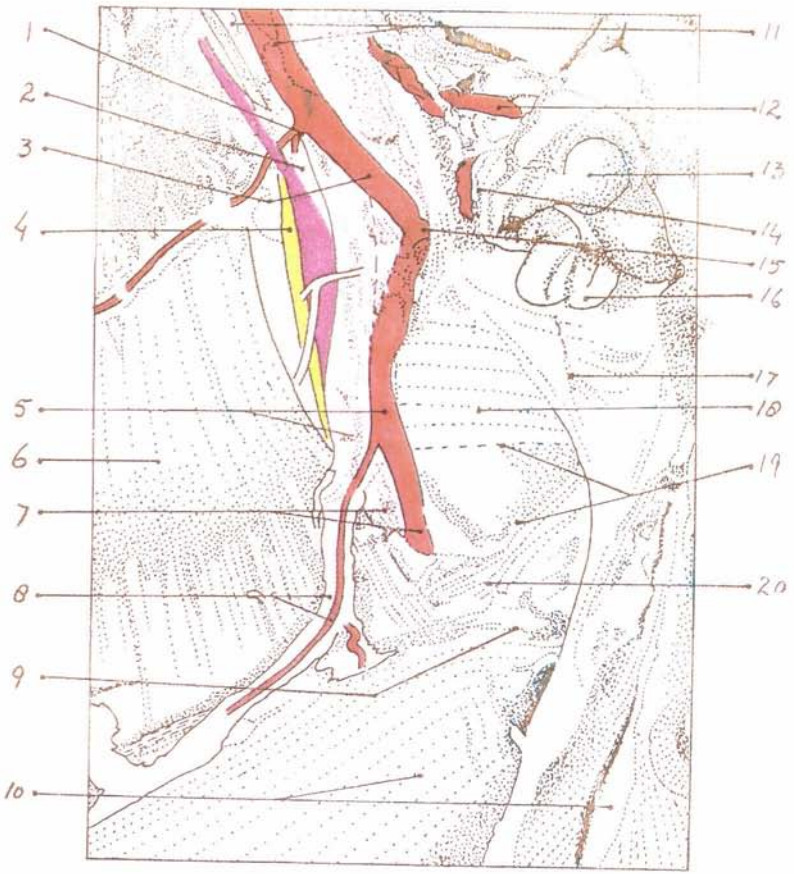

Fig. 7.4 : 1. fermoral artery (origin); 2. vasa afferentia to iliofemoral lymph node from superficial inguinal lymph nodes; 3. deep femoral artey; 4. genitofemoral nerve; 5. pudendoepigastric trunk and vein; 6. obliquus internus abdominis muscle; 7. external pudendal artery and vein; 8. caudal epigastric artery and vein; 9. deep inguinal ring (borders); 10. rectus abdominis muscle; 11. external iliac artery and vein; 12. right uterine artery; 13. right ovary; 14. right uterine tube in wall of ovarian bursa; 15. medial circumflex femoral artery (origin); 16. right uterine horne; 17. parietal peritoneum (cut edge); 18. obliquus externus abdominis muscle (pelvic tendon or inguinal ligament); 19. superficial inquinal ring (border); 20. obliquus externus abdominis muscle (border of abdominal tendon forming medial crus of superficial inguinal ring).

External pudendal vein in inguinal canal: It is the second branch of pudendoepigastric vein and leaves the abdominal cavity through the inguinal canal.

Borders of deep inguinal ring: Its medial border is related to lateral boder of prepubic tendon. Limit is formed by the attachment of obliquus internus abdominis to the inguinal ligament.

Rectus abdominis muscle: It is confined to the ventral abdominal wall. It extends from the sternum to the pubis. It lies or arises on the lateral border of the sternum as far craniad as the third costal cartilage.

Deep femoral artery: It arises from external iliac artery near cranial border of pubis. It passes ventral to pectin pubis muscle, between pectineus, iliopsoas and obturator externus muscles and finally divides into several muscular branches in the adductor muscle.

DISSECTION: The trunk has been cut transversely at the level of fifth lumbar vertebra. The transaction has been extended ventrally. It reveals the pelvic inlet and other structures in cranial view. Fig. 7.5.

Spinal cord in vertebral canal: It extends from medulla oblongata at the foramen magnum to the level of cranial half of the second sacral vertebra.

Mesocolon: Mesocolon attaches the colon to the dorsal abdominal wall. It is not very distinct as it is obliterated by the adhesion of the spiral loop to the mesentery. Only the sigmoid colon has a free mesocolon.

Ascending colon: It is the first part of the colon that connects cecum to transverse colon. It can be divided into three parts namely proximal loop, spiral loop and distal loop. The spiral loop is further divided into centripetal coils, central flexure and centrifugal coils.

Broad ligament of uertus : Broad ligament of uterus is attached to the flank about a hand's breadth ventral to the level of tuber coxae.

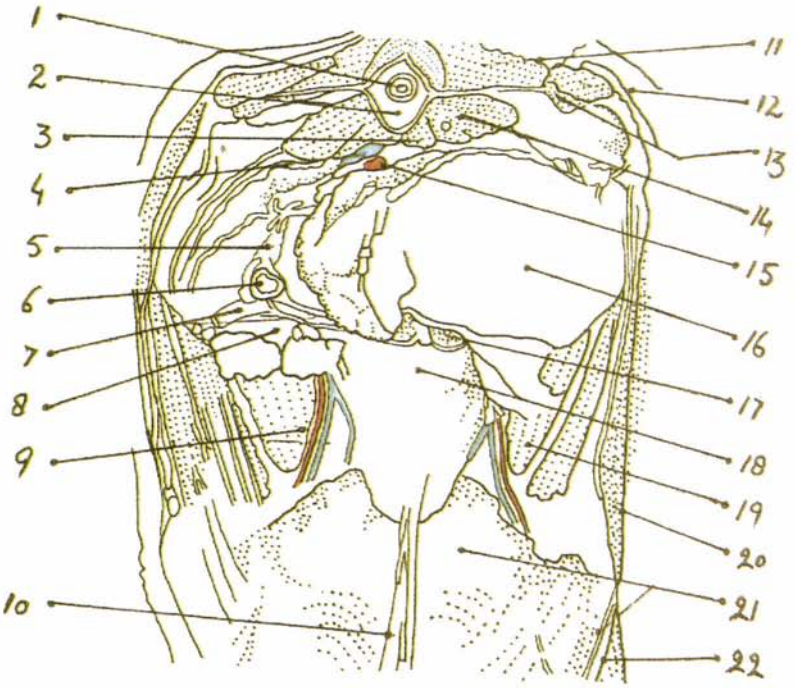

Fig. 7.5 : 1. spinal cord in vertebral canal; 2. lumbar vertebra V; 3. psoas minor muscle; 4. caudal vena cava; 5. mesocolon; 6. descending colon; 7. broad ligament of uterus; 8. cranial border of broad ligament; 9. caudal epigastric artery and vein; 10. median vesicular ligament; 11. longissimus lumborum muscle; 12. iliocostalis lumborum muscle; 13. quadratus lumborum muscle; 14. psoas major muscle; 15. abdominal aorta; 16. impression of rumen in adipose tissue; 17. uterus; 18. pubic brim; 19. obliquus internus abdominis muscle; 20. transversus abdominis muscle; 21. rectus abdominis muscle; 22. peritoneum and transverse fascia.

Cranial border of broad ligament: Cranial border of broad ligament of uterus attaches the uterus to the sublumbar region.

Middle ligament of bladder: It is a median triangular fold formed by the reflection of the peritoneum from the ventral half of the pelvis and abdomen.

Longissimus lumborum muscle: It occupies the angle formed by the spines and transverse processes of lumbar vertebrae. It remain covered by tendinous tissue throughout its entire length.

Iliocostalis lumborum muscle: It is a well developed muscle originating by tendinous fibres from iliac crest as well as from aponeurosis of longissimus lumborum muscle and the lumbar fascia. In the area of the third or fourth lumbar vertebra it emerges from beneath the thoracolumbar fascia to terminate tendinously at the caudal border of the last rib.

Quadratus lumborum muscle: it is flat bundle of muscles present on the ventral surface of the lumbar transverse processes. Dorsal to the muscle lie the heads of last three ribs

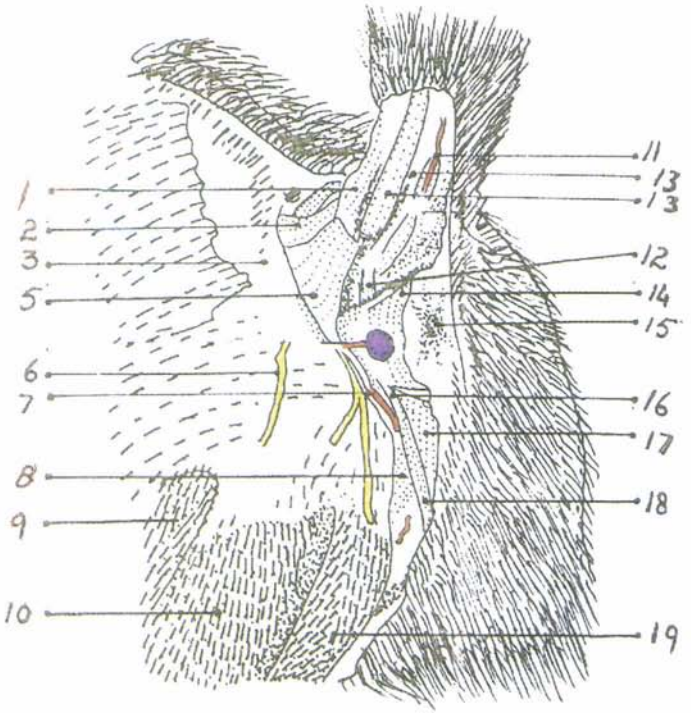

Fig. 7.6 :1. intertransversarii caudae muscle; 2. sacrocaudalis dorsalis lateralis muscle; 3. broad sacrotuberous ligament (caudal border); 4. coccygeus muscle; 5. caudal rectal artery; 6. pudehndal nerve (cutaneous branches); 7. ventral perineal artery; 8. ischiocavernosus muscle; 9. gluteobiceps muscle; 10. semitendinosus muscle; 11. median caudal artery; 12. retractor penis muscle (origin); 13. sacrocaudalis muscle (ventral medial and lateral parts); 14. sphincter ani externus muscle; 15. anus; 16. retractor penis muscle (pars rectalis); 17. bulbospongiosus muscle; 18. retractor penis muscle (pars penina); 19. semimembranosus muscle.

and ventrally the psoas major muscle is placed.

