THORACIC WALL, ABDOMINAL REGION, MUSCLES OF THE VERTEBRAL COLUMN

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I. THORAX

region between neck and abdomen, Chest
includes the primary organs of the respiratory and cardiovascular systems.

Thoracic wall
bounds the thoracic cavity formed by the skin, bones, fasciae, and muscles

Thoracic cavity
cavity between neck and abdomen
includes the heart and the lungs protected by the thoracic wall.

Thoracic cage
bony portion of the thoracic wall “Thoracic skeleton”

Thoracic skeleton

Formed

POSTERIORLY 12 thoracic vertebrae and the posterior parts of the ribs
ANTERIORLY sternum and costal cartilages
separated from each other by the intercostal spaces laterally.

The thorax is one of the most dynamic regions of the body. Although the joints between the bones of the thorax have limited movement ability, the whole outcome of these movements permits expansion of the cavity during inspiration. During inspiration, the thoracic cavity can expand in antero-posterior, vertical and transverse dimensions.

Functions of the thoracic wall

- Protects vital thoracic and abdominal organs
- Resists the negative (sub-atmospheric) internal pressures generated by the elastic recoil of the lungs and inspiratory movements.
- Provides attachment for and support the weight of the upper limbs.
- Provides the origins of many of the muscles that move and maintain the position of the upper limbs relative to the trunk.
- Provides attachments for muscles of the abdomen, neck, back, and respiration.

The thoracic cage is open superiorly and inferiorly; superior and inferior thoracic apertures.

The superior thoracic aperture is bounded:

- Posteriorly, by vertebra T1 (body of T1 protrudes anteriorly into the opening)
- Laterally, by the 1st pair of ribs and their costal cartilages
- Anteriorly, by the superior border of the manubrium

Structures pass between thoracic cavity & neck via oblique/kidney-shaped Superior Thoracic Aperture:

- Trachea, esophagus, nerves, and vessels that supply and drain the head, neck, and upper limbs

The inferior thoracic aperture is bounded: (larger, ring-like origin of diaphragm)

- Posteriorly, by 12th thoracic vertebra (body of T12 protrudes anteriorly into the opening)
- Posterolaterally, by 11th & 12th pairs of ribs
- Anterolaterally, by costal margins (joined costal cartilages of ribs 7-10)
- Anteriorly, by xiphisternal joint

Diaphragm

- completely occludes the opening (inferior thoracic aperture).
- separates the thoracic and abdominal cavities almost completely.
- primarily controls the volume/internal pressure of the thoracic cavity.
- provides the basis for air exchange.
- protrudes upward so that upper abdominal viscera (e.g., liver) receive protection from the thoracic cage.

Through this large opening, closed by the diaphragm pass

- Esophagus
- Large vessels (Thoracic aorta becomes abdominal aorta, Inferior vena cava goes up to the heart, azygos vein)
- Thoracic duct
- Vagus, phrenic nerves

Muscles of the thoracic wall

1) Serratus posterior muscles
2) Levator costarum muscles
3) Intercostal muscles (External, internal and innermost)
4) Subcostal muscle
5) Transverse thoracic muscle

These muscles either elevate or depress the ribs helping to increase the volume of the thoracic cavity. The diaphragm is a shared wall (actually floor/ceiling) separating the thorax and abdomen. Although it has functions related to both compartments of the trunk, its most important (vital) function is serving as the primary muscle of inspiration.

Accessory muscles of respiration

The movement of the diaphragm alone is sufficient for normal and quiet breathing. Extra physical exercise (Usain Bolt while breaking a world record, or someone running to catch a public bus; when you need extra energy in a short time; as in stress response) and pulmonary diseases (with difficulty in breathing; dyspnea) increases the work of breathing.

Under these conditions one needs extra muscles; accessory muscles to work in order to breathe properly. The upper accessory muscles assist with inspiration; and the upper chest, and abdominal muscles assist with expiration.

MUSCLES OF INSPIRATION
Diaphragm (main muscles of inspiration/contracts → moves down → more space for inspiration)
External intercostal muscles (E opposite for I)
Scalene muscles (moving the 1st and 2nd ribs up; more space)
Serratus posterior superior
Levatores costarum
SCM (Sternocleidomastoid muscle)

MUSCLES OF EXPIRATION (passive; diaphragm relaxes, moves up, less space, expiration)
Internal intercostal muscles (I opposite for E)
Serratus posterior inferior
Subcostalis & Transverse thoracis
Anterolateral abdominal wall muscles
Quadratus lumborum (fixing the last rib)

Muscles, Vessels & Nerves of the Thoracic Wall

The arterial supply to the thoracic wall derives from the:
• Thoracic aorta, through the posterior intercostal and subcostal arteries.
• Subclavian artery, through the internal thoracic and supreme intercostal arteries.
• Axillary artery, through the superior and lateral thoracic arteries.

