

BASIC SCIENCES • ANATOMY

— STUDY NOTES

Veterinary Angiology Notes: How the Heart and Vessels Are Built (PDF)

Angiology is the anatomy of circulation — heart, blood vessels and lymphatics as one branch. These notes are the **plan**: the three coats a vessel wall is built from and where that plan stops, what separates an elastic from a muscular artery, what an anastomosis and an end artery cost the patient, how the heart is built as an organ, the two circulations and the portal route that breaks their rule, and the lymphatic half — lymphocentres and haemal nodes included.

INSIDE THESE NOTES

- 1 · The branch, and where it stops
- 2 · One plan, three coats
- 3 · Down the tree
- 4 · Two artery types, and four arrangements
- 5 · The heart as an organ
- 6 · Two circulations, and the exception
- 7 · Lymph: route, centres and the node that is not one

LEVEL

Vets & veterinary students

EDITION

2026-09-05

READ ONLINE

vet-ebooks.com/articles/veterinary-angiology-notes

Veterinary Angiology Notes: How the Heart and Vessels Are Built (PDF)

STUDY NOTES · BASIC SCIENCES · ANATOMY · UPDATED 2026-09-05

CONTENTS

- 1 1 · The branch, and where it stops
- 2 2 · One plan, three coats
- 3 3 · Down the tree
- 4 4 · Two artery types, and four arrangements
- 5 5 · The heart as an organ
- 6 6 · Two circulations, and the exception
- 7 7 · Lymph: route, centres and the node that is not one

LEARNING OBJECTIVES

After working through these notes you will be able to:

- ✓ **Name** the three coats of a vessel wall and say what each is made of.
- ✓ **Distinguish** an elastic artery from a muscular artery, and explain what each is for.
- ✓ **Explain** why an arteriole can close its lumen and an artery cannot.
- ✓ **Predict** the consequence of occluding an end artery versus an anastomosing one.
- ✓ **Locate** the heart by rib number in the dog, ox and horse.
- ✓ **Trace** lymph from a drainage area to a vein, and tell a haemal node from a lymph node.

TL;DR

Angiology is the anatomy of circulation — heart, blood vessels and lymphatics as one branch. These notes are the **plan**: the three coats a vessel wall is built from and where that plan stops, what separates an elastic from a muscular artery, what an anastomosis and an end artery cost the patient, how the heart is built as an organ, the two circulations and the portal route that breaks their rule, and the lymphatic half — lymphocentres and haemal nodes included.

AT A GLANCE

THE BRANCH	Heart + blood vessels + lymphatic vessels and organs
THE WALL PLAN	Tunica intima · tunica media · tunica externa
WHERE IT STOPS	The terminal circulation — arteriole, capillary, venule
TWO ARTERY TYPES	Elastic (stores the stroke) · muscular (distributes)
ONLY ONE CAN SHUT	The arteriole. No artery can occlude its own lumen
CAPILLARY	6–30 µm wide, 0.5–1.0 mm long, no coats
NO CAPILLARIES AT ALL	Cornea and hyaline cartilage
HEART WALL	Epicardium · myocardium · endocardium
BLOOD VOLUME	6–8% of bodyweight — but 4% in the cat
PORTAL VEIN	Runs between TWO capillary beds
LYMPH UNIT TO LEARN	The lymphocentre, not the individual node
HAEMAL NODE	No afferent or efferent lymph vessels. That is the test

01 1 • The branch, and where it stops

- **Angiology** = the organs of circulation of blood and lymph. Greek *angion*, a vessel.
- One branch, three parts: the **heart**, the **blood vessels**, the **lymphatic vessels and organs**.
- It is **structure**. The cardiac cycle, the action potential and blood-pressure control are physiology and sit elsewhere.
- Named regional arteries and veins belong to the species pages. What belongs here is the plan they all follow.

02 2 • One plan, three coats

COAT	MADE OF	DOES
Intima	Endothelium + subendothelial layer + internal elastic lamina	The only layer touching blood, and the only one a capillary keeps
Media	Elastic sheets, smooth muscle, or a mixture	Sets the calibre. This layer classifies the vessel
Externa	Collagen + elastic, helical; external elastic lamina	Takes the longitudinal pull; fixes the vessel into its surroundings

- The plan describes every vessel **except the terminal circulation** — and that exception is the point: exchange needs the shortest distance between blood and tissue.
- **Vasa vasorum** nourish a thick wall. They do not branch off the lumen they supply; they arrive from outside, from neighbouring arterial plexuses.

