MEDICAL EDUCATION RESOURCE

Ribs and Costal Cartilages

Introduction

- The **thorax** is an **osseocartilaginous cavity** that provides **protection and support** to vital thoracic viscera (heart, lungs, and great vessels).
- The thoracic cage is **dynamic**, not rigid—it moves at its joints to increase or decrease its diameters during **respiration**.
- **Functionally:**
    - Expansion = **Inspiration**
    - Contraction = **Expiration**

Bones of Thorax

- The skeleton of the thorax consists of:
    1. **12 thoracic vertebrae** (posteriorly)
    2. **12 pairs of ribs and costal cartilages** (laterally)
    3. **Sternum** (anteriorly)

Ribs (Costae)

- There are **12 ribs on each side** forming the major part of the thoracic skeleton.

- Number may vary (presence of cervical or lumbar rib; absence of 12th rib).

Features:

- Ribs are **bony arches**, one below another, with **intercostal spaces** in between.
- **Obliquity:** Increases up to the 9th rib, then decreases toward the 12th.
- **Length:** Increases from 1st to 7th; decreases thereafter.
- **Breadth:** Decreases from above downward.

Classification:

1. **According to articulation with sternum:**
    - **True ribs (1–7):** Attach directly to sternum via costal cartilages.
    - **False ribs (8–10):** Join cartilage of rib above (vertebrochondral).
    - **Floating ribs (11–12):** Free anterior ends (vertebral ribs).
2. **According to morphology:**
    - **Typical ribs:** 3rd–9th
    - **Atypical ribs:** 1st, 2nd, 10th, 11th, 12th

Typical Rib – Features

- Each rib has **two ends** and a **shaft**:

- **Anterior (sternal) end:** Oval and concave for costal cartilage.
- **Posterior (vertebral) end:** Head, neck, and tubercle.
- **Shaft:** Convex outward; **costal groove** along lower inner surface for **intercostal vessels and nerve**.

Side Determination:

- Head posterior, costal groove inferior, convexity lateral.

Ossification of a Typical Rib

- Each typical rib ossifies from **three centers**:
  1. **One primary center** for the **shaft** (in 2nd month of fetal life).
  2. **Two secondary centers**—one for the **head**, one for the **tubercle** (appear at puberty and fuse by 20 years).

11th and 12th ribs:

- Ossify from **two centers** — one for shaft, one for head.

Costal Cartilages

- Represent the **unossified anterior parts** of ribs made of **hyaline cartilage**.
- Provide **elasticity** to thoracic wall.

Attachments:

- **1st–7th ribs:** Costal cartilages attach directly to sternum.
- **8th–10th ribs:** Join each other forming the **costal margin**.
- **11th–12th ribs:** Small, free ends in the abdominal wall muscles.

Muscle Attachments:

- **Anterior surface:**
  - 1st cartilage ? Subclavius, costoclavicular ligament.
  - 2nd–6th ? Pectoralis major.
  - Lower cartilages ? Abdominal wall muscles.
- **Posterior surface:**
  - 1st ? Sternothyroid.
  - 2nd–6th ? Sternocostalis.
  - 7th–12th ? Transversus abdominis and diaphragm.

Clinical Anatomy

- **Rib fractures:**
  - Common at the **angle** due to indirect trauma.
  - **Upper two ribs** protected by clavicle; **lower two** flexible—rarely fractured.

- **Cervical rib:**
    - Arises from C7, compressing **brachial plexus** or **subclavian artery** (Thoracic Outlet Syndrome).
- **Rib variations:**
    - Absence of 12th rib or presence of extra cervical/lumbar ribs possible.
- **Costochondritis:**
    - Inflammation at costochondral junction causing chest pain mimicking cardiac pain.

Summary Table

STRUCTURE	FEATURE / FUNCTION
True ribs	1st–7th, attach to sternum
False ribs	8th–10th, join cartilage above
Floating ribs	11th–12th, free anteriorly
Ossification centers	Shaft (primary), head & tubercle (secondary)
Costal cartilage	Hyaline cartilage, elasticity to thorax
Common fracture site	Rib angle
Clinical relevance	Rib fracture, cervical rib, costochondritis