

GROSS ANATOMY OF THE INTERCOSTAL SPACES

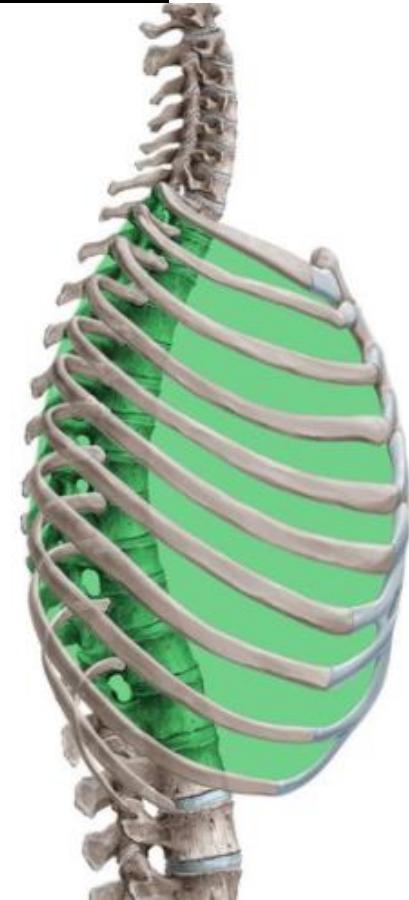
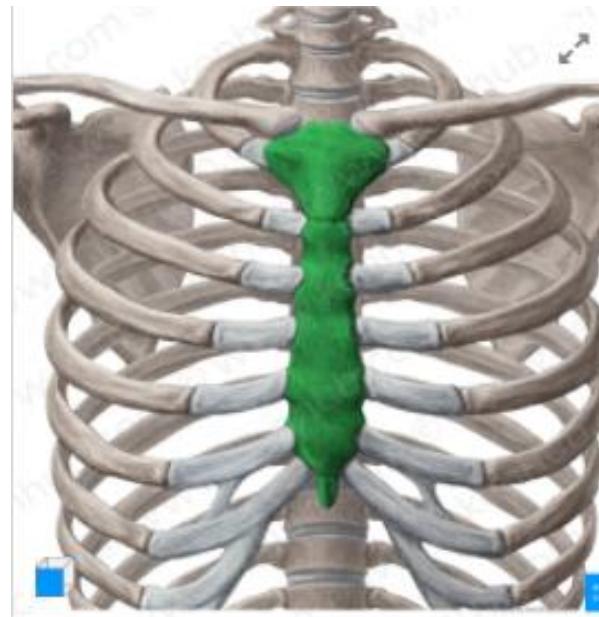


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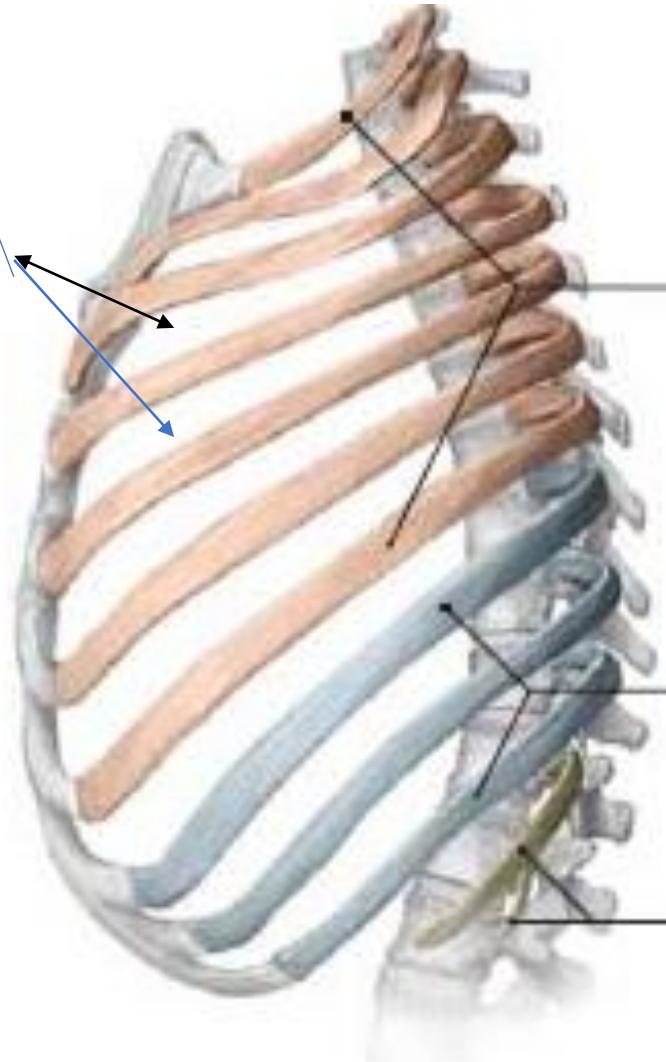


LEARNING OBJECTIVES

1. Describe an intercostal space.
2. State the contents of an intercostal space.
3. Describe the muscles, nerve and blood supply of the intercostal space.
4. The clinical correlates/Applied Anatomy of the intercostal space.

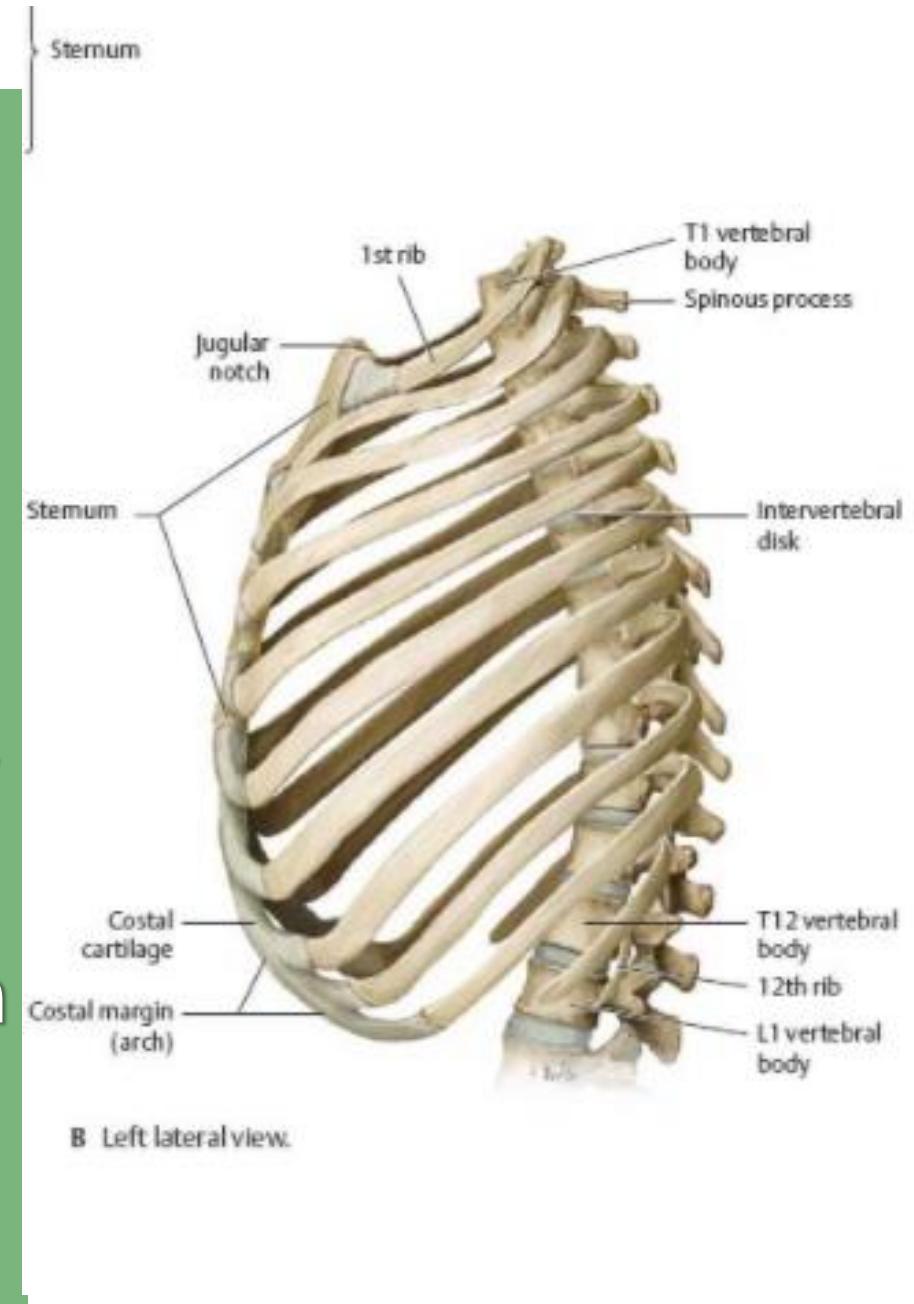
INTRODUCTION

**Intercostal
spaces**

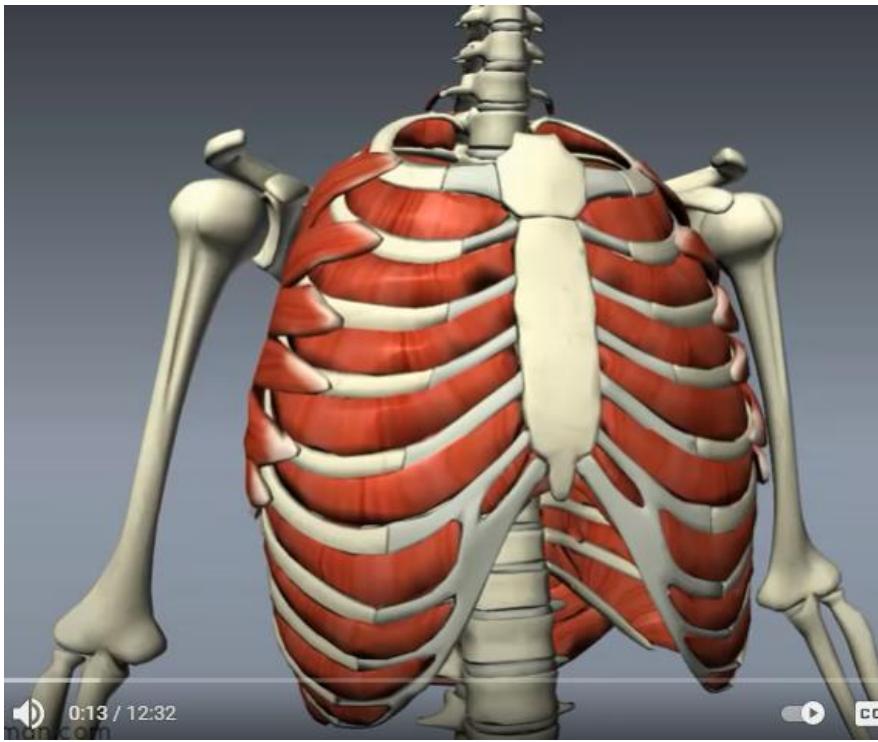


INTRODUCTION

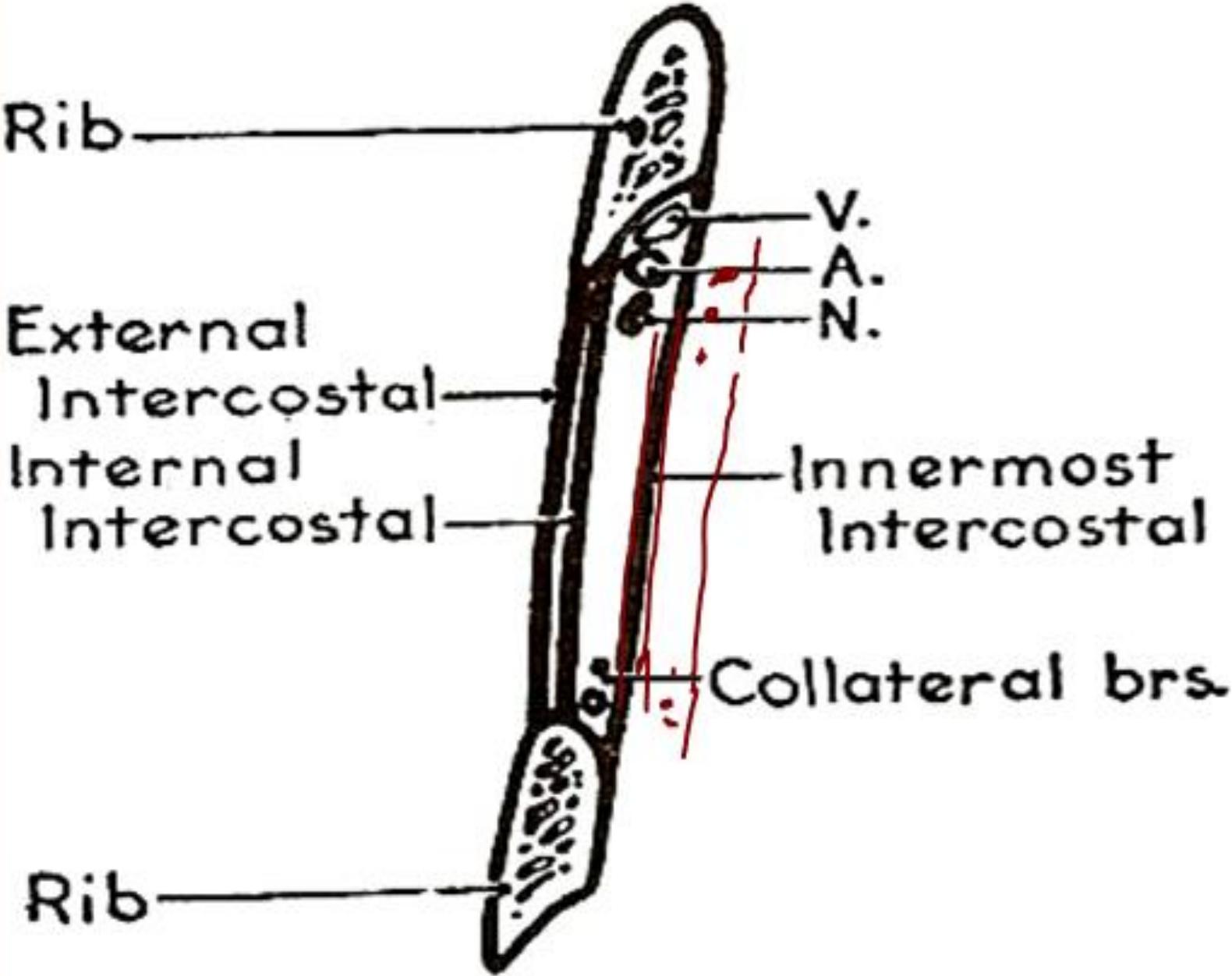
- The intercostal spaces separate the ribs and their costal cartilages from one another and allow smooth expansion of the cage during inspiration.
- The spaces are named according to the rib forming the superior border of the space, for example, the 4th intercostal space lies between the 4th rib and 5th rib; therefore, there are 11 intercostal spaces in the rib cage.