DOWN THE TREE

The coats thin out, then stop

The bar is wall thickness, not the width of the lumen.

-  **Elastic artery** — elastic sheets store the stroke
-  **Muscular artery** — smooth muscle; narrows, never shuts
-  **Arteriole** — one muscle layer; can close completely
-  **Capillary** — no coats: endothelium and pericytes
-  **Venule** — collects from the exchange bed
-  **Vein** — wide lumen, thin media, valves

Fig 1. Wall thickness and composition along the tree. Diagram — Vet-eBooks.com, drawn for this guide.

- Three coats hold from the aorta to the arteriole, and from the venule back.
- Across the exchange bed there are **none**: endothelium, basal membrane, pericytes.
- Capillary **6–30 µm** wide, **0.5–1.0 mm** long. **Cornea** and **hyaline cartilage** have none at all.
- Only an **arteriole** can shut its lumen. Only a **vein** carries valves.

4 • Two artery types, and four arrangements

	ELASTIC ARTERY	MUSCULAR ARTERY
Where	Aorta, its branches near the heart, pulmonary trunk	Everything further out
Media	Concentric elastic membranes	Smooth muscle in spiral layers
For	Expansion chamber — smooths the stroke	Distributes; adjusts calibre
Closes?	No	No

ARRANGEMENT	MEANS	COSTS OR SAVES
Anastomosis	Two arteries joining	A second route; a blockage need not kill the region
End artery	Only supply, no useful join	Occlusion = infarction
AV anastomosis	Arteriole straight to venule	Bridge type: temperature control in skin, pinna, nose
Portal system	Vein between two capillary beds	Gut blood is filtered by the liver first

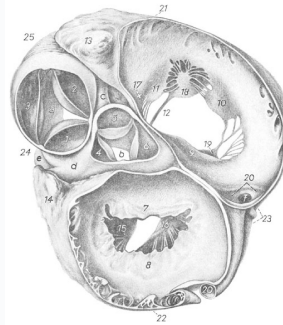


Fig 2. Base of the bovine heart: all four valves in one plane, with the coronary arteries leaving the aortic root. Image — Nickel, Schummer & Seiferle, *The Circulatory System*, Vol. 3. Reproduced for educational reference.

- Wall in three layers: **epicardium** (= the visceral serous pericardium), **myocardium**, **endocardium**.
- Right ventricle wall $\approx$ **half** the left's — lower work load. Its cavity has an **inflow route** and an **expulsion route**; trabeculae carneae in the first, absent from the second.
- Two **atrioventricular** valves, cusps tethered by chordae tendineae to papillary muscles. Two **semilunar** valves, untethered.
- The **coronary arteries** (*aa. coronariae*) leave the aorta just above its valve — the first branches of the systemic circuit. They run in the **coronary groove**, and their blood returns through the **coronary sinus** straight into the **right atrium**.

SPECIES	HEART LIES BETWEEN RIBS	LEFT OF MIDLINE
Dog	3rd (4th)–6th (7th)	4/7
Cat	4th–7th	—
Pig	3rd–6th	—
Ox	3rd–5th (6th)	5/7
Sheep, goat	2nd–5th	—
Horse	3rd (2nd)–6th	3/5

TWO CIRCUITS

A figure of eight, heart in the middle

SYSTEMIC — THE LARGER CIRCUIT

left ventricle → aorta → body capillaries →
venae cavae → right atrium

PULMONARY — THE SMALLER CIRCUIT

right ventricle → pulmonary trunk →
lung capillaries → pulmonary veins → left atrium

PORTAL — BETWEEN TWO CAPILLARY BEDS

gut capillaries → portal vein → liver capillaries →
hepatic veins → caudal vena cava

Fig 3. The two circuits, and the portal route between two capillary beds. Diagram — Vet-eBooks.com, drawn for this guide.

- **Systemic** (larger) and **pulmonary** (smaller), in series: a figure of eight with the heart in the middle.
- Blood volume **6–8%** of bodyweight — the **cat is 4%**. Circulation time **≈30 s** in a large animal, **≈7 s** in a cat.
- A **portal vein** runs between two capillary beds. Gut blood meets the liver before it meets anything else.
- Fetal shunts leave adult traces: **oval fossa** (foramen ovale) and **ligamentum arteriosum** (ductus arteriosus). The ductus closes because **its own tunica media contracts** at the first breath.

LYMPH

Learn the drainage area, not the nodes

A lymphocentre names the area, so it survives a species change.

