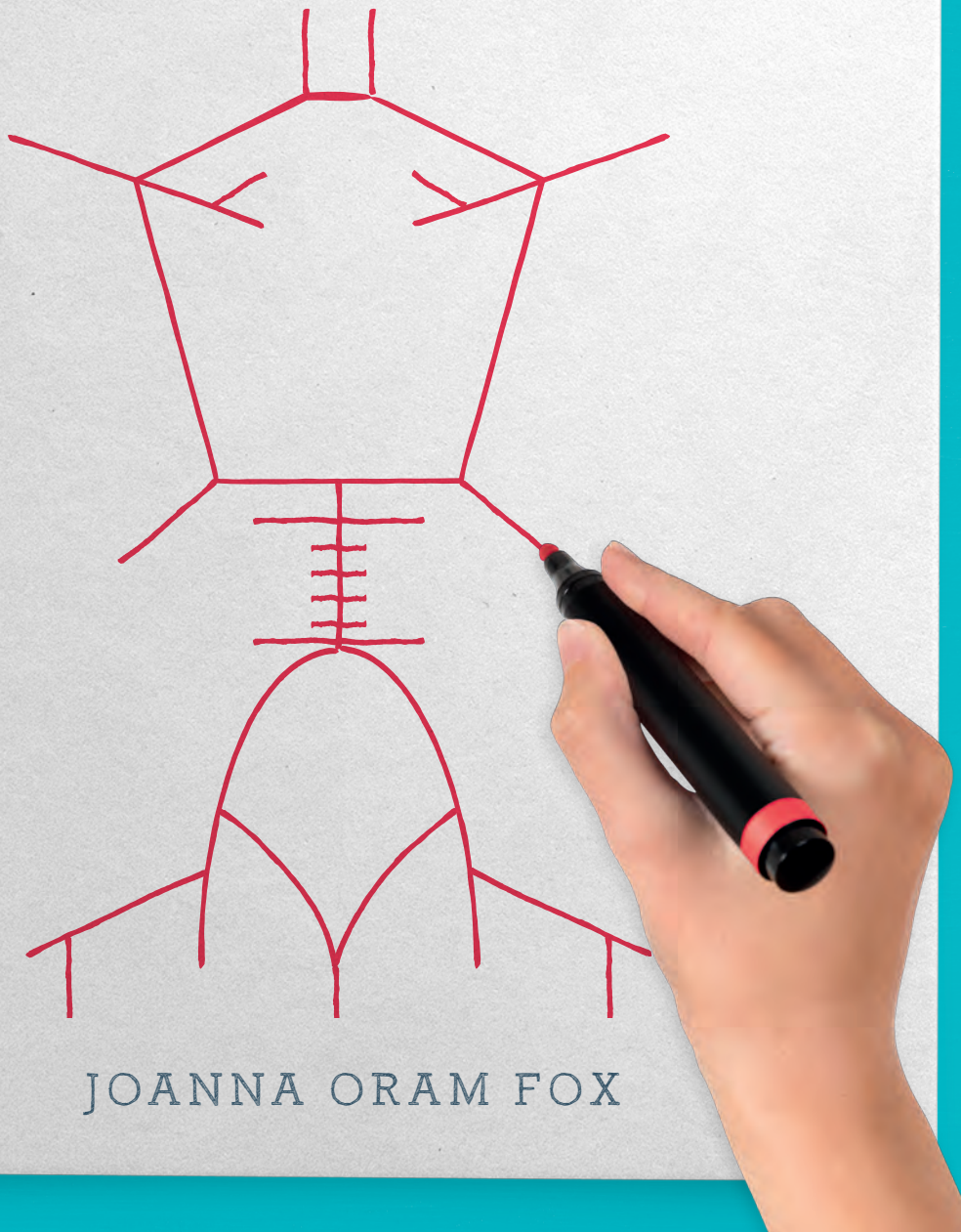
2ND EDITION

Quick Draw ANATOMY For Anaesthetists



JOANNA ORAM FOX

Quick Draw
ANATOMY
For Anaesthetists

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Quick Draw ANATOMY For Anaesthetists

2ND EDITION

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Scion

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Preface to the first edition

I have always found anatomy a tricky subject: it was my 'last minute' subject when revising for exams. During final FRCA preparation, both I and Kiran Singh-Kandola realised that drawing simplified diagrams helped us to label any anatomy image shown to us, and so it might help others too.

This idea stayed an idea for a long time. I then started teaching some of the diagrams to core trainees studying for the primary FRCA. They seemed enthused to have an easy way to learn anatomy, but there seemed to be no revision books which did this.

I developed the step-by-step approach to drawing the diagrams from the way I taught people to draw them. In the last few years I have added many more drawings/diagrams, with the aim of covering most of the syllabus for anatomy.

Many of the diagrams are done in a step-by-step 'how to draw' method. For some topics, such as the eye and the spleen, rather than step-by-step drawing, the salient points and general anatomy needed for the exams are covered.

The main idea of the book is to make anatomy simpler for you to learn. Lots of tips are included, some about how to draw and some to help you answer some common questions. The book should aid you in all primary and final FRCA exam revision.

Joanna Oram Fox
Cardiff

Acknowledgments

I would like to thank Kiran Singh-Kandola for being a great revision partner. From the inception of this idea, we designed simple diagrams to help us remember complicated anatomy. He was involved with the original drawings of the trigeminal nerve, cervical plexus, parts of the eye, epidural space, caudal anatomy, brachial plexus, cubital fossa, wrist, femoral canal and popliteal fossa.

About the author

Dr Joanna Oram Fox graduated in medicine from Cardiff University in 2007. She obtained certificates of clinical excellence in medicine, surgery and general practice and won the prestigious Willie Seager surgery prize.

Joanna worked four general years as a junior doctor covering medicine, surgery, obstetrics and gynaecology, paediatrics and emergency medicine. During this time she worked in Australia and developed an interest in anaesthetics.

Joanna completed anaesthetic training in 2018 with a specialist interest in advanced airway and regional anaesthesia. She then completed a post-CCT fellowship in the Royal Perth Hospital, Australia. During her time in Perth, she worked alongside the renowned Dr Andrew Heard in the wetlab, teaching 'Can't intubate, can't oxygenate' scenarios, both in Australia and Taiwan.

On her return to the UK Joanna worked for a time in Taunton and then returned to her home hospital and Trust, Cardiff and Vale. She is currently the regional anaesthesia lead for the department.

She recently published *Quick Draw Anatomy for Medical Students*, a more comprehensive anatomy book, but based around the same simple style of illustration.

Abbreviations

AFOI	awake fibreoptic intubation
ASIS	anterior superior iliac spine
CD	collecting duct
CF	cubital fossa
CN	cranial nerve
DCT	distal convoluted tubule
EJV	external jugular vein
FCR	flexor carpi radialis
FCU	flexor carpi ulnaris
FO	foramen ovale
FR	foramen rotundum
FRCA	Fellow of the Royal College of Anaesthetists
GFR	glomerular filtration rate
IJV	internal jugular vein
IMA	inferior mesenteric artery
IOP	intraocular pressure
IVC	inferior vena cava
LAD	left anterior descending
LMS	left main stem
MN	median nerve
PCT	proximal convoluted tubule
PL	palmaris longus
RA	radial artery
RBC	red blood cell
RMS	right main stem
SCM	sternocleidomastoid muscle
SLN	superior laryngeal nerve
SM	somatic motor
SMA	superior mesenteric artery
SOF	superior orbital fissure
SPG	sphenopalatine ganglion
SS	somatic sensory
SVC	superior vena cava
UA	ulnar artery
UN	ulnar nerve
VS	visceral sensory

How to use the book

For the anatomical sections that have step-by-step drawings, the idea is to learn how to draw each diagram quickly and efficiently.