The Intercostal Spaces

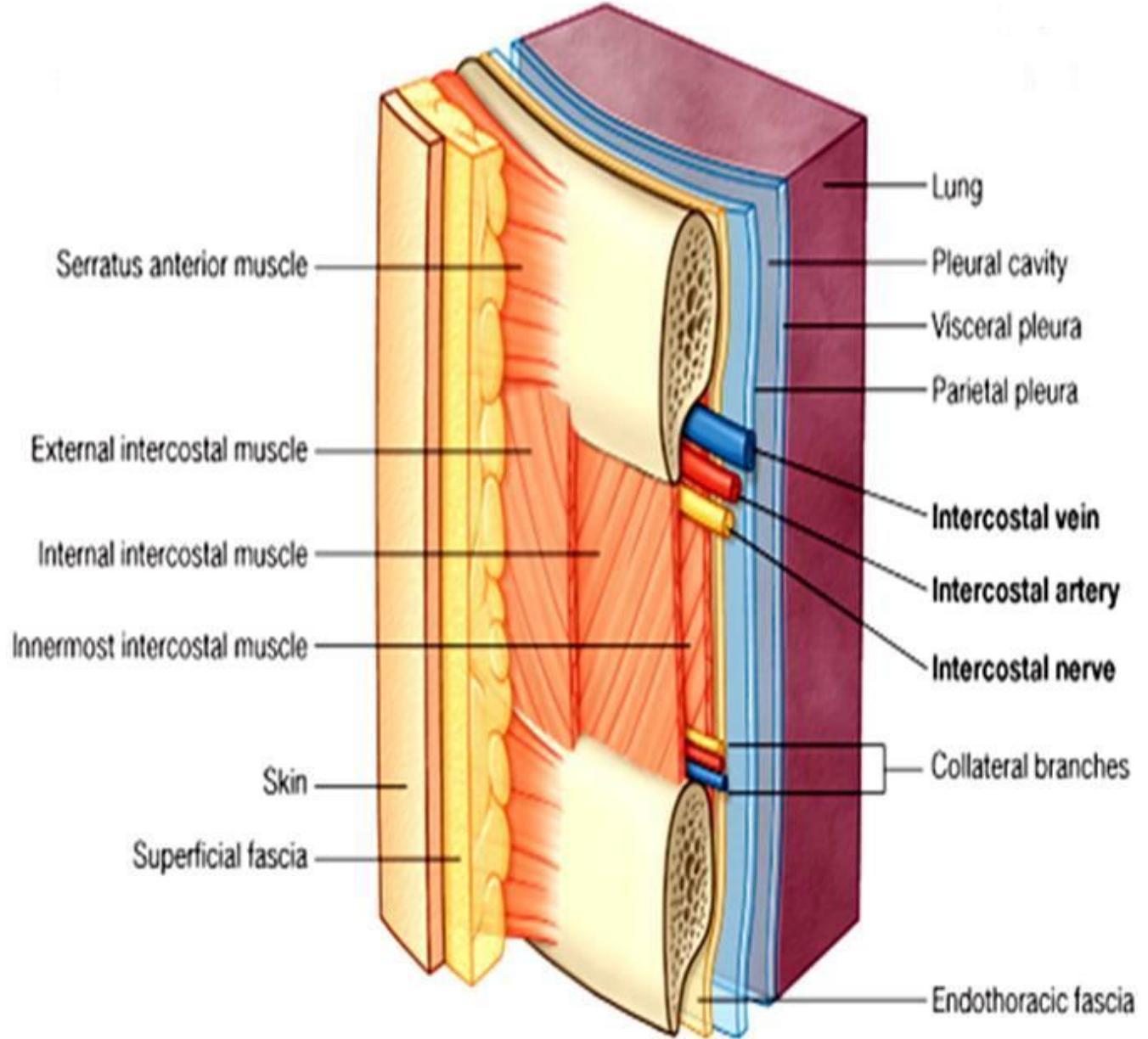


Vertical section of intercostal space



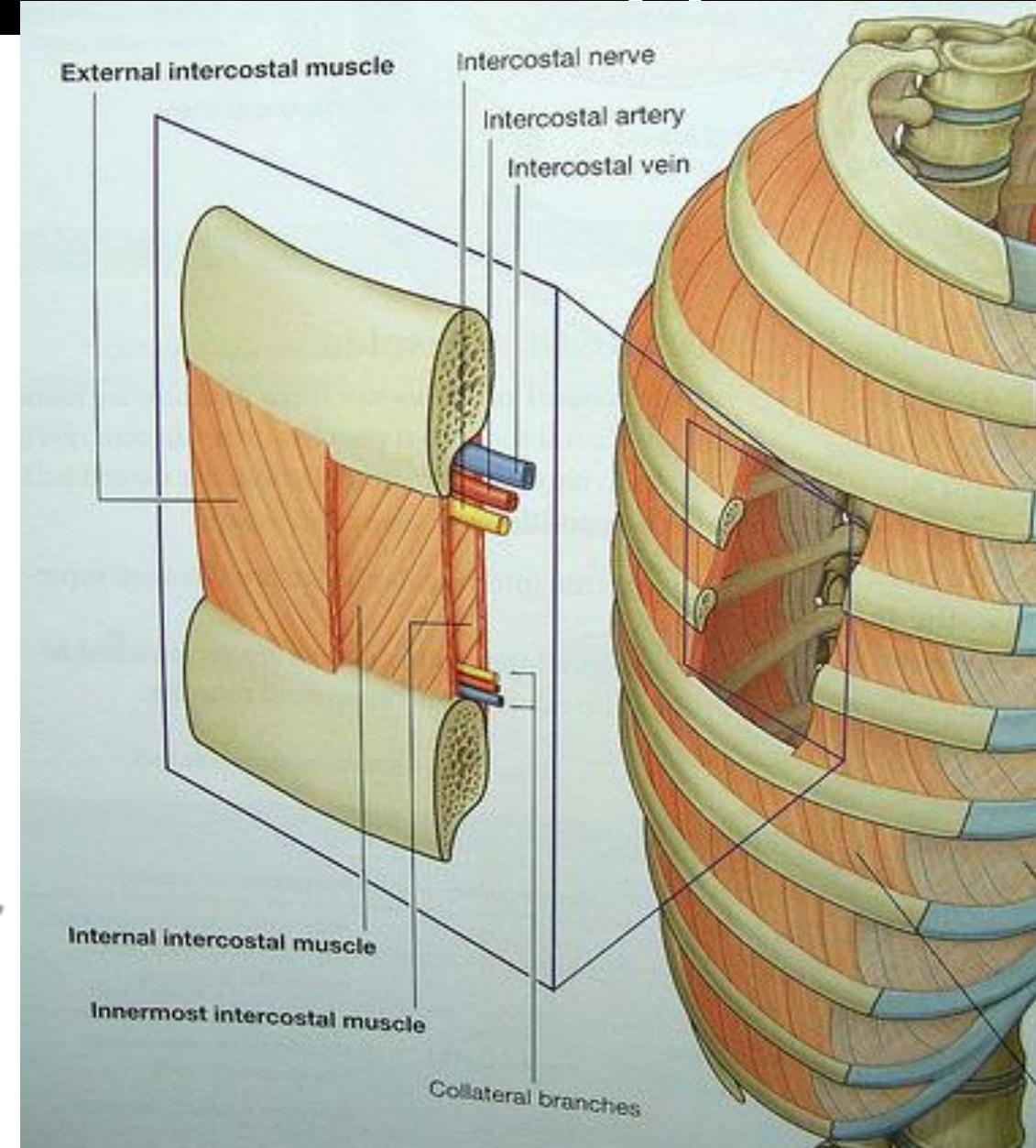
CONTENTS OF THE INTERCOSTAL SPACE

- **1. Intercostal MUSCLES**
- **2. Intercostal NERVES**
- **3. Intercostal VESSELS**



Intercostal muscles (Superficial to deep)

- Each intercostal space has three muscles:
 - External Intercostal
 - Internal Intercostal
 - Innermost Intercostal
- Action:
 - Tend to pull the ribs nearer to each other
 - Strengthen the tissue of the space