Abdominal aorta: This vessel courses left to the posterior vena cava and is in relation to thoracic duct and inner lumbar muscles dorsally. It gives dorsal branches to lumbar region and ventral branches to the visceral organs.

Transverse abdominis muscle: It is named from the general direction of its fibres. It can be seen as a muscular sheet on the deep face of the obliquus internus abdominis and the rectus abdominis muscles.

Peritoneum: It is thin serous membrane which lines the abdominal cavity and the pelvic cavity (in part) and covers its viscera to a greater or lesser extent. In the male it is a closed sac, but in the female it has two small openings, these are the abdominal orifices of the uterine or fallopian tubes, which at their ends communicate with the uterus, and so indirectly with the exterior. The free surface of the membrane is smooth and has glistening appearance. The outer surface is related to the slubserous tissue, which attaches it to the abdominal wall.

DISSECTION: The skin and fascia has been removed on left aspect of perineum, below the rest of the tail, to expose the median caudal artery, besides other structures in left caudolateral view. Fig. 7.6.

Intertransversarii caudae muscle: It lies just lateral to sacrocaudalis dorsalis meaialis muscle. It is a caudal continuation of longissimus dorsi muscle in caudal region.

Coccygeus muscle: This muscle lies between broad sacrotuberal ligament and the rectum. It extends from medial side of ischiatic spine to transverse processes of first three coccygeal vertebrae.

Caudal rectal artery: The dorsal perineal artery continues as caudal labial artery between constrictor vulvae, and retractor clitoris muscles and supplies the perineal region and mammary gland. During its course it gives off caudal rectal artery supplying sphincter ani muscle, caudal segment and tail fold.

Pudendal nerves (cutaneous proximalis and caudalis branches): Near the leser is ischiatic foramen the pudendal nerve

gives proximal and distal cutaneous branches. Proximal branch arises just cranial to cranial border of coccygeus muscle and distal branch arise just distal to the proximal branch. These supply skin over the semitendinosus and semimembranosus muscles respectively.

Ventral perineal artery: In females, the internal pudendal artery after furnishing vagina, vestibule ad major vestibular gland gives off ventral perineal artery at ischiatic arch supplying cutaneous branches to perineal region lateral and ventral to mammary gland and vulva.

Ischiocavernosus muscle: It is a thick muscle, convered by aponeurotic fascia, and extends from the medial surface of the ischiatic tuber (or from medial part of ischiatic arch in female) to the body of penis, covering the crus of penis (or to the crus of the clitoris in female).

Gluteobiceps muscle: It lies superficial to gluteus medius and is an expansive muscle on lateral aspect of hip and thigh extending upto the patella and cranial border of tibia.

Semitendinosus muscle: It is long fleshy muscle placed on candolateral aspect of rump between gluteobiceps and semimembranosus muscles.

Sacrocaudalis muscle (ventral, medial and lateral parts): It lies on lateral aspect of sacrum, and coccygeal vertebrae. Lateral part is larger arising from lateral surface of sacrum at third sacral foramen. Medial muscle arises medial to lateral part and inserts alongwith the lattar ventrally on transverse processes of caudal vertebrae.

Retractor penis muscle (origin): It is composed of smooth muscle fibres. It originates from second and third or third and fourth caudal vertebrae. It passes around the lateral surface of rectum, covered by the terminal part of the levator ani. It is thin and flat and is applied to the lateral surface of the penis at the second caudally convex sigmoid flexor.

Sphincter ani externus muscle: This sphincter muscle surrounds the anus. Its superficial fibers which are attached to the skin

are radial. In female these fibres cross ventral to anus and contine into opposite labium as constrictor vulvae.

Retractor penis muscle (pars rectalis): It passes around the lateral surface of rectum. Its strands join the fibres of longitudinal muscle of rectum sphincter of anus and levator ani muscles.

Retractor penis muscle (pars penina): Fibres run from root of origin to the second curve within a fascial band.

Bulbosongeosus muscle: It covers the bulb of the penis, beginning at the bulbourethral gland and ending near the junction of the crura of the penis. It tapers to a point distally and is covered, by dense fascia. A median raphe divides the muscle, except at the ends.

Semimembranosus muscle: It is a long thick, fleshy muscle which lies on the caudal aspect of rump arising from the area about the ischiatic tuber and coursing distally to insert the medial surface of the stifle.

DISSECTION: The gluteobiceps and middle gluteal muscles are dissected and removed from their origin. The structures that lie superficial to the borad sacrotuberous ligament, and the lateral half of the pelvis are revealed in left lateral view. Fig. 7.7.

Gulteus medius muscle: It is a thick fleshy muscle, largely filling the space between coxal tuber and the greater trochanter. It is composed of a large superficial head known commonly as the gluteus medius and a deep smalled head, the gluteus accessories.

Lumbar nerves V and VI (cutanei lateralis dorsalis branches, clunium cranialis): The dorsal branches of fifth and sixth lumbar nerves extend caudally and reach the gluteal region, innervate the cutaneous area of the pelvic limb. The sensory components of dorsal branches extend over the iliac crest to gluteal region and are called cranial clunial nerves.

Gluteal lymph nodes: These are found at greater ischiatic notch and are present on broad sacrotuberal ligament underlying gluteobiceps muscle.

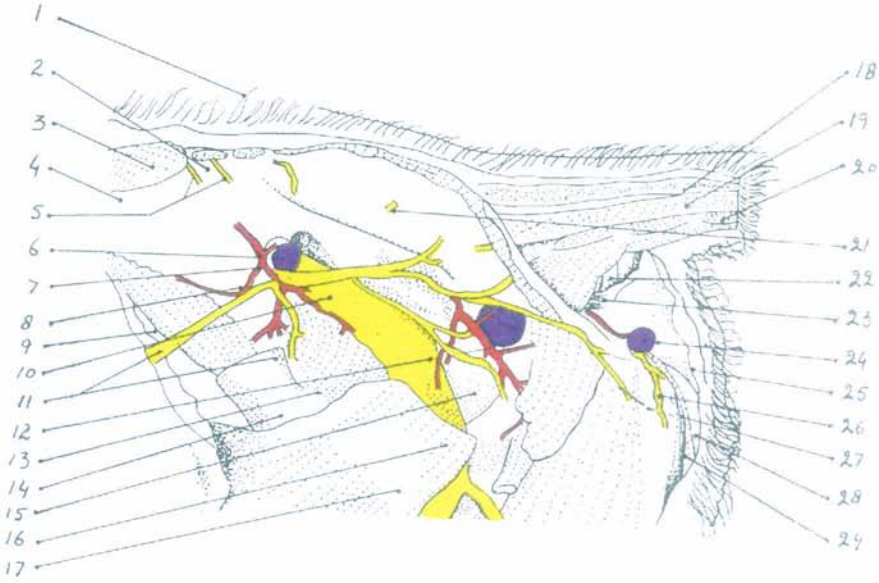

Fig. 7.7 : 1. gluteobiceps muscle (origin); 2. ilium (tuber sacrale); 3. gluteus medius muscle; 4. ilium (tuber coxae); 5. lumbar nerves V, VI (lateral dorsal cutaneous branches, cranial clunial nerves); 6. gluteal lymph nodes; 7 cranial gluteal artery; 8. caudal gluteal nerve; 9. iliacus muscle; 10. ischiatic nerve; 11. cranial gluteal nerve; 112. caudal gluteal artery; 13. gluteus profundus muscle; 14. gluteus accessorius muscle; 15. gemelli muscles; 16. gluteus medial muscle; 17. greater trochanter of femur; 18. sacrocaudalis dorsalis muscle (medial and lateral part); 19. sacrocaudalis dorsalis lateralis muscle; 20. intertransversarii caudae muscles; 21. sacral nerves I to III (lateral dorsal branches, middle clunial nerves); 22. retractor penis muscle; 23. levator ani muscle; 24. tuberalis lymph node; 25. ischiatic lymph node; 26. pudendal nerve (distal cutaneus branch); 27. pudendal nerve (proximal cutaneous branch); 28. bulbospongiosus muscle; 29. retractor penis muscle (part penina).

Cranial gluteal artery: It arises from the internal iliac artery on the medial surface of ilium. It ramifies in the gluteal muscle after curving laterally round the caudal border of ilium.

Gluteus caudalis nerve: It receives fibres from ventral branches of first and second sacral nerves. It courses caudally along the lateral surface of broad sacrotuberal ligament and deep gluteal muscle giving dorsal and ventral branches.

Ischiatic nerve: Ischiatic nerve derives its fibres from ventral branches of last lumbar and first and second sacral components of the lumbosacral plexus. It passes through greater ischiatic foramen and lies on the lateral surface of the broad sacrotuberal ligament. It gives fibres to semimbranosus, semitendinosus and gluteobiceps muscles.

Cranial gluteal nerve: It derives its fibres from ventral branches of sixth lumbar and first sacral nerves. It soon divides into branches supplying ilium and lateral gluteus muscle. It also supplies gluteus medius, gluteus profundus and tensor fascia lata muscles.

