

Thorax

skeleton, joints, muscles; blood supply, venous, and lymphatic drainage, and innervation of thoracic wall, mammary gland, mediastinum, heart

Thorax boundaries	upper part of trunk, box for vital organs external upper: 1/ jugular notch 2/ clavicle 3/ acromion of scapula 4/ spinous process of C7 (vertebra prominens) external lower: 1/ xiphoid process 2/ left and right costal arches 3/ vertebra Th12 internal upper: superior thoracic aperture (made from jugular notch, 1st pair of ribs, vertebra Th1) internal lower: inferior thoracic aperture (full filled by diaphragm)
Orientation lines	unpaired: 1/ anterior median line 2/ posterior median line paired: 1/ sternal line 2/ parasternal line 3/ mid-clavicular line 4/ anterior axillary line 5/ middle axillary line 6/ posterior axillary line 7/ scapular line 8/ paravertebral line

Thoracic wall

Layers of thoracic wall	1st layer (proper thoracic wall): 1/ osteothorax (ribs, sternum, thoracic vertebrae + their joints) 2/ proper muscles of thoracic wall (intercostal muscles, transverse thoracic m., subcostal mm.) 3/ intrinsic muscles of back (erector spinae m.) 4/ intercostal neuro-vascular bundle (vein, artery, nerve) 5/ endothoracic fascia 6/ parietal pleura 2nd layer (middle): 1/ pectoralis fascia 2/ thoracohumeral mm. 3/ spinohumeral mm. 4/ spinocostal mm. 3rd layer (superficial): 1/ skin 2/ subcutaneous tissue + mammary gland 3/ superficial structures (supraclavicular nn., intercostobrachial nn., thoracoepigastric vv.)
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Thoracic vertebrae (12)	1/ body of vertebra – costal facets 2/ arch of vertebra – lamina and pedicle superior and inferior vertebral notch – intervertebral foramen vertebral foramen 3/ processes: transverse process – costal facets superior and inferior articular processes – superior and inferior articular facets spinous process
Ribs	12 pairs – costal bone, costal cartilage true ribs: 1st to 7th false ribs: 8th to 10th floating ribs: 11th to 12th costal bone: 1/ head of rib – articular facet of head (for costal facet of vertebra) crest of head of rib 2/ neck of rib – crest of neck of rib 3/ body of rib – tubercle of rib + articular facet (for transverse process of vertebra), costal crest, costal sulcus 1st rib – groove for subclavian a., tubercle for anterior scalene m., groove for subclavian v. 2nd rib – tuberosity for serratus anterior m.
Sternum	1/ manubrium – jugular notch, clavicular notches, costal notches for 1st and 2nd ribs 2/ body of sternum – costal notches for 2nd to 7th ribs 3/ xiphoid process sternal angle – between manubrium and body, attachment for 2nd pair of ribs
Joints of thorax	costovertebral joints: 1/ joints of heads of ribs 2/ costotransverse joints sternocostal joints: 1st to 7th ribs to sternum interchondral joints: costal arch (cartilages of 7th to 10th rib)
connections of vertebrae	syndesmoses: short ligaments: interspinous ligg., intertransverse ligg., ligg. flava long ligaments: anterior and posterior longitudinal ligg. synchondroses: intervertebral discs between vertebral bodies nucleus pulposus, anulus fibrosus total number 23, 1st between C1-C2, last one between L5-S1 synostoses sacrum synovial joints of vertebral column: between superior and inferior articular processes
curvatures of spine	in sagittal plane: lordosis - cervical and lumbar kyphosis - thoracic and sacral in frontal plane: scoliosis

Muscles of thorax	thoracohumeral mm. 1/ pectoralis major m. 2/ pectoralis minor m. 3/ serratus anterior m. 4/ subclavius m.
	proper thoracic mm. 1/ intercostal mm. (external, internal, innermost) 2/ transverse thoracic m. 3/ subcostal mm.
Diaphragm	cupula extends on the right side to the 4th intercostal space on the left side to the 5th intercostal space central tendon caval opening (Th8) – inferior v. cava, phrenocoabdominal br. of right phrenic n. muscular portion – sternal part, costal part, lumbar part esophageal hiatus (Th10) – esophagus, vagus nn., esophageal vv., phrenocoabdominal br. of left phrenic n. aortic hiatus (Th12) – aorta, thoracic duct through limbs of lumbar part pass: azygos v., hemiazygos v., sympathetic trunk, splanchnic nn. (greater, lesser, least) innervation: phrenic n.
Muscles of back	spinohumeral: 1st layer: 1/ trapezius m. 2/ latissimus dorsi m. 2nd layer: 1/ levator scapulae m. 2/ rhomboid major m. 3/ rhomboid minor m. spinocostal: 1/ posterior superior serratus m. 2/ posterior inferior serratus m. intrinsic muscle of back: 1/ erector spinae m.