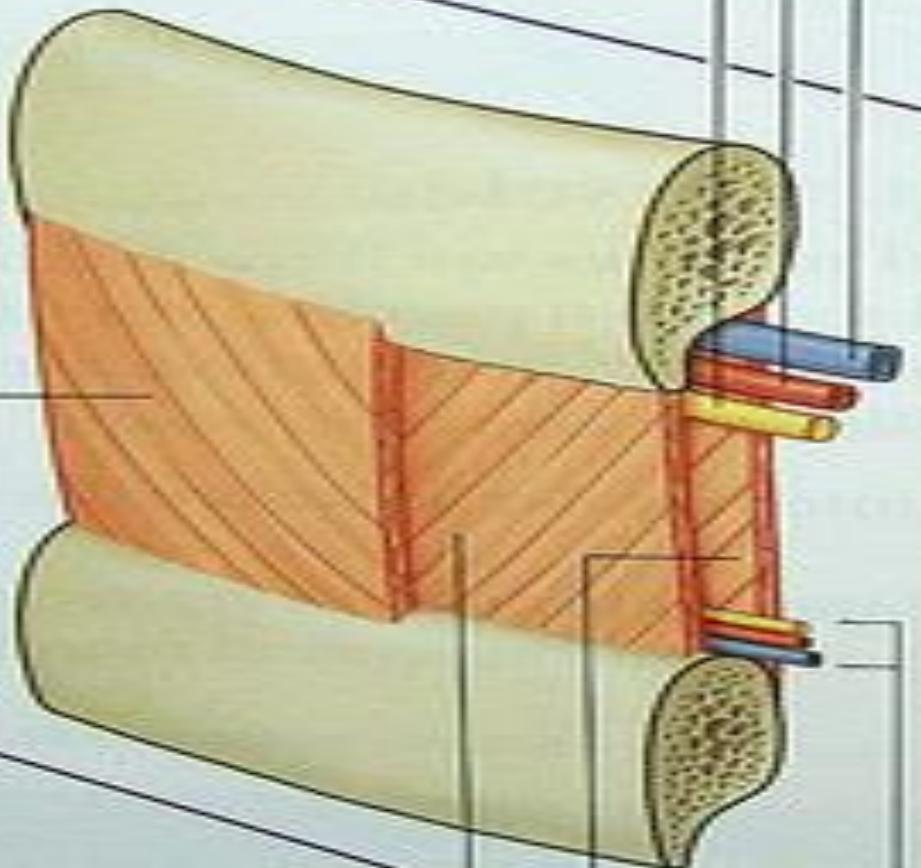


External intercostal muscle

Intercostal nerve

Intercostal artery

Intercostal vein

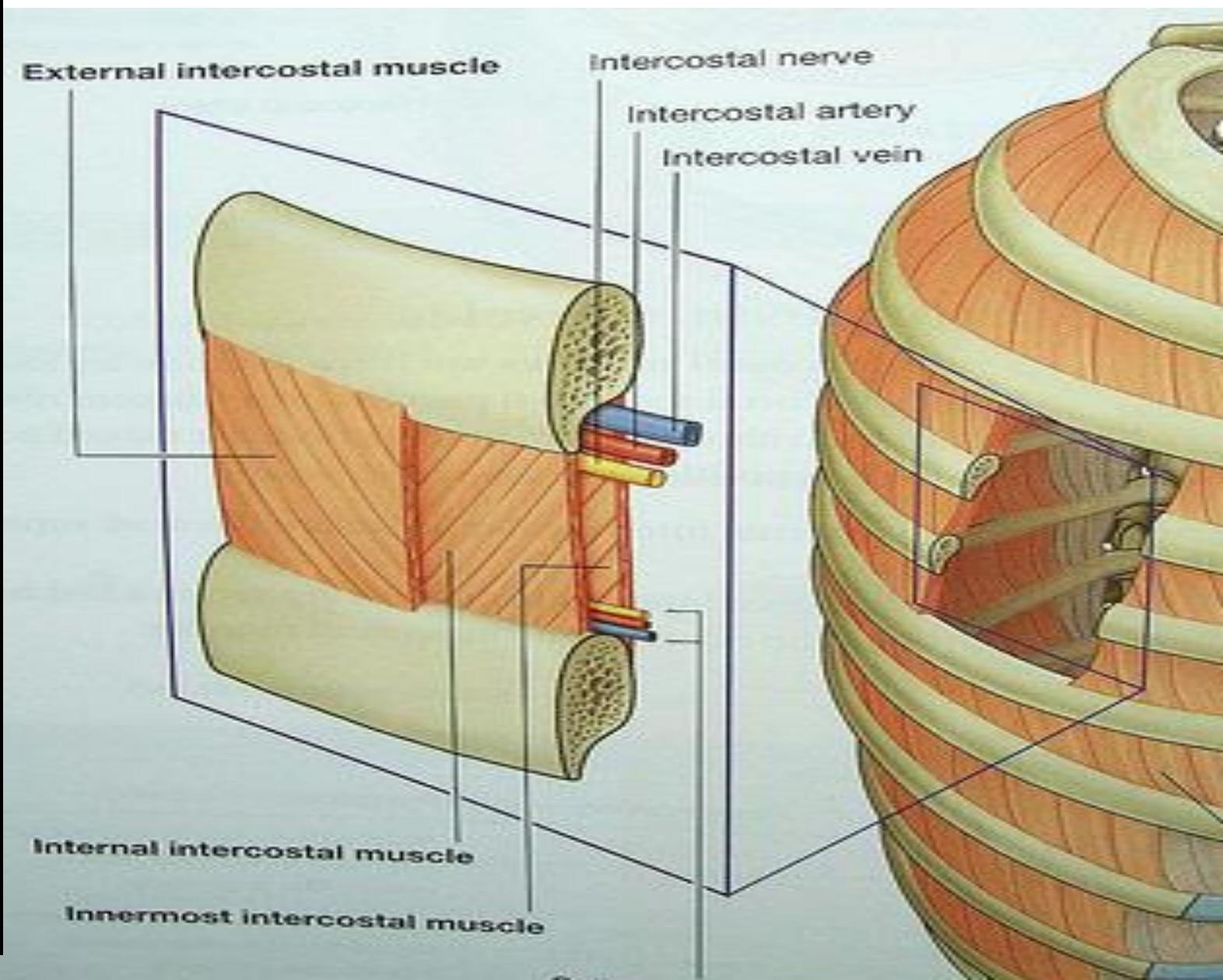


Internal intercostal muscle

Innermost intercostal muscle

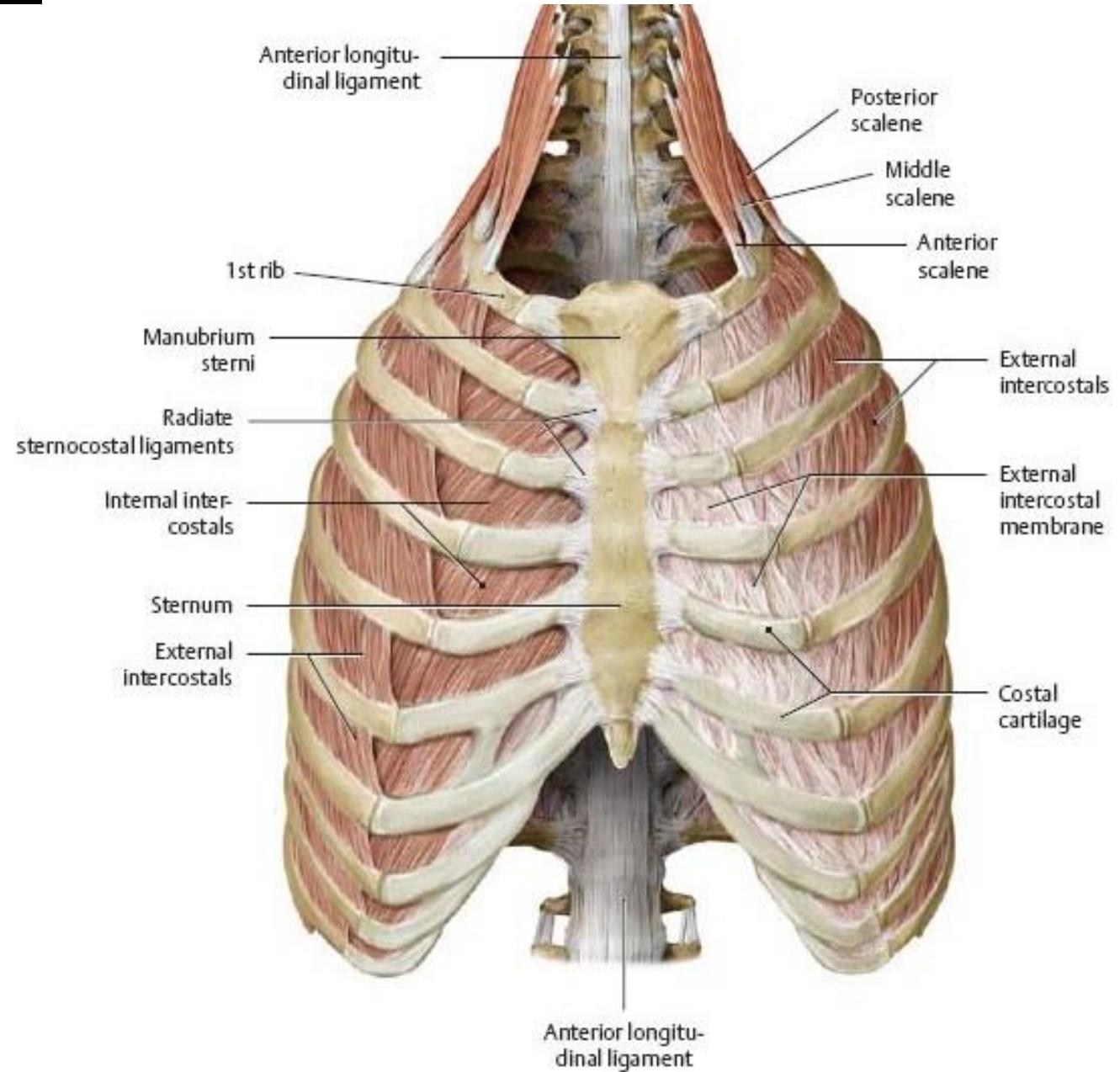
Collateral branches

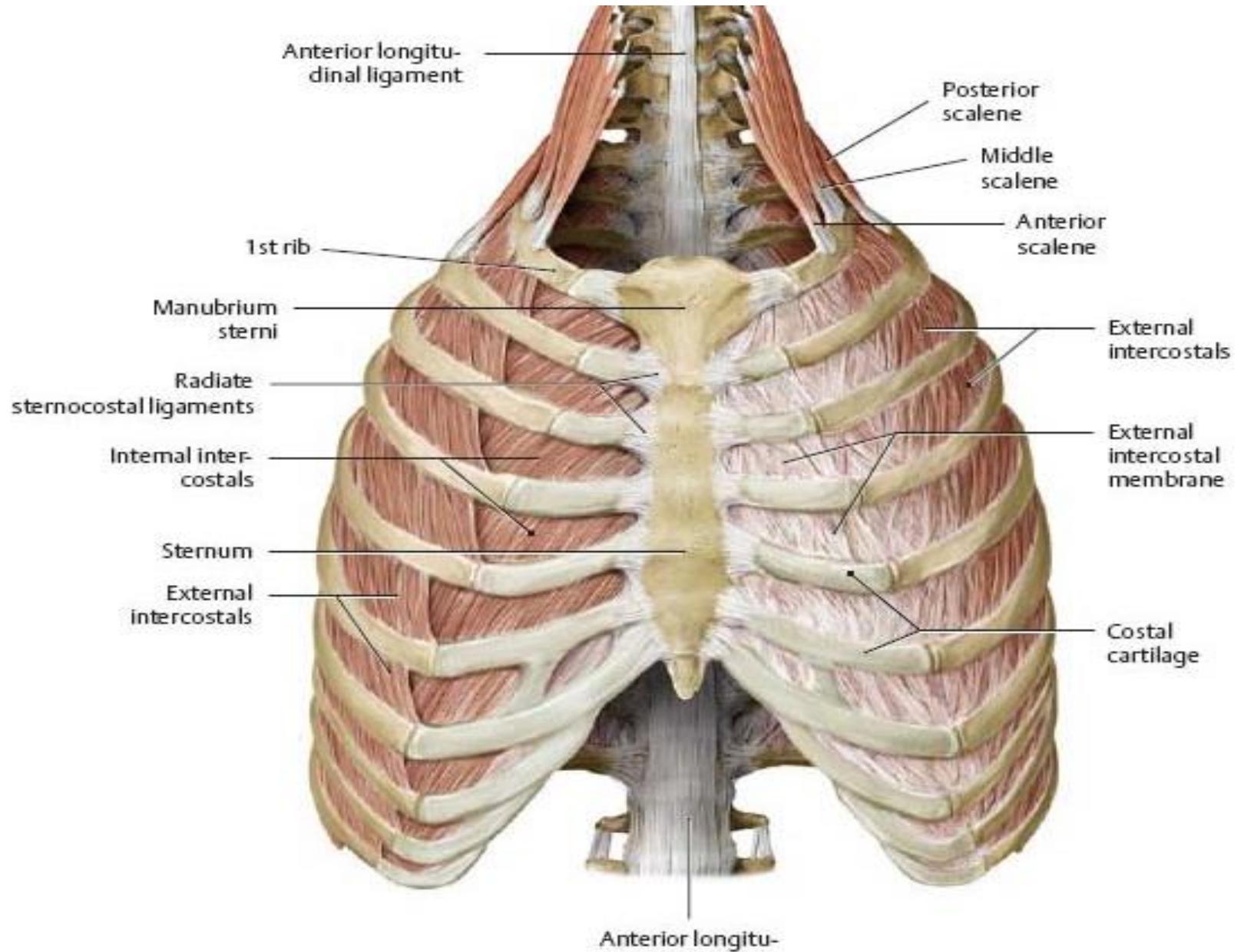
**Neurovascular
bundles are
located between
the internal &
innermost
intercostal
muscles, they
have a strict order
of VAN from top to
bottom.**



External Intercostal Muscle

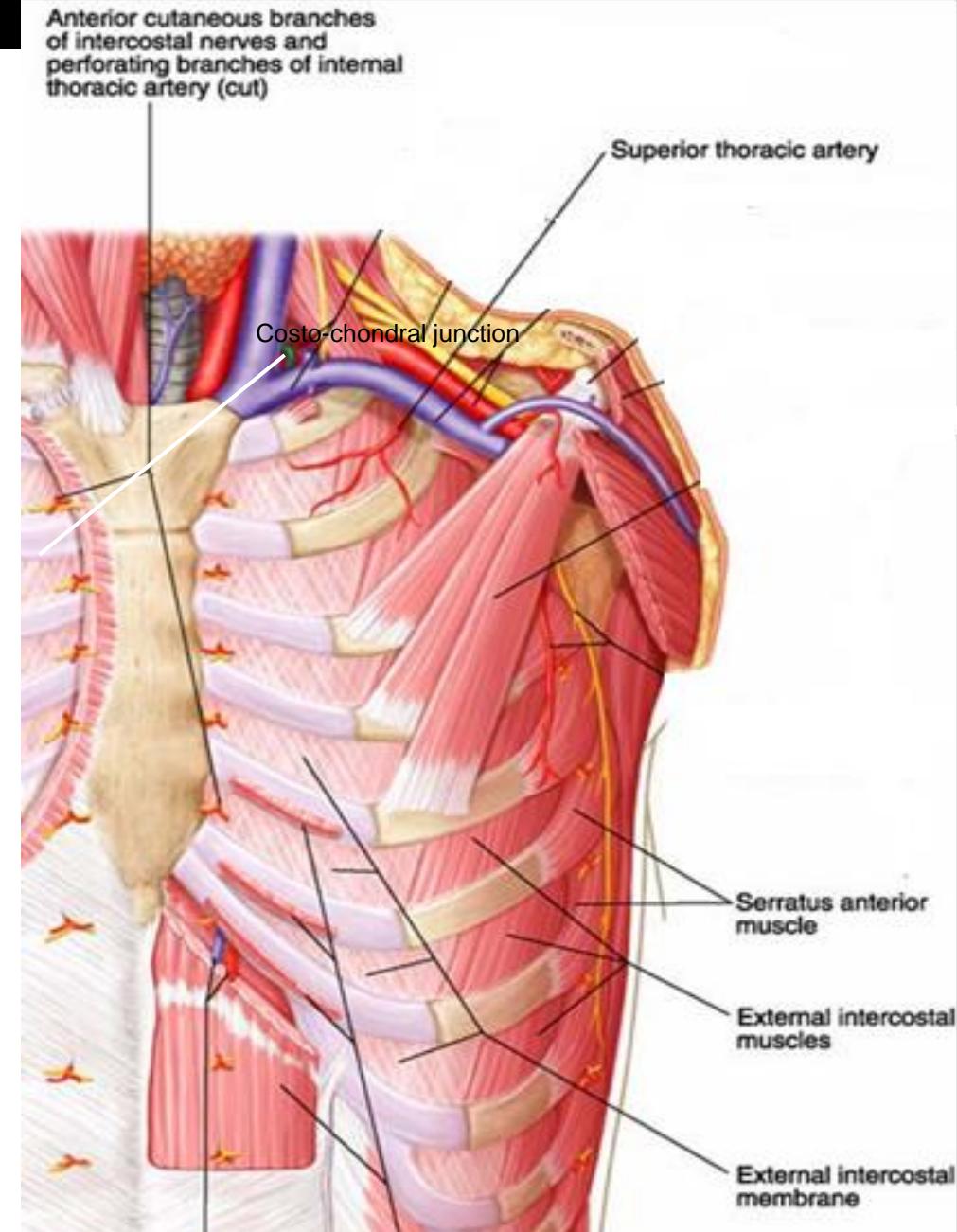
- Most superficial
- The external intercostal muscles (11 pairs) occupy the intercostal spaces from the tubercles of the ribs posteriorly to the costochondral junctions anteriorly



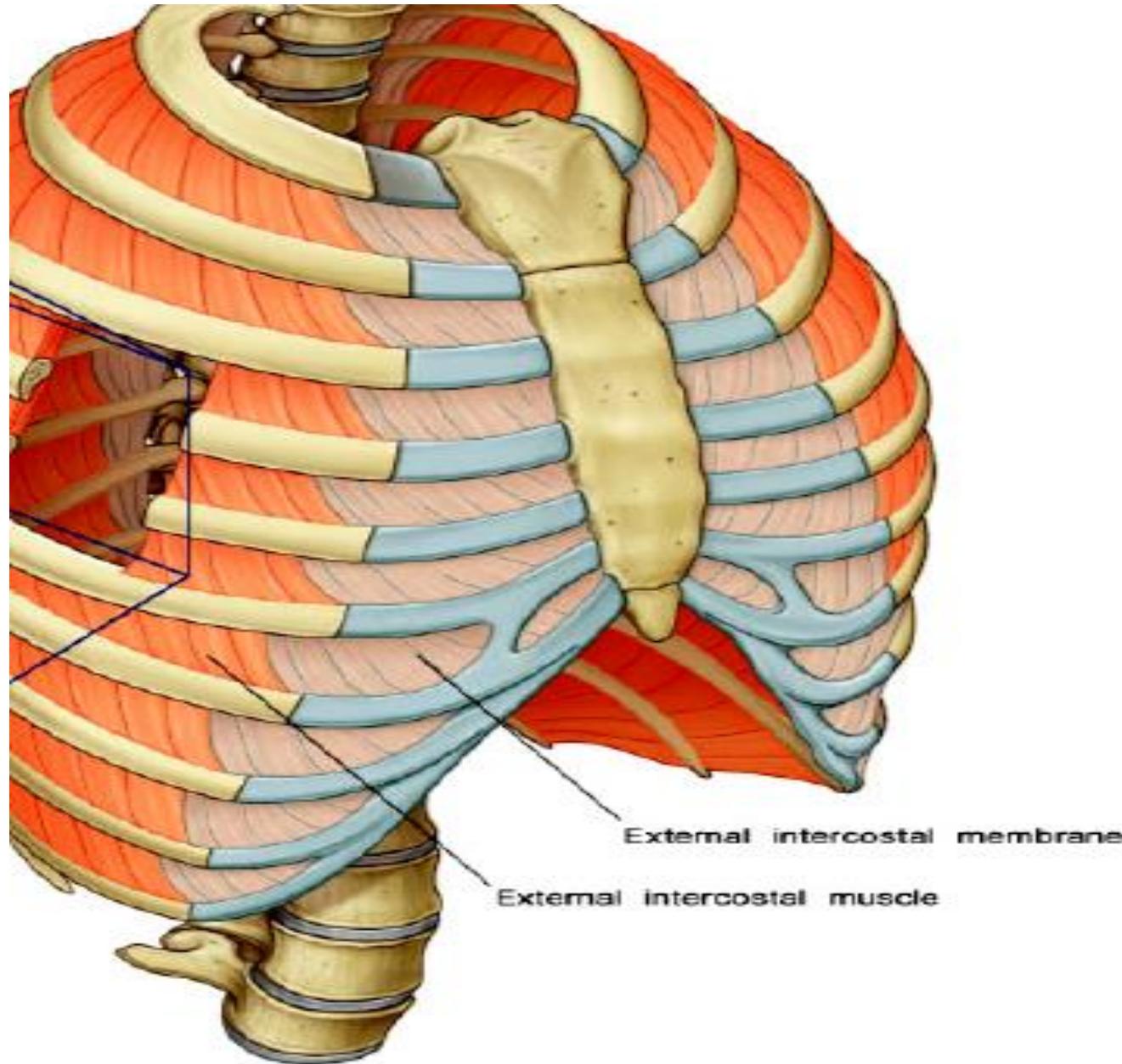


External Intercostal Muscle

- **Origin:** The muscle fibers run inferoanteriorly from lower border of the rib above
- **Insertion:** upper border of rib below
- Extends from the rib tubercle behind to the costo-chondral junction in front
- Deficient anteriorly & replaced by external (anterior) intercostal membrane