At each stage the diagram follows conventional labelling:

- Green for nerves
- Blue for veins
- Red for arteries
- Black for structures

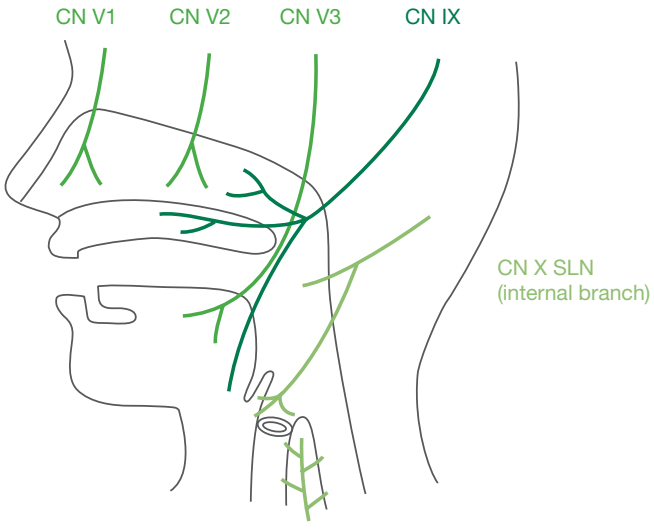
For subsequent steps the colours are shown as tints to allow you to easily see the new lines drawn in the next step.

Once you can draw diagrams without thinking (e.g. using the shape memos like ‘diamond’ for the popliteal fossa), then you should learn to label them.

Finally, you should learn to explain what you are drawing. For example, the brachial plexus can be drawn in less than 15 seconds. Then you explain it whilst drawing, which should take around a minute. This will give an excellent impression in viva or OSCE examinations.

Happy drawing!

4.1 Airway sensation



CN V trigeminal nerve
- **CN V1** – anterior ethmoidal nerve
- **CN V2** – sphenopalatine nerve
- **CN V3** – lingual nerve

CN IX glossopharyngeal nerve

CN X vagus nerve
- **CN X RLN** – recurrent laryngeal nerve
- **CN X SLN** – superior laryngeal nerve

To answer the question:

"Which nerves do you need to anaesthetise for an awake fibreoptic intubation (AFOI)?"

you need to know the diagram above.

Airway sensation is from cranial nerves V, IX and X.

TRIGEMINAL NERVE, CN V

- V1 branch: the anterior ethmoidal nerve; innervates the septum and nasal cavity.
- V2 branch: the sphenopalatine, greater and lesser palatine nerves. The greater palatine nerve innervates the gums and the mucous membrane of the hard palate. The lesser palatine nerve innervates the nasal cavity, the soft palate, the tonsils and the uvula.
- V3 branch: the lingual nerve; sensory innervation of the tongue.

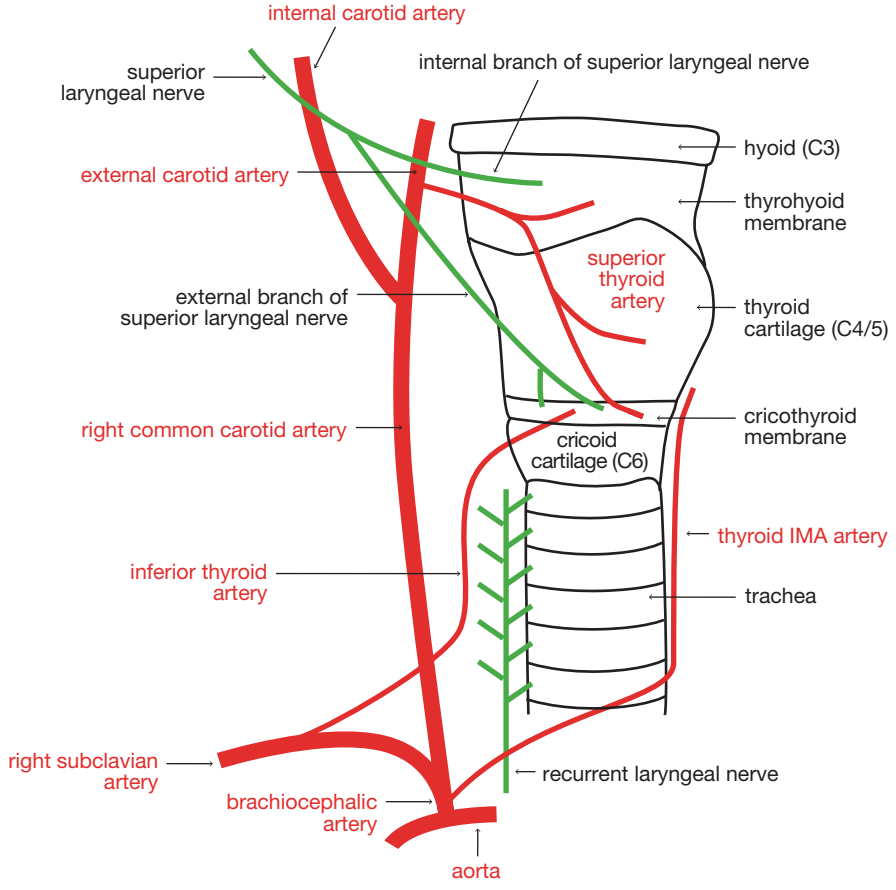
GLOSSOPHARYNGEAL NERVE, CN IX

- Sensory innervation to upper pharynx and posterior third of the tongue.

VAGUS NERVE, CN X

- Superior laryngeal nerve: sensory innervation to the lower pharynx, epiglottis, vallecula and piriform fossa.
- Recurrent laryngeal nerve: sensation to the vocal cord and subglottic mucosa.

4.2 Larynx

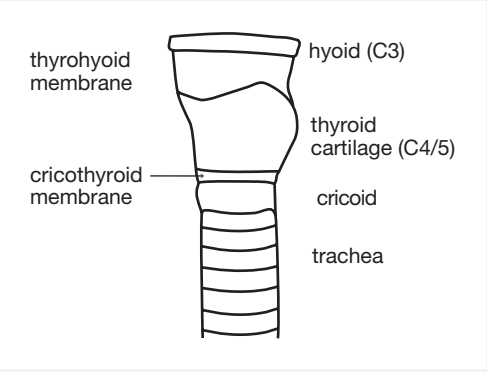

internal carotid artery
superior laryngeal nerve
internal branch of superior laryngeal nerve
hyoid (C3)
external carotid artery
thyrohyoid membrane
superior thyroid artery
external branch of superior laryngeal nerve
thyroid cartilage (C4/5)
right common carotid artery
cricothyroid membrane
cricoid cartilage (C6)
thyroid IMA artery
inferior thyroid artery
trachea
right subclavian artery
recurrent laryngeal nerve
brachiocephalic artery
aorta

How to draw

STEP 1

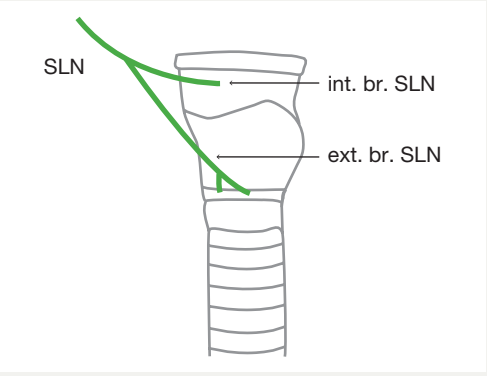
Draw the main structures in black pen.