Caudal gluteal artery: This is one of the terminal branches of internal iliac artery. It arises near the lesser ischiatic notch. Its branches ramify in the ventral and lateral muscles of tail.

Gluteus profundus: It is fan shaped muscle placed in caudal aspect of hip joint. The base of the muscle is wide and insertion is on the neck of the femur.

Gluteus accessories muscle: It is the deeper part of gluteus medius muscle which is a strap like muscle between main portion of gluteus medius and deep gluteus muscles. It inserts by a strong tendon distal to greater trochanter of femur.

Gemelli muscle: It is a triangular muscle, having a fan shaped origin and a tendinous insertion. It extends from ventorlateral aspect of ischium to trochanteric fossa of femur.

Sacrocaudalis dorsalis medialis muscle: It lies on the dorsal medial aspect of tail and is continuous with multifidus muscle.

Sacrocaudalis dorsalis lateralis muscle: It lies immediately lateral to sacorcaudalis dorsalis medialis muscle. It is a caudal

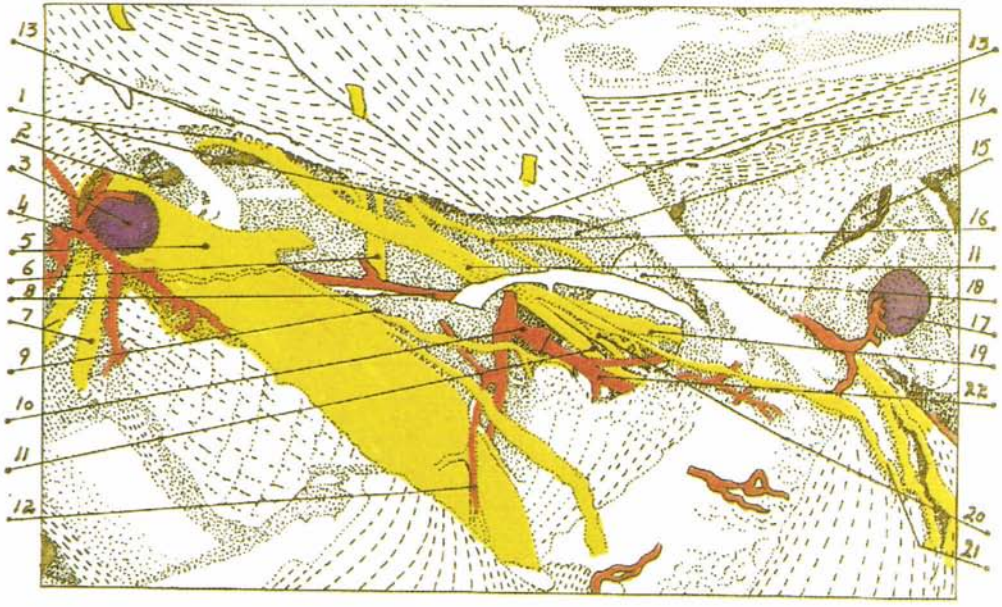

Fig. 7.8 : 1. sacral nerves II to IV 2. greater ischiatic foramen; 3. ischiatic lymph node; 4. cranial gluteal artery; 5.ischiatic nerve; 6. pelvinus nerve; 7. cranial gluteal nerve; 8. interal iliac artery; 9. caudal cutaneous femoral nerve; 10. caudal guteal artery; 11. pudendal nerve; 12. ischiatic nerve (arterial supply); 13. sacrotuberous ligament; 14.rectum; 15. retractor penis muscle (origin); 16. caudal rectal nerve; 17. tuberal lymph node; 18. lesser ischiatic foramen; 19. pudendal nerve (distal cutaneous branch); 20. deep perineal nerve; 21.pudendal nerve (proximal cutaneous branch); 21. internal pudendal artery.

continuation of longissimus dorsi muscle.

Intertransversarii ventralis lateralis muscle: It is present on ventral aspect of sacrum and arises from lateral aspect of vental part of sacrum at third pelvic foramen. It terminates ventrally on transverse processes of cocceygeal vertebrae.

Sacral nerve I-III (lateralis dorsalis branches, clunium medii nerves): Dorsal branches emerge through the dorsal sacral foramina. Dorsalateral branches of first to third sacral nerves innervate the middle part of gluteal region by their cutaneous branches and therefore are called the middle clunial nerve.

Levator ani muscle: It is a thin band like muscle, arising from medial side of ischiatic spine near lesser ischiatic foramen. Its fibres course dorsoventrally on the lateral surface of the rectum.

Tuberalis lymph node: It is placed subcutaneously medial to ischiatic tuberosity and medial to insertion of broad sacrotuberal ligament.

Ischiatic lymph nodes: These lie on the lateral surface of the broad sacrotuberal ligament in front of the caudal border and above the leser ischiatic notch.

Ischiatic lymph nodes: These lie on the lateral surface of the braod sacrotuberal ligament in front of the caudal boder and above the lesser ischiatic notch.

Ischiatic origin of gluteobiceps muscle: It is an expansive muscle situated on the lateral aspect of hip and thigh. It originates from ischiatic tuber, sacral spines, sacrosciatic ligament and gluteal fascia.

DISSECTION: The broad sacrotuberous ligament has been dissected and removed. The ischiatic lymph node has also been removed. It reveals the course of branches of the third and fourth sacral nerves and the internal pudendal artery. Their course is also displayed at lesser ischiatic foramen. Fig. 7.8.

Greater ischiatic foramen: Cranial border of the broad sacrotuberal ligament completes the greater ischiatic foramen.

Greater ischiatic notch is formed by medial border of ilium.

Pelvinus nerve: It receives branches from dorsal branches of third sacral nerve with fibres from second and fourth sacral nerves.

Caudal cutaneous femoral nerve: It is a small nerve of the caudal region of the thigh. Its origin is from dorsal border of ischiatic nerve. It courses caudad on lateral surface of broad sacrotuberal ligament i.e. on the origin of deep gluteus muscle.

Pudendal nerve: At its origin it courses caudoventrally and is medial to borad sacrotuberal ligament dorsal to internal iliac artery and from its medial side it gives a large pelivic nerve. It supplies the coccygeus and levator ani muscles.

Artery supplying ischiaticus nerve: It is the terminal branch of internal iliac artery. It arises at leser ischiatic notch and traverses to ischiatic nerve.

Lesser is ischiatic foramen: Lateral border of the ischium is thick, rounded and concave in length forming the lesser ischiatic notch. In living condition this notch forms foramen with broad sacrotuberal ligament.

Deep perineal nerve: It is given off from pudendal nerve just distal to the caudal border of lesser ischiatic foramen. It is joint by medial branch of caudal cutaneous femoral nerve and supplies to coccygeus, levator ani, bulbospongiosus, ischiocavernosus, sphincter ani and urethralis muscle.

Internal pudendal artery: Arises from internal iliac artery as a second terminal branch. It the caudal part of pelvic cavity it gives rise to urethralis artery. It ends at the pelvic exit into perineal ventral artery of penis or clitoris.

Sacral nerves (second to fourth): They arise from conus medullaris and divide within the vertebral canal into dorsal and ventral branches which emerge through the foramina caudal to corresponding vertebrae. The dorsal branches are slender and divide into medial muscular and lateral cutaneous branches. The dorsolateral branches of the first to third sacral nerves innervate the middle part of the gluteal region and are therefore,

called the middle clunial nerves. The corresponding (dorsolateral) branches of fourth and fifth sacral nerves innervate the base of tail including the tail region. The ventral branches of first two or three nerves contribute to the formation of lumbosacral plexus. The ventral branches of remainging sacral nerves constitute mainly the pudendal, perineal and caudal rectal nerves.

DISSECTION: The skin has been incised and removed from right and left sides of perineal region. The superficial and deep fascia on left side of perineum has been removed. The dissection shows the depth within the perineum of the retractor peins muscle and the penile body (including the sigmoid flexure). The following superficial structures of perineal and scrotal regions are revealed in right caudolateral view. Fig. 7.9.

Cod fat: It is a thick layer of adipose tissue lining the scrotum.

Testis and epididymis enclosed in tunica vaginalis of vaginal process: Testicle is covered by serous membrane which is the visceral layer of tunica vaginalis. This layer of vaginal tunic also covers the epididymis.

Retractor penis (pars panina): This part of muscle runs along the ventral surface of the penis, to which it is loosely attached. Near the glans it splits into bundles which pass through the bulbospongiosus muscle and are attached to tunica albuginea.

Dartos fascia: This fascia is apparently derived form obliquus abdominis muscle.

Dartos septum: Dartos is closely adherent to skin, consists of fibroelastic tissue and smooth muscle. This forms the septum of the scrotum.

DISSECTION: The skin is incised and removed from perineal region. the parietal tunica vaginalis has been removed to display the testis and epidymis suspended within the cavity of the vaginal process. The contents of the vaginal process within the left side of the scrotum are revealed in caudal view. Fig. 7.10.