External Intercostal muscle

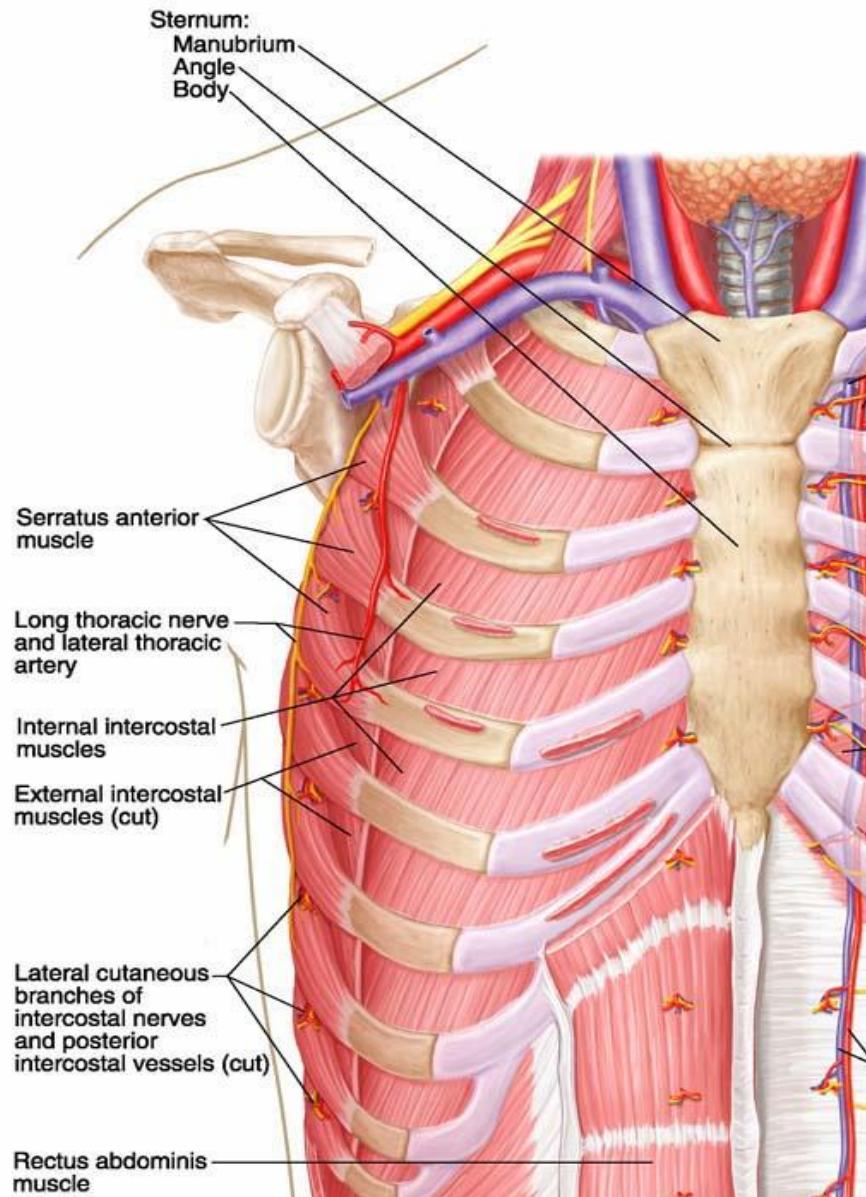


External Intercostal Muscles (continues)

- These muscles are continuous inferiorly with the external oblique muscles in the anterolateral abdominal wall.
- The external intercostals are most active during inspiration; they maintain or increase the tonus of the intercostal space.
- They elevate the ribs during forced inspiration.

Internal Intercostal Muscle (Intermediate layer)

- The internal intercostal muscles (IIM) (11 pairs) run deep to and at right angles to the external intercostals
- The IIM are attached to the bodies of the ribs and their costal cartilages as far anteriorly as the sternum and as far posteriorly as the angles of the ribs.
- Between the ribs posteriorly, medial to the angles, the internal intercostals are replaced by the internal intercostal membranes

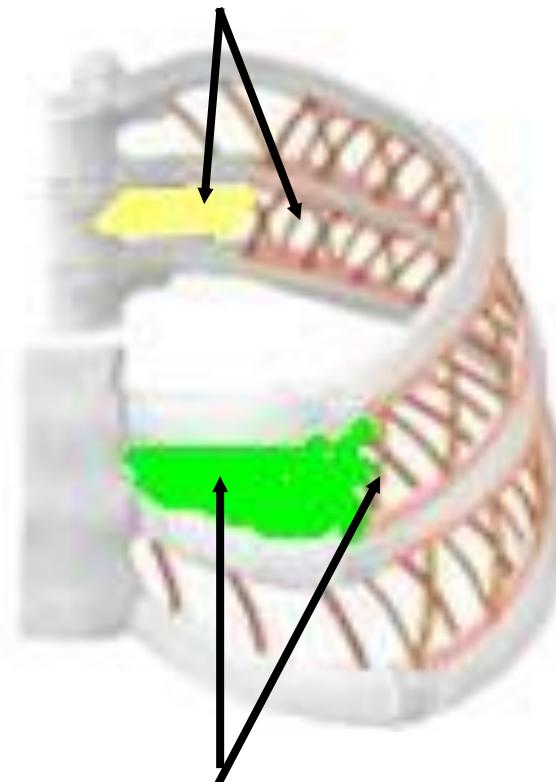




Angle of the rib

costochondral junction

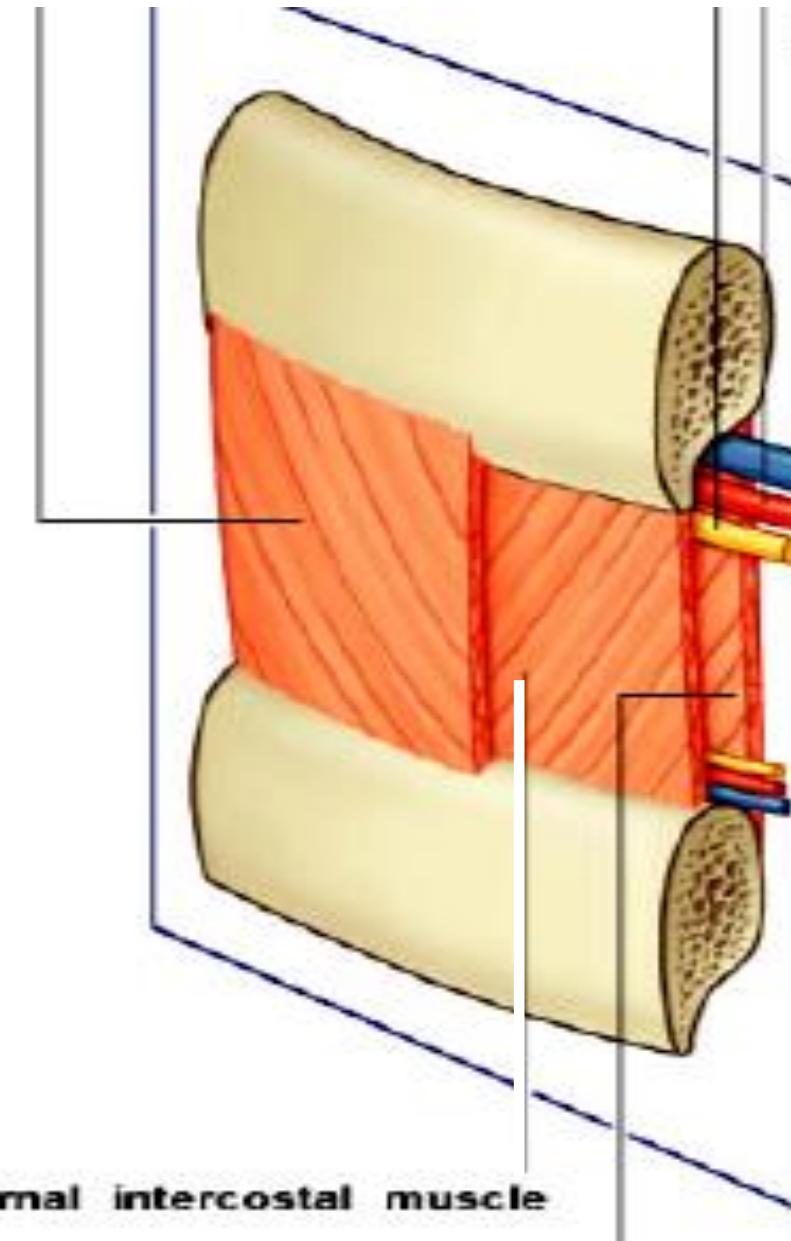
posterior intercostal membrane &
internal intercostal muscle

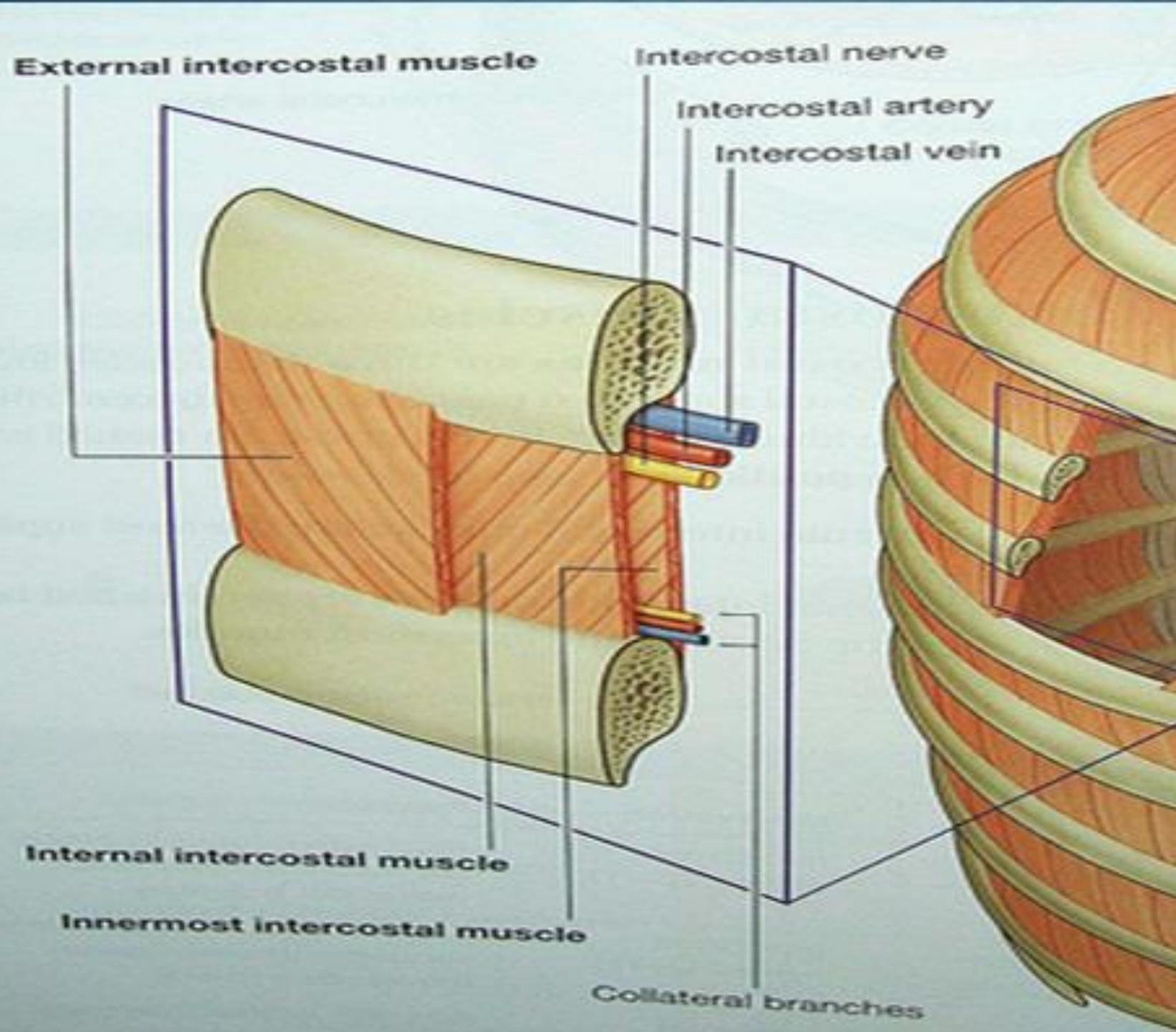


anterior intercostal membrane &
external intercostal muscle

Internal Intercostal Muscle cont'd

- Their fibers run inferoposteriorly from the floors of the costal grooves to the superior borders of the ribs inferior to them.