- Start with the trachea, a rectangle shape with lines to represent the cartilage rings (c-shaped).
- Then add in the cricoid cartilage by drawing a trapezium above the trachea (see image). The cricoid cartilage is actually slightly larger at the back than the front, in the shape of a signet ring.
- Next draw an irregular polygon to represent the thyrohyoid membrane, thyroid cartilage and cricothyroid membrane.
- Draw 2 lines inside this to separate the 3 structures.
- Draw the hyoid bone as a rounded rectangle above the thyrohyoid membrane.



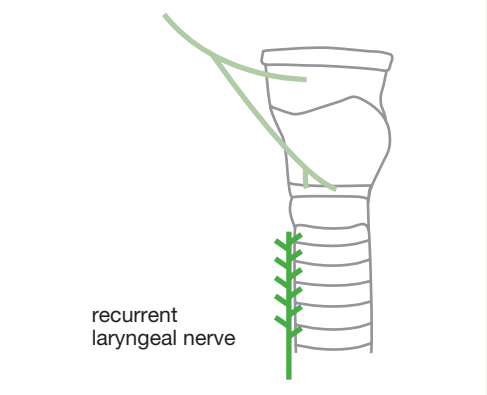
STEP 2

- Draw the superior laryngeal nerve (SLN), a branch of the vagus nerve (CN X). The SLN branches from the vagus nerve at approximately C2. It then divides into the internal branch and external branch at the level of hyoid (C3).
- The internal branch pierces the thyrohyoid membrane with the superior laryngeal artery. It supplies sensation to the mucosa above the vocal cords.
- The external branch supplies the cricothyroid muscle (see where it ends on the diagram).



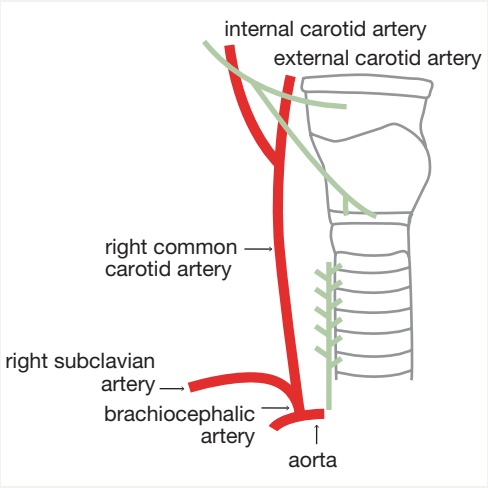
STEP 3

- Draw in the recurrent laryngeal nerve, a branch of the vagus nerve. It runs in the groove between the oesophagus and the trachea and supplies sensation to the mucosa of the larynx below the vocal cords. It also innervates most of the intrinsic muscles of the pharynx except the cricothyroid muscle.



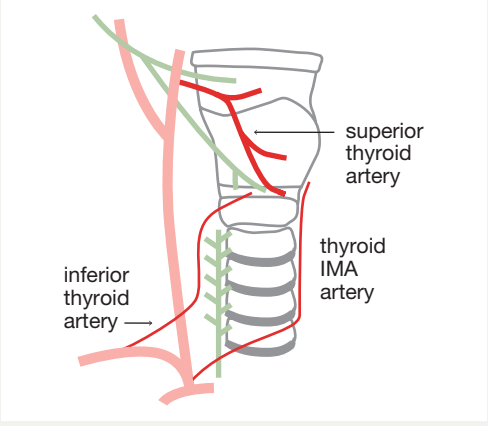
STEP 4

- Draw in the arch of the aorta inferiorly. The brachiocephalic artery arises here and then divides into the right subclavian artery and the right common carotid artery.
- The common carotid artery ascends and divides into the internal and external carotid arteries at the level of the thyroid cartilage (approximately C4).
- The left carotid and left subclavian arteries arise directly from the aortic arch (not shown here).



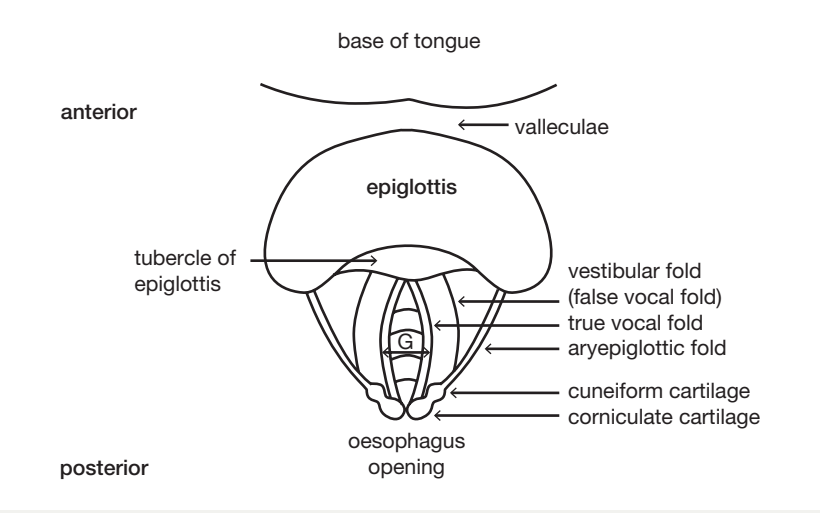
STEP 5

- Draw in the inferior thyroid artery, a branch of the thyrocervical trunk which arises from the right subclavian artery.
- Draw in the superior thyroid artery, a branch of the external carotid artery (at approximately C3). Finally draw in the thyroid IMA artery, a variable branch of the brachiocephalic artery. This artery is only present in 3–10% of the population. It can be the reason for bleeding during a tracheostomy.



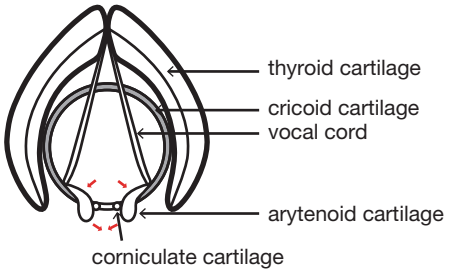
4.3 Laryngoscopic view of the vocal cords

G glottis



Looking through the mouth at the larynx with a laryngoscope is an essential skill for an anaesthetist. Being able to describe exactly what you can see will show the consultant anaesthetist that you know what you are looking at, and it may give you a bit more time to intubate before they take over.

The image above shows exactly what you will see, the tongue base superiorly and the corniculate cartilage (in front of the oesophagus) posteriorly.



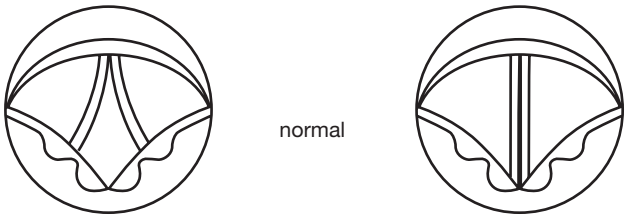
This image shows what the view would look like with no soft tissue and shows how the cartilage is moved to open and close the vocal cords.