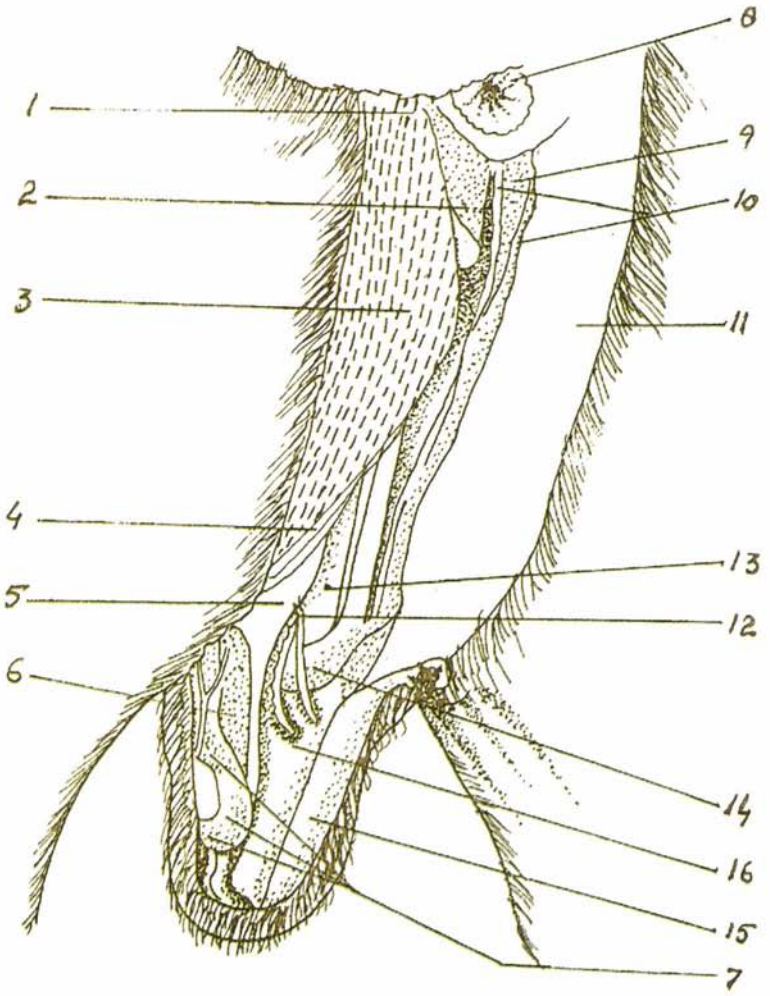

Fig. 7.9 : 1. ischiatic tuber (ventral tuberosity); 2. ischiocavernosus muscle; 3. semimembranosus muscle; 4. gracilis muscle; 5. cod fat; 6. cremaster muscle; 7. tunica vaginalis (enclosing testis and epididymis); 8. anus; 9. bulbospongiosus muscle; 10. retractor penis muscle (pars penina); 11. adipose tissue in superficial fascia 12. medial suspensory lamina of mammary gland and scrotum; 13. penile body (distal bend of sigmoid flexure); 14. retractor penis muscle; 15. dartos fascia; 16. dartos septum.

Intact vaginal process containing spermatic cord: The peritoneal sac which surrounds the adult testis traces its origin to an evaggination of the peritoneum covering the genital ridge into the substance of the gubernaculums. The cavity thus formed is called the vaginal process.

Parietal tunica vaginalis (cut edge): It is fibroserous sac which is continous with the parietal peritoneum of the abdomen at the deep inguinal ring. It is thin dorsally, but is thick in its scrotal part, where it is strengthened by fibrous tissue derived from the transverse fascia.

Head of epididymis: The head lies covered by tunica albugenia which is long curved over the dorsal extremity down the cranial border of testicle.

Radicals of left testicular vein (in tunica albugenia of testicle): Testicular vein runs alongwith the artery in the interal ring extremity down the cranial border of testicle.

Left testis: Long axis is vertical and has an elongated oval outline with the caudal border attached. The left testicle is larger and longer than right.

Branches of left testicular artery (in tunica albugenia): Testicular artery descends in the cranial part of spermatic cord and is very tortuous near the testicle. It is particularly embedded in tunica albugenia and detaches lateral braches which ascend and detaches lateral branches which ascend and descend in tortuous fashion to the surface of each testicle.

Tail of epididymis: It is large and is closely attached at the ventral extremity of the testicle by ligamentum epididymis. Tail of the epididymis is continued as vas deferens.

Cavity of vaginal process: it is flask like serous sac which extends through the inguinal canal to the bottom of the scrotum. It is the space between visceral and parietal layers and communicates with the peritoneal cavity through the vaginal ring.

Convolutions of testicular artery (embedded in pampiniform plexus of veins): It is a branch of abdominal aorta. It descends

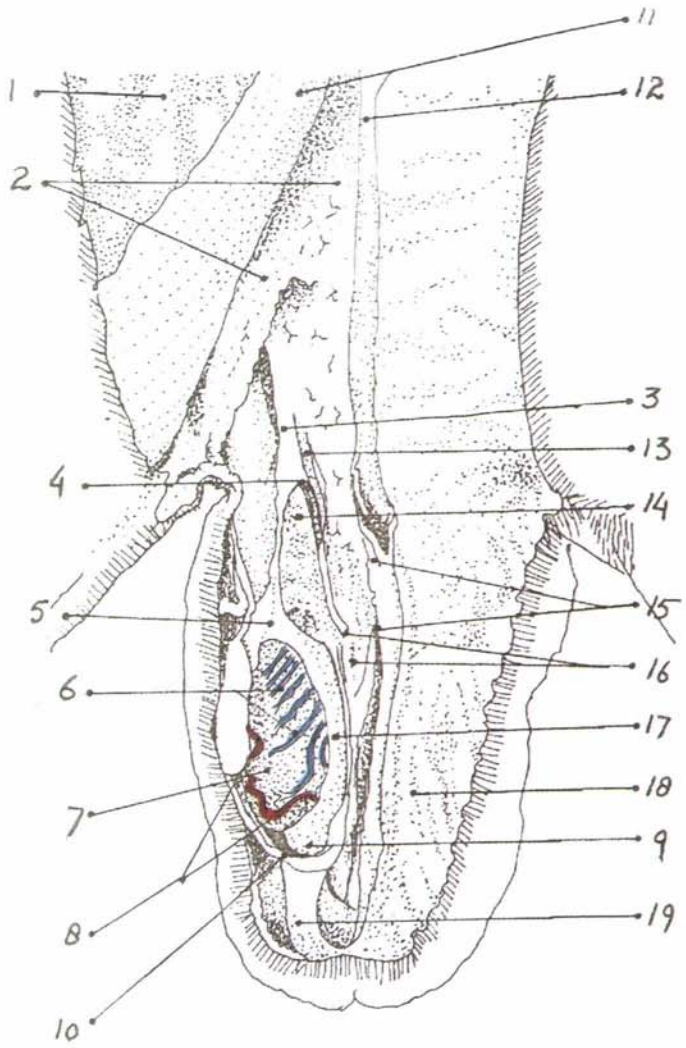

Fig. 7.10 :1. semimembranosus muscle; 2. cod fat (surrounding neck of scrotum); 3. vaginal process (containing spermatic cord); 4. tunica vaginalis (parietal layer); 5. epididymis (head); 6. left testicular vein (in tunica albuginea); 7. left testis; 8. left testicular artery (in tunica albuginea); 9. epididymis (tail); 10. vaginal process (cavity); 11. gracilis muscle; 12. retractor penis muscle; 13. cremaster muscle; 14. testicular artery (embed in pampiniform venous plexus); 15. medial suspensory lamina; 16. mesorchium; 17. epididymis (body); 18. dartose fascia; 19. tunica vaginalis joined to dartos at apex of scrotum.

in the cranial part of the spermatic cord and is very tortuous near the testicle. The veins on leaving the testicle form pampiniform plexus around the artery in the spermatic cord.

Mesorchium: The support of the testis from the abdominal roof is called the mesorchium.

Epididymis (body): Body of epididymis is narrow and lies on the lateral part of caudal border of a testicle to which it is attached by a narrow serous fold.

DISSECTION: The left hind limbs have been removed. The skin of the udder has been dissected and reflected downwards. The superficial and deep fascia of udder is exposed, besides, other structures are also revealed.

Fig. 7.11.

Lumbales I, II nerves (medial cutaneous branches): The ventral branches of first and second lumbar nerves emerge through the respective intervertebral foramina and pass laterally between the intertransversarii lumborum muscles dorsally and psoas muscle ventrally to continue deep to the craniolateral border of the transverse processes caudal to them. Close to their emergence they give branches to the psoas and the quadratus lumborum muscles. The second lumbar nerve may supply a branch to gluteofemoral nerve or its cranial branch. On the surface of peritoneum these divide into lateral and medial branches. After their course between the muscles the lateral branches end in the skin Of the lateral abdominal wall, while the medial branches end in the skin of the ventral abdominal wall. These branches, together with the thirteenth thoracic, are collectively known as cranial preputial nerves.

Left cranial teat: Each teat has a single lactiferous duct which becomes wide dorasally into a sinus called milk cistern. The teat opens by a narrow outlet closed by a sphincter of smooth muscles and elastic tissue.

Iliacus muscle: It is a rounded muscle on the ventrolateral surface of the ilium and the fibres run parallel to ilium. Alongwith psoas muscle it forms iliopsoas with which it is closely adherent.