Blood supply of thoracic wall

Thoracic aorta	posterior intercostal aa. – for 3rd to 11th intercostal spaces subcostal a. – below 12th rib
Subclavian a.	internal thoracic a. anterior intercostal aa. musculophrenic a. superior epigastric a. (anastomoses with inferior epigastric a.) costocervical trunk supreme intercostal a. – for 1st and 2nd intercostal spaces
Axillary a.	thoracoacromial a. lateral thoracic a. thoracodorsal a.

Venous drainage of thoracic wall

Azygos v.	arch of azygos v. receives: right posterior intercostal vv. right superior intercostal v. hemiazygos and accessory hemiazygos vv. left posterior intercostal vv.,
Right brachio-cephalic v.	receives: right supreme intercostal v.
Left brachio-cephalic v.	receives: left supreme intercostal v. left superior intercostal v. left internal thoracic v.
Superior v. cava	receives: azygos v. right internal thoracic v.
Axillary v.	receives: lateral thoracic v., to it open thoracoepigastric vv.
Vertebral venous plexus	external and internal Veins of thoracic wall form cavo-caval and porto-caval anastomoses!

Lymphatic drainage of thoracic wall

Parietal lymph nodes	intercostal lnn. parasternal lnn. phrenic lnn.
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Innervation of thoracic wall

Sensory innervation	Thoracic wall is supplied by brachial plexus and by intercostal nn. 1/ intercostal nn. 2/ supraclavicular nn. 3/ intercostobrachial nn.
Motor innervation	1/ phrenic n. (diaphragm) 2/ intercostal nn. (intercostal mm., transverse thoracic m., subcostal m.) 3/ long thoracic n. (serratus anterior m.) 4/ medial and lateral pectoral nn. (pectoralis major and minor mm.) 5/ thoracodorsal n. (latissimus dorsi m.) 6/ dorsal br. of spinal nn. (intrinsic muscles of the back) 7/ accessory n. (trapezius m.) 8/ subclavian n. (subclavius m.)

Neurovascular bundle in intercostal space

VAN is made	(in cranio-caudal direction) by: posterior intercostal Vein posterior intercostal Artery intercostal Nerve runs between (in dorso-ventral direction): 1. endothoracic fascia and internal intercostal membrane 2. fibres of internal intercostal mm., separates innermost intercostal mm. 3. endothoracic fascia and internal intercostal mm.
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Mammary gland

Blood supply	1/ pectoral brr. of thoracoacromial a. 2/ lateral mammary brr. of lateral thoracic a. 3/ medial mammary brr. of internal thoracic a. (perforating brr.)
Innervation	1/ lateral mammary br. from intercostal nn. 2/ medial mammary br. from intercostal nn. 3/ medial and intermediate supraclavicular nn. from cervical plexus
Lymphatic drainage	1/ axillary lnn. (predominantly pectoral lnn.) important for metastases 2/ parasternal lnn. 3/ supraclavicular lnn. (deep cervical lnn.) 4/ superficial inguinal lnn.

Mediastinum

Mediastinum	part of thoracic cavity between right and left pleural cavities
borders	ventral: sternum + costal cartilages + transverse thoracis m. dorsal: thoracic vertebrae (bodies) caudal: diaphragm lateral: mediastinal pleura right and left cranial: superior thoracic aperture
division	horizontal plane, which connects sternal angle and intervertebral disc between Th4 - Th5 divides mediastinum to: 1/ superior mediastinum 2/ inferior mediastinum – by pericardium is divided into: anterior mediastinum middle mediastinum posterior mediastinum
Superior mediastinum	communicates with anterior mediastinum and posterior mediastinum
content	right brachiocephalic v. left brachiocephalic v. + its tributaries superior v. cava + its tributaries right and left phrenic nn. – different passage right and left vagus nn. – different course, left recurrent laryngeal n. aortic arch – brachiocephalic trunk left common carotid a. left subclavian a. trachea (thoracic part) esophagus thoracic duct superficial cardiac plexus sympathetic trunk (covered by endothoracic fascia) anterior mediastinal lnn.

Anterior mediastinum	fissure behind body of sternum and in front of pericardium communicates with superior mediastinum
content	thymus parasternal lnn. superior and inferior sternopericardiac ligg.
Middle mediastinum	separated by pericardium from other parts of mediastinum, from posterior mediastinum is also separated by bronchopericardiac membrane
content	heart + pulmonary trunk, ascending aorta, left and right pulmonary vv., superior and inferior v. cava deep cardiac plexus left and right phrenic nn. + pericardiophrenic vessels (between pericardium and mediastinal pleura) bifurcation of trachea tracheobronchial lnn.
Posterior mediastinum	
borders	anterior – pericardium, bronchopericardiac membrane posterior – Th5-Th12 inferior – diaphragm superior – imaginary line: intervertebral disc Th4-Th5 and sternal angle, direct communication with superior mediastinum (important for spreading of inflammation to neck and to abdominal cavity)
content	thoracic aorta esophagus anterior and posterior vagal trunks thoracic duct azygos v., hemiazygos v., accessory hemiazygos v. sympathetic trunk (covered by endothoracic fascia) greater, lesser and least splanchnic nn. posterior mediastinal lnn.