N.B. Anaesthetists often refer to the corniculate cartilage as ‘the arytenoids’. As you can see this is technically the corniculate and cuneiform cartilage.

Nerve supply to the larynx

The nervous supply to the larynx is by the external branch of the superior laryngeal nerve above the cords and the recurrent laryngeal nerve below. Both are branches of the vagus nerve (CN X).

The external branch of the superior laryngeal nerve only supplies cricothyroid muscle and the recurrent laryngeal nerve supplies all other muscles of the larynx. Hence, damage to the recurrent laryngeal nerve can lead to vocal cord palsy.



The vocal cords are used to generate sound by vibration of air passing between the adducted cords. Abducted cords are for breathing/breathy sounds and whispering. The vocal cords oscillate due to increased pressure beneath the vocal folds. The lower part of the vocal cords move before the upper part and this creates a wave-like motion. The pitch of a person's voice depends on length, size and tension of their vocal cords.

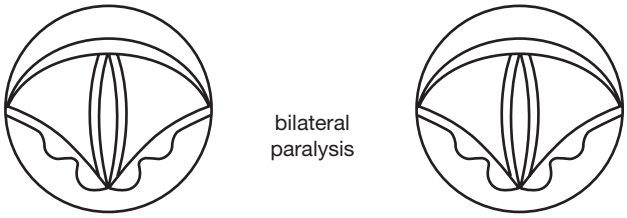
Superior laryngeal nerve damage

- The external branch may be damaged during thyroid surgery.
- It supplies cricothyroid muscle.
- Damage leads to a loss of vocal cord tensions and hence a hoarse voice.
- If unilateral the other side often compensates.

Recurrent laryngeal nerve damage

This is also known as vocal cord paresis and this can cause bilateral and unilateral paralysis as shown over the page.

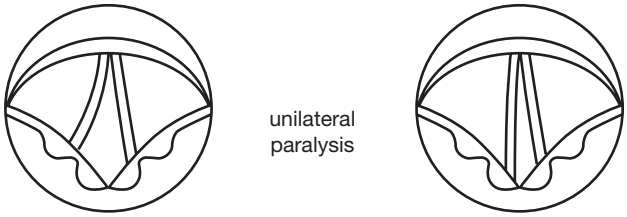
BILATERAL DAMAGE



- Complete transection of the nerve causes complete paralysis of most muscles except cricothyroid (innervated by the superior laryngeal nerve).
- This leads to a half abducted, half adducted position – the cadaveric position.
- **Symptoms:** patient cannot speak or cough.

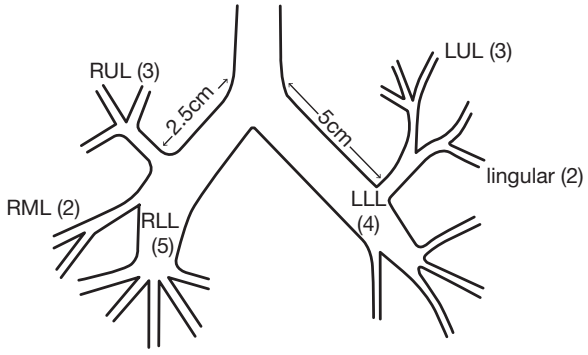
- Trauma/partial transection leads to partial paralysis.
- This leaves the cords in an adducted position.
- **Symptoms:** respiratory distress, stridor, life threatening.

UNILATERAL DAMAGE



- If one cord is damaged then the other cord will partially compensate.
- The damaged cord will sit in an adducted position as cricothyroid muscle should still work (due to innervation by the superior laryngeal nerve).
- **Symptoms:** breathy voice, weak cough, sensation of shortness of breath and sometimes swallowing difficulties.

4.4 Bronchial tree



LLL - left lower lobe
LUL - left upper lobe
RLL - right lower lobe
RML - right middle lobe
RUL - right upper lobe

19 Segments - Right - upper - 3
- middle - 2
- lower - 5
10

- Left - upper - 3
- lingular - 2
- lower - 4
9

This is a common topic for a question. Learning to draw the diagram is not important, but knowing the number of segments and their names is useful.

I remember it as '325, 324'. This adds up to 19 segments in total, 10 on the right and 9 on the left.

The right main bronchus is approximately 2.5 cm long and straight, about 25° off the midline.

The left main bronchus is approximately 5 cm long and lies more horizontally over the heart, about 45° off the midline.

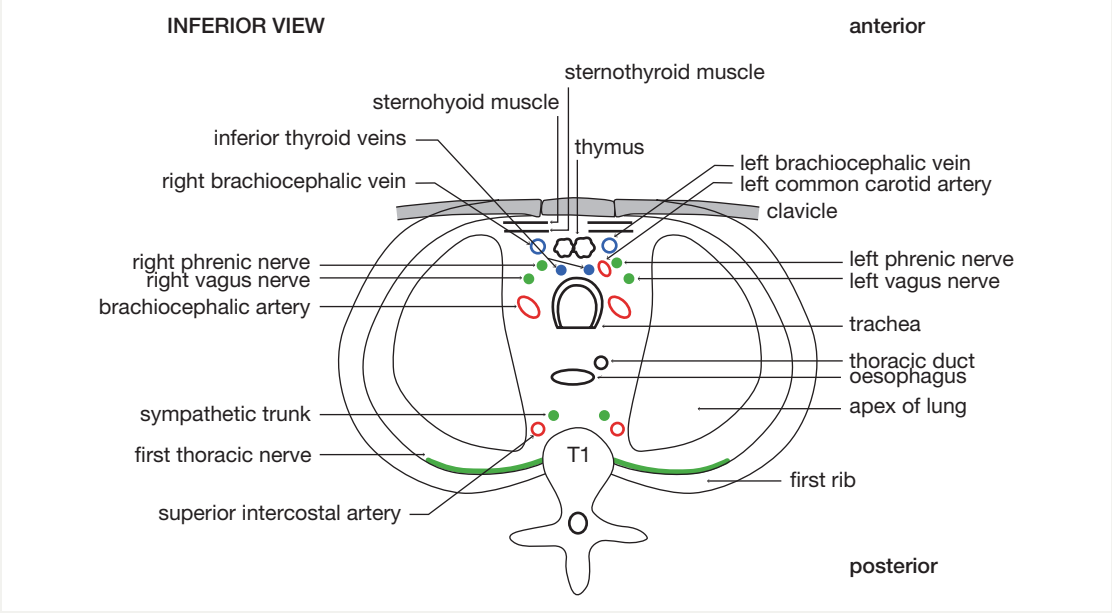
RIGHT SIDE

- 3: APA – Apical, Posterior, Anterior
- 2: LM: Lateral, Medial
- 5: APALM: Apical, Posterior, Anterior, Lateral, Medial

LEFT SIDE

- 3: APA – Apical, Posterior, Anterior
- 2: IS – Inferior, Superior (LINGULAR)
- 4: APAL – Apical, Posterior, Anterior, Lateral (there is no medial one – this can be remembered by thinking that the heart lies where it would have been!)