External intercostal muscle

Intercostal nerve

Intercostal artery

Intercostal vein

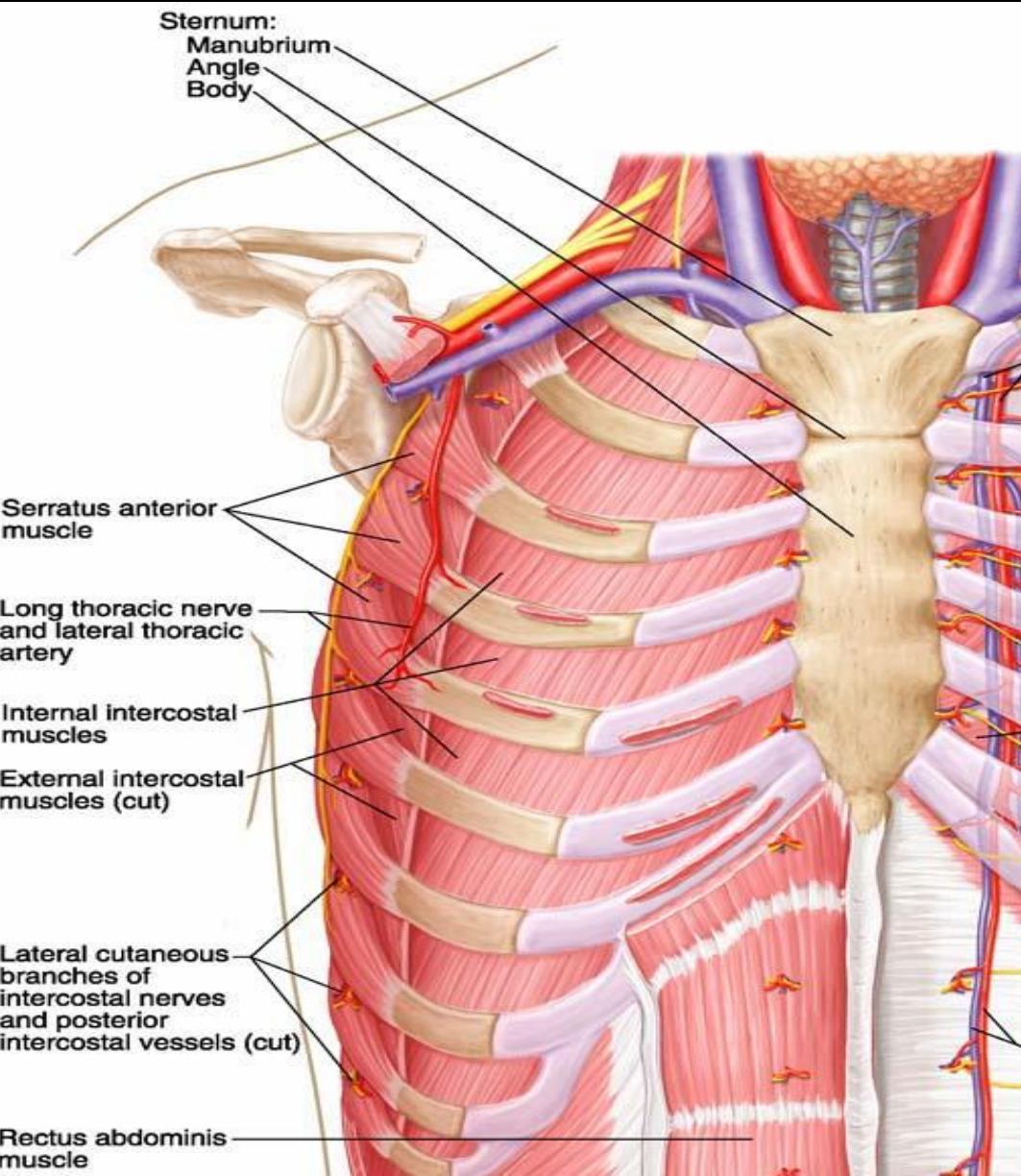
Internal intercostal muscle

Innermost intercostal muscle

Collateral branches

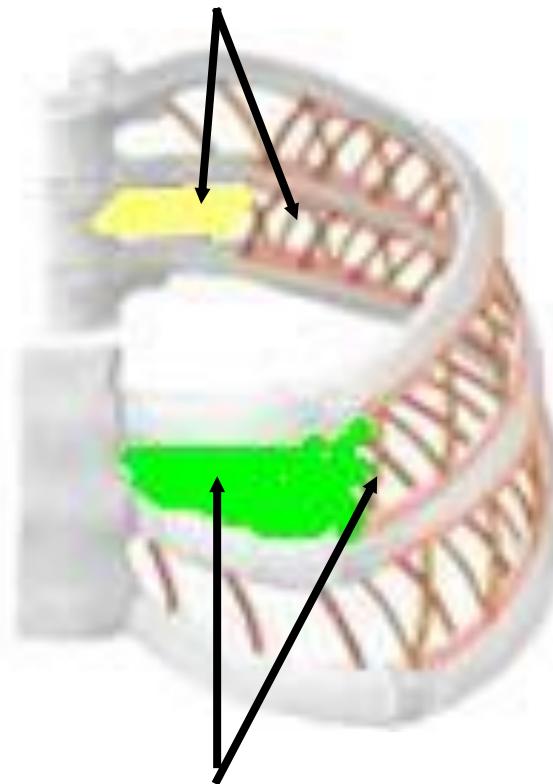
Internal Intercostal Muscle cont'd

- Fibers directed **downward & backward**
- **Origin:** From subcostal groove of the rib above
- **Insertion:** upper border of rib below
- Extends from the sternum in front to the angle of the rib behind
- Deficient posteriorly & replaced by internal (posterior) intercostal membrane
- **Action:** Depresses the rib downwards during expiration



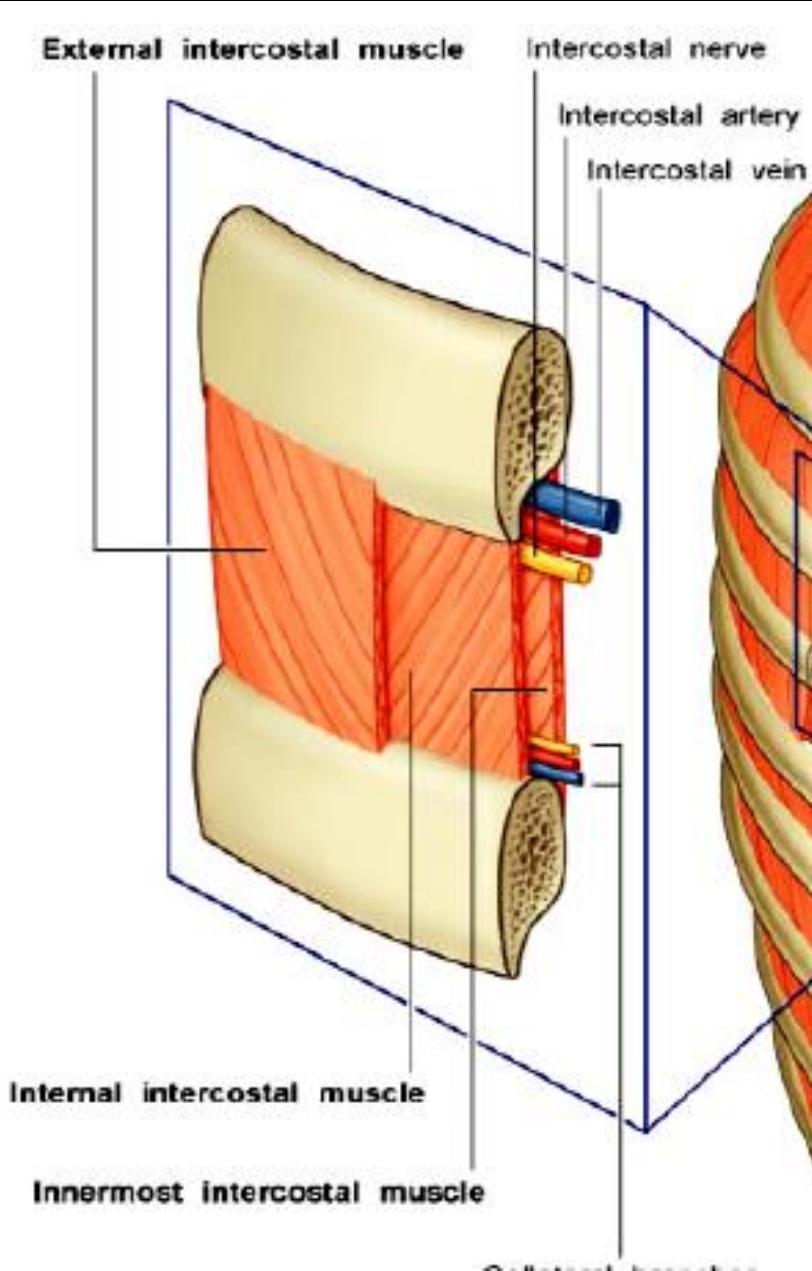


posterior intercostal membrane &
internal intercostal muscle



anterior intercostal membrane &
external intercostal muscle

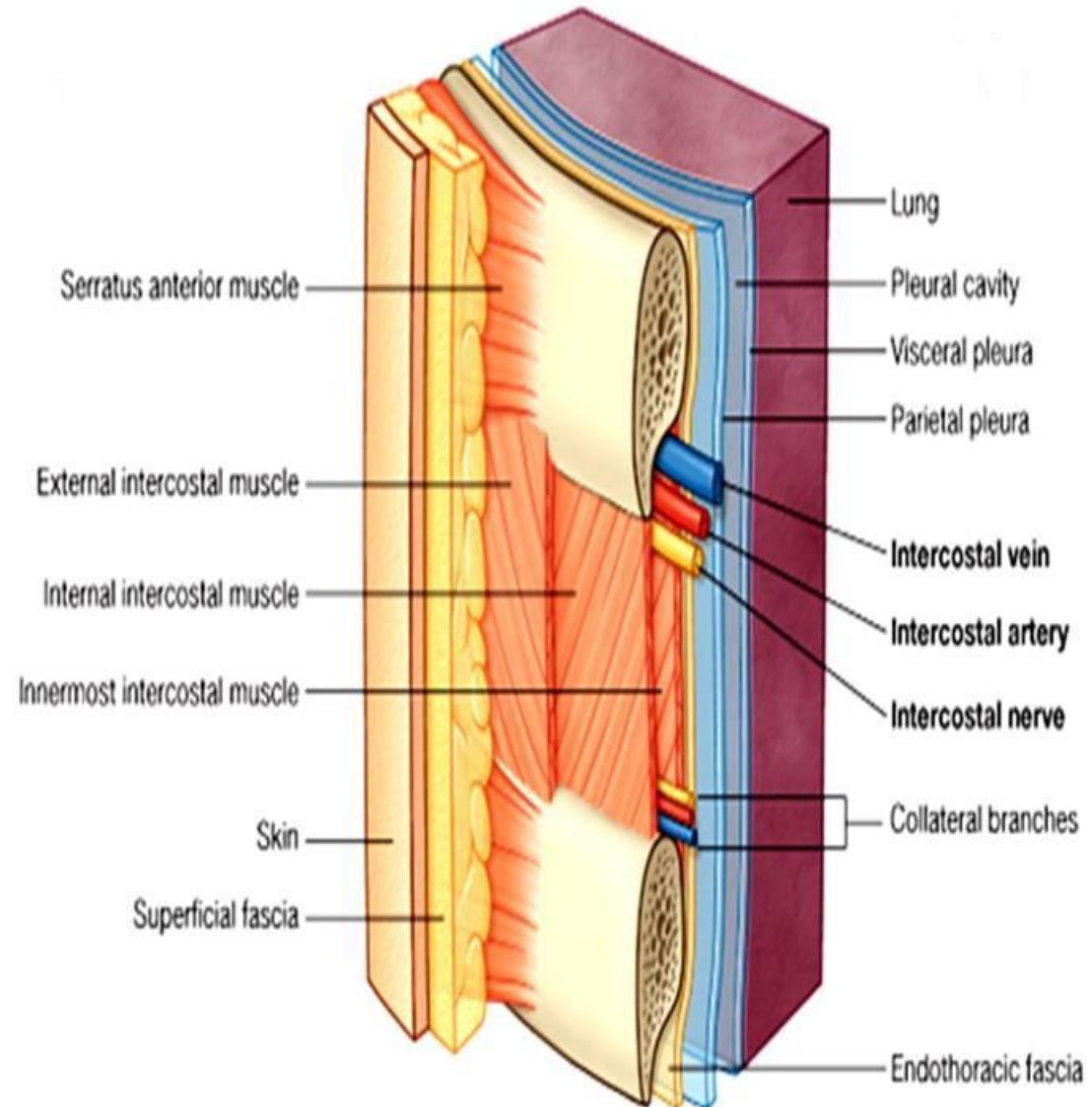
Innermost Intercostal Muscle (Deepest layer)



- The **innermost intercostal muscles** are similar to the **internal intercostals** and are essentially their deeper parts.
- The **innermost intercostals** are separated from the **internal intercostals** by the **intercostal nerves and vessels**

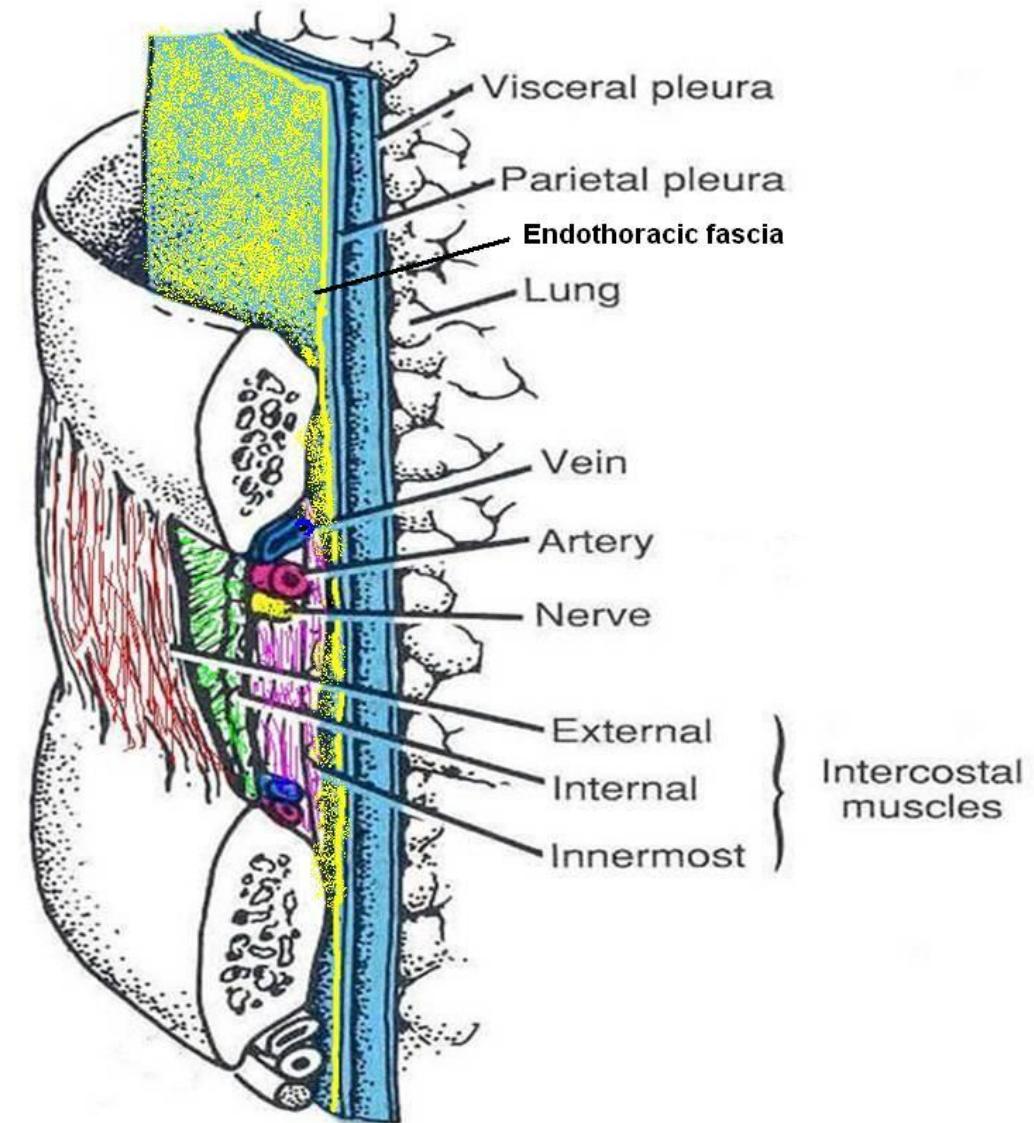
Innermost Intercostal Muscle

- Related externally to intercostal nerve and vessels, and internally to endothoracic fascia