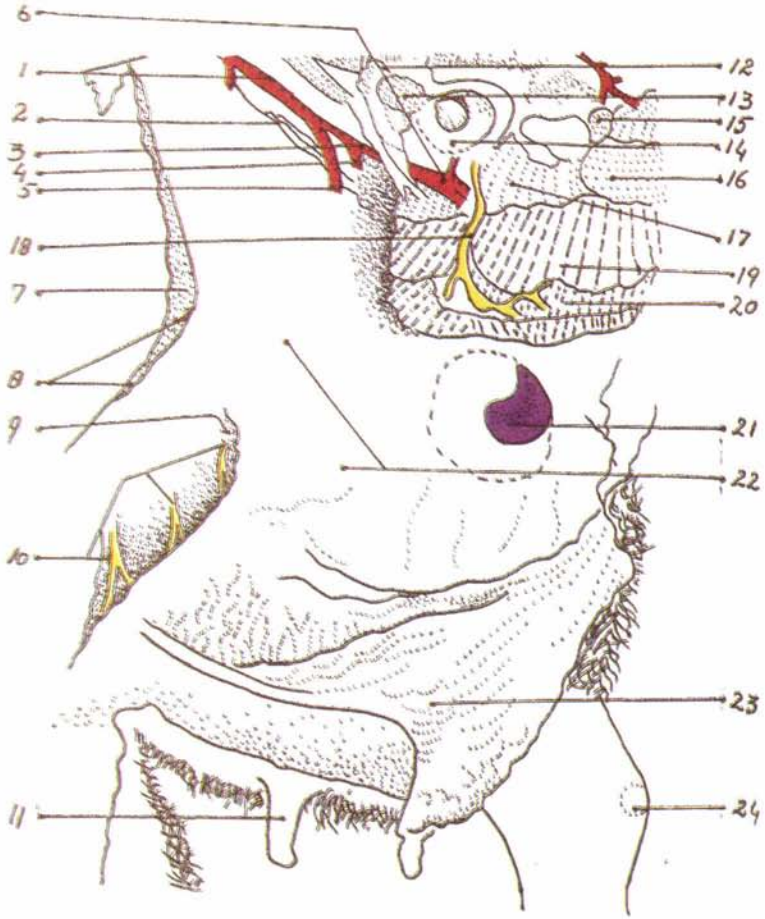

Fig 7.11 : 1. external iliac artery; 2. genitofemoral nerve (lumbar III and IV); 3. deep femoral artery; 4. pudenoepgastric trunk; 5. femoral artery; 6. medial circumflex femoral artery; 7. obliquus internus abdominis muscle; 8. obliquus externus abdominis muscle; 9. yellow abdominal tunic; 10. lumbales nerves I and II (ventral medial cutaneous branches); 11. left cranial teat; 12. iliacus muscle; 13. rectus femoris muscle; 14. acetabulum; 15. femoris muscle; 16. semimembranosus muscle; 17. obturatorius externus muscle; 18. obturator nerve; 19. abductor muscle; 20. gracilis muscle; 21. superficial inguinal lymph nodes; 22. lateral suspensory lamina; 23. superficial fascia of udder; 24. right calcaneus (tuberosity).

Rectus femoris muscle: It is the part of quadriceps femoris muscle and is fusiform and rounded in shape. It originates from the two depressions on the body of the ilium and inserts on the base and cranial surface of the patella.

Biceps femoris muscle: It lies caudal to and in part upon the gluteus superficialis and medius. It extends in a curved direction from the sacral and caudal spines to the lateral surface of the stifle and leg.

Adductor muscle: It is a thick fleshy muscle found crossing the midline of the thigh to insert on the medial aspect. It has a loose attachment with semimembranosus muscle caudally.

Pectineus muscle: It is a fleshy and a large muscle which is triangular in shape. At the origin it is single but has two insertions. It passes the proximal surface of vastus medialis on the medial aspect of thigh.

Gracilis muscle: It is a broad flat muscle, lying superficially on the caudal portion of the medial aspect of the thigh.

DISSECTION: The skin is removed carefully from anterior to posterior side of udder. The subcutaneous abdominis vein or "milk vein" pierces the oblique and straight abdominal muscles. The xiphoid cartilage, transverse fascia and transverse abdominal muscle are also removed from left side. The left "milk well" and the structures traversing it are revealed in left dorsolateral view. Fig. 7.12.

Xiphoid cartilage (sternum): This constitutes the caudal extremity of the sternum which is formed of thin cartilaginous plate connected in front with the last bony segment. Its dorsal surface is concave and gives attachment to the diaphragm.

Linea alba (mid line, white raphe): It consists of white fibrous tissue extending from xiphoid cartilage to the prepublic tendon. It is formed due to tendinous insertions of oblique and transverse muscles of abdomen. The umbilicus is slightly caudal to the middle of the linea alba.

Subcutaneous abdominis vein at milk well: It is also know as

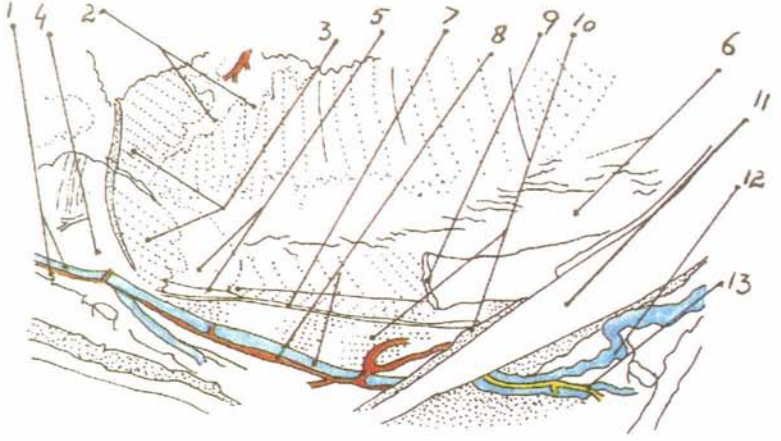

Fig. 7.12 : 1. internal thoracic artery and vein; 2. costal arch; 3. diaphragm; 4. transversus thoracic muscle; 5. sternum (xiphoid cartilage); 6. peritoneum; 7. transversus abdominis muscle; 8. cranial epigastric artery and vein; 9. linea alba; 10. rectus abdominis muscle; 11. obliquus externus abdominis muscle; 12. subcutaneous abdominal vein (at milk well); 13. thoracic nerve x (ventral cutaneous branch).

milk vein or cranial epigastric superficial vein. It arises from circulus venosus mammae, carries blood in a cranial direction and clearly bulges the abdominal skin. It passes through the abdominal wall between xiphoid cartilage and the eight costal cartilage to discharge into cranial vena cava by way of the internal thoracic and subclavian veins. Its point of penetration can be palpated with the finger and is known as the milk well.

N.B. i) The size of this aperture is sometimes considered an indication of the potential for milk production. About four hundred litres of blood must flow through the udder to produce a litres of milk.

ii) At the time of emergency the milk vein can be used for intravenous injection.

DISSECTION: The skin on the cranial side and over the udder is removed. The pelvic tendon of the external oblique abdominal muscle has been incised and the lateral suspensory lamina of the udder is reflected ventrally. The superficial

inguinal (mammary) lymph nodes, in left lateral view are revealed. Fig. 7.13.

Iliofemoral lymph node (deep inguinal lymph node): It is present in the anterior aspect of external iliac artery before the point of origin of deep femoral artery.

Epigastricus lymph node: It is a small node of the caudal epigastric artery near the pectin of pubis on inner surface of rectus abdominis muscle.

Fig. 7.13 :1. external iliac artery; 2. iliofermoral lymph node; 3. pudendoepigastirc trunk; 4. epigastric lymph node; 5. lateral suspensory lamina (attachment); 6. obliquus externus abdominis muscle (pelvic tendon inserting on prepubic tendon); 7. external puendal artery and vein; 8. genitofemoral nerve (lumbar); 9. obliquus external abdominis muscle (insertion on linea alba); 10. external pudendal artery (basal caudal branch to lymph node); 11. rectus femoris muscle;12. uterus; 13. prepubic tendon; 14. symphysial tendon; 15. caudal labial and mammary vein; 16. vasa efferentia lymphatica (leaving hilus); 17. superficial inguinal lymph nodes; 18. mammary gland (parenchyma); 19. lateral suspensory ligament.

External pudendal artery (caudal basal branch): External pudendal artery continues as caudal mammary artery. It is large and divides at the base of mammary gland into two branches cranial and caudal. These supply the lymph nodes as well.

Uterus: It lies entirely in the abdominal cavity. Horns are more extensive than they appear. Free part of the horn curves first ventrally, then cranially and laterally. Then they turn caudally and dorsally forming spiral coils. Cervical canal of the uterus is spiral.

Caudal labial et mammary veins: These veins carry the blood from perineal region to the udder.

Superficial inguinal lymph nodes: -

i) Scrotal lymph nodes: They are two to four nodes, situated below the prepubic tendon lie in the mass of fat around the neck of scrotum. If only one node is present it lies dorsolateral to the penis at the level of pectin pubis immediately behind the spermatic cord and below the retractor penis muscles.

ii) Mammary lymph nodes: They are one to three nodes, situated more caudally than in males. They lie between the thighs and the posterior half of the base of the udder and the ventral wall of pelvis.

Mammary gland (parenchyma or gland substance): Parenchyma is pinkish grey in colour and of firmer consistency than the fat, which is found around and within the gland. It is enclosed by fibroelastic capsule which sends numerous trabeculae inwards forming interstitial tissue and divides the gland into lobes and lobules.

DISSECTION: The reflection of the pelvic tendon of the external abdominal muscle opens the inguinal canal. The dorsal border of the abdominal tendon becomes visible, and forms the medial rim of the superficial inguinal ring. The cranial rim of the deep ring, formed by the dorsocaudal border of the internal oblique muscle, also becomes visible. The inguinal canal and associated structures, in left lateral view are also revealed. Fig. 7.14.

Dorsocaudal border of obliquus internus abdominis muscle: The caudal border forms the cranial boundary or border of the deep inguinal ring. The dorsal border of the muscle usually forms a more or less distinct ridge bordering the paralumbar fossa.

Vasa efferentia lymphatica: These are lymph vessels which carry lymph away from the lymph nodes. They start at the terminal sinus of the nodes.

Genitofemoral nerve: It is always formed by the parts of ventral branches of second, third and fourth lumbar nerves. It continues in a caudoventral direction between psoas muscles in a plexiform manner supplying these and quadratus lumborum muscle. Finally, it divides into cranial and caudal branches. During their course caudally and ventrally these branches usually unite before arriving at the deep inguinal ring or they may remain separate and merely exchange fibres. In the former case the combined nerve divides again into cranial and caudal branches at the deep inguinal ring. The cranial branch supplies the cremaster muscle and then divides into two branches, one of them goes to the fold of the flank and the other is distributed to the cranial part of the udder and teat including its apex. The caudal branch gives one or two small branches to cranial mammary gland and to cremaster muscle. The main branch, however, passes to the caudal mammary gland. In the males the caudal branch of the genitofemoral nerve supplies the middle and caudal surfaces of the scrotum and sends cutaneous branches as far cranially as the preputial orifice.