4.5 Thoracic inlet

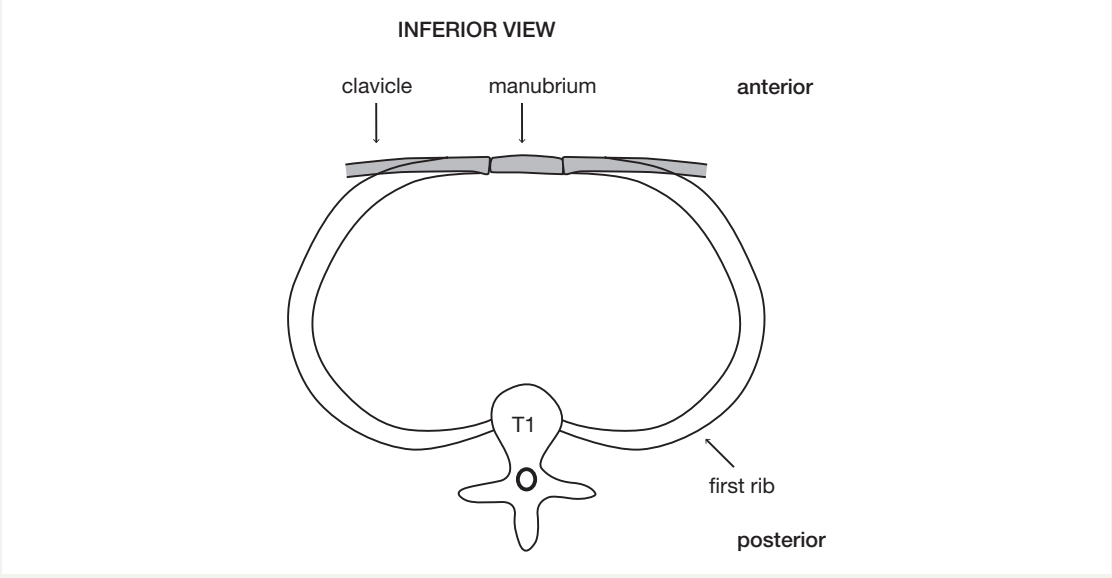


Another exam favourite!

This is a complicated area; it basically means “what is at the level of the 1st rib?”.

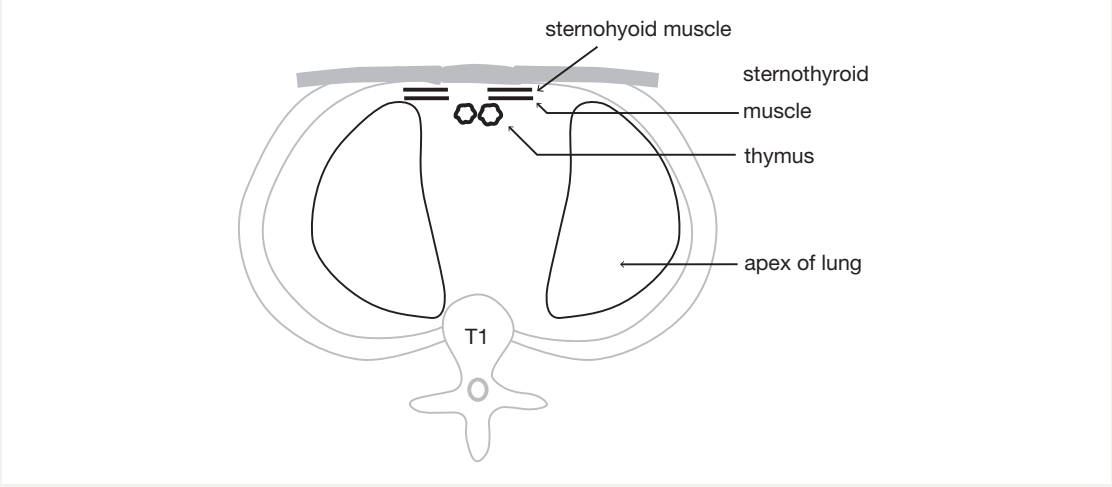
How to draw

STEP 1



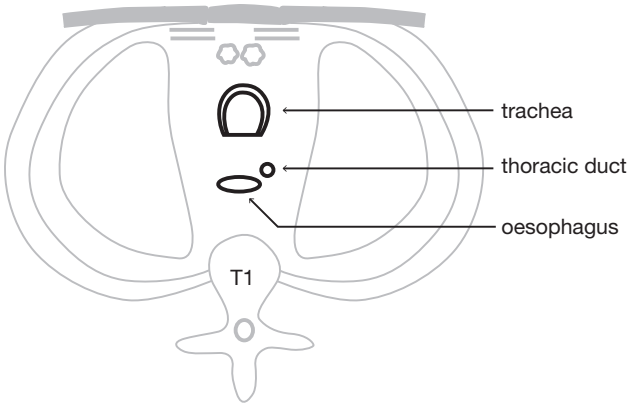
- Draw an oval shape with T1 in the centre at the back.
- Draw a second oval inside this; the outer area is the first rib.
- Draw a straight line at the front that represents the manubrium and the clavicle.

STEP 2



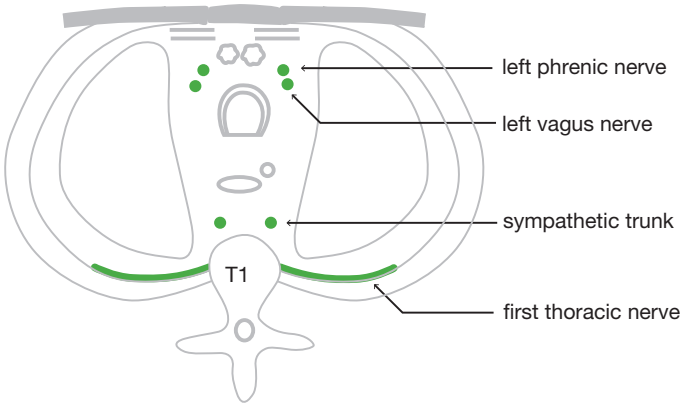
- Draw an enclosed semicircle on each side to represent the apex of each lung. Draw 2 sets of small parallel lines at the front just behind the manubrium. These are the sternohyoid and sternothyroid muscles. Just behind these draw two little fluffy cloud shapes to represent the thymus.

STEP 3



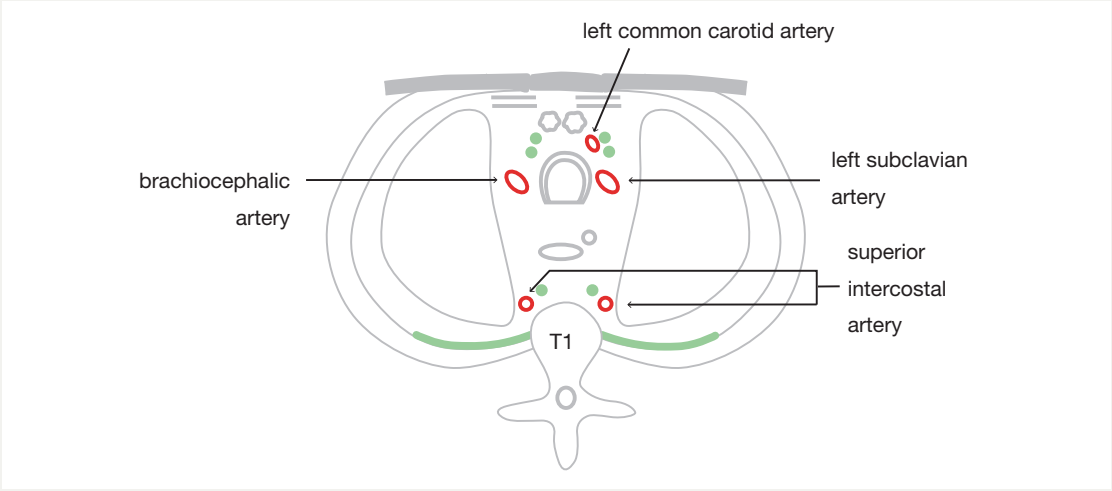
- Add in a trachea behind the thymus and then draw the oesophagus and thoracic duct behind the trachea.