Heart

location	in middle mediastinum in sac called pericardium
function	pumping blood throughout the body via circulatory system Systemic circulation: LV (left ventricle) → Aorta → Human body → Superior and inferior v. cava → RA (right atrium) Pulmonary circulation: RV (right ventricle) → Pulmonary trunk → Lungs → Pulmonary vv. → LA (left atrium)
Pericardium	1/ fibrous pericardium – fixation through: superior and inferior sternopericardial ligg. pericardiophrenic ligg. bronchopericardial membrane vertebropericardial ligg. 2/ serous pericardium – parietal layer visceral layer (epicardium)

Heart wall

Cardiac skeleton

External features

Chambers

Right atrium

Right ventricle

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	Opening of pulmonary trunk (pulmonary trunk) with pulmonary valve: anterior semilunar cusp (valvula) right semilunar cusp (valvula) left semilunar cusp (valvula)
Left atrium	true left atrium – left auricle – pectinate mm. openings of pulmonary vv. (superior and inferior pulmonary vv.) openings of smallest cardiac vv. Interatrial septum – valvula of foramen ovale (falx septi) Left atrioventricular orifice – left atrioventricular valve (bicuspid, mitral): anterior and posterior cusps
Left ventricle	inflow tract – trabeculae carneae anterior and posterior papillary mm. tendinous cords (chordae tendinae) outflow tract – opening of aorta (ascending aorta) with aortic valve: posterior semilunar cusp (valvula) – posterior aortic sinus right semilunar cusp (valvula) – right aortic sinus (dilation with beginning of right coronary a.) left semilunar cusp (valvula) – left aortic sinus (dilation with beginning of left coronary a.) Interventricular septum: 1/ membranous part (between inflow part of right ventricle and outflow parts of left ventricle) 2/ muscular part
Blood supply	branches of ascending aorta: 1/ right coronary a. br. of sinuatrial node br. for conus arteriosus atrial brr. right marginal br. br. of atrioventricular node right, anterior and posterior ventricular brr. posterior interventricular br. – septal interventricular brr. 2/ left coronary a. circumflex br. left marginal br. atrial brr. left posterior ventricular br. anterior interventricular br. br. for conus arteriosus lateral (diagonal) br. septal interventricular brr. left anterior ventricular brr.

Venous drainage	coronary sinus (in coronary sulcus, on posterior side of heart) and tributaries: great cardiac v. (= ant. interventricular v.) and its tributaries: left marginal v. oblique v. of left atrium left posterior ventricular v. middle cardiac v. (= posterior interventricular v.) small cardiac v. to the right ventricle open directly: right marginal ventricular v. right anterior ventricular vv. smallest cardiac vv.
Conducting system	controls activity of heart, parts: 1/ sinuatrial node – SA node (in right atrium between opening of superior v. cava and beginning of right auricle) 2/ atrioventricular node – AV node (in right atrium near to opening of coronary sinus) 3/ atrioventricular bundle (bundle of Hiss) 4/ right and left bundle branches (Tawara branches) 5/ subendocardial branches (Purkynje fibres) There are more connections between SA and AV node, as well as between SA node and myocardium of left atrium.
Innervation of heart	autonomic nervous system – influences frequency of rate and force of contractions 1/ sympathetic fibers increase heart rate and causes dilatation of coronary aa. cardiac nn. (from cervical and thoracic ganglia) 2/ parasympathetic fibers decrease heart rate and causes constriction of coronary aa. cardiac brr. (from vagus n.) together create: superficial cardiac plexus – in superior mediastinum, on aortic arch deep cardiac plexus – in middle mediastinum, on bifurcation of trachea
Lymphatic drainage	subendocardial, myocardial, subepicardial lymphatic networks → right collector – right lymphatic trunk of heart left collector – left lymphatic trunk of heart lymph from right collector → preaortic lnn. → anterior mediastinal lnn. → thoracic duct → left venous angle lymph from left collector → retroaortic ln. → inferior tracheobronchial lnn. → right lymphatic duct → right venous angle
Auscultation of heart	Testut's points: (IC = intercostal) 1/ aortic valve (point A) – right 2nd IC space near sternum 2/ tricuspid valve (point B) – right 5th IC space near sternum 3/ bicuspid valve (point C) – left 5th IC space in midclavicular line 4/ pulmonary valve (point D) – left 2nd IC space near sternum