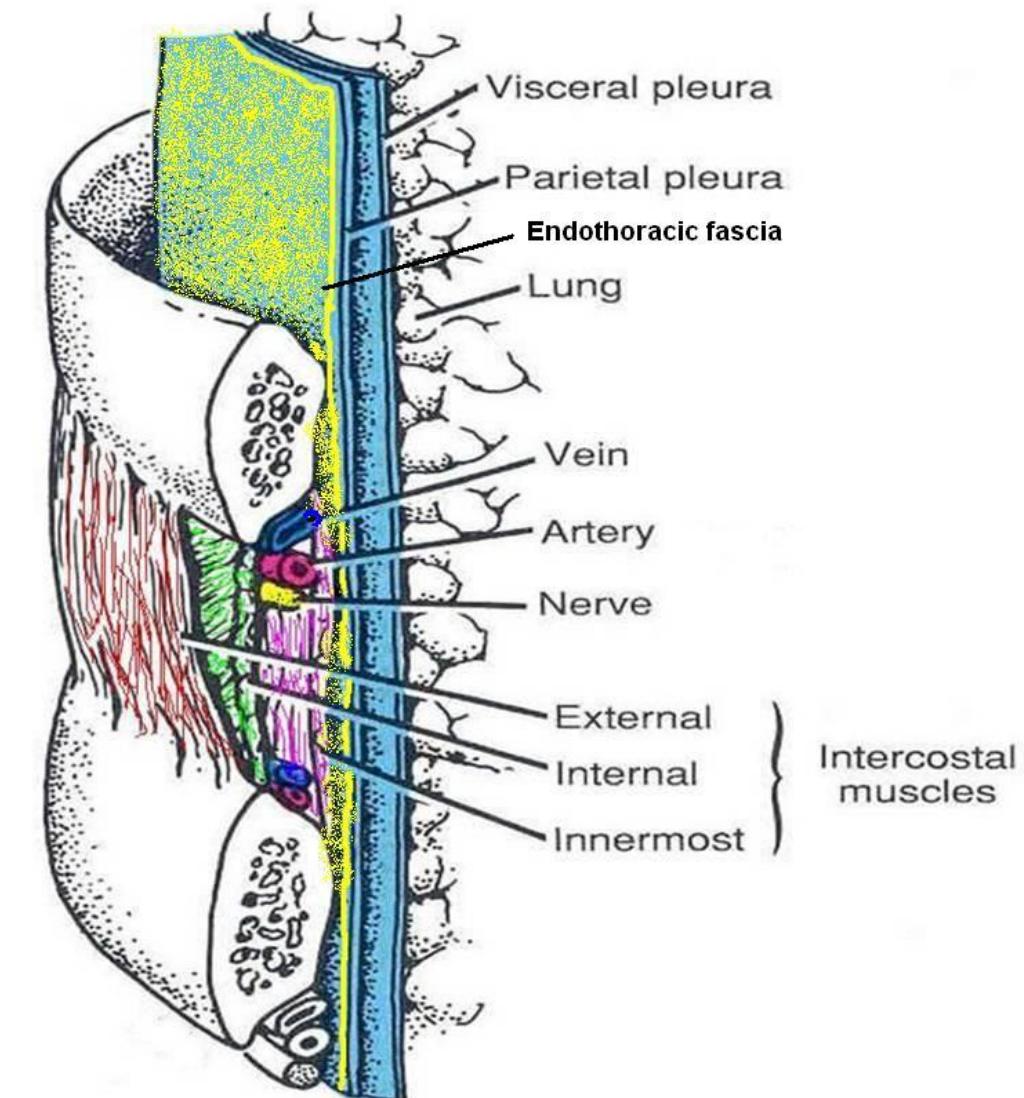
Endothoracic Fascia

- It is the extrapleural fascia that lines the wall of the chest
- It is located between the muscles and bones of the thoracic wall and the parietal pleura, extends over the apex (cupola) of the pleura as the suprapleural membrane, and forms a thin layer between the diaphragm and the pleura.



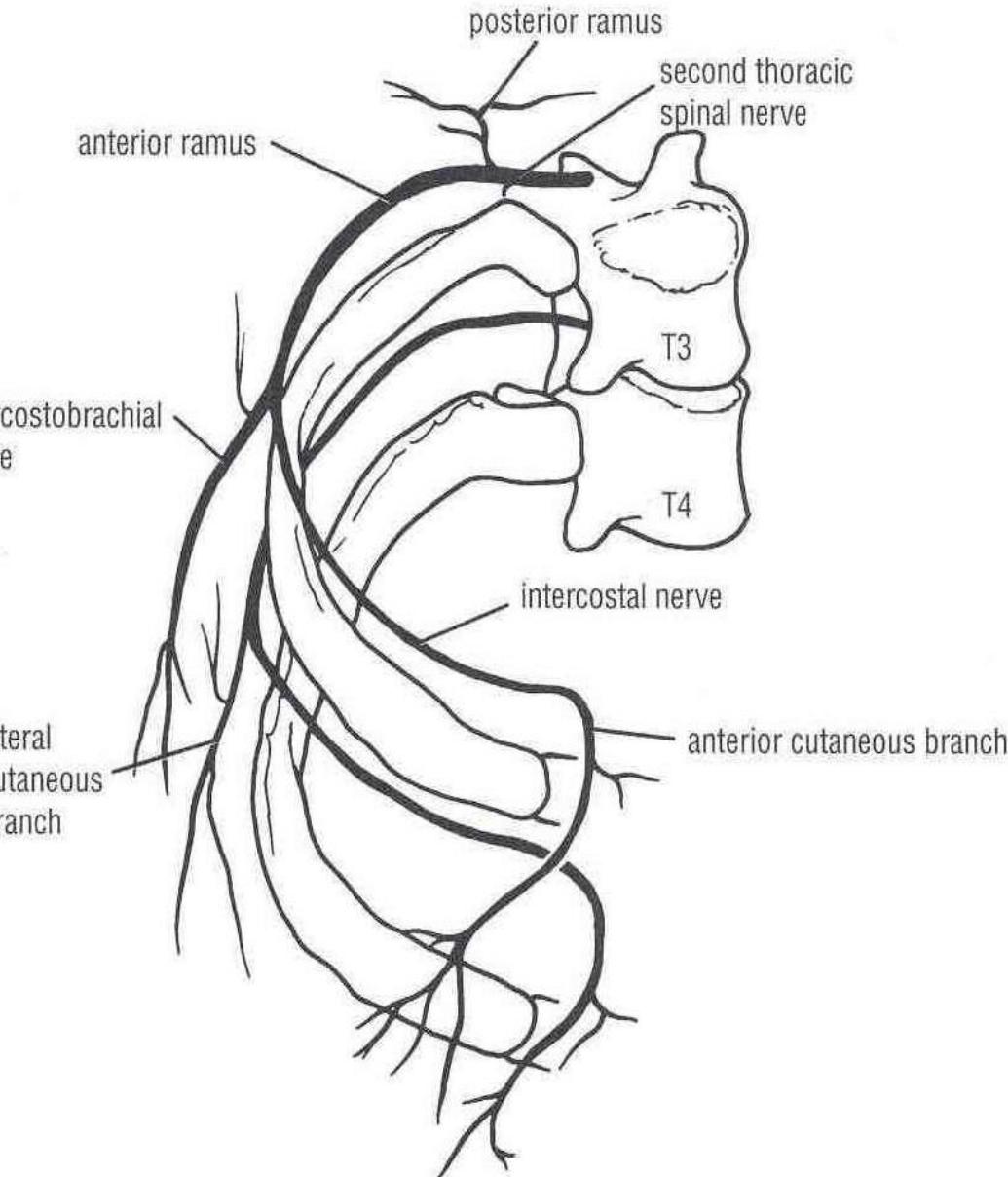
Endothoracic Fascia

- Lies between the innermost and the internal intercostal muscles
- Runs high in the intercostal space, related to subcostal groove of the rib above
- Has a strict order in arrangement: Vein-Artery-Nerve (VAN), from top to bottom
- As the innermost intercostal muscle is not forming a complete layer, the bundle is generally covered on the inside by the endothoracic fascia



Intercostal Nerves

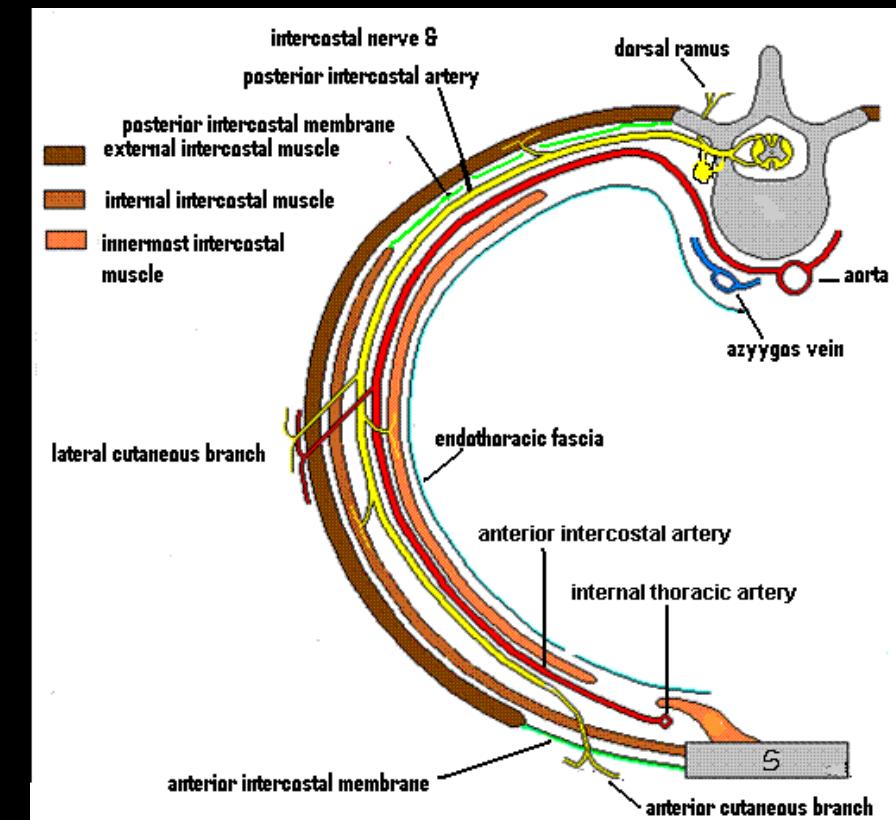
- **Twelve pairs**
- **Are the anterior primary rami of the thoracic spinal nerves.**
- **1-6 distributed in the intercostal spaces, 7-11th supply the anterior abdominal wall**
- **Anterior ramus of 12th nerve runs forward in the abdomen as the subcostal nerve**

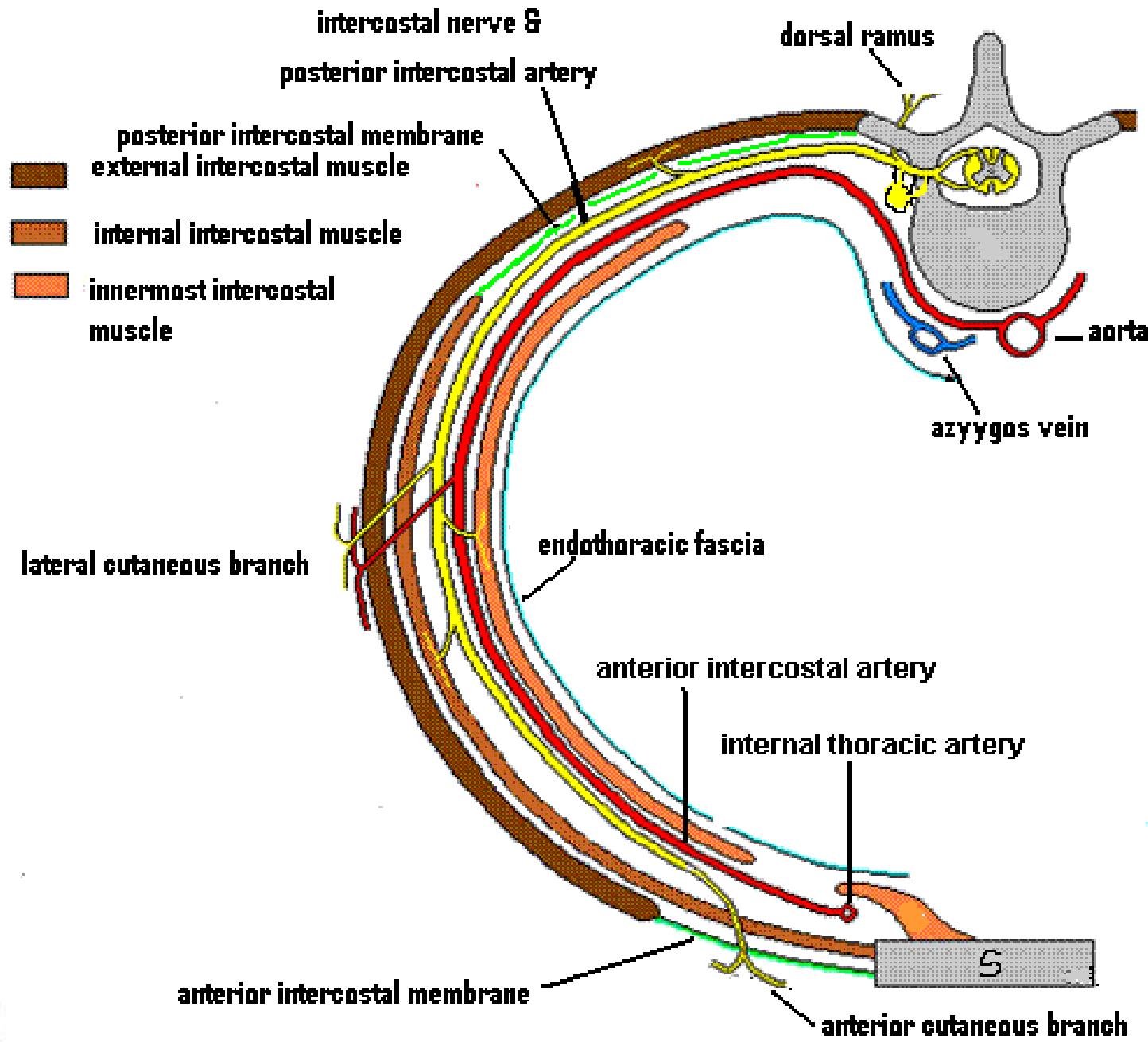


Intercostal Nerves cont'd

- These are mixed nerves & supply the:
 - The skin
 - Muscles of the intercostal space & abdomen
 - The parietal pleura & parietal peritoneum

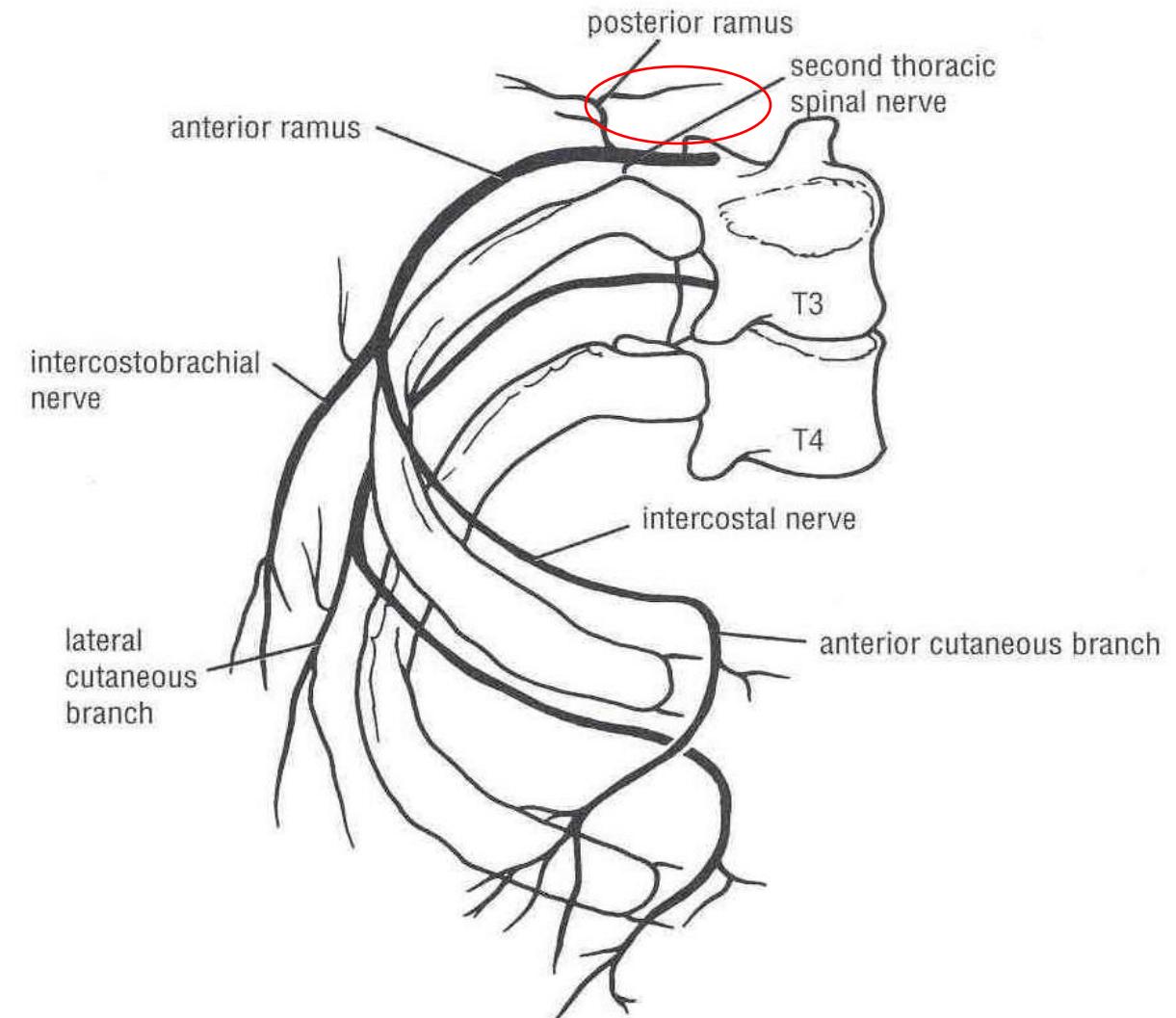
- Branches:
 - Rami communicantes
 - Collateral branches
 - Lateral cutaneous
 - Anterior cutaneous
 - Muscular branches
 - Pleural
 - Peritoneal (7th-11th)