STEP 4



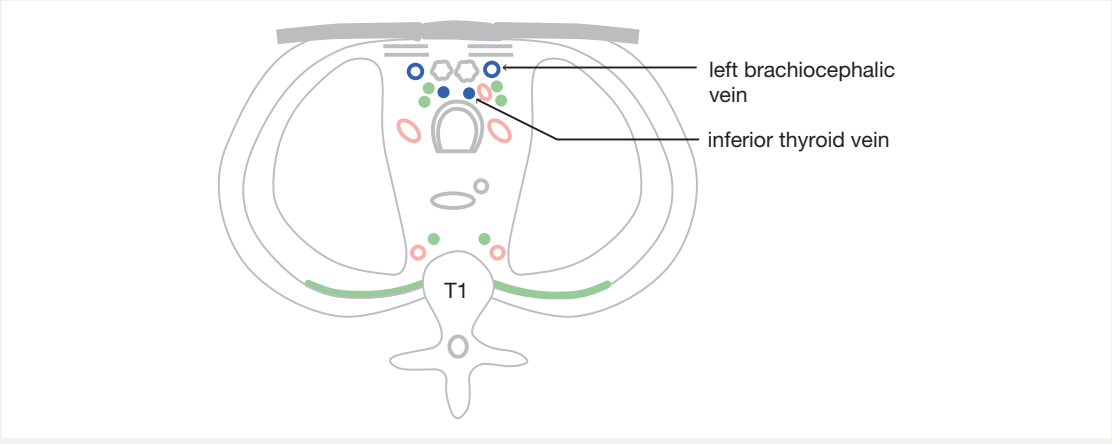
- Draw 2 green lines from T1 to just in front of the posterior first rib; these represent the first thoracic nerves.
- Draw 2 green dots anterior to T1 body; these are the sympathetic trunks.
- Draw 2 green dots just in front of and lateral to the trachea; these are the right and left vagus nerves.
- Draw 2 green dots just in front of the vagus nerves; these are the phrenic nerves.

STEP 5



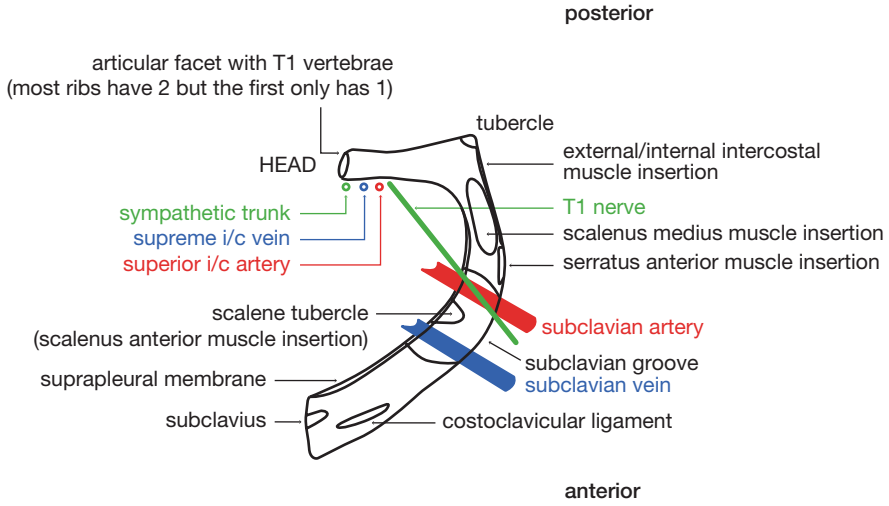
- Draw 2 red circles just lateral and behind the sympathetic trunks; these are the superior intercostal arteries.
- Draw 2 red ovals lateral to the trachea; these represent the brachiocephalic artery and the left subclavian artery.
- Draw a red circle just anterior to the left subclavian artery and medial to the phrenic and vagus nerves; this is the left common carotid artery.

STEP 6



- Draw 2 blue dots just in front of the trachea; these are the inferior thyroid veins.
- Draw 2 blue circles anterior to these and lateral to the thymus; these are the brachiocephalic veins.

4.6 First rib



Sometimes in the exam you are handed the first rib (plastic version) and asked to explain which way up it lies and what runs in what groove.

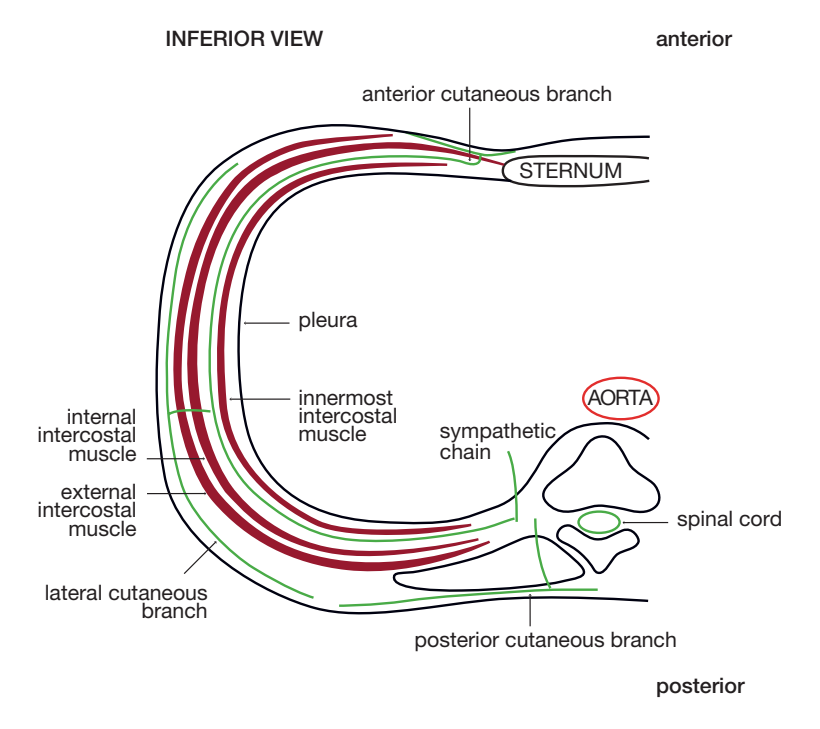
The under surface of the first rib is smoother. If you lay the rib on the table you can see it is the correct way up as the head will touch the surface.

The image shows the superior surface of the first rib. It is important to know where the vessels run over the rib.

If you find the scalenus tubercle (for scalenus anterior) then you will find the subclavian groove.

- The subclavian artery runs posteriorly to this and the subclavian vein runs anteriorly.
- The T1 nerve root runs under the subclavian artery.

