LIVING ANATOMY: IMPLICATIONS OF RESPIRATION

CONVOCATION
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“I believe you are taught anatomy in our school more thoroughly than any other school to date, because we want you to carry a living picture of all or any part of the body in your mind....”

Andrew Taylor Still, MD,DO
RESPIRATORY VOLUME CURVE
ELASTIC RECOIL
CHEST WALL

- Semi-rigid cylinder
- Allows body movement
- Protects organs
- Prevents tissue collapse during pressure gradient development within thoracic cavity
- Anchor against which diaphragm can work
THORACIC CAGE

- Ribs, spine, sternum, costal cartilage
- 105 articulations
  - Costovertebral
  - Costotransverse
  - Costochondral
  - Chondrosternal
  - Sternomanubrial
  - facet
BONEY THORAX

- Ribs
- spine
- sternum
- Costal cartilage
COSTOVERTEBRAL JOINTS

- Ribs 2-11 articulate with two vertebral bodies and the intervertebral disc.
- Each rib articulates with the transverse process of a vertebrae.
COSTAL CARTILAGE
STERNUM
STERNUM
SCALENES

- Initiate respiration
- Anterior, middle, posterior
- Origin: transverse process C3 – C7
- Insertion: ribs 1 and 2
TRANSVERSUS ABDOMINIS

- **Exhalation**
- **Fibers horizontally oriented, like a belt**
- **Origin:**
  - *inner* surface cartilage
  - last six ribs
  - Thoracolumbar fascia
  - Iliac crest / inguinal ligament
- **Insertion:**
  - Rectus aponeurosis
EXTERNAL OBLIQUE ABDOMINIS

- Exhalation
- Origin: lateral boarders of lower eight ribs
- Insertion: rectus aponeurosis, anterior iliac crest
- Fibers oriented diagonally downward
INTERNAL OBLIQUE
ABDOMINIS

- Exhalation
- Origin: cartilage lower three ribs, rectus aponeurosis
- Insertion: iliac crest and inguinal ligament
- Fibers run diagonally upward
QUADRATUS LUMBORUM

- Inserts on 12th rib
  - Transverse process of L1-L4
  - Iliac crest
  - Lateral to psoas
  - Complex muscle:
    - Vertical fibers
    - 2 sets of oblique fibers

- Acts against upward pull of diaphragm on 12th rib
- Holds 12th rib down
- Activates in response to diaphragm, after beginning of inspiration
DIAPHRAGM

- Primary muscle of respiration
- Separates abdomen and thorax
- Allows abdominal contents to function like a piston
Global influence on body:
- Muscles of mouth, pharynx
- Abdominal and thoracic organ motion
- Postural effects
- Has continuous anterior and posterior fascial connections with pelvis and skull
DIAPHRAGM

- Central tendon
  - Flexible aponeurosis designed to resist pulling forces
  - Attachment site for muscle fibers
- Hiatus for Inferior vena cava
- Anterior attachment to pericardium
DIAPHRAGM

- Costal fibers
- Innervation: **Phrenic nerves** (2)
- Origin: central tendon
  - Shortest anteriorly
  - Longest posteriorly
- Insertion: Sternum, Inner surface lower six ribs, Posterior arcuate ligament,
  - 12th rib
  - Psoas
  - Quadratus lumborum
DIAPHRAGM

- Crural fibers
  - Pillars of diaphragm
  - Derivative dorsal esophageal mesentery

- Innervation: Vagus

- Hiatus:
  - Aorta
  - esophagus

- Insert on L3 to L4 vertebrae
DIAPHRAGM POWER
DIAPHRAGM POWER
DIAPHRAGM POWER
ABDOMINAL ORGANS SUSPENDED FROM SPINE
MOTION IMPORTANT FOR CANCER TREATMENT

- Tumors decrease motion of tissue
- Respiration moves tumor in and out of treatment field
- Must decrease dose to tumor to prevent damage to healthy tissue
RESPIRATORY MOTION

- Inhalation moves abdominal organs
  - Superior → Inferior
  - Posterior → Anterior
HYSTERESIS

- Organ does not exactly retrace its path during a respiratory cycle
INSPIRATORY EFFECT ON KIDNEY MOTION [15]
ORGAN HYSTERESIS [12]
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AVERAGE ORGAN MOTION
4-D CT: superior/inferior [12]

- **LIVER**
  - 1.3 cm

- **SPLEEN**
  - 1.3 cm

- **RIGHT KIDNEY**
  - 1.3 cm

- **LEFT KIDNEY**
  - 1.1 cm
KIDNEY LESIONS
ULTRASOUND EVALUATION
[15]

- Normal /
  less than 1 cm:   Right: 2.5cm  Left: 1.8cm
- Lesion 1-2 cm:   Right: 2.3cm  Left: 1.5cm
- Lesion 2+ cm:    Right: 1.9cm  Left: 1.3cm
“Keep your minds full of pictures of the normal body all the time while treating the afflicted”

Andrew Taylor Still, MD, DO
REFERENCES:

2. A.T. Still, *Philosophy of Osteopathy*; 1899, 4th reprint, AAO
REFERENCES