The intercostal veins accompany the intercostal arteries, nerves and lie most superior in the costal grooves (VAN). The 12 pairs of thoracic spinal nerves supply the thoracic wall.

Pectoral region
Anterior part of thoracic wall.

4 muscles here! They move the pectoral (shoulder) girdle!
pectoralis major, pectoralis minor, subclavius, & serratus anterior

The first 3 between anterior thoracic wall & bones of the upper limb
Serratus anterior to the scapula.

Pectoralis major
largest & most superficial of the pectoral region muscles
• Powerful adduction & Medial rotation of arm!
• Large, Fan-shaped muscle → covers the superior part of thorax.
• Underlies the breast. Breast lie over the pectoralis major!
Pectoralis major-Deltoid form deltopectoral groove) ➔ “Cephalic vein” here!

The subclavius and pectoralis minor muscles underlie pectoralis major. Both subclavius and pectoralis minor pull the tip of the shoulder inferiorly.

Serratus anterior
• strong protractor of the scapula
• used when punching or reaching anteriorly (sometimes called the “boxer’s muscle”).
• holds the scapula against the thoracic wall when doing push-ups or when pushing against resistance (e.g., pushing a car).
**BREASTS**

most prominent superficial structures in the anterior thoracic wall (pectoral region) in women

- **Important**
  1. Reproduction
  2. Back pain
  3. Aesthetics
  4. Breast cancer

- **Consist of**
  mammary glands and associated skin and connective tissues.

Mammary glands ➔ modified sweat glands @ superficial fascia @ anterior thoracic wall.

Have a series of ducts and associated secretory lobules. ➔ converge to form 15 to 20 lactiferous ducts.

Lactiferous ducts (milk) open independently onto the nipple.

- **Nipple** surrounded by areola (L. small area) circular pigmented area of skin
- The mammary glands within the breasts are accessory to reproduction in women. They are rudimentary and functionless in men, consisting of only a few small ducts or epithelial cords.

**FEMALE BREASTS**

The amount of fat surrounding the glandular tissue determines the size of non-lactating breasts.

- In nonlactating women ➔ dominant component fat
- In lactating women ➔ dominant component glandular tissue

The roughly circular body of the female breast rests on a bed that extends transversely from the lateral border of the sternum to the mid-axillary line and vertically from the 2nd through 6th ribs.

The mammary gland is firmly attached to the dermis of the overlying skin, especially by the suspensory ligaments (of Cooper).

- Most lymph (>75%), especially from the lateral breast quadrants, drains to the axillary lymph nodes.
- Lymph from breast ➔ first ➔ anterior (pectoral) lymph nodes ➔ finally to apical lymph nodes @ apex of axilla!

- Some lymph from breasts, particularly from the medial breast quadrants, ➔ parasternal lymph nodes or to the opposite breast.

- Lymph from inferior quadrants may pass deeply to abdominal lymph nodes.

**2. ABDOMINAL REGION**

Abdominal wall covers a large area.

- **Superior border**: Xiphoid process & right & left costal margins
- **Posterior border**: Vertebral column
- **Inferior border**: Upper parts of hip bones

Layers of the abdominal wall

- **Skin**
- **Superficial fascia (Subcutaneous tissue=**
- **Muscles & their deep fascias**
- **Extraperitoneal fascia**
- **Parietal peritoneum**

5 muscles @ antero-lateral abdominal wall
2 muscles @ posterior abdominal wall
5 muscles @ antero-lateral abdominal wall

**3 flat muscles**

1. External oblique
2. Internal oblique
3. Transversus abdominis

**2 flat muscles near the midline**

1. Rectus abdominis
2. Pyramidalis
Rectus abdominis covered by aponeuroses of the 3 flat muscles.

Antero-lateral abdominal muscles fxns:
1) Flexion of the trunk
2) A firm, but flexible, wall ⇒ keeps the abdominal viscera within the abdominal cavity
3) Protects the viscera from injury
4) Helps maintain the position of the viscera in the erect posture against the action of gravity
5) Assists in both quiet and forced expiration by pushing the viscera upward (which helps push the relaxed diaphragm further into the thoracic cavity)
6) Increases intra-abdominal pressure, including parturition (childbirth), urination, defecation (expulsion of feces from the rectum), vomiting, and coughing.