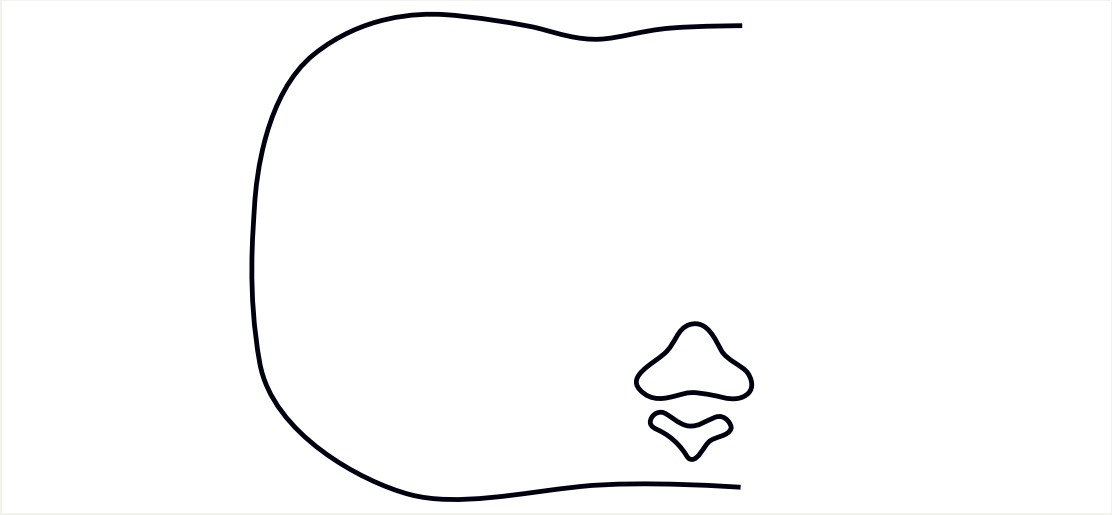
4.7 Intercostal nerves



The intercostal nerves arise from the anterior rami of the thoracic nerves T1 to T11. The upper 2 nerves supply the upper limb and the thorax. The next 4 nerves supply the thorax and the lower 5 nerves supply the thorax and abdominal walls. The 7th intercostal nerve terminates at the xiphoid process and the 10th intercostal nerve terminates at the navel.

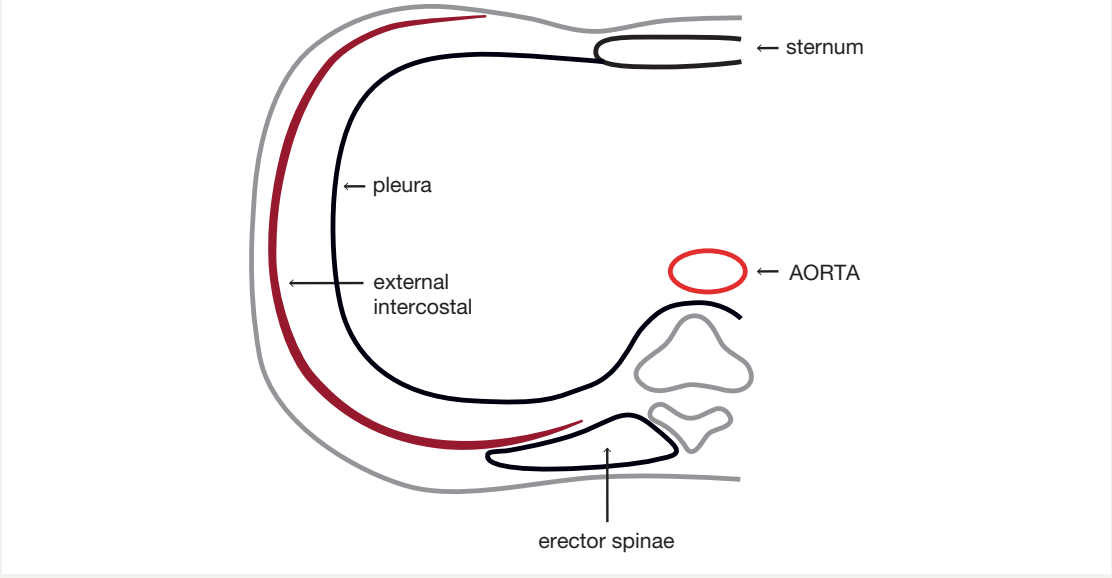
How to draw

STEP 1



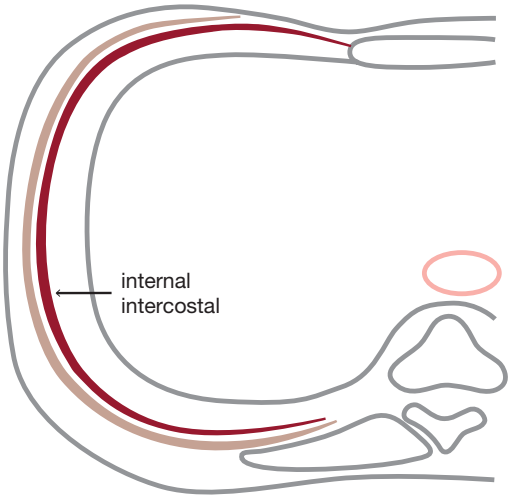
- Draw an approximate semicircle to represent the thorax and then draw one of the thoracic vertebrae (in two halves, the body and the spinous processes).

STEP 2



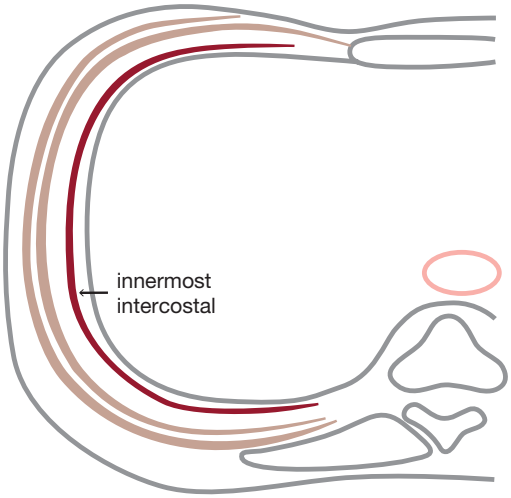
- Add in the external intercostal muscle by drawing a brown semicircle from the transverse process anteriorly. Draw the erector spinae muscle.
- Draw the pleura, anterior to the thoracic vertebral body and ending by drawing the sternum. Add the aorta anterior to the pleura.

STEP 3



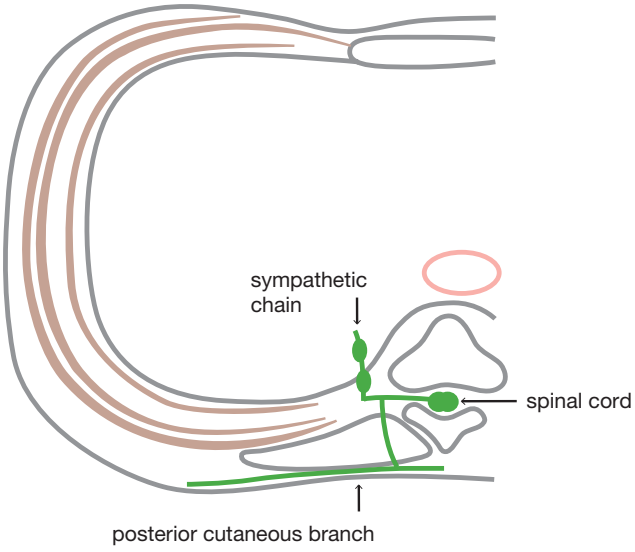
- Draw the internal intercostal muscle by drawing a semicircular line from the transverse process to the sternum.