Lateral suspensory laminae of udder: Arise from the symphysial tendon caudal to the udder. On reaching the abdominal floor they diverge and pass laterally to the superficial inguinal ring. They extend ventrally over the udder and divide into superficial and deep layers. The superficial layer attaches to the skin where it reflects off the udder to the medial face of thigh, while the deep layer is thicker and attaches to convex lateral surface of the udder by numerous lamellae which pass into the gland.

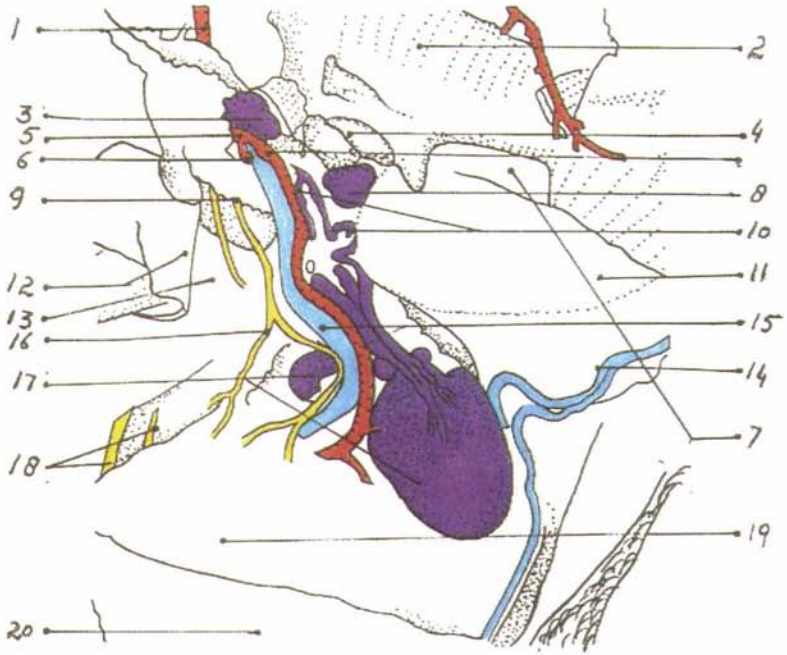

Fig. 7.14 : 1. external iliac artery; 2. ischium; 3. iliofemoral lymph node; 4. acetabulum; 5. pudendoepigastric trunk; 6. medial circumflex femoral artery; 7. obturator foramen; 8. epigastric lymph node; 9. obliquus internus abdominis muscle; 10. vasa efferntia lymphatica; 11. symphysial tendon; 12. pelvic tendon; 13. abdominal tendon; 14. caudal labial and mammary vein; 15. external pudends artery and vein; 16. genitofemoral nerve (lumbar III and IV); 17. superficial inguinal lymph nodes; 18. lumbar nerve II (medial ventral cutaneous branch); 19. mammary gland (parenchyma); 20. lateral suspensory lamina.

DISSECTION: The superficial inguinal lymph node on the left side has been dissected and removed from its attachment with that on the right side. The paths of dorsal venous trunks in the substance of the udder have been dissected. The three venous drainage routes, and the arteries are revealed in lateral view. Fig. 7.15.

Superficial'vein (draining venous plexus of left cranial teat): Venous blood is drained by external pudendal vein through superficial cranial epigastric vein Dorsal labial and mammary veins too drain blood from the surrounding regions.

Medial suspensory lamina (caudal edge): The medial part of suspensory lamina is well developed. It is median in position and is chiefly yellow elastic tissue. It is also called ligamentum suspensorium. The two glands are separated by this double septum which attaches to the medial flat surface of each gland.

Caudal mammary vein (dorsal labial): Dorsal labial and mammary vein runs caudodorsally over the ischiatic notch· into the internal pudendal vein that goes towards the pelvic cavity. In addition they drain the medial aspect of thigh adjacent to udder and the skin covering the caudal aspect of mammary gland.

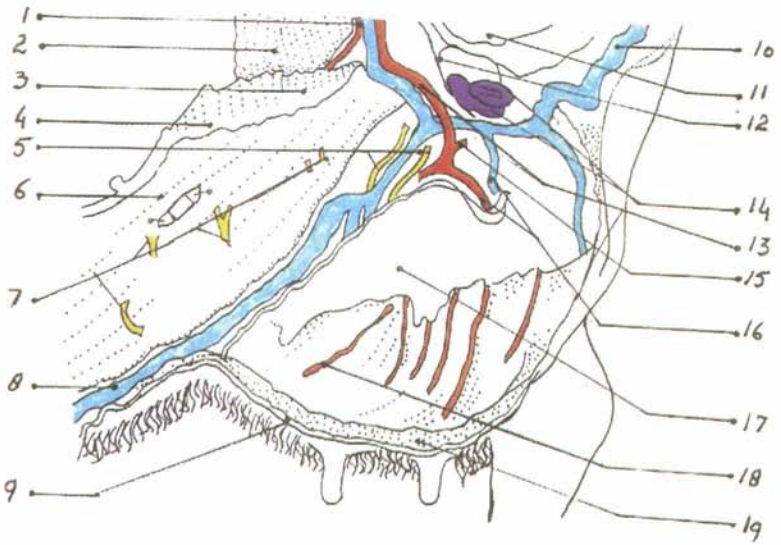

Fig. 7.15 :1. caudal epigastric artery; 2. right abdominal wall; 3. rectus abdominis muscle; 4. obliquus internus abdominis muscle; 5. genitofemoral nerve; 6. obliquus externus abdominis muscle; 7. spinal nerves (Th. XIII to L. II, ventral medial cutaneous branches); 8. subcutaneous abdominal vein (milk vein); 9. superficial vein (venous plexus of cranial teat); 10. caudal labial and mammary vein; 11. symphysial tendon; 12. medial suspensory lamina (caudal edge); 13. external pudendal artery and vein (in inguinal canal); 14. superficial inguinal lymph nodes; 15. external pudendal artery (caudal basal branch); 16. caudal mammary artery and vein; 17. udder (parenchyma); 18. lateral suspensor lamina lymph nodes (vasa afferentia lymphatica); 19. udder (superficial fasia).

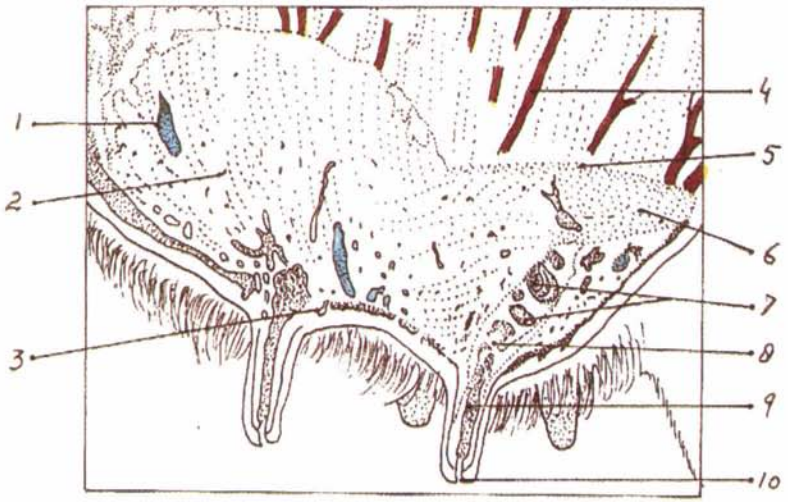

Fig. 7.16 : 1. cranial mammary vein (large tributary); 2. cranial quarter (glandular parenchyma); 3. teat (venous circule at the base); 4. vasa afferentia lymphatica; 5. lateral suspensory lamina; 6. caudal quarter (glandular parenchyma); 7. terminal collecting duct (orifice); 8. gland sinus; 9. teat sinus; 10. teat orifice.

Cranial mammary (caudal epigastric superficial) vein: In ruminants the superficial caudal epigastric vein is called the cranial mammary vein. In ruminants the superficial cranial and caudal epigastric veins are responsible for bulk of venous drainage from the udder.

Superficial fascia of udder: The superficial fascia of the udder is formed by the superficial abdominal fascia covering the inguinal region.

DISSECTION: An incision has been made through the axis of the teat slanting obliquely and laterally through the lateral part of the forequarter. The cut also passes through the parenchyma of hind quarter. A second cut is made which passes through the lateral part of the left hind quarter. The internal structure of the left half of the udder are revealed in lateral view. Fig. 7.16.

Glandular parenchyma of left cranial quarter: Cut surface of the mammary gland has granular appearance because its

glandular part is divlded by connective tissue into lobes and lobules.

Components of venous circle at base of teat: Blood passes through numerous thick walled teat veins i.e. papillary veins. These veins anastomose freely in the vascular layers of teat and join the circle of veins at the base of teat. This is called **Furstenberg's venous ring.** There are cranial and caudal veins also at the base of the udder.

Orifice of terminal collecting duct: Each teat opening is lined by stratified squamous epithelium which leads into a narrow canal. There is only one teat canal.

Gland sinus: The part of the milk sinus lying within the gland is called pars glandularis. It is continuous with the pars papillaris without a distinct demarcation. Numerous bays forming the glandular part of the sinus bulge into the parenchyma.

Teat sinus: Teat canal dilates proximally to form the milk. sinus which serves as collecting chambers for milk. This part of the teat is known as pars papillaris. There is only one sinus.

Teat orifice: The apex of the teat has only one teat orifice which is the opening of the lactiferous ducts.

