MASTERING ANATOMY
A Comprehensive Guide to MCQs, Essays, and OSPEs

- Introductory module
- The pectoral region & upper limb
- Thorax





Published by,
Department of Anatomy
Faculty of Medicine
Uva Wellassa University

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Authored by:

Department of Anatomy

Faculty of Medicine

Uva Wellassa University

Mastering Anatomy

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Message from the Vice Chancellor

Dear Students,

It is with great pleasure that I extend my heartfelt congratulations and sincere appreciation to the Faculty of Medicine, Uva Wellassa University of Sri Lanka including Senior Professor Muditha Vidanapathirana, the Founder Dean of the Faculty of Medicine, for this remarkable initiative of publishing “Mastering Anatomy: A Comprehensive Guide to MCQs, Essays & OSPEs”.

This book is an invaluable resource, offering immense benefits not only to MBBS undergraduates of Uva Wellassa University but also to medical students across the country.

I encourage you to take full advantage of the excellent resources developed by the Faculty of Medicine to enhance your academic journey. Resources such as this guide can make your studies more effective, efficient, and rewarding.

Wishing you all the very best in your academic and professional pursuits.

Senior Professor Kolitha B. Wijesekara
B.Sc. (Hon.) (Peradeniya), M.Phil. (Peradeniya), Dr. Sc. Agr. (Gottingen, Germany), M.Biol.
Vice Chancellor
Uva Wellassa University
06.01.2025



Message from the Dean

As the Founder Dean of the Uva Wellassa Medical Faulty, it is with great pride and enthusiasm that I present to you “Mastering Anatomy: A Comprehensive Guide to MCQs, Essays, and OSPEs.” This publication represents a significant milestone in our ongoing commitment to enhancing the educational experience for our students.

In the ever-evolving field of medicine, a thorough understanding of anatomy is foundational to your future success. This guide has been meticulously crafted to provide you with a comprehensive resource that not only covers a wide range of question formats MCQs, essays, and OSPEs but also offers detailed answers and explanations to reinforce your learning.

Our aim with this book is to equip you with the tools necessary to excel in your examinations and to deepen your grasp of anatomical concepts. We believe that this guide will serve as an invaluable asset in your academic journey,
offering clarity, confidence, and a robust framework for your studies.

I extend my heartfelt gratitude to the faculty members and contributors who have dedicated their expertise and effort to make this resource possible. It is our hope that you will find this guide to be a source of support and inspiration as you navigate your medical education.

Wishing you every success in your studies and future medical career.

Sincerely,

Senior Professor Muditha Vidanapathirana,
Founder Dean,
Faculty of Medicine,
Uva Wellassa University



Message from the Head of the Department

Dear students,

As the Head of the Department of Anatomy, I am delighted to add my voice to this significant endeavor with the publication of “Mastering Anatomy: A Comprehensive Guide to MCQs, Essays, and OSPEs.” This guide is not just a collection of questions; it is a carefully designed resource aimed at fostering a deep understanding of anatomical principles, which are essential for any aspiring medical professional.

The journey through medical education can be challenging, and our department is committed to providing you with the tools and knowledge necessary to thrive. This guide will serve as a vital companion in your studies, helping to bridge the gap between theoretical concepts and practical application.

I encourage you to engage with the content actively—utilize the detailed explanations and varied question formats to enhance your comprehension and critical thinking skills. Your success in mastering anatomy will lay the groundwork for your future clinical experiences and patient care.

I would like to express my gratitude to all the faculty members who contributed their time and expertise to create this resource. Together, we can inspire the next generation of medical practitioners.

May this guide empower you on your educational journey, and I wish you all the best in your studies and future careers in medicine.

Warm regards,

Dr. Lakmal Dissanayake
Head of the Department of Anatomy
Uva Wellassa Medical Faculty

ANATOMY MCQ

(T/F & SBA) QUESTIONS

1. **INTRODUCTORY MODULE**
2. **THE PECTORAL REGION AND UPPER LIMB**
3. **THORAX**

INTRODUCTORY MODULE

Q1. Which of the following is/are true regarding epithelia?

(A) All types of epithelia lie on the basement membrane.

(B) Has a rich capillary bed surrounding the cells.

(C) Simple epithelia are found on surfaces involved in filtration.

(D) Stereocilia are present in stratified epithelium.

(E) Cytoskeleton of adjacent cells joined by adhesion junctions.

Q2. Which of the following is/are true regarding fertilization?

(A) It commonly takes place in the ampullary region of the uterine tube.

(B) It requires capacitated spermatozoa.

(C) The acrosomal reaction is induced by the proteins of zona pellucida.

(D) Cortical and zona reactions do not prevent polyspermy.

(E) It results in the restoration of the diploid number of chromosomes.

Q3. Which of the following is/are derived from the mesoderm?

(A) Red blood cells

(B) Bone

(C) Epidermis

(D) Neuron

(E) Epithelium of colon

Q4. Which of the following is/are resident cells of connective tissues?

(A) Adipocyte

(B) Basophils

(C) Fibroblast

(D) Lymphocyte

(E) Neutrophils

Q5 Which of the following structures is/are correctly matched with its features?

(A) Brush border - presence of cilia

(B) Large intestine - presence of a pseudostratified columnar epithelium

(C) Alveoli - presence of a simple cuboidal epithelium

(D) Ureter - presence of a transitional epithelium

(E) Tympanic membrane of ear - presence of sweat glands

Q6. Which of the following is/are true regarding the dermis?

(A) It is composed of both loose and dense connective tissue.

(B) In it type I collagen is found

(C) It is poorly innervated.

(D) It causes wrinkling with aging when the collagen and elastin in it progressively degenerate.

(E) It gives nourishment to the epidermis.

Q7. Which of the following is/are true regarding the offspring of a female carrier of an x-linked recessive disorder and a normal male?

(A) Half of their children will be symptomatic.

(B) Half of their daughters will be symptomatic.

(C) Half of their sons will be asymptomatic.

(D) Half of their daughters will be carriers.

(E) Half of their sons will be symptomatic.

Q8. Which of the following is/are true regarding the offspring of a female carrier of an x-linked recessive disorder and a normal male?

(A) Half of their children will be symptomatic.

(B) Half of their daughters will be symptomatic.

(C) Half of their sons will be asymptomatic.

(D) Half of their daughters will be carriers.

(E) Half of their sons will be symptomatic.

Q9. Which of the following is/are true regarding Turner syndrome?

(A) In this condition, premature cataracts are common.

(B) Cells contain 45 chromosomes.

(C) The offspring have a 50% chance of inheriting the disease.

(D) There is an increased risk of infertility.

(E) They are shorter than the average height.

Q10. Which of the following is/are true regarding inheritance?

(A) A Gene is a portion of a DNA molecule.

(B) Genes contain information for the production of many proteins.

(C) Alleles are different types of genes, occupying the corresponding levels of homologous chromosomes.

(D) Combination of genes in an individual's cell constitutes his/her genotype.

(E) Dominant alleles are represented by simple letters (lowercase characters)

Q11. Which of the following genetic conditions is/are correctly matched with the type of inheritance?

(A) Achondroplasia - Autosomal recessive

(B) Thalassemia - Autosomal dominant

(C) Duchenne muscular dystrophy - X linked recessive

(D) Haemophilia A - X linked dominant

(E) Huntington chorea - Autosomal dominant

Q12. Which of the following conditions are caused by mutations in mitochondrial DNA?

(A) Leber’s hereditary neuropathy

(B) Diabetes mellitus with sensorineural deafness

(C) Bloom syndrome

(D) Fragile X syndrome

(E) Duchenne muscular dystrophy

THE PECTORAL REGION AND UPPER LIMB

Q13.Which of the following is/are true regarding the female mammary gland?

(A) It extends from the outer border of the sternum beyond the anterior axillary line.

(B) Its axillary tail passes to the axilla up to the level of 1st rib.

(C) It consists of 30 - 50 lobes.

(D) It develops from the epithelium of the skin.

(E) Its base usually extends from the 1st to the 7th rib in the midclavicular line.

Q14. Which of the following is/are true regarding the female mammary glands?

(A) It is fully encapsulated.

(B) In it, fibrous connections pass from the skin to the deep fascia.

(C) Its axillary tail goes superolateral to the pectoralis major.

(D) It is normally mobile with the contraction of the pectoralis major muscle.

(E) It lies on the serratus anterior muscle.

Q15. Which of the following muscles constitute the rotator cuff?

(A) Subscapularis

(B) Biceps Brachii

(C) Triceps

(D) Teres minor

(E) Infraspinatus

Q16. Which of the following structures traverses the quadrangular space?

(A) Axillary nerve

(B) Circumflex scapular artery

(C) Posterior circumflex humeral artery

(D) Profunda brachii vessels

(E) Radial nerve

Q17. A 50-year-old woman presented with weakness in the extension of her left wrist and fingers. She sustained a left humeral shaft fracture following a car accident one month ago. What is the most likely structure involved?

(A) Brachial artery
(B) Median nerve
(C) Profunda brachii artery
(D) Radial nerve
(E) Ulnar nerve

Q18. Which of the following is/are true regarding the axillary artery?

(A) It extends up to the lower border of Teres major muscle.
(B) It lies posterior to the pectoralis major muscle.
(C) It lies lateral to the medial cord of the brachial plexus.
(D) It lies medially in the axillary vein.
(E) It is the continuation of the common carotid artery.

Q19. Which of the following is/ are true regarding the axillary nerve?

(A) It supplies the skin superficial to the deltoid muscle.
(B) It can get damaged with subglenoid dislocation of the humerus.
(C) Its damage can impair the shoulder joint adduction.
(D) It does not give rise to any cutaneous branches.
(E) Its anterior branch runs posterior to the surgical neck of the humerus.

Q20. A 20-year-old man presented with a wrist drop following a road traffic accident. On examination, there was impaired sensation in the anatomical snuff box and impaired extension of fingers at metacarpophalangeal joints. All upper limb reflexes are preserved. What is
the anatomical site of the lesion?

(A) Anterior interosseous nerve
(B) Posterior interosseous nerve
(C) Radial nerve damage at the shaft of the humerus
(D) Radial nerve damage at the wrist
(E) Radial nerve damage at the axilla

Q21. Which of the following is/are true regarding the consequences of the complete division of the Ulnar nerve immediately above the wrist?

(A) Results of loss of adduction of the thumb.
(B) Results paralysis of the interosseus muscle.
(C) Results in a lesser degree of ulnar claw than when injured at the elbow level.
(D) Results loss of sensation over the dorsal surface of distal phalanx of the ring finger.
(E) Results paralysis of the biceps muscle.

Q22. Which of the following is/are true regarding the carpal tunnel?

(A) Median nerve goes through it.
(B) Radial nerve goes through it.
(C) Ulnar nerve goes through it.
(D) In carpal tunnel syndrome, the sensation of the palm is lost.
(E) Carpal tunnel syndrome may result due to osteoarthritis.

Q23. A 35-year-old gymnast is seen by his physician months after he sustained a fall to an outstretched right arm from the parallel bars. He complains of persisting pain with exercise involving the anatomical snuff box of the right wrist. He had been seen in a hospital emergency room for the initial injury but was told that x-rays were negative, and told it was a simple sprain.
Which of the following is the most likely diagnosis?

(A) Colle's fracture
(B) Scaphoid fracture
(C) Smith fracture
(D) Lunate fracture
(E) Supra condylar fracture of the humerus

Q24. Which of the following is/are true regarding the mid palmar space?

(A) It is directly continuous with the flexor sheath of long flexors.
(B) It is superficial to the long tendons of the hand.
(C) It is bound by the fascia covering the adductor pollicis
(D) It can get infected in manual workers.
(E) It is continuous proximally with a carpal tunnel.

Q25. Which of the following is/are true regarding the blood supply of the hand?

(A) Superficial palmar arch lies just beneath the palmar aponeurosis.

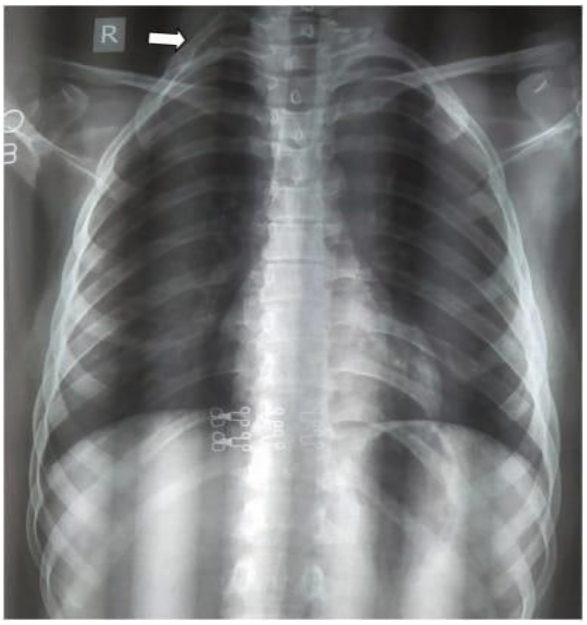
(B) Deep palmar arch gives common palmar digital arteries.

(C) Radial artery is the main blood supply of the hand.

(D) Summit of the deep palmar arch is distal to that of the superficial palmar arch.

(E) Via the vincula longa blood is supplied to the flexor digitorum profundus tendons

Q26. A 32-year-old female presented to the hospital with complaints of numbness and tingling in the right arm, particularly in the medial aspect, accompanied by occasional weakness in the affected limb. She reports that these symptoms are exacerbated by activities that require overhead arm movements such as reaching or lifting. On further questioning, she mentions occasional episodes of hand coldness in her right hand. Physical examination revealed atrophy of the intrinsic muscles of the hand, decreased sensation in the T1 dermatome. Additionally, there is a palpable fullness in the supraclavicular region on the right side. X-ray is as follows.



What is the most likely diagnosis?

(A) Right cervical node enlargement

(B) Right 1st rib fracture

(C) Right cervical rib

(D) Right clavicular fracture

(E) Right scapular fracture

Q27. Which of the following muscles are innervated by the nerve marked in the dissected specimen.

(A) Biceps Brachii

(B) Supinator

(C) Pronator teres

(D) Abductor pollicis brevis

(E) Medial 2 lumbricals



THORAX

Q28. Which of the following is/are true regarding the thoracic cage?

(A) 1st rib has a tubercle for the attachment of the anterior scalene muscle.

(B) A part of the brachial plexus is adjacent to the subclavian groove of the 1st rib.

(C) Rib fractures are more common in children than in adults.

(D) Manubriosternal joint is at the level of the 3rd costal cartilage.

(E) Floating ribs are connected to the sternum via the costal margin.

Q29. Which of the following is/are true regarding the 1st rib?

(A) Sympathetic trunk lies in contact with the posterior border of the neck alongside the head.

(B) It has no angle.

(C) The Supra-pleural membrane is attached to the shaft in front of the subclavian groove.

(D) Articulates with the T1 vertebra only.

(E) First rib is the strongest, broadest, flattest, and most curved rib.

Q30. Which of the following is/are true regarding an intercostal space?

(A) Internal intercostal muscle attach to the inner surface of the ribs only at its lateral curvature.

(B) The digitations of transversus thoracic diverge on each side to the 2nd-6th costal cartilages.

(C) External intercostal muscles extend from superior costotransverse ligament upto the cartilage.

(D) Innermost intercostal muscles cross more than one intercostal space.

(E) Serratus posterior superior muscle aids in expiration.

Q31. Which of the following is/are true regarding the intercostal nerves?

(A) It supplies the muscles of the intercostal space and parietal pleura.

(B) It gives collateral and lateral cutaneous branch before reaching the angle of the rib.

(C) The 1st intercostal nerve has no anterior or lateral cutaneous branches.

(D) The lateral cutaneous branch of the 2nd intercostal nerve crosses the axilla to the medial side of the arm.

(E) A needle is introduced just below the lower border of the rib to deliver an aesthetic solution.

Q32. Which of the following statements is/are true about intercostal arteries?

(A) Upper 2 intercostal spaces are supplied by the superior intercostal artery.

(B) The lower 9 intercostal arteries cross the front of the vertebra behind the hemiazygos vein.

(C) There are no anterior intercostal arteries in the last 2 intercostal spaces.

(D) The posterior intercostal artery anastomoses with the anterior intercostal arteries.

(E) The anterior intercostal artery of the 5th intercostal space arise from the musculophrenic artery.

Q33. Which of the following is/are true regarding the T4/T5 level?

(A) The tracheal bifurcation occurs at this level.

(B) Highest point of the aortic arch can be seen.

(C) Oesophagus deviates to the left.

(D) Pulmonary trunk bifurcation occurs.

(E) Indicates the upper limit of the left atrium.

Q34. A 72-year-old female with a history of gastro-oesophageal reflux disease is brought to the emergency department after an episode of vomiting while she was lying on her back. Based on the patient's position at the time of aspiration, which part of the lungs is most likely to show evidence of aspiration pneumonia?

(A) Right upper lobe

(B) Left upper lobe.

(C) Right lower lobe

(D) Left lower lobe

(E) Right middle lobe

Q35. Which of the following are true regarding the esophagus?

(A) It is approximately 25 cm long.

(B) Upper part is supplied by the recurrent laryngeal nerve.

(C) Most constricted part is the gastro esophageal junction.

(D) Contains smooth muscles only.

(E) Esophagus is derived from the foregut.

Q36. Which of the following is/are true regarding the trachea?

(A) It commences at the level of C6 vertebra.

(B) In full inspiration, tracheal bifurcation descends to T6 level.

(C) Tracheal rings are round shaped hyaline cartilage.

(D) Left recurrent laryngeal nerve runs in the groove between trachea and the oesophagus.

(E) Tracheostomy may be required for laryngeal obstruction.

Q37. Which of the following is /are true regarding Tetralogy of Fallot.?

(A) It is an acyanotic congenital heart defect.

(B) Characterized with pulmonary stenosis.

(C) Children can present with bluish lips and tongue.

(D) Characterized with an ejection systolic murmur best heard at the right 2nd intercostal space.

(E) There is a left to right shunt of blood across the VSD

Q38. Which of the following structures contribute to the formation of interventricular septum?

(A) Superior endocardial cushions

(B) Walls of the primitive ventricle

(C) Conotruncal ridge

(D) Primitive atrium

(E) Bulbus cordis

Q39. Which of the following is/are true regarding the blood supply and venous drainage of the heart?

(A) SA node is usually supplied by the Right coronary artery.

(B) Right ventricle is only supplied by the right coronary artery.

(C) Heart is supplied by coronary arteries that arise from the aortic sinus.

(D) Venae cordis minimae opens into the right atrium.

(E) Anterior cardiac veins open into the coronary sinus.

Q40. Which of the following is/are true regarding the heart?

(A) Pulmonary trunk and Pulmonary veins lie anterior to the transverse sinus.

(B) Fibrous pericardium encloses the whole heart and the root of the great vessels.

(C) Pericardial fluid lies between the fibrous and serous pericardium.

(D) Right border consists of the right atrium.

(E) Excessive fluid accumulation in the pericardial cavity causes pericardial tamponade.

Q41. Which of the following is/are true regarding the heart?

(A) Pulmonary valve is bicuspid.

(B) Papillary muscles contract to open atrio-ventricular valves.

(C) Musculi pectinati can be found in the right ventricle.

(D) Smooth and rough parts of the right atrium are divided externally from sulcus terminalis.

(E) Moderator band conveys the right branch of the atrioventricular bundle.

Q42. Which of the following is/are true regarding the vagus nerve?

(A) Right vagus runs on the surface of the trachea.

(B) Right vagus hooks around ligamentum arteriosum to form recurrent laryngeal nerve.

(C) Left vagus supplies the pulmonary plexus.

(D) Recurrent laryngeal nerves supply the whole of the trachea and adjacent oesophagus.

(E) Each vagus lies behind the lung root.

Q43. Which of the following is/are true regarding the aorta?

(A) It lies anterior to the pulmonary trunk.

(B) Arch of aorta lies completely in the superior mediastinum.

(C) Ascending aorta has no branches.

(D) Aortic arch is related to the left recurrent laryngeal nerve.

(E) Pulmonary trunk bifurcates in the concavity of the arch.

Q44. Which of the following is/are true regarding the actions of the diaphragm?

(A) When diaphragm contracts vena caval foramen open widely results in increased venous return.

(B) Oesophageal opening is held closed by the pinch like action resulting from contraction of crus.

(C) The aortic opening is widely opened during inspiration.

(D) During abdominal straining, diaphragmatic contraction aids in raising intra-abdominal pressure.

(E) Hiccup is a spasmodic contraction of the diaphragm.

Q45. Which of the following is/are true regarding the nerve supply of the diaphragm?

(A) fibers of the right crus that loops around the oesophageal opening are supplied by left phrenic nerve.

(B) The lower intercostal nerves give proprioceptive fibers to the periphery of the diaphragm.

(C) Right hemi-section of the spinal cord at C5 level results in paralysis of the right dome.

(D) Both phrenic nerves divide into anterior, lateral, and posterior branches under the diaphragm.

(E) The downward course of the phrenic is due to caudal movement of the diaphragm during development.

Q46. What is the most significant finding in the given x-ray?

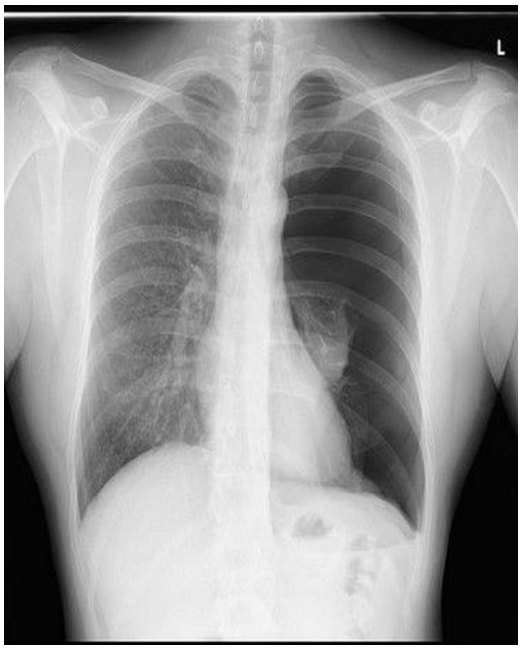
(A) Right middle lobe pneumonia.

(B) Pulmonary oedema

(C) Left sided pneumothorax

(D) Right lung collapse

(E) Cardiomegaly



Q47. Which of the following is/are true regarding the azygos venous system?

(A) The azygos vein arches over the root of the right lung to drain into SVC at T4 vertebral level.
(B) About 10% of the population have an azygous lobe.
(C) The thoracic duct and aorta are to the right of the azygos vein.
(D) 2nd, 3rd, 4th intercostal spaces on the right drain to azygos vein via superior intercostal vein.
(E) In congenital absence of IVC, the azygos vein enlarges.

Q48. Which of the following is/are true regarding the right lung?

(A) Apex of the lung extends into the root of the neck.
(B) Healthy lungs float freely on the water.
(C) Oblique fissure meets the inferior border at the 6th costal cartilage level.
(D) Transverse fissure corresponds to the medial border of the scapular.
(E) When the superior lobe of the right lung has a separate medial part, it's called the azygos lobe.

Q49. Which of the following is/are true regarding the phrenic nerve?

(A) Passes behind the anterior scalene muscle.
(B) Crosses the arch of the aorta on the right side.
(C) Runs through mediastinum in front of the lung root.
(D) Right phrenic nerve lies medial to IVC.
(E) Left phrenic nerve pierces the tendinous part of the diaphragm.

Q50. In coronary bypass graft surgery of a 49-year-old woman, the internal thoracic artery is used as the coronary artery bypass graft. The anterior intercostal arteries in intercostal spaces three to six are ligated. Which of the following arteries will be expected to supply these intercostal spaces?

(A) Musculophrenic
(B) Superior epigastric
(C) Posterior intercostal
(D) Lateral Thoracic
(E) Thoracodorsal

Q51. A 41-year-old man is admitted to the emergency department with complaints of shortness of breath, dizziness, and sharp chest pain. The 2 white arrows in his chest radiograph indicate the region of pathology/disease.



What is the structure indicated by the arrows?

(A) Superior vena cava
(B) Right ventricle
(C) Left ventricle.
(D) Arch of aorta.
(E) Pulmonary artery

Q52. Which of the following is/are true regarding bronchopulmonary segments?

(A) Apex is directed towards the hilum of the lung.
(B) Has a segmental venous drainage.
(C) There are 10 bronchopulmonary segments in the right lung.
(D) One segment can be removed surgically.
(E) Has a segmental lymphatic drainage.

Q53. Which of the following is/are true regarding the diaphragm?

(A) Oesophageal opening lies between the fibers of the right crus of the diaphragm.

(B) Oesophageal hiatus traverses both left and right vagus nerves.

(C) Opening of IVC is between the fibers of the left crus of the diaphragm.

(D) The opening of the IVC transmits the phrenic nerve.

(E) Subcostal nerves pass posterior to the medial arcuate ligament.

ANATOMY MCQ (T/F & SBA) ANSWERS

1. INTRODUCTORY MODULE
2. THE PECTORAL REGION AND UPPER LIMB
3. THORAX

INTRODUCTORY MODULE

Answer- Q1

(A) T

(B) F - Epithelial tissue does not contain blood vessels to prevent bleeding because this tissue is constantly exposed to mechanical and chemical wear and tear. Although this tissue is avascular, it is well supplied with nutrients through a diffusion mechanism.

(C) T

(D) F - Stereocilia are the projections in the pseudostratified columnar epithelium cells. They are cylindrical non-motile. They are found in some parts of the male reproductive tract such as the epididymis and vas deferens

(E) T

Answers - Q2

(A) T

(B) T - capacitation is a process where the spermatozoa are conditioned by the removal of glycoproteins and seminal proteins at their acrosomal end, for them to penetrate the corona radiata cells around the female egg (oocyte)

(C) T - both the bonding of the sperms to the zona pellucida and the acrosomal reaction is mediated by ZP3 and zona proteins which are found in the zona pellucida

(D) F - in cortical and zona reactions, the cortical oocyte granules are released, which contain lysosomal enzymes.

a) The oocyte membrane becomes impenetrable to other spermatozoa

b) Zona pellucida alters its structure and composition to prevent sperm binding and penetration. These reactions prevent polyspermy (penetration of more than one spermatozoa into the oocyte)

(E) T - the main results of fertilization

a) Restoration of diploid number of chromosomes

b) Determination of the sex of the new individual

c) Initiation of cleavage (without fertilization, the oocyte usually degenerates 24 hours after ovulation)

Answers - Q3

(A) T

(B) T

(C) F - epidermis is of ectodermal origin

(D) F - neurons are of ectodermal origin

(E) F - epithelium of the colon is of endodermal origin

Mesodermal derivatives are as follows,

From paraxial mesoderm:

a) Myotome (muscles)

b) Sclerotome (tendon, cartilage and bone)

c) Dermatome (dermis)

d) Axial skeleton

From intermediate mesoderm:

a) Uro-genital structures

From lateral plate mesoderm:

a) Lateral body wall folds

b) Mesothelial/serosal membranes - peritoneal/pericardial / pleural membranes

From all categories of mesoderm:

a) Blood and blood vessels

Answers - Q4

(A) T

(B) F

(C) T

(D) F

(E) F

Resident cells live in matrix, stationary cells permanently housed in the connective tissue. They support, maintain, and repair the extracellular matrix.
Examples - fibroblast, adipocytes, mesenchymal cells

Answer - Q5

(A) F - Brush border is the microvillus-covered surface of simple cuboidal and simple columnar epithelium sound in different parts of the body.

Micro-villi are finger-like projections of the plasma membrane, where they are specialized for absorption, where their presence may increase the surface area as much as 30 folds.

(B) F - in the large intestine the epithelium is a simple columnar epithelium.

(C) F - alveoli has a simple squamous epithelium

(D) T - transitional epithelium is considered as the urothelium

(E) F - the tympanic membrane (ear drum) is a thin fibrous membrane separating the external auditory canal from the cavity of the middle ear. There are no sweat glands on this membrane.

The external auditory canal is lined by hairy skin containing sebaceous glands and modified apocrine glands which secrete a waxy material called cerumen.

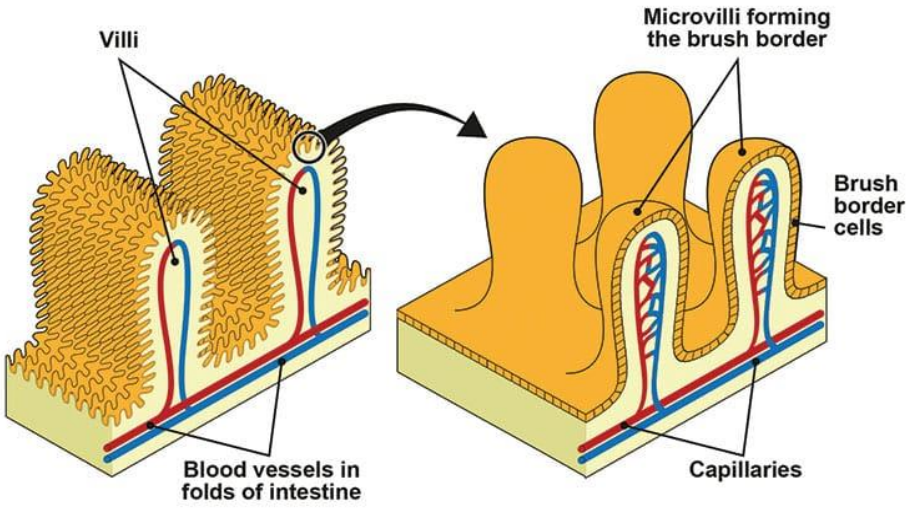


Figure 1: microvilli forming the brush border is a part of the villi

Cilia	Stereocilia	Microvilli
Cilia are tiny hair like structures found on the surface of some cells	Stercocilica are bundle of actin filaments	Microvilli are folds of cell membranes of certain cells
Found in the respiratory passage	Found in the cochlea in the inner ear, and some parts of the male reproductive tract such as epididymis and vas deferens	Found in locations where absorption and secretion take place, especially in the digestive tract and kidneys.
Some are motile while some are non-motile	Non-motile	Non-motile
Move cells and propel objects. In the respiratory tract, cilia sweep out mucus, dust and other foreign material.	Stereocilia in the inner ear aids in hearing and balance while stereocilia in the male reproductive tract facilitate absorption.	Increase the surface area for absorption.
9+2 structure present	9+2 structure absent	9+2 structure absent

Classification of Epithelia can be done as follow

Number of cell layers	Type of cells	Special features	Example
Simple (one layer)	Squamous		Peritoneum, vascular epithelium
	Cuboidal		Collecting tubule of kidney
		Microvilli	Proximal convoluted tubule of kidney

	Columnar		Gallbladder
		Microvilli	Small intestine
		Surface cilia	Fallopian tube
		Pseudostratification	Respiratory tract
		Goblet cells	Small and large bowel
		Stereocilia	Vas deferens
Stratified	Squamous		Oral cavity
		Keratinisation	Epidermis of skin
	Cuboidal		Exocrine gland ducts
	Transitional		Bladder

Answers - Q6

(A) T - the papillary layer contains loose connective tissue while the reticular dermis contains dense irregular connective tissue.

(B) T -

Collagen can be classified as follows

Type I - is the main structural collagen and is found in fibrous supporting tissue (dermis/tendons/ligaments/bones)

Type II - is the main structural collagen of hyaline cartilage

Type III - forms a reticular supporting meshwork that is prominent in highly cellular tissues such as the liver/bone marrow / lymphoid organs

Type IV - mesh forming collagen and an important constituent of basement membranes.

Type VII - forms special anchoring fibrils that link extracellular matrix to basement membranes.

(C) F

(D) T

(E) T - since the epithelium has no vascular supply, it receives all its nutrients via diffusion from the dermis.

Answers - Q7

(A) F - only 1/4th of the children will be symptomatic

(B) F - 1/2 of the daughters can be carriers but not symptomatic (diseased)

(C) T - only 1/2 of the sons will be diseased

(D) T

(E) T

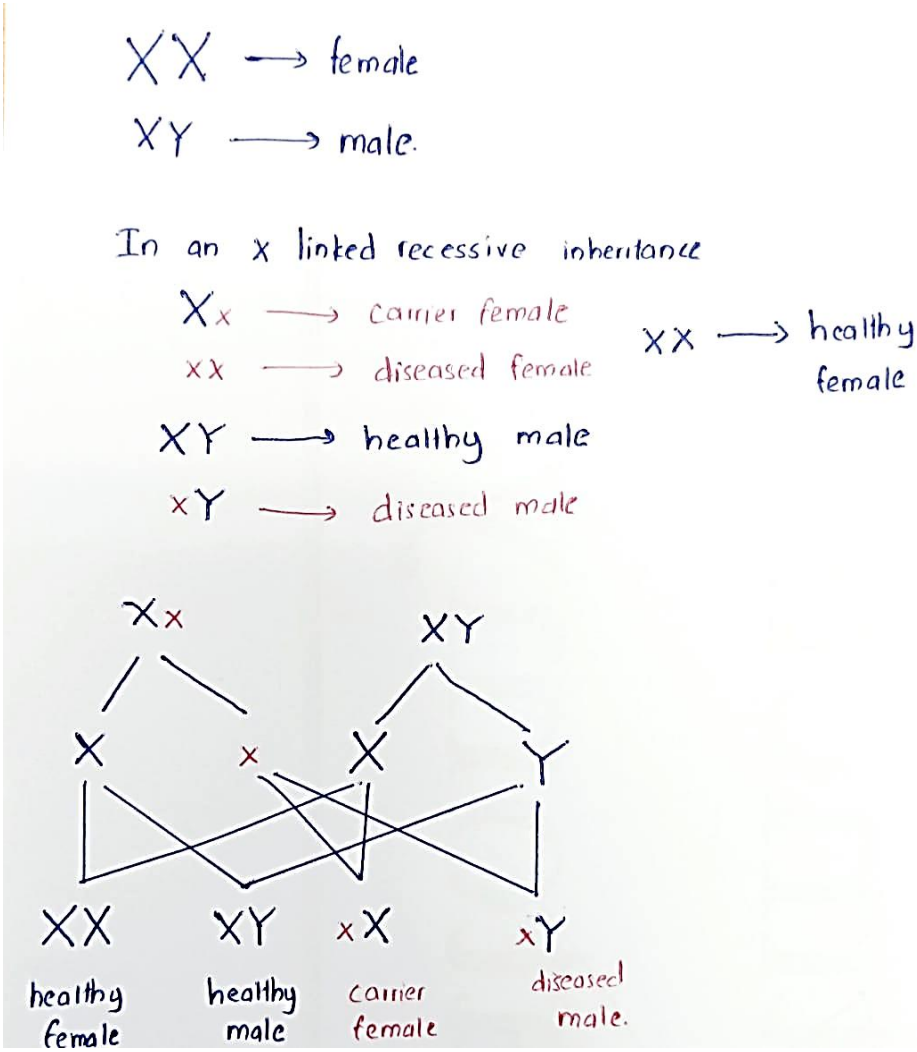


Figure 2: Inheritance of the X-linked recessive disorders

Answers - Q8

(A) F - Down's syndrome is trisomy 21

(B) T

(C) T - it can be due to Robertsonian translocation, mosaicism, and nondisjunction.

(D) F

(E) T - mainly atrio-ventricular septal defects

Inheritance of down's syndrome is as below,

1. Meiotic nondisjunction (94%)

- The risk of this phenomenon increases with maternal age.

2. Robertsonian translocation (5%)

- extra 21 chromosome goes and join on another chromosome most commonly 14th chromosome.

3. Mosaicism (1%)

- In this phenomenon, only a group of cells in the body will have the trisomy.

Here, there will be a milder form of Down's syndrome with minimum cognitive impairment

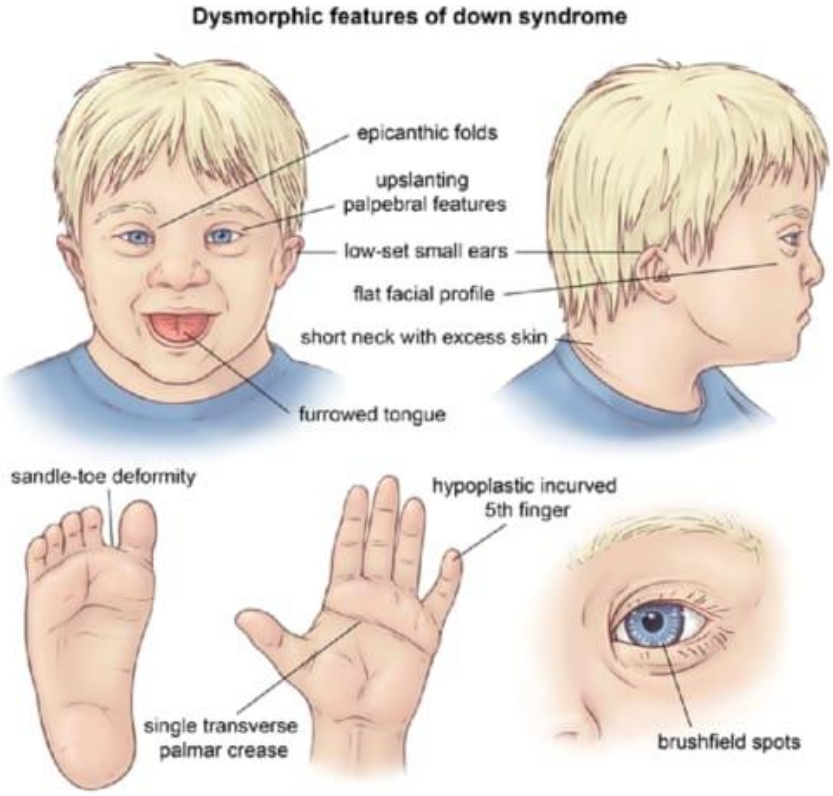


Figure 3: Dysmorphic features of Down Syndrome - 1

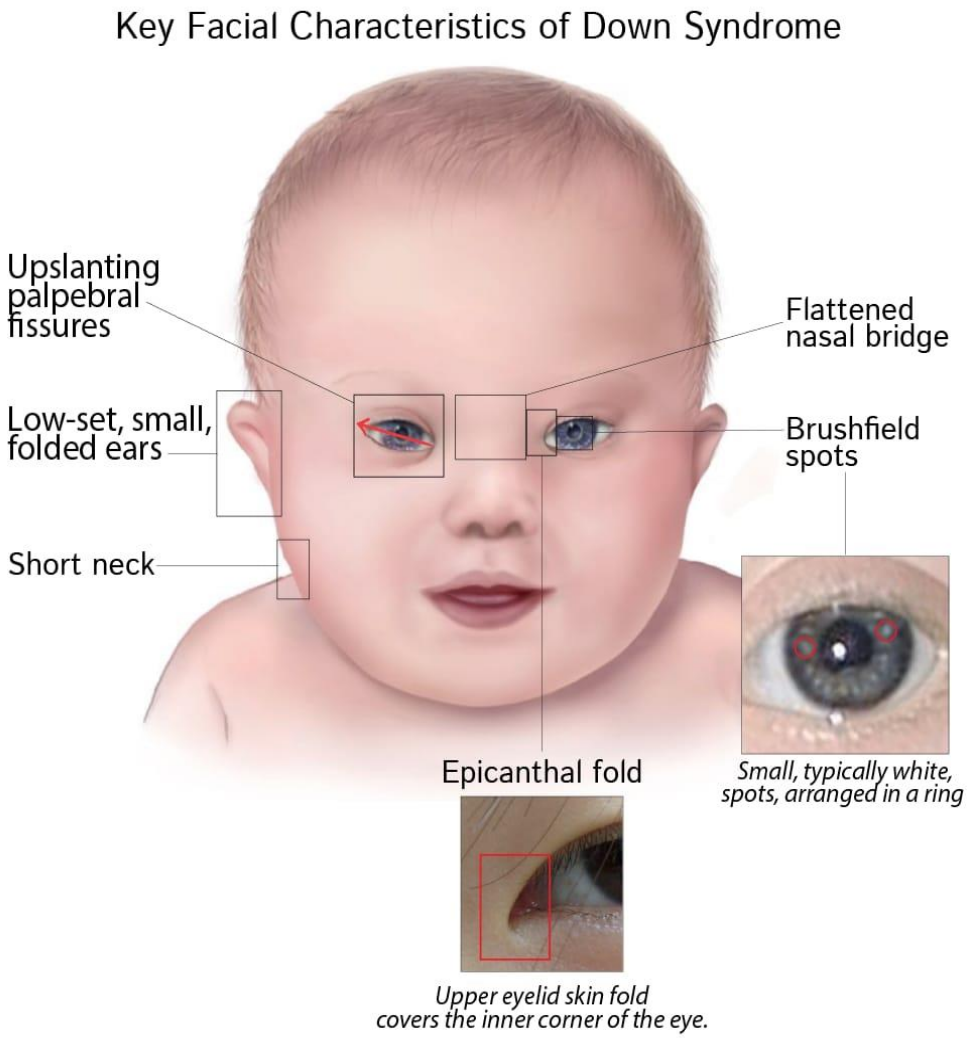


Figure 4: Dysmorphic features of Down's syndrome - 2

Answers - Q9

(A) T

(B) T

(C) F

(D) T

(E) T

Turner syndrome

- This is a sex chromosomal abnormality
- Genotype - 45, XO
- Most instances of Turner syndrome are not inherited.

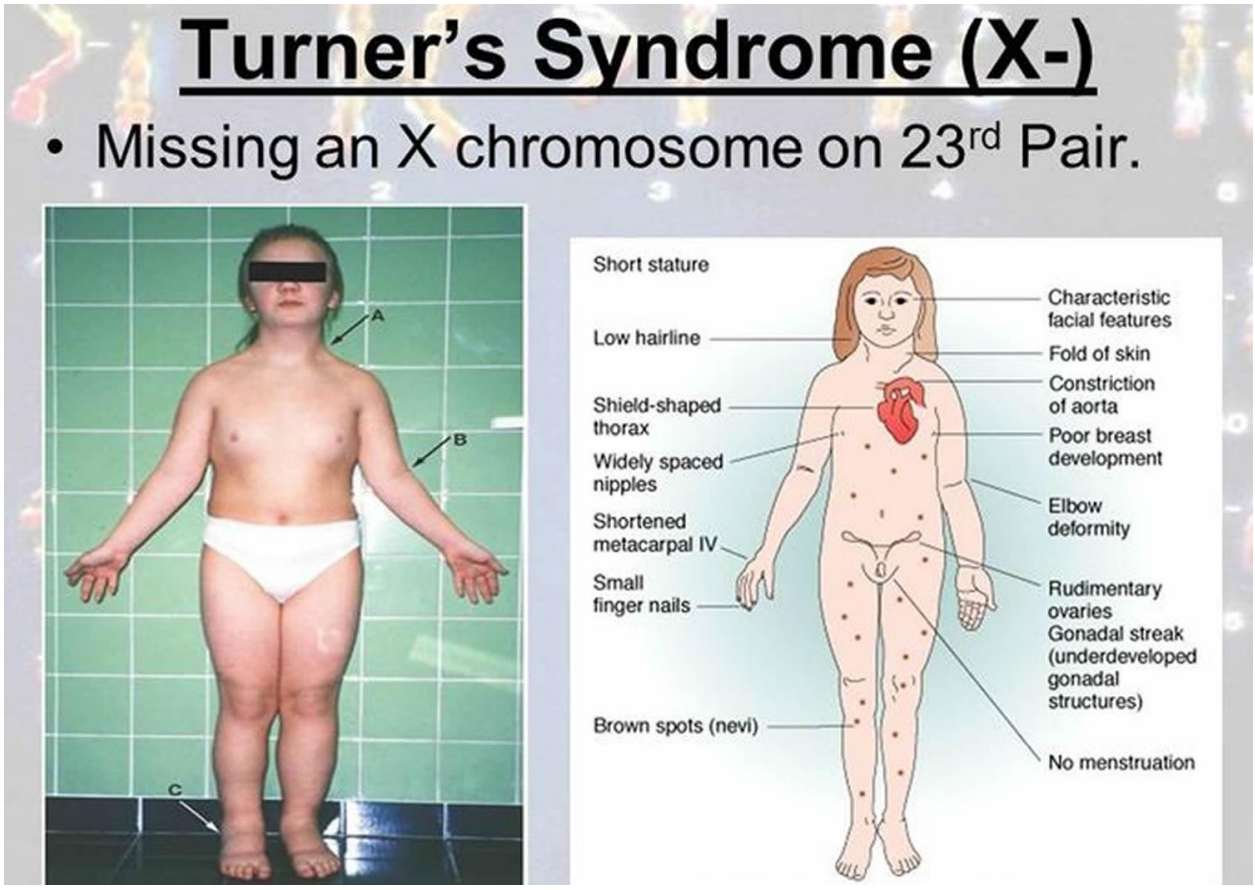


Figure 5: Dysmorphic feature of Turner's syndrome

Answers - Q10

(A) T - Gene is a unit of DNA sequence that encodes specific function, specially protein synthesis.

(B) T - A single gene only contains information to synthesize a single protein. But this stem is true as it says that genes altogether will produce many proteins.

(C) T - Alleles are a pair of genes that occupy a specific location on a particular chromosome and control the same trait.

(D) T - Genotype is the genetic makeup of an organism. In simple terms, it is the complete set of genes/chromosomes that an individual has inherited.

(E) F - The dominant allele is represented by a capital letter, while the recessive allele is represented by a simple letter.

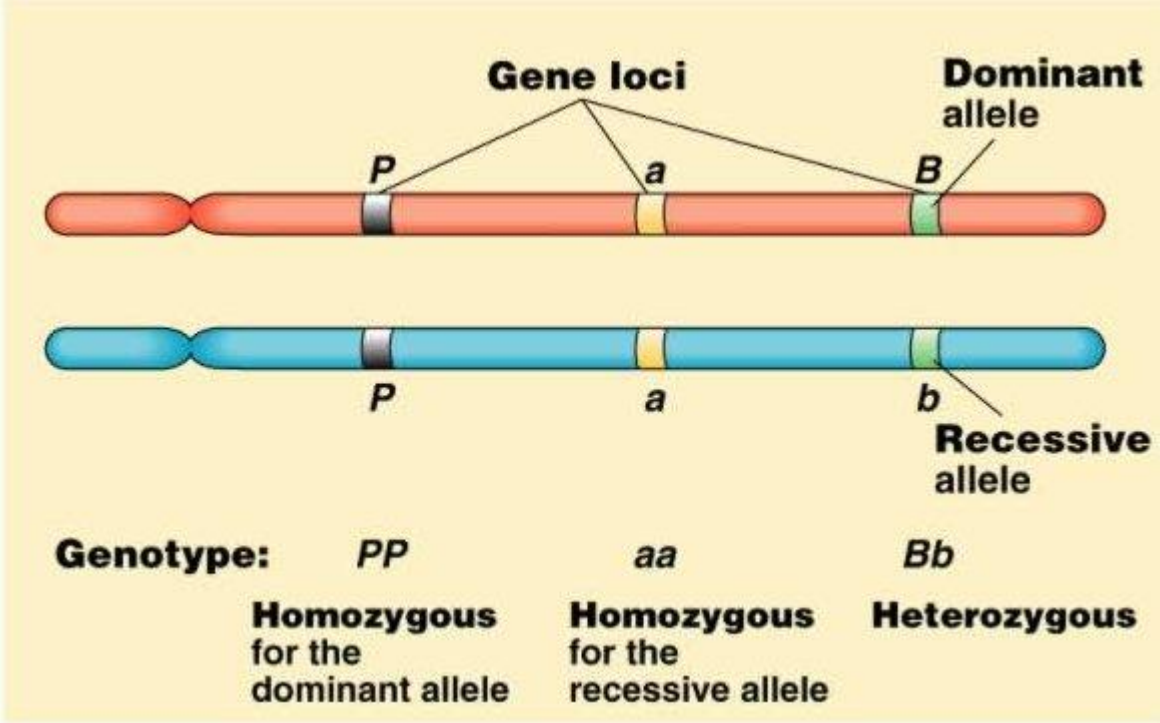


Figure 6: arrangement of allele in a chromosome

Answers - Q11

(A) F - autosomal dominant inheritance

(B) F - autosomal recessive

(C) T -

(D) F - X linked recessive

(E) T -

Answers - Q12

(A) T - Leber hereditary optic neuropathy (LHON) is a maternally inherited bilateral subacute optic neuropathy. LHON typically produces severe and permanent visual loss in young men. With the rare exceptions of two distinct mitochondrial DNA mutations, LHON is usually not associated with myopathy but some patients present with movement disorders or cardiac conduction defects [37]. LHON is discussed in greater detail elsewhere.

(B) T - Maternally inherited diabetes and deafness (MIDD) is a rare form of diabetes first described in 1992. It is a mitochondrial disorder that is characterized by progressive

insulinopenia and sensorineural hearing loss, most commonly caused by a genetic mutation at position 3243 in the tRNA.

(C) F - Autosomal Recessive Pattern

A rare, inherited disorder marked by shorter than average height, a narrow face, a red skin rash that occurs on sun-exposed areas of the body, and an increased risk of cancer.

(D) F - X-linked dominant pattern

Classic physical features include a long and narrow face with prominent forehead and chin, large ears, and testicular enlargement, but these features typically are not obvious until adolescence or adulthood. Intellectual disability is usually in the moderate range. Expressive language is more affected than receptive language. Behavioral features may include features of attention deficit hyperactivity disorder (ADHD; hyperactivity, inattention), autism spectrum disorder (ASD; gaze aversion, stereotypic movements [eg, hand flapping, hand biting], hyperarousal, social impairment, and unusual speech), or anxiety.

Females have less features.

(E) F - X linked recessive.

DMD is a genetic disease due to the mutation of the dystrophin gene, located on chromosome Xp21. It is inherited as an X- linked recessive trait. Mutations in the dystrophin gene result in diseases known as dystrophinopathies, which encompass Duchenne muscular dystrophy, Becker muscular dystrophy, and an intermediate form.

THE PECTORAL REGION AND UPPER LIMB

ANSWERS - Q13

(A) F - Extends from the sternal edge to the mid-axillary line

(B) F - the axillary tail is at the level of 3rd rib

(C) F - it consists of 15 - 20 lobes in the lactating breast

(D) T - it is a modified sweat gland

(E) F - it extends from the 2nd rib upto 6th rib in mid clavicular line.

ANSWERS - Q14

(A) F - it has no capsule. But some name the deep membranous layer of the superficial fascia (upward continuation of the membranous layer of superficial abdominal fascia of Scarpa) as the posterior capsule of the mammary gland.

(B) F - these fibrous connections/strands are named as suspensory ligaments of Cooper. They connect the dermis of the overlying skin to the ducts of the breast and to the deep membranous layer of the superficial fascia.

Deep fascia is found on the pectoral muscle.

Between the posterior capsule and the fascia over the pectoralis major muscle, is the retromammary space.

(C) F - its tail runs supero-laterally into the axilla upto the level of 3rd rib.

(D) T - There is a retro-mammary space in front of the pectoralis major muscle. If a malignant lesion invades this space and then the pectoralis major muscle, then the breast will show reduced mobility with the contraction of the pectoralis major muscle.

(E) T - it lies over 4 muscles

i. Pectoralis major

ii. Serratus anterior

iii. Rectus abdominis

iv. External oblique muscle

Answers - Q15

(A) T

(B) F

(C) F

(D) T

(E) T

- The primary biomechanical role of the rotator cuff is to stabilize the glenohumeral joint by compressing the humeral head against the glenoid. Additionally, rotator cuff muscles help in the mobility of the shoulder joint by facilitating abduction, medial rotation, and lateral rotation.
  - Subscapularis: Medial (internal) rotation of the shoulder
  - Supraspinatus: Abduction of the arm, necessary for the initial 0 to 15 degrees of shoulder abduction motion (The deltoid muscle abducts the arm beyond 15 degrees)
  - Infraspinatus: Lateral (external) rotation of the shoulder
  - Teres Minor: Lateral (external) rotation of the shoulder

- Nerve Supply

The subscapular nerve (upper and lower branches) innervates the subscapularis muscle.

- Originate from the posterior cord of the brachial plexus
- C5, C6, C7

The suprascapular nerve innervates the infraspinatus and supraspinatus

- Originates from the superior trunk of the brachial plexus
- Passes through the suprascapular foramen
- C5 and C6

The axillary nerve innervates teres minor

- Originates from the posterior cord of the brachial plexus
- Passes through the quadrangular space into the posterior scapula region
- C5 and C6

Answers - Q16

(A) T

(B) F

(C) T

(D) F

(E) F

- The quadrangular space is rectangular-shaped with four boundaries:
  - Superior – inferior margin of teres minor.
  - Lateral – surgical neck of the humerus.
  - Medial – long head of triceps brachii.
  - Inferior – superior aspect of teres major.

- The quadrangular space is a passageway that allows structures to travel between the axilla and posterior compartment of the upper arm.
- It contains the axillary nerve and posterior circumflex humeral artery (and accompanying vein) as they travel into the posterior upper arm.

Quadrangular space syndrome

- Quadrangular space syndrome refers to compression of the axillary nerve and posterior circumflex humeral artery as they pass through the quadrangular space.
- Compression is thought to occur secondary to hypertrophy of the muscular borders of the space, or by the formation of fibrotic bands between the muscles.
- Clinical features include pain and paresthesia in the distribution of the axillary nerve, as well as pain upon shoulder abduction and external rotation.

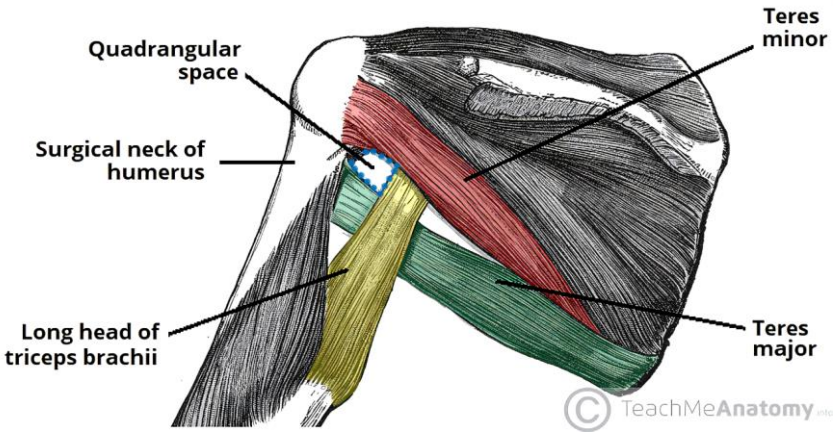


Figure 7: Arrangement of the