



Anatomical References

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70.1 Cranial Nerves

There are 12 cranial nerves which together convey specialized sensory input from the ears, tongue (taste), and nose (smell) together with skin sensation from the face, scalp, and neck; specialized motor control of the muscles of facial expression, some neck movements, and the delicate movements of the tongue, larynx, and muscles responsible for controlling swallowing; and finally parasympathetic control of the autonomic functions of the gastrointestinal tract and its offshoots (Table 70.1).

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Table 70.1 Cranial nerves

Cranial nerve	Role (<i>S</i> Sensory; <i>M</i> Motor)	Course	Notes
I (Olfactory)	S—smell	Multiple through olfactory plate	
II (Optic)	S—vision	Optic canal	Part of central nervous system
III (Oculomotor)	M—all but two eye muscles	Superior orbital fissure	
IV (Trochlear)	M—sup. oblique	Superior orbital fissure	Smallest, longest, exits back of the brainstem
V (Trigeminal)	V1 S—ophthalmic	V1 Sup. Orb. fissure	M—mastication
	V2 S—maxillary	V2 F. rotundum	
	V3 S—mandibular	V3 F. ovale	
VI (Abducens)	M—abducens	Superior orbital fissure	
VII (Facial)	M/S (taste)	Internal acoustic canal→	M—facial expression, platysma, Stapedius <i>Secretory</i> —submandibular/lingual
	T—temporal Z—zygomatic B—buccal M—mandibular C—cervical	Facial canal (→chorda tympani) → Stylomastoid foramen	
VIII (Vestibulocochlear)	S—hearing and balance	Internal acoustic canal	
IX (Glossopharyngeal)	M/S—(taste)	Jugular foramen	M—stylopharyngeus, <i>secretory</i> —parotid
X (Vagus)	M/S	Jugular foramen	M—larynx, pharynx, GI tract
XI (Accessory)	M—neck	Jugular foramen	M—trapezius and sternomastoid
XII (Hypoglossal)	M—tongue	Hypoglossal canal	

70.2 Dermatomes and Myotomes

There is a fairly rigid demarcation of cranial and spinal nerve projection on the skin surface (dermatome). This is mirrored in the distribution of skeletal muscle control throughout the body (myotome) (Fig. 70.1).

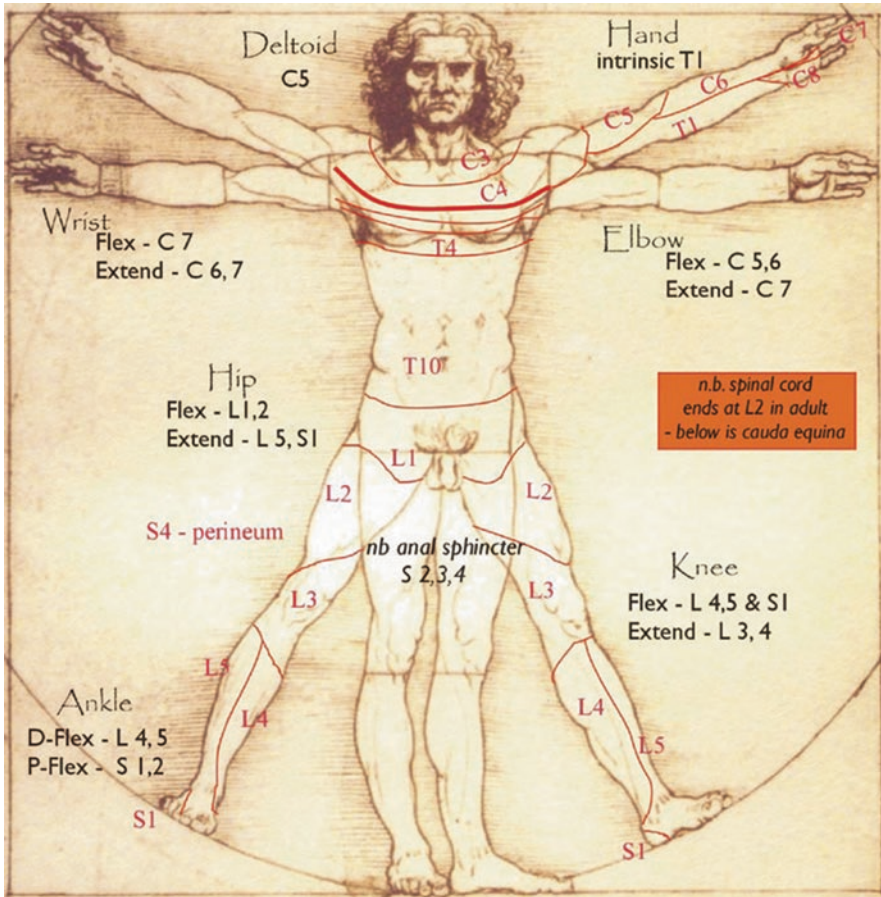


Fig. 70.1 Dermatomes and myotomes in Vitruvian Man (After Da Vinci)

70.3 Brachial Plexus

This is a nerve network receiving cutaneous sensory input from and controlling the muscles of the hand, forearm, arm, and shoulder from Cervical (C) 5 to Thoracic (T) 1. Each anterior nerve Root contributes to three Trunks which in turn refashion into the key median, ulnar, and radial nerves (Fig. 70.2).

Roots Trunks Division Cords Nerves

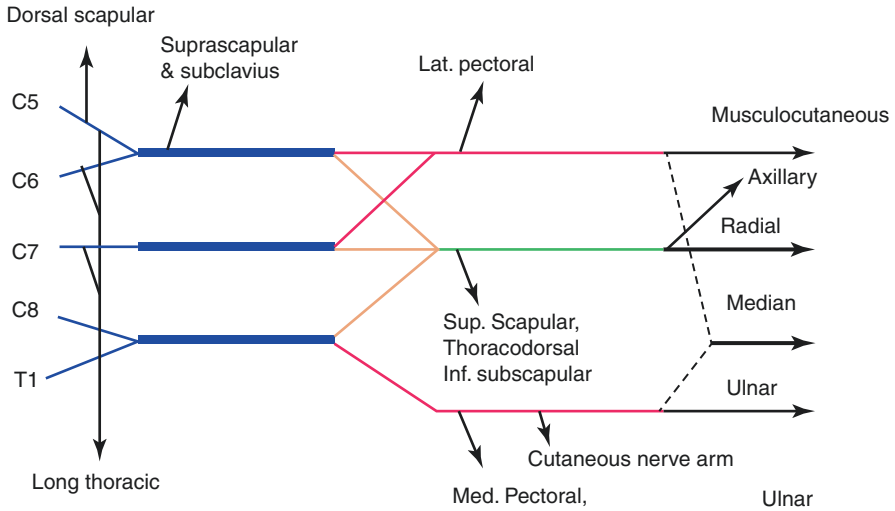


Fig. 70.2 Brachial plexus

70.4 Segmental Liver Anatomy

The liver is the largest organ within the body. It has a dual blood supply (in-flow—portal vein 75%, hepatic artery 25%), which feeds a sinusoidal network with reformation as the hepatic veins and then drainage into the IVC.

There is a fundamental division into Right and Left along the “*Principle Plane*” of *Cantlie*,¹ each being supplied by right and left portal vein, respectively. The plane runs from gallbladder bed along the line of the middle hepatic vein toward its confluence with the left hepatic vein.

The “anatomical” lobes are a smaller left and larger right divided by a fissure from which the *falciform ligament* emerges to narrow onto the undersurface of the umbilicus. Its free edge carries the obliterated umbilical vein as the *ligamentum teres*.

There are *eight segments (of Couinaud)*² that are numbered in a clockwise manner I to IX. The *falciform ligament* separates segments II and III from IV. They are potentially independent units with a limited crossover (Fig. 70.3).

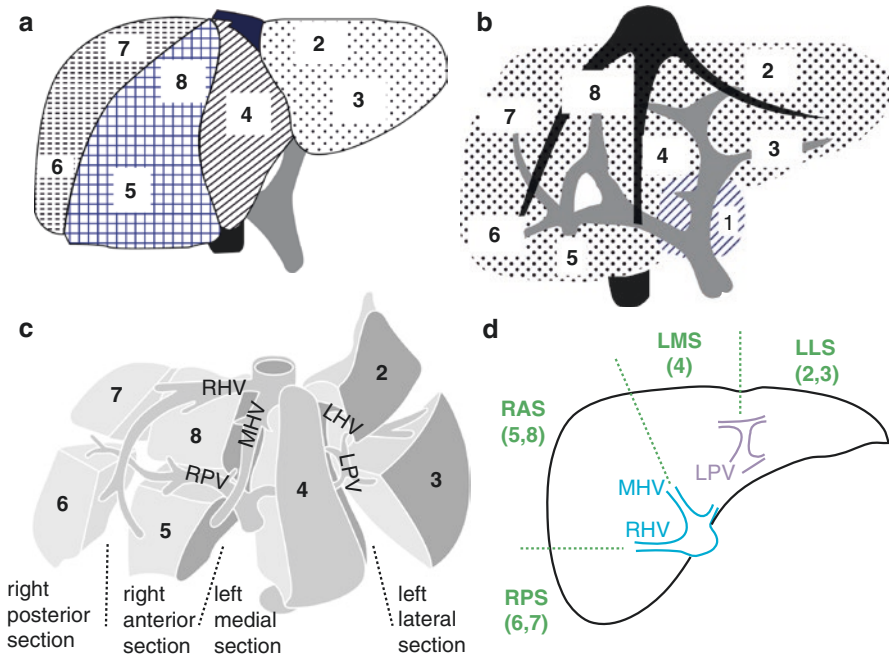


Fig. 70.3 Liver anatomy. (a) segmental anatomy of liver (1-8). (b) coronal plane of liver showing distribution of segments 1-8. (c) 3D representation of liver showing distribution of segments 1-8 with 4 sections. (d) Four sections defined by right hepatic vein (RHV), middle hepatic vein (MHV) and left hepatic vein (LHV)

¹ Sir James Cantlie (1851–1926)—Scottish surgeon with close ties to Hong Kong where he founded the School of Medicine.

² Claude Couinaud (1922–2008)—French anatomist who developed this segmental concept in the 1950s.

- *Right*—V, VI, VII, VIII
- *Left*—II, III, IV (quadrate lobe)
- *Segment I—caudate lobe*. Surrounds the vena cava, and has separate venous drainage through 4–8 small direct veins.

70.5 The Lungs and Diaphragm

The respiratory tract can be anatomically divided into upper and lower parts. The upper tract consists of the nasopharynx and larynx, whereas the lower tract comprises the trachea, bronchi, and the lung parenchyma. The carina refers to the point of division of trachea into the bronchi with the right main bronchus being more vertical than the left, as well as being shorter and wider.

The right lung is divided into three lobes. The upper and middle lobes are divided by the horizontal fissure, and the middle and lower lobes are divided by the oblique fissure. The left lung is smaller and has an upper and lower lobe and a smaller analogous lobe restricted by the heart known as the lingular lobe. The hilum of the lung consists of the main bronchus, with the bronchopulmonary (hilar) lymph nodes inferior to it. The vessels consist of the pulmonary artery superiorly, with the pulmonary veins entering below it.

The lungs are surrounded by two layers of pleura. The visceral pleura adheres to the lung surface, and the parietal pleura lines the inner chest wall, outer mediastinum, and diaphragm.

The *diaphragm* is composed of the costal and crural domains. The costal diaphragm is a thin layer of muscle that extends from the ribs laterally and anteriorly to the central tendon at the apex of the domed diaphragm. The crural diaphragm is a thicker layer of muscle connecting the central tendon to the esophagus, aorta, and vertebrae posteriorly.

Figure 70.4 illustrates the developmental origins of the diaphragm and these are: the septum transversum, the pleuroperitoneal folds, and the somites of the esophageal mesoderm.

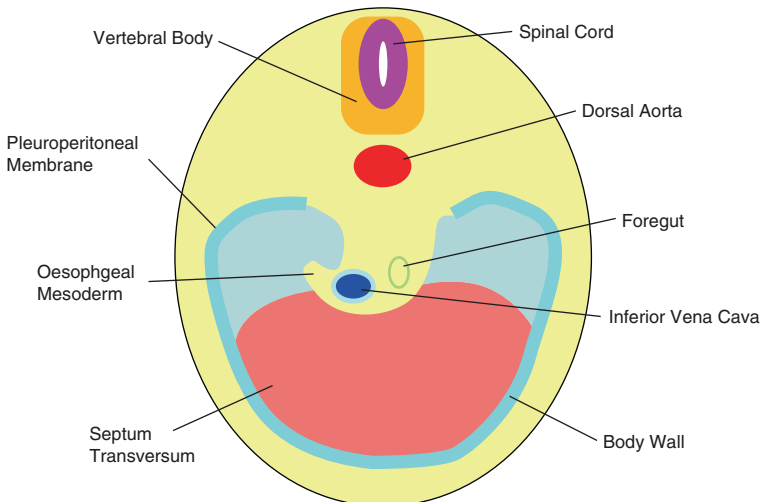


Fig. 70.4 Embryology of diaphragm

70.6 Heart

Almost two-thirds of the sternocostal (anterior) surface of the heart is formed by the right ventricle. The left border is formed by the left ventricle and the auricle of the left atrium, and the right border is formed by the right atrium (which is related to the central tendon of the diaphragm at the level of T8).

*Koch's triangle*³ indicates the location of the atrioventricular node and is composed of the base of the septal leaflet of the tricuspid valve, the anterior side of the tendon of *Todaro*, and the medial margin of the coronary sinus ostium.

The conducting tissue of the heart is made up of a:

- Sinoatrial (SA) node
 - Blood supply—right coronary artery in 90% and left coronary artery in 10%.
- Atrioventricular (AV) node
 - Blood supply—right coronary artery in 60–70% of the population and left coronary artery in 30–40%.

70.7 Gastrointestinal Tract

The embryonic gastrointestinal tract can be divided into foregut, midgut, and hindgut, each with a blood supply derived from arteries from the front of the aorta—respectively the coeliac axis, superior mesenteric, and inferior mesenteric arteries (Fig. 70.5).

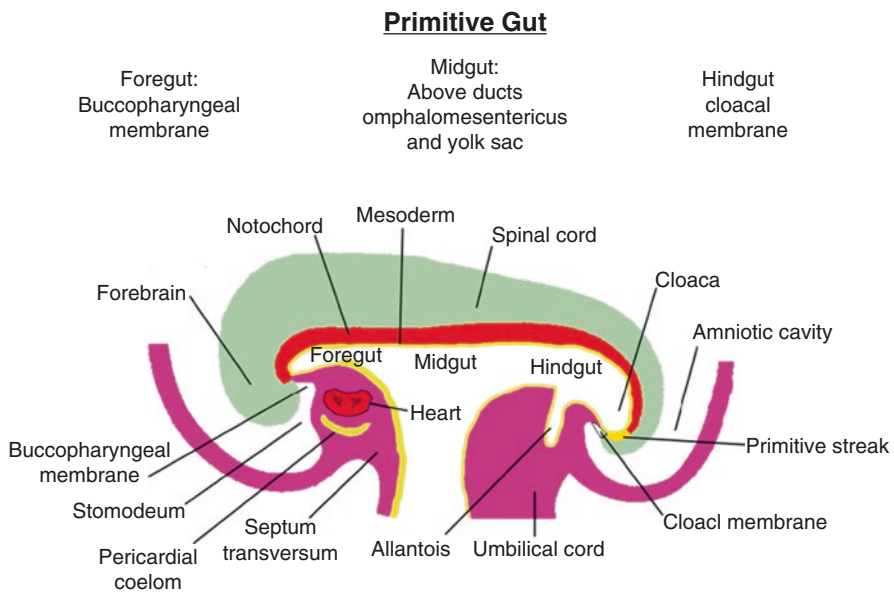


Fig. 70.5 Cross-section of the embryo at day 18 (post-fertilization)

³Walter Karl Koch (1880–1962)—German cardiologist.

The foregut runs from the mouth through to the 2nd part of the duodenum, the midgut to a point about 2/3 along the future transverse colon and the hindgut to the upper anal canal.

70.8 Genitourinary System

There are three distinct renal structures embryologically: the *pronephros* (cervical), *mesonephros* (thoracolumbar), and the *metanephros* (lumbar) derived from a bulge (*nephrogenic cord*) on the posterior abdominal wall, lateral to the attachment of the dorsal mesentery. Both the pronephros and mesonephros disappear though the mesonephric duct (or Wolffian duct) persists.

This Wolffian duct forms mainly the male genital tract, whereas the paramesonephric (or Mullerian) duct forms the female genital tract. The coelomic epithelium lining the medial nephrogenic cord forms the gonads (ovaries and testes). The cloaca is divided by the urorectal septum into the broad ventral Primitive urogenital sinus, and the narrow dorsal Primitive rectum (Figs. 70.6 and 70.7).

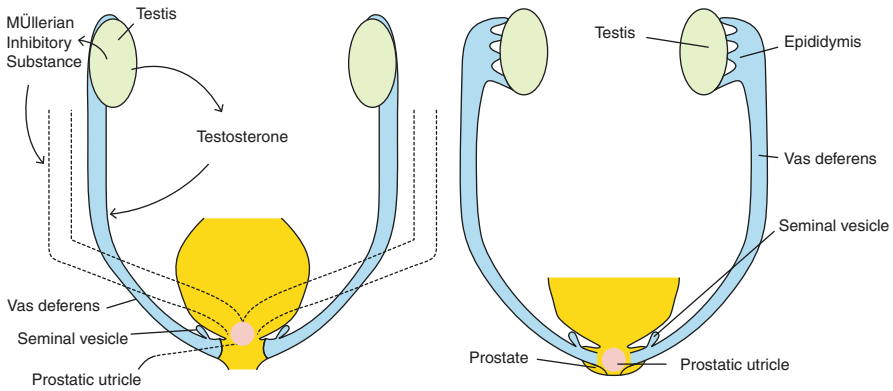


Fig. 70.6 Development of male genitalia

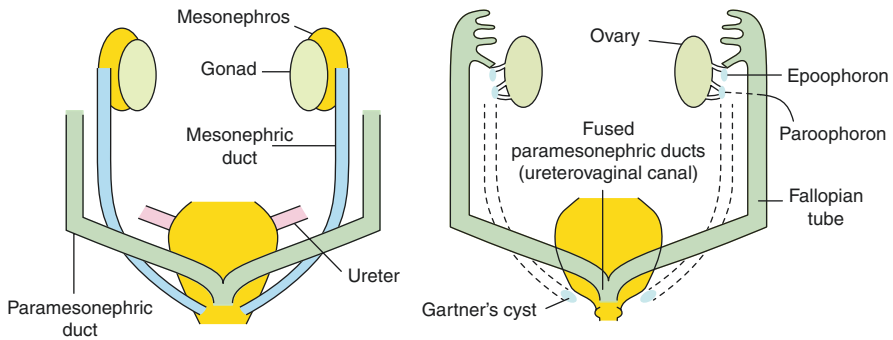


Fig. 70.7 Development of female genitalia

The *metanephros* (*permanent kidney*) develops from two sources. The lower part of the mesonephric duct forms the ureteric bud, which gives rise to the collecting part of the kidney: ureter, pelvis, calyces, and collecting tubules. The lower segments of the intermediate mesoderm comprise the metanephric cap, which forms the nephrons.

70.9 Inguinal Anatomy

The inguinal canal runs between the deep ring formed within transversus abdominis and the superficial triangular-shaped defect in the external oblique aponeurosis and is the pathway for the indirect inguinal hernia. The floor is formed by the in-turned aponeurosis as the inguinal ligament. Its roof is formed by arching fibers from the internal oblique and transversus abdominis muscles. Its anterior wall is formed by the external oblique aponeurosis and internal oblique muscle laterally with the posterior wall formed by the transversalis fascia and the conjoint tendon medially.

Hasselbach's triangle is the posterior wall: Bounded medially by the lateral margin of the rectus sheath; infero-laterally by the inguinal ligament; and laterally by the inferior epigastric artery. This is the site of a direct inguinal hernia.

70.10 Pharyngeal Arches

Pharyngeal (or branchial arches) are mesodermal thickenings in the cranial most part of the foregut appearing in the 4th week. There are six initially but the fifth arch disappears entirely. Each has its own nerve, artery, and cartilaginous core (Table 70.2).

Table 70.2 Pharyngeal apparatus

Name	Nerve	Artery	Muscle	Bone	Other
1st (Mandibular arch)	Mandibular nerve, chorda tympani	Maxillary artery	Masseter, temporalis, mylohyoid, anterior digastric	Malleus, incus	
2nd (Hyoid arch)	VI (Facial)	Stapedial artery	Stapedius, stylohyoid, posterior digastric, platysma, facial, frontalis	Stapes, styloid process, part of hyoid, and lesser cornu	
3rd	IX (Glossopharyngeal)	Internal carotid	Stylopharyngeus	Greater cornu, and part of hyoid	Thymus(part), inferior parathyroids
4th	X (superior laryngeal)	Aortic arch (part) Right subclavian (part)	Larynx and soft palate		Superior parathyroids
6th	X (recurrent laryngeal)	Pulmonary (part).			