ONE WAY ONLY — AND IT ENDS IN A VEIN

drainage area → vasa afferentia → node →
vasa efferentia → duct → vein

In primary lymph - out secondary: filtered, lymphocyte-rich

The by-pass. Afferents can skip the nearest node.

Fig 4. The lymph route, and what changes at the node. Diagram — Vet-eBooks.com, drawn for this guide.

- Two components: the **cellular** (lymphoreticular tissue) and the **vascular** (the lymph vessel system).
- A node is a **capsule**, a **cortex** with lymph **follicles**, and a **medulla**. Afferents enter at the surface, efferents leave at the **hilus**.

- Route: drainage area → **vasa afferentia** → regional node → **2–4 vasa efferentia** → further nodes → duct → vein.
- **Primary lymph** in, **secondary lymph** out — filtered and enriched with lymphocytes.
- Afferents can **by-pass** the nearest node; nodes are linked in parallel as well as in chains. The node that swells need not be the closest.
- **Lymphocentre** = the group at one site. Location is constant across species; number is not — one or two in dog and ruminants, many small ones in pig and horse.
- No absolute norm for node size: within a region, number and size vary **inversely**.

	LYMPH NODE	HAEMAL NODE
Lymph vessels	Afferent AND efferent — part of the lymph route	Neither. This is the test
Colour	Pale, grey, fawn	Bluish-red to brownish
Where	All species, in named groups	Chiefly ruminants, on the aorta and caudal vena cava
Trap	—	A lymph node that took up red cells after bleeding also looks red — but keeps its vessels

KEY TERMS — QUICK GLOSSARY

Tunica	A coat of a vessel wall. Three of them, named intima, media and externa.
Vasa vasorum	The small vessels supplying the wall of a large vessel.
Anastomosis	A join between two vessels, giving a region a second supply route.
End artery	A vessel with no useful collateral, so occluding it infarcts its territory.
Arteriovenous anastomosis	A direct arteriole-to-venule link that skips the capillary bed.
Portal system	A vein running between two capillary beds rather than back to the heart.
Chordae tendineae	Tendinous cords tethering an atrioventricular cusp to a papillary muscle.
Vasa afferentia / efferentia	The lymph vessels entering and leaving a lymph node.
Lymphocentre	The functionally analogous group of nodes at one site, named for its drainage area.
Haemal node	A dark red nodule, chiefly in ruminants, with NO afferent or efferent lymph vessels.

QUICK REVISION — REMEMBER THESE

- 1 Three coats: **intima** (endothelium + subendothelial layer + internal elastic lamina), **media** (elastic sheets and/or smooth muscle), **externa** (collagen and elastic, helical).
- 2 The plan excludes the **terminal circulation**. A capillary is endothelium, basal membrane and pericytes — nothing else.
- 3 **Elastic** artery = expansion chamber; **muscular** artery = distributor. The media decides which.
- 4 An **ordinary** artery narrows but does not close; the **arteriole** does, because its media is one muscle layer. **Throttle arteries** are the named exception.
- 5 **Vasa vasorum** feed a thick wall — and they arrive from OUTSIDE, not from the lumen they supply.
- 6 **End artery** = no useful collateral = infarction. Treat it as a spectrum, not a switch.
- 7 The heart wall is three layers too, and the **epicardium is the visceral serous pericardium**.
- 8 Right ventricle wall $\approx$ **half** the left's; its cavity has an inflow and an expulsion route.
- 9 Lymph: drainage area $\rightarrow$ vasa afferentia $\rightarrow$ node $\rightarrow$ 2–4 vasa efferentia $\rightarrow$ duct $\rightarrow$ vein.
- 10 Node **location** is constant across species; node **number** is not. Hence the lymphocentre.

MEMORY AIDS

I-M-E, inside out — Intima, Media, Externa — alphabetical from the lumen outwards.

Elastic stores, muscular sends — The aorta **stores** the stroke and gives it back; the named arteries **send** blood where it is needed.

Portal = two ports — A portal vein docks at **two** capillary beds. Every other vein docks at one and goes home.

TEST YOURSELF — ACTIVE RECALL

Cover the answers and try to retrieve each one from memory first — self-testing beats re-reading.

1. Name the three coats of a vessel wall from the lumen outwards, and the one group of vessels the plan does not describe.
2. What separates an elastic artery from a muscular one, and what is each for?
3. Which vessel can close its lumen completely, and what is the named exception among the arteries?
4. Give the capillary's dimensions and name two tissues that have none.
5. Where do the vasa vasorum come from?
6. What is an end artery, and why does the term need care?
7. Between which ribs does the heart lie in the dog, the ox and the horse?
8. Why do vets learn lymphocentres, and how do you tell a haemal node from a lymph node?