Atypical Intercostal Nerves

- **First thoracic nerve:**
 - Has no anterior cutaneous branch
 - Is joined to the brachial plexus by a large branch that corresponds to the lateral cutaneous branch
- **Second thoracic nerve :**
 - Is joined to the medial cutaneous nerve of the arm by brachial plexus by a branch called the intercostobrachial nerve that corresponds to the lateral cutaneous branch

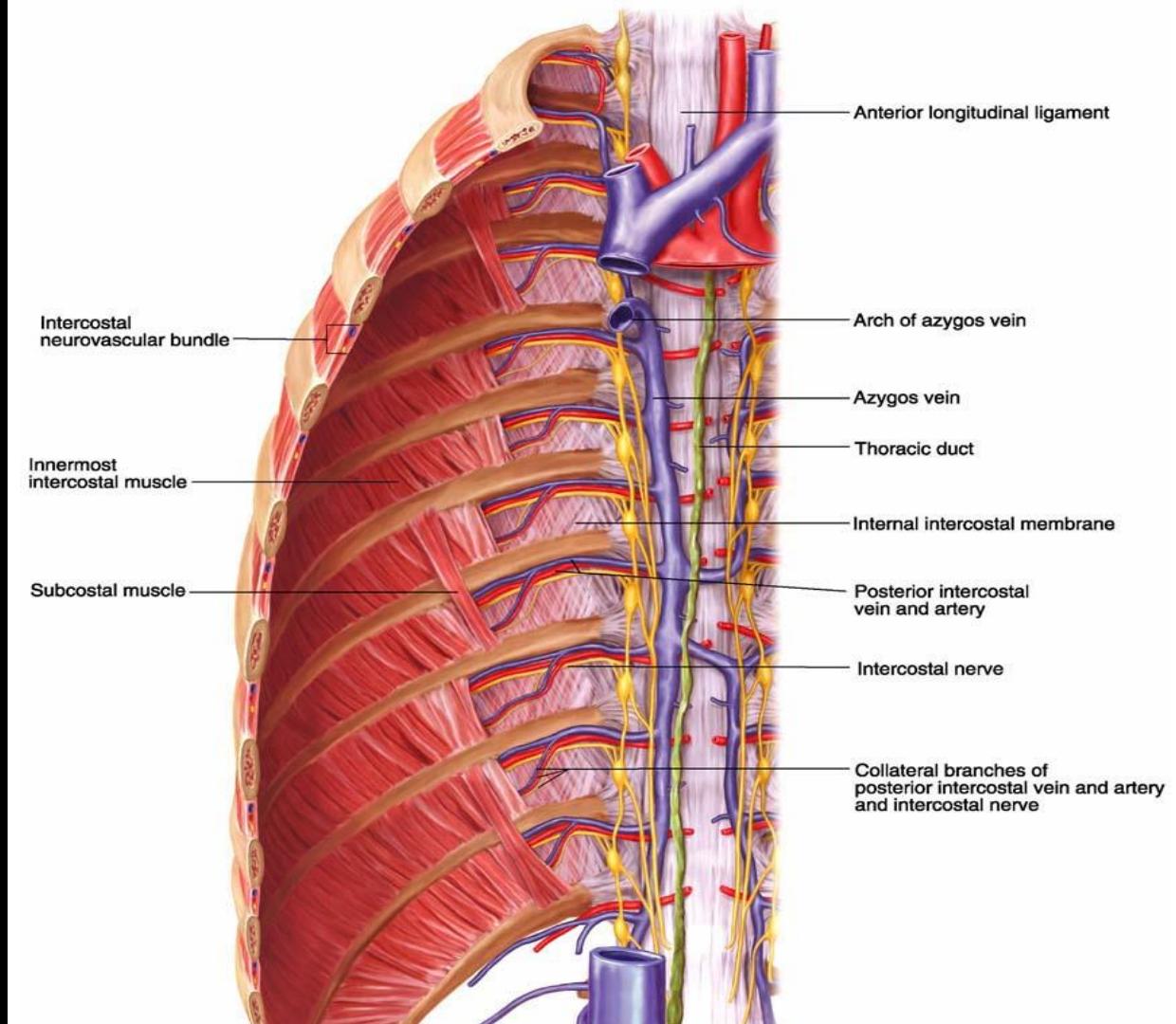


Intercostal Arteries

- Each intercostal space contains:
 - A single posterior &
 - Two anterior intercostal arteries
- Each artery gives off branches to the muscles, skin, parietal pleura (& breast)

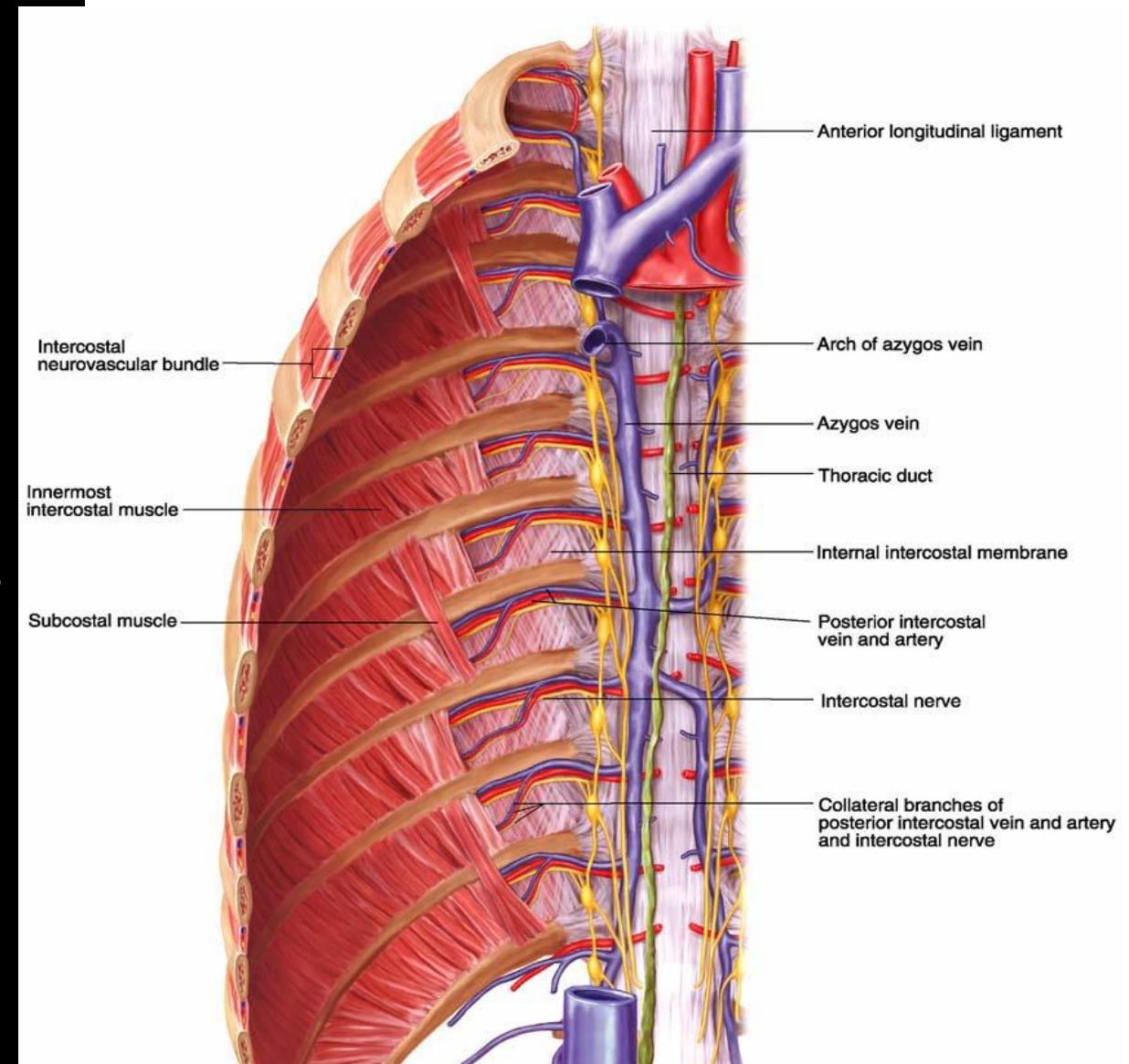
Posterior Intercostal Arteries

- In the upper two spaces, arise from the superior intercostal artery (a branch of costocervical trunk of the subclavian artery)
- In the lower nine spaces, arise from the branches of thoracic aorta
- The course and branching of the intercostal arteries follow the intercostal nerves

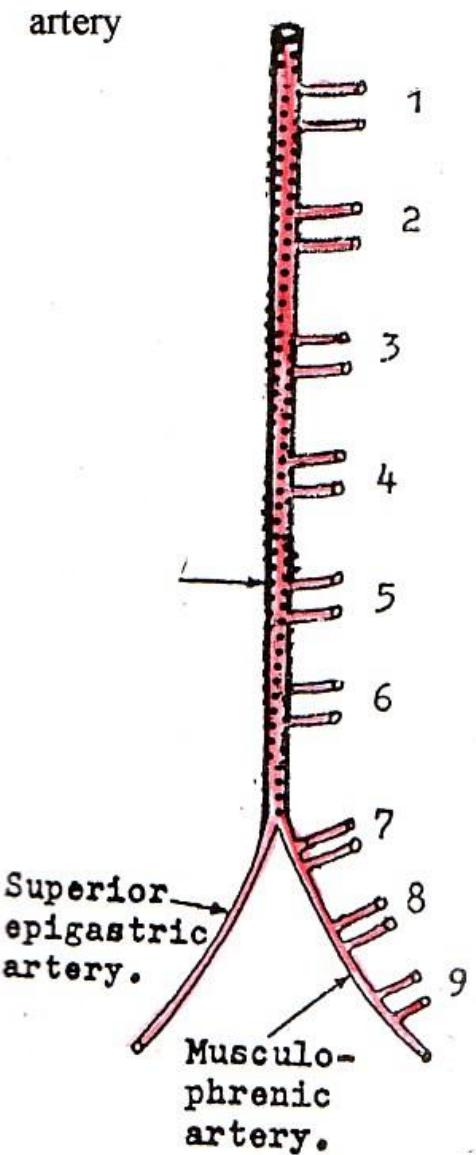
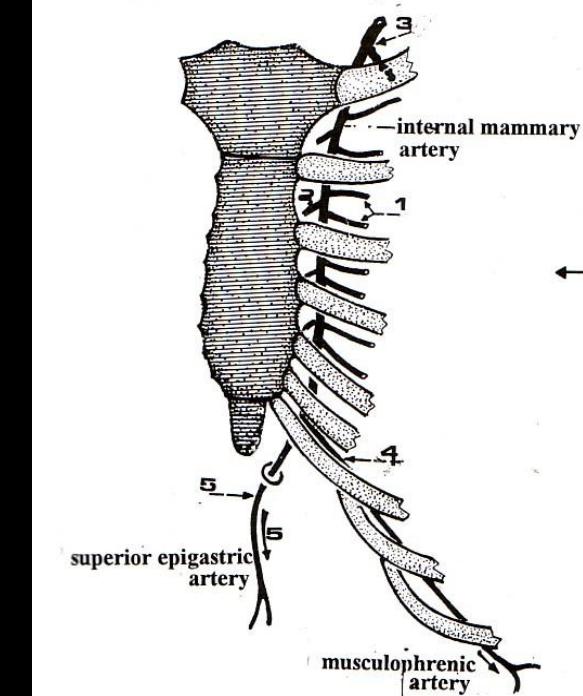


Intercostal Veins

- Accompany intercostal arteries and nerves
- Each space has posterior & anterior intercostal veins
- Eleven posterior intercostal and one subcostal vein
- Lie deepest in the costal grooves
- Contain valves which direct the blood posteriorly



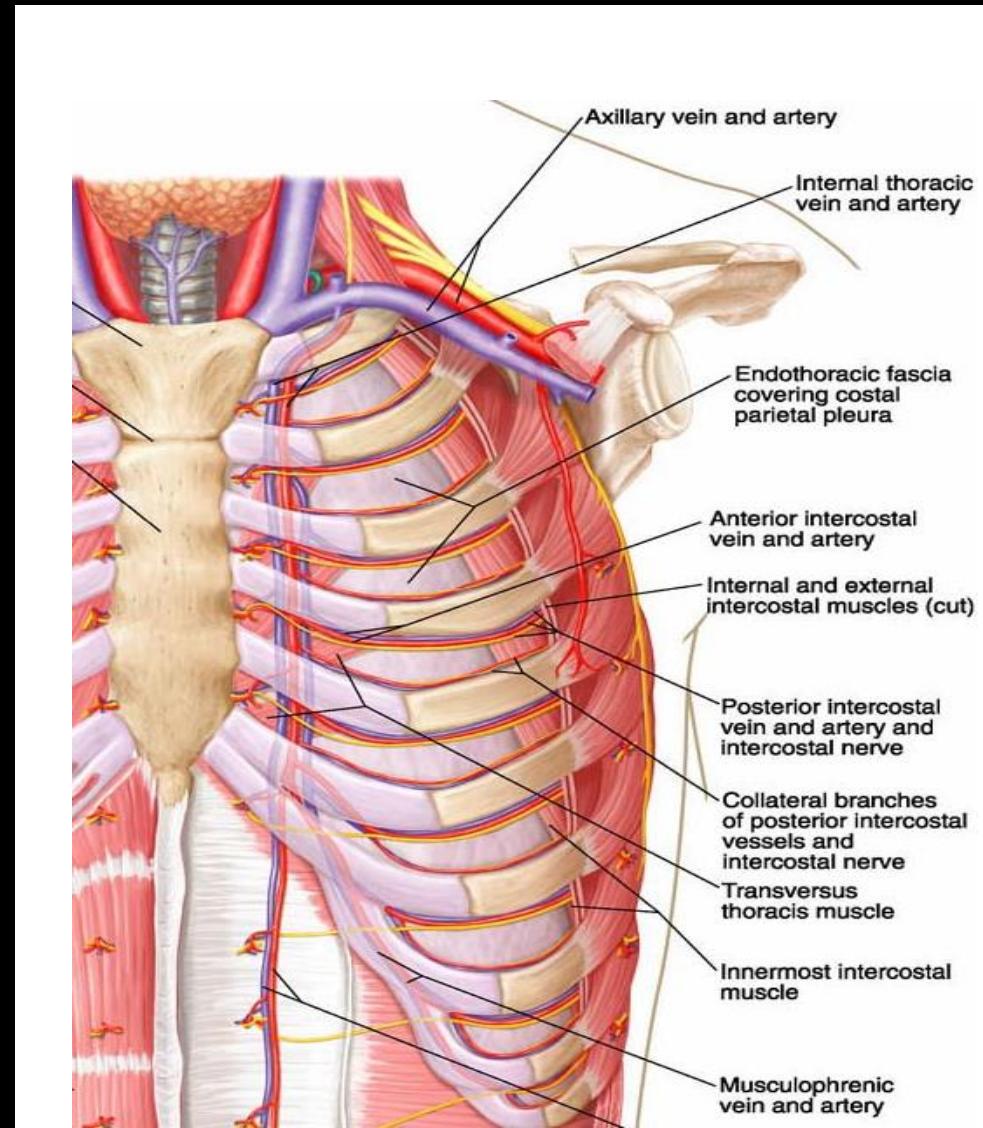
- Anterior Intercostal arteries
- 2 small arteries in each of the 9 spaces.
- The upper 6 from internal mammary artery
- The lower 3 from musculophrenic artery
- NB. Internal mammary or internal thoracic artery is a branch from 1st part of subclavian artery



Origin of the anterior intercostal arteries

Anterior Intercostal Arteries

- In the upper six spaces, arise from the internal thoracic artery
- In the lower five spaces arise from the musculophrenic artery (one of the terminal branch of internal thoracic)
- Form anastomosis with the posterior intercostal arteries



Posterior Intercostal Veins

- On right side:

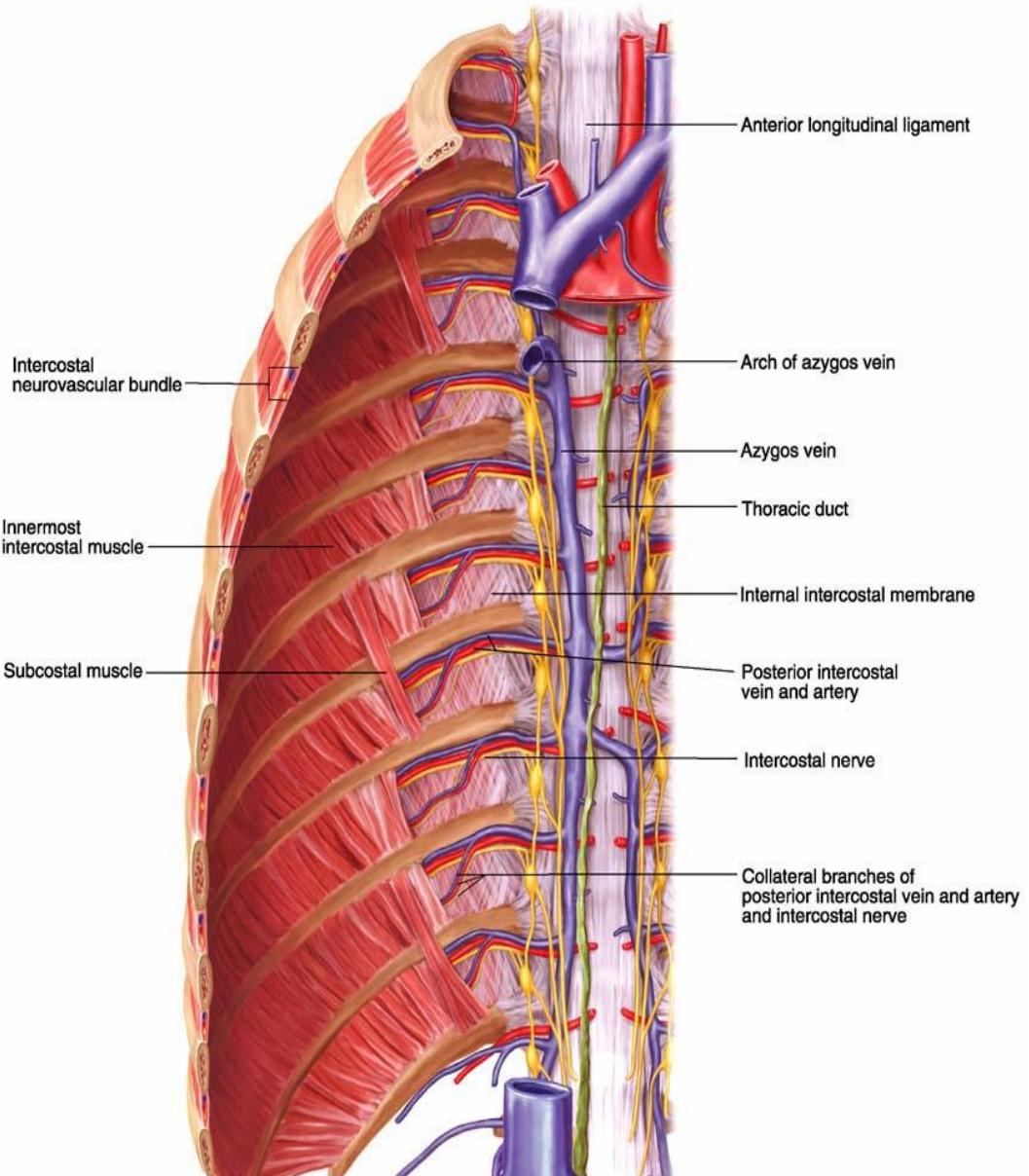
The first space drains into the right brachiocephalic vein

Rest of the intercostal spaces drain into the azygos vein

- On left side:

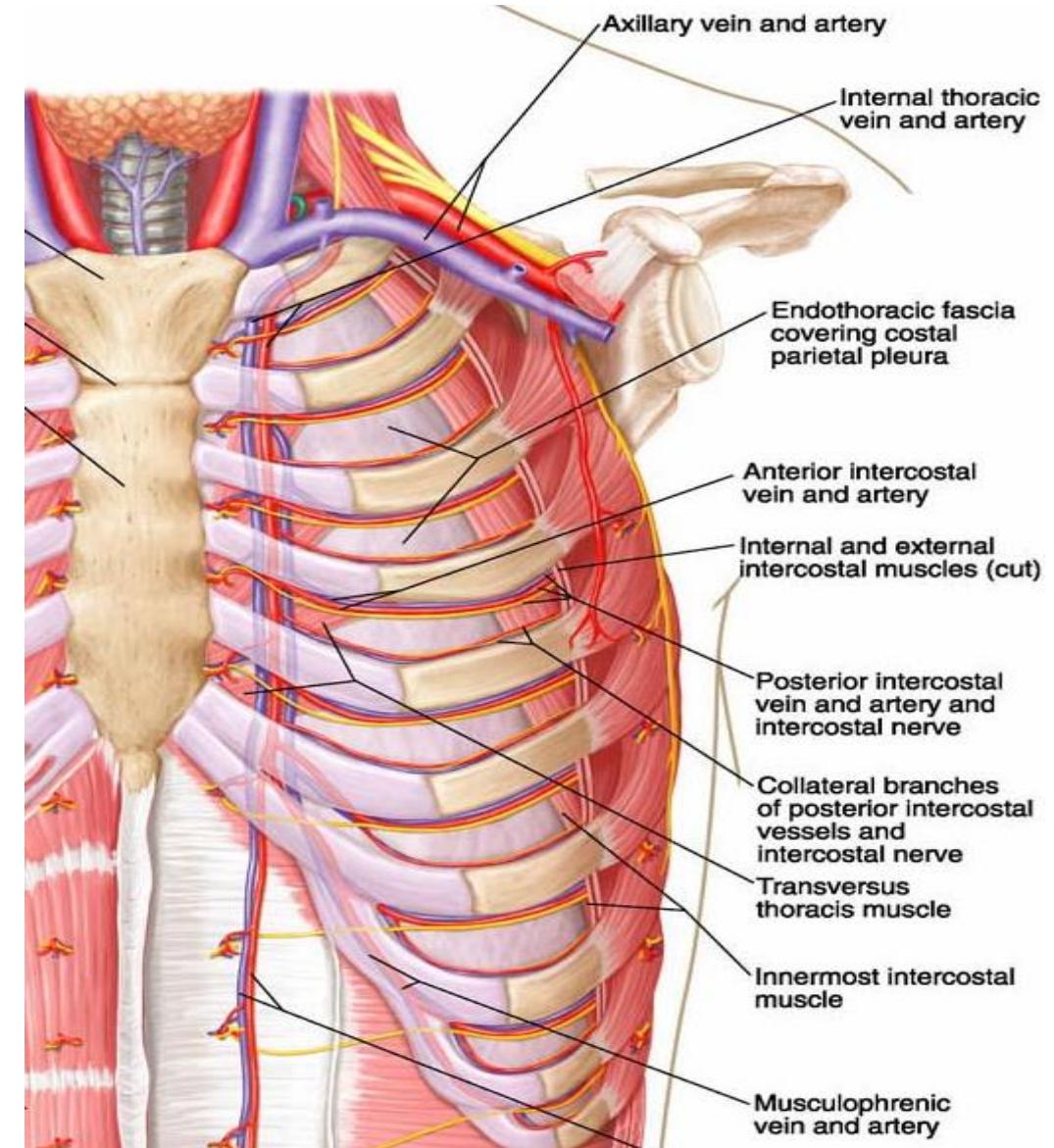
The upper three spaces drain into the left brachiocephalic vein.

Rest of the intercostal spaces drain into the hemiazygos and accessory hemiazygos veins, which drain into the azygos vein



Anterior Intercostal Veins

- The lower five spaces drain into the musculophrenic vein (one of the tributary of internal thoracic vein)
- The upper six spaces drain into the internal thoracic vein
- The internal thoracic vein drains into the subclavian vein.



Lymphatics

- Lymph vessels of the intercostal space conform to the general rule, that deep lymphatics follow arteries
 - Anteriorly drain into anterior intercostal nodes that lie along the internal thoracic artery
 - Posteriorly drain into posterior intercostal nodes that lie in the posterior mediastinum

Applied Anatomy

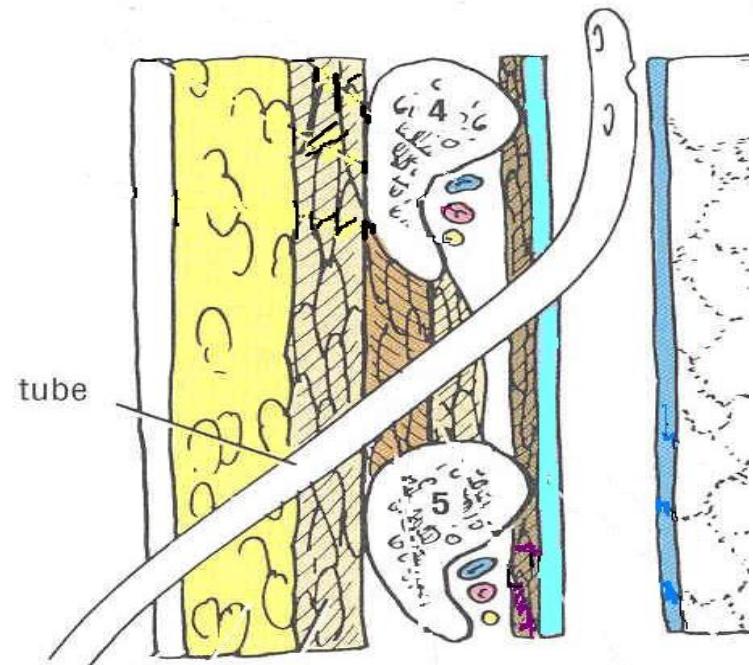
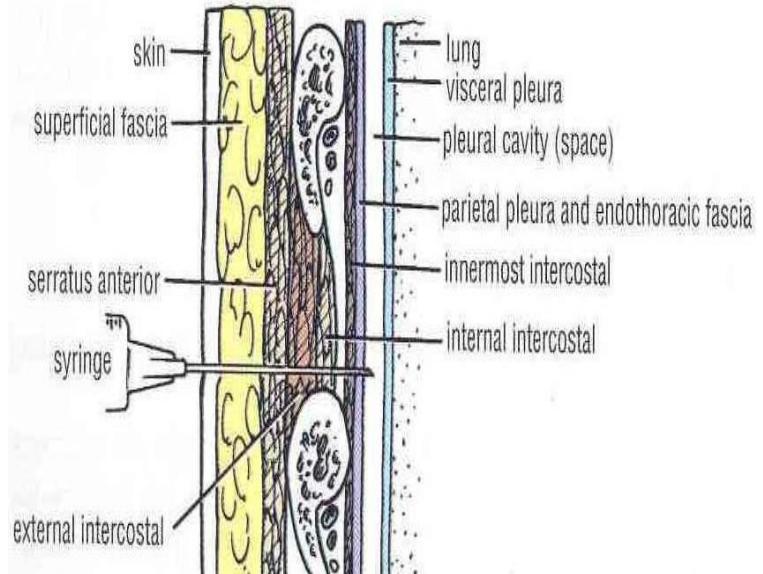
- **Sternum:**
 - used for marrow biopsy
 - May be split to make surgical access to heart, great vessels and thymus
- **Sternal angle as an important landmark for counting ribs, costal cartilages and intercostal spaces**
- **Thoracic outlet syndrome: Compression of nerves /vessels at the superior aperture of thorax**
- **Cervical rib**
- **Referred pain: Disease in the thorax may reveal pain in the anterior abdominal wall.**

Applied Anatomy cont'd

- Traumatic injuries to the thorax:
 - Fracture of rib is extremely painful condition as periosteum of the rib is supplied by the intercostal nerves above & below the rib
 - Fractured rib may penetrate the lung (and produce pneumothorax) or may damage the upper abdominal organs
 - Injuries involving multiple ribs result in flail chest.
 - The flail segment is sucked in during inspiration and pushed out during expiration

Applied Anatomy cont'd

- The intercostal spaces are important access points for:
- Surgical procedures, e.g. resection of (part of) the lung
- Percussion and auscultation of underlying structures e.g. heart & lung
- To obtain a sample of pleural fluid or drain pus/blood from the pleural cavity. The needle/drain is passed through the intercostal space just above the upper border of the rib to avoid the neurovascular bundle .



Intercostal Nerve Block

- This procedure involves infiltration of anesthetic around the intercostal nerve trunk and its collateral branches