STEP 4



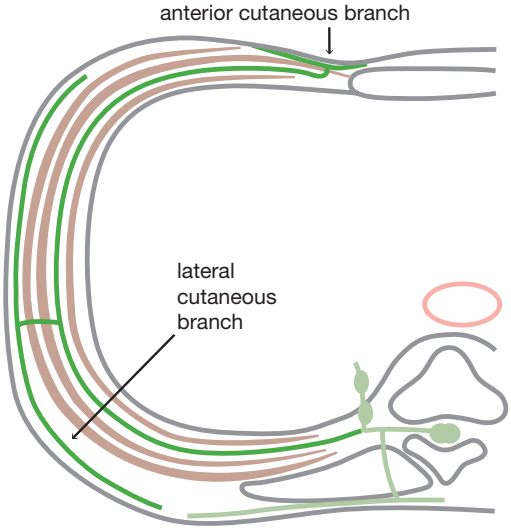
- Draw the innermost intercostal muscle by drawing a semicircular line just inside the pleura.

STEP 5



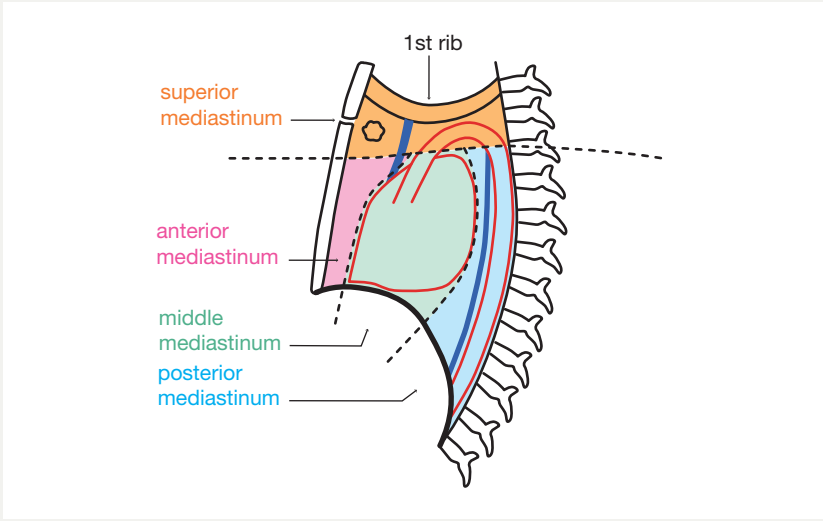
- Draw the spinal cord in between the body of the vertebrae and the spinous process.
- Draw the sympathetic chain anteriorly and the posterior cutaneous nerve posteriorly.

STEP 6



- As a new branch from the spinal nerve, draw a semicircular nerve between the innermost and internal intercostal muscles. Finish it anteriorly with an anterior cutaneous branch.
- Draw a lateral cutaneous branch from the anterior branch as shown.

4.8 Mediastinum



The mediastinum has been known to come up in the FRCA and so it is an important area to know.

The mediastinum is divided into the:

- superior mediastinum
- anterior mediastinum
- middle mediastinum
- posterior mediastinum

You should also know a cross-section anatomy through approximately T6 (anterior, middle and posterior) as this has also been asked about.

ANTERIOR MEDIASTINUM

- This contains loose connective tissue, fat, lymphatic vessels, lymph nodes and branches of internal thoracic vessels.
- The thymus sometimes extends inferiorly into the anterior mediastinum.

MIDDLE MEDIASTINUM

- This contains major organs and vessels including the heart, ascending aorta, pulmonary trunk, superior vena cava, pericardium, tracheal bifurcation and left and right main bronchi.
- There are also tracheobronchial lymph nodes.

POSTERIOR MEDIASTINUM

- This is where the thoracic descending aorta lies. Branches that come off the aorta here are the posterior intercostal arteries, bronchial arteries, oesophageal arteries and superior phrenic arteries.
- The oesophagus, thoracic duct, azygos vein, hemiazygos vein and sympathetic trunks lie here.

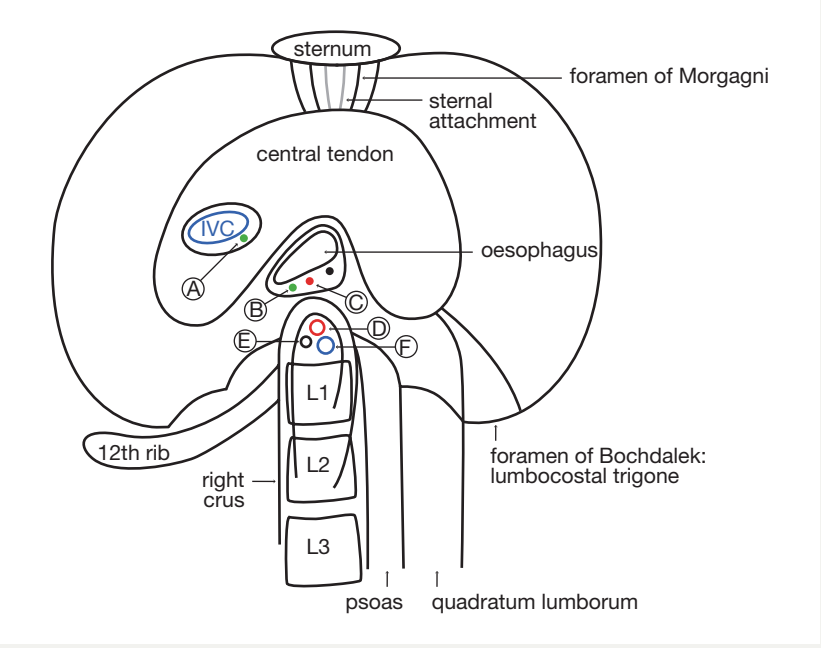
SUPERIOR MEDIASTINUM

- Major blood vessels are in this part of the mediastinum, including the arch of aorta and branches (brachiocephalic, left common carotid, left subclavian artery), the superior vena cava, left and right brachiocephalic veins, supreme intercostal vein and azygos vein.
- Nerves here are the right and left vagus nerves, phrenic nerves, cardiac nerves and sympathetic trunk.
- Other structures include the thymus, trachea, thoracic duct, sternohyoid and sternothyroid muscles.

4.9 Diaphragm

- **A** right phrenic nerve
- **B** vagal trunks
- **C** left gastric vessels
- **D** aorta
- **E** thoracic duct
- **F** hemiazygos vein

IVC inferior vena cava



This would not be easy to draw in an exam but it does get asked about. This is the simplest version of the diaphragm that I could come up with.

The main things to learn are what passes through where and the nerve supply.

The motor supply of the diaphragm is from the left and right phrenic nerves (C3, 4 and 5). The phrenic nerve also supplies sensation to the central tendon. The sensation at the edge of the diaphragm is from the intercostal nerves T5 to T12.

The right crus of the diaphragm arises from L1 to L3. The left crus arises from L1 to L2.

Caval opening: **T8**

- Vena cava (**8** letters)
- R phrenic (**8** letters) nerve

Oesophageal opening: **T10**

- Oesophagus (**10** letters)
- Vagal trunk (cranial nerve **10**)
- Left gastric vessels

Aortic hiatus (**12** letters): **T12**

- Aorta
- Thoracic duct (**12** letters)
- Azygos vein