ANSWERS

1. Tunica intima, tunica media, tunica externa. It excludes the **terminal circulation** — arterioles, capillaries and venules — where the wall is reduced to endothelium, basal membrane and pericytes.
2. The media. **Elastic**: concentric elastic membranes; it is stretched by the stroke and recoils between strokes, smoothing the output. **Muscular**: smooth muscle in spiral layers; it distributes blood and adjusts its calibre.
3. The **arteriole** — its media is a single layer of muscle and its internal elastic lamina has broken into a network. An **ordinary** artery narrows but cannot occlude; the exception is a **throttle artery**, whose intimal cushions bulge in and close the lumen (skin, lung, erectile tissue).
4. 6–30 µm in diameter, 0.5–1.0 mm long. The **cornea** and **hyaline cartilage** have no capillaries at all.
5. Not from the lumen of the segment they supply. They arrive from outside as recurrent branches of neighbouring arterial plexuses and break up into capillaries inside the wall.
6. A vessel that is the only supply to its territory, so occlusion infarcts it. It needs care because it is a spectrum: most territories have some collateral, and the real question is how much, and how fast it would have to open.
7. Dog 3rd (4th)–6th (7th); ox 3rd–5th (6th); horse 3rd (2nd)–6th. More of it lies left of the median plane in every species — 4/7 dog, 5/7 ox, 3/5 horse.
8. Because node **location** is constant across species while node **number** is not (one or two in dog and ruminants; many small ones in pig and horse). A true lymph node has **afferent and efferent lymph vessels**; a haemal node has neither.

WHEN TO REFER OR ESCALATE

- An enlarged node that is **not** the one nearest the lesion — afferents by-pass, and nodes are linked in parallel as well as in series.
- A reddish node in a ruminant: decide whether it is a **haemal node** or a lymph node that has taken up red cells, by looking for afferent and efferent vessels.
- Judging a node as “enlarged”: there is **no absolute norm**, and within a region node number and node size vary inversely.
- A continuous murmur in a young animal: consider a **persistent ductus arteriosus**, a left-to-right shunt.
- Auscultating a domestic mammal: the left thoracic wall is the approach, and the triceps covers the field down to the 4th–5th intercostal space.

SOURCES

1. Nickel R, Schummer A, Seiferle E. *The Anatomy of the Domestic Animals, Vol. 3: The Circulatory System, the Skin and the Cutaneous Organs of the Domestic Mammals*. Verlag Paul Parey — the vessel-wall plan (pp. 7–13), the heart (pp. 19, 27), the lymphatic system (pp. 269, 281, 307).
2. König HE, Liebich H-G. *Veterinary Anatomy of Domestic Animals: Textbook and Colour Atlas*, 7th ed. Thieme — §1.5 and ch. 13 (pp. 53–56, 471, 493).
3. Sisson S, Grossman JD. *The Anatomy of the Domestic Animals*, Vol. I, 5th ed. — the classical Angiology chapter.
4. Dyce KM, Sack WO, Wensing CJG. *Textbook of Veterinary Anatomy*, 5th ed. Elsevier.
5. Constantinescu GM. *Illustrated Veterinary Anatomical Nomenclature*, 4th rev. ed. — the naming authority for the Latin used here.

MORE FREE STUDY NOTES & RESOURCES

More free veterinary study guides

This is one of a growing library of free veterinary study guides on vet-ebooks.com — built for students and practising vets, sourced from the standard veterinary texts, every one free with a downloadable PDF and no sign-up.

3,400+

VETERINARY BOOKS

400+

DRUG PROFILES (PAPICH)

Study notes

+ FREE PDF EACH

All free

NO SIGNUP NEEDED

RELATED ON VET-EBOOKS.COM

Veterinary Anatomy Notes: Illustrated Study Guide

— the branch map this page sits under.

The Cardiac Cycle in Veterinary Physiology

— what the structure on these pages actually does.

Blood Pressure Regulation

— why a muscular artery's media matters minute to minute.

Starling Forces and Oedema

— what crosses the capillary wall, and why lymph exists.

www.vet-ebooks.com

For educational use. Always confirm doses + clinical decisions against current authoritative texts and your own clinical judgment. © vet-ebooks.com — share freely, do not modify.