2 muscles @ posterior abdominal wall
1) Iliopsoas ⇒ Psoas major + Iliacus  Main flexor of thigh, Moves the body up from supine position to erected position also anterior thigh muscle or anterior pelvic girdle muscle
2) Quadratus lumborum  Unilateral contraction ⇒ Lateral flexion of the trunk; expiration muscle = fix rib XII

Inguinal canal
- slit-like passage
Above & parallel to lower half of inguinal ligament (formed by aponeurosis of external abdominal oblique)

Inguinal ligament formed by aponeurosis of external abdominal oblique

Contents of the inguinal canal
- Genital branch of genitofemoral nerve
- Spermatic cord (in men)
- Round ligament of uterus (in women)

Inguinal canal ==4 cm== between dep & superficial inguinal rings
- Deep (internal) inguinal ring @ beginning of the inguinal canal.
- Superficial (external) inguinal ring @ end of the inguinal canal superior to pubic tubercle.
- Opening @ aponeurosis of external oblique.

Inguinal hernia ⇒ protrusion of a peritoneal sac (with /without abdominal contents) through a weakened part of the abdominal wall in the groin.

Peritoneal sac enters the inguinal canal
- Indirectly, through the deep inguinal ring
- Directly, through the posterior wall of the inguinal canal.

3. Muscles of the vertebral column

2 major groups of muscles in the back:
- Extrinsic back muscles ⇒ superficial and intermediate muscles produce and control limb and respiratory movements, respectively.
- Intrinsic (deep) back muscles ⇒ specifically act on the vertebral column, produce its movements and maintaining posture.

Muscles in the superficial and intermediate groups are extrinsic muscles because they originate embryologically from locations other than the back. Innervated by anterior rami of spinal nerves.
- Superficial group consists of muscles related to and involved in movements of the upper limb;
- Intermediate group consists of muscles attached to the ribs and may serve as a respiratory function.

Muscles in the superficial group
- Trapezius
- Latissimus dorsi
- Rhomboid major
- Rhomboid minor
- Levator scapulae
- Rhomboid major/minor & Levator scapulae ⇒ Deep to trapezius @ superior part of back anterior rami of cervical nerves and act on the upper limb
- Trapezius ______ motor fibers from a cranial nerve, the spinal accessory nerve (CN XI).

Trapezius
- attaches the pectoral girdle to the cranium and vertebral column.
- assists in suspending the upper limb.
- Latissimus dorsi (L. widest of back)
- covers a wide area of the back.
- large, flat triangular muscle
begins in the lower portion of the back and tapers as it ascends to a narrow tendon
attaches to the humerus anteriorly.

extension, adduction, and medial rotation of the upper limb.

Levator scapulae acts with the descending part of the trapezius to elevate the scapula, or fix it (resists forces that would depress it, as when carrying a load.
The rhomboids (major and minor) form broad parallel bands from the vertebrae to the medial border of the scapulae.

**Muscles in the intermediate group**

Two thin muscular sheets in the superior and inferior regions of the back, immediately deep to the muscles in the superficial group; serratus posterior superior and serratus posterior inferior muscles. These muscles are related to the movements of the thoracic cage.

**Intrinsic Back Muscles - according to their relationship to the surface**

1. **Superficial**
   - Splenius muscles
   - Splenius capitis et. cervicis

2. **Intermediate**
   - Erector spinae - Chief extensors of the vertebral column

3. **Deep layers**
   - Semispinalis/Multifidus/Rotatores
   - Erector spinae: lie in a “groove” on each side of the vertebral column between spinous processes centrally & angles of the ribs laterally.
The interspinales, intertransversarii, and levatores costarum are minor deep back muscles that are relatively sparse in the thoracic region. The interspinal and intertransversarii muscles connect spinous and transverse processes, respectively.

**Suboccipital Region**

- muscle “compartment” deep to the superior part of the posterior cervical region
- under trapezius, sternocleidomastoid, splenius, and semispinalis muscles
- includes the posterior aspects of vertebrae C1 and C2

4 small muscles deep to the semispinalis capitis muscles: **two rectus capitis posterior (major and minor)**
**two obliquus capitis (superior and inferior) muscles.**

**Suboccipital Triangle:** A region of the neck bounded by the following 3 suboccipital muscles:

- Contents:
  1) Third part of vertebral artery
  2) Dorsal ramus of nerve C1-suboccipital nerve
  3) Suboccipital venous plexus

**Extrinsic back muscles**

- Superficial back muscles – produce & control limb movements
- Intermediate back muscles – produce & control respiratory movements
- Intrinsic (deep) back muscles specifically act on the vertebral column producing its movements and maintaining posture.
  - innervated by the **posterior rami of spinal nerves**
  - act to maintain posture and control movements of the vertebral column