DISSECTION: The lateral suspensory lamina has been partially removed to reveal the structures that traverse the inguinal canal, and those at the neck of the scrotum. Besides, other superficial structures are also observe in lateral view. Fig. 7.17.

Medial circumflex femoral artery (obturatorius branch):

It runs ventral to pelvic floor and gives rise to obturatorius branch which passes through obturator foramen supplying the obturator muscle in the pelvic cavity.

Obturatorius nerve: It is the continuation of the ventral branch of the fifth lumbar nerve together with the femoral. It courses caudoventrally under the peritoneum between the corresponding blood vessels to the cranial end of the obturator foramen and supplies obturatorius externus muscle, including its intrapelvic part.

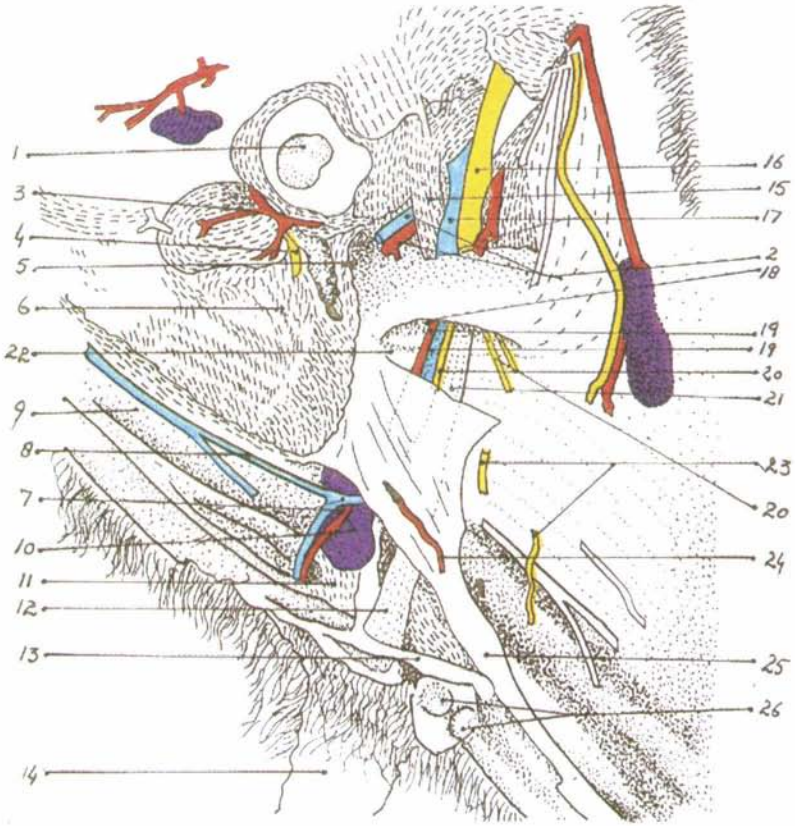

Fig. 7. 17: 1. acetabulum; 2. medial circumflex femoral artery and vein; 3. obturator branch of 2; 4. obturator nerve; 5. prepubic tendon; 6. symphysial tendon; 7. external pudendal artery and vein; 8. dorsal penile vein; 9. penile body; 10. superficial inguinal lymph node; 11. retractor peins muscle (distal bend of sigmoid flexure); 12. cremaster muscle (vaginal process); 13. lateral suspensory lamina; 14. scrotum; 15. sartorius muscle; 16. femoral nerve; 17. femoral artery and vein; 18. superficial inguinal ring (lateral rim); 19. external pudendal artery and vein; 20. genitofemoral nerve (lumbar III and IV, caudal and cranial branches); 21. cremaster muscle (vaginal process); 22. superficial inguinal ring (medial rim); 23. lumbalis nerve (ventral medial cutaneous branches); 24. superficial caudal epigastric artery; 25. preputialis caudalis muscle; 26. teats.

Dorsal penile vein: This is the second terminal branch of the internal pudendal vein. It courses to bulbi penis, profunda penis and dorsalis penis. Dorsal penile veins participate in the formation of the venous plexus.

Penile body: Body of the penis beyond the first sigmoid flexure becomes flattened.

Cremaster muscle: It may be regarded as a detached portion of the obliquus internus abdominis muscle which separates as a slip of fleshy tissue to enter the inguinal canal. It is well developed and almost completely encloses the vaginal tunic to the neck of scrotum.

Scrotum: It is ovoid and compressed from before backwards. It is long and pendulous, having a well marked neck in relaxed condition. Just cranial to scrotum are four rudimentary teats.

Sartorius muscle: It is strap like muscle coursing across the medial surface of the thigh to the stifle joint. Femoral vessels pass between its two origins. It has tendinous insertion.

Femoral nerve: It is the strongest nerve of the lumbar plexus formed mainly by the fifth lumbar nerve. At its emergence it supplies psoas and iliacus muscles. It terminates in the quadriceps femoris muscles.

Lateral rim of superficial inguinal ring: superficial inguinal ring has medial and lateral crura. The lateral angles are separated by a distance of 15 cms. which take a diverging course.

Caudal genitofemoral (L. III, IV nerve): it emerges through superficial inguinal ring and supplies mainly the caudal mammary gland. In males it supplies scrotum and preputial orifice.

Cranial genitofemoral (L. III. IV): It emerges along the cranial aspect of superficial inguinal ring or through the aponeurosis of obliquus externus abdominis and supplies cremaster muscle.

Medial rim of superficial inguinal ring: The medial angles are divided by prepubiic tendon at the sides of which they are palpable. The two medial rims form an apex of "V", with lateral

rim forming the open part.

Caudal epigastric superficial artery: This artery corresponds to the cranial mammary artery, dividing in the base of the udder.

Caudal preputial muscle (lateral part arising from lateral suspensory lamina): It is a modified cutaneous muscle present on dorsolateral side of the penis, caudal to preputial orifice. It is flattened out in the form of a fan. These fibres come to the median line to terminate there.

DISSECTION: The remaining part of lateral suspensory lamina has been reflected to reveal the superficial ring and its traversing structures. It reveals the fascia and vessels of the inguinal and scrotal regions in right lateral view. Fig. 7.18.

Dorsal penile artery: It is the branch of the penile artery which in turn is the branch of internal pudendal artery. Dorsal branch supplies the dorsum and courses towards the tip of the organ.

Penis (proximal bend of sigmoid flexure): It is "S" shaped curve just caudal to scrotum due to which about 30 cms of the penis is folded when retracted.

Retractor penis muscle: It attaches to penile fascia at distal bend of sigmoid flexure. It has two parts which arise on the roots of the penis and pass on the either side of ventral curve of sigmoid flexure. Retractor penis ends 12 to 15 cms caudal to glans.

External pudendal artery (scrotal branch ramifying in scrotal septum): External pudendal artery attains a superficial position in the inguinal region where it divides into caudal epigastric superficial artery running cranially and ventral scrotal which supplies the scrotum.

Lateral suspensory lamina (scrotal and mammary):

Lateral suspensory sheets arise from symphysial tendon caudal to udder and on the abdominal floor pass laterally to the superficial inguinal ring.

Teats: There are four **papilla mammae** or teat in udder. They are cylindrical, peg like appendages with rounded tips. The

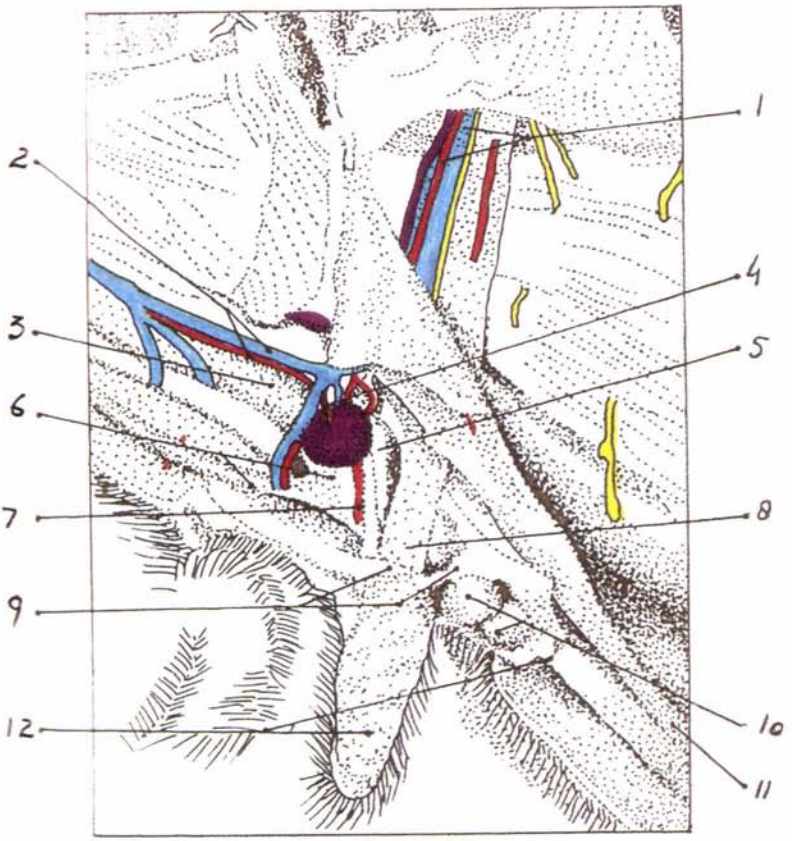

Fig. 7.18: 1. external pudendal artery and vein (at superficial inguinal ring); 2. dorsal penile artey and vein; 3. penis (proximal bend of sigmoid flexure); 4. superficial inguinal lymph node; 5. medial suspensory lamina; 6. retractor penis muscle (attachment at distal bend of sigmoid flexure); 7. external pudendal artery (scrotal branch); 8. cremaster muscle (vaginal process); 9. lateral suspensory lamina; 10. teats; 11. preputialis caudalis muscle; 12. dartos tunic.

long axis of teat often deviates in a craniolateral direction, especially when the cisterns are full of milk. The base or root of the teat is that region which contains the widest part of cistern. As a rule, it is found at the transition between the hair bearing skin of udder and the hairless skin of teat.

Caudal preputial muscle: It is a retractor of the prepuce. It

arises in the inguinal region and converge on the cranial part of prepuce. This muscle draws the prepuce caudally.

Dartos tunic: It is the second layer from without inwards forming the wall of the scrotum. It is reddish in colour and closely adherent to the skin except dorsally. It consists of fibroelastic tissue and smooth muscles. Along the raphe it forms a median partition, the septum of the scrotum, which divides the scrotum into two pouches. At the bottom of the scrotum, fibres connect the dartos closely with the vaginal tunic, constituting the scrotal ligament. Elsewhere the dartos is loosely connected with the underlying tunic by alveolar tissue.

SURGICAL ANATOMY FOR COMMON SURGICAL AFFECTIONS OF PELVIC REGION

EPIDURAL ANAESTHESIA

A) **Anatomical location:** There lies some space within the vertebral canal which surrounds the spinal cord and its enveloping membranes (spinal piamater, arachnoid, and dura mater). It is bounded internally by the dura mater (a continuation of the cranial dura mater). Externally, it is limited by vertebral bodies and arches, intervertebral discs, and associated ligaments. The periosteum of the vertebrae is a continuation of the outer layer of the cerebral dura and joins with the internal meningeal layer of the dura mater at the foramen magnum. The epidural space terminates at this point. The space contains spinal nerve roots, blood vessels, spinal membranes within which is the cord and associated spinal fluid, and fat and aerolar tissue in which the cord is suspended The dorsal sensory and ventral motor roots of the spinal nerves usually penetrate the dura separately and unite within the epidural space.

B) **Site for surgical approach:**

i) Between last sacral vertebra and first coccygeal vertebra.

i) Between first and second coccygeal vertebrae.

C) **Structures encountered:** skin, subcutis sacrococcygeus dor-

salis muscle, supraspinous ligament, interarcuate ligament, epidural fat, epineurim (connective tissue sheath) in continuation of dura medial caudal artery, caudal dorsolateral artery, caudal ventrolateral vein, median caudal vein, caudal ventrolateral vein, caudal dorsolateral vein, dorsoateral branch of fourth and fifth sacral nerves,

URETHROTOMY

A) **Anatomical location:** Male urethra consists of pelvic and extrapelvic spongiose parts. The pelvic part is small, of uniform lumen and about 12 cm long. The extra pelvic part is enlarged to form bulb of penis that is covered by thick tunica albuginea and encloses rich cavernosus tissue at its origin. The pelvic part has openings, ejaculatory orifices (opening of ductus deferens and seminal vesicle on seminal colliculus, pars disseminate of prostate and bulbourethral glands). The bulb of penis is the enlargement at the origin of penis.

B) Site for surgical approach:

i) Ischial urethrotomy: A skin incision. about 7-8 cm long, is made along the mid line and 2-3 cm below the ischial arch at perineal area ventral to the anus.

ii) Postscrotal urethrotomy A 10 cm long cutaneous incision is made about 5 cm behind the scrotum at the raphe.

C) Structures encountered:

i) skin, superficial and deep fascia, bulbocavernosus (accelerator . urinea), erector penis, retractor penis muscles, corpus cavernosum penis and urethra, dorsal and deep artery and vein of penis.

ii) skin, superficial and deep fascia, retractor penis, corpus cavernosum penis. corpus cavernosum urethra, dorsal and deep arteries and veins of penis, dorsal nerve of penis and sympathetic nerve fibres.

VASECTOMY

A) Anatomical location: Inguinal canal is an oblique space on

either side of prepublic tendon in the posterior part of the abdominal wall and directed ventrolaterally. They are two slit like openings, deep and superficial inguinal rings. The inguinal canal is the enclosed space between the muscular part of the obliquus abdominis internus anteriorly and aponeurotic part of obliquus abdominis externus posteriorly. The spermatic cord, cremaster muscle, tunica vaginalis, external pudendal vessels and genitofemoral nerve pass through the inguinal canal in males. The structures constituting the spermatic cord converge at the deep inguinal ring, pass through inguinal canal, emerge at superficial inguinal ring, cross the side of penis and at the neck of scrotum on dorsoventral part of testis.

B) **Site for surgical approach:** A 3-4 cm long incision is made above the neck of the scrotum cutting through the skin and subcutaneous tissue to expose the spermatic cord.

C) **Structures encountered:** skin, dartos (dervived from abdominal tunic), spermatic fascia (derived from obliquus abdominis externus), cremasteric fascia (derived from obliquus abdominis internus), infundibuliform fascia (derived from transverse abdominis), tunica vaginalis reflexa which lines the scrotum, tunica vaginalis propria which covers the spermatic cord and testicle, spermatic cord which contains anterior to posterior spermatic artery, spermatic vein, spermatic nerve, lymph vessels, ductus deferens, external cremaster muscle (posterior most which binds the blood vessels and nerves.

CASTRATION

A) **Anatomical location:** The scrotum is situated in front of the inguinal region. It is ovoid, but compressed from before backward. It is long, pendulous, and has well marked neck when scrotum is not contracted. The testicles have an elongated, oval out line. The long axis is vertical, the attached border being posterior. The medial surface is somewhat flattened.

B) **Site for surgical approach:** A 10-15 cm long incision is made

at the caudal and distal part of scrotum.

C) **Structures encountered:** skin, dartos, spermatic fascia, cremasteric fascia, infundibuliform fascia, tunica vaginalis reflexa (which lines the scrotum), tunica vaginalis propria (which covers spermatic cord and testicle), spermatic cord which contains anterior to posterior, spermatic artery, spermatic nerve, spermatic vein, lymph vesse!s, ductus deferens, posteriorly external cremaster muscle which binds the blood vessels and nerves.

INGUINAL HERNIA

A) **Anatomical location:** There may be a wide oblique passage from the abdomen into the scrotum - **scrotal hernia** through which bowel and omentum can pass with ease, or there may be only a small pocket in the peritoneum over the internal inguinal ring, which allows organs to pass into the canal but not through it **inguinal hernia.**

B) **Site for surgical approach:** It should be approached by an incision overlying the external inguinal ring. In the female this is best accomplished by an incision medial to the inguinal mammary tissue, whereas in the male incision should be over inguinal ring, and parallel to the fold of flank.

C) **Structures encountered:** skin, abdominal muscle, tunica vaginalis containing content of hernia, peritoneum, spermatic cord containing spermatic artery, vein, nerve and ductus deferens.

ARTERIA ANI

A) **Anatomical location:** In uncomplicated arteria ani, the anal outlet is closed while depression and sphincter are normally developed. However, in females communication between the rectum and vagina is present which produces rectovaginal fistula.

B) **Site for surgical approach:** A circular incision is made at the usual site of the anus and a skin disc of about 2-3 cm in diameter is removed.

C) **Structures encountered:** Skin, muscle, mucous membrane, internal pudendal artery and vein, caudal rectal artery, sympathetic nerves from caudal mesenteric plexus, caudal rectal nerves, deep perineal nerve.

OPERATION FOR PROLAPSE OF RECTUM

A) **Anatomical location:** It is terminal part of the bowel extending from the pelvic inlet to the anus. It consists of a cranial part largely covered by peritoneum, and a wider retroperitoneal part, the ampulla recti. External longitudinal fibres from the dorsal surface of rectum form the rectococcygeus muscle, attached to the second and third coccygeal vertebrae. The ventral longitudinal fibers decussate in the tendinous centre of the perineum. The terminal thickening of inner circular muscle forms the sphincter ani internus muscle.

B) **Site for surgical approach:** A transverse incision is made around the base of the prolapsed Part, 1.5 to 2 cm from the anus.

C) **Structures encountered:** The rectal wall is composed of mucosal, submucosal, inner circular muscle, outer longitudinal muscle and serosal advential layers. The external longitudinal fibres at the dorsal rectal wall constitute rectococcygeus muscle The ventrally located longitudinal fibres blend with perineal fascia and terminate in smooth muscle. The arterial supply to the rectal wall is from the rectal branches of internal iliac and internal pudendal arteries and the nerve supply from the rectal nerves coming from the third to fourth sacral spinal nerves. The venous blood drains into the internal pudendal vein. On account of prolapse, there is interference in drainage of blood and the vessels become prominent and congested.

AMPUTATION OF TAIL

A) **Anatomical location:** The structures which form the tail are skin, superficial caudal fascia, deep caudal fascia, sacrococcygeus dorsalis medialis muscle (on dorsomedial aspect of tail), sacrococcygeus dorsalis lateralis muscle (lat-

eral to sacrococcygeus dorsalis medialis muscle), intertransversalis caudae muscle (bundles between transverse processes) sacrococcygeus ventralis lateralis and sacrococcygeus ventralis medialis muscles (on ventral aspect of the sacral and caudal vertebrae), caudal vertebrae and intervertebral discs, ventrolateral and dorsolateral caudal vessels give blood supply. Nerve supply is by caudal spinal nerves.

B) **Site for surgical approach:** At the base of the appendage or at a point well above the seat of the lesion.

C) **Structures encountered:** As mentioned in anatomical location. Skin, superficial and deep fascia, sacrococcygeus dorsalis, lateralis and ventralis intertransversale, fibrocartilage disc between two, vertebrae, middle coccygeal artery and vein and lateral coccygeal artery and vein and caudal nerves.

“This Page is Left Intentionally Blank”

Index

D

E

F

M

N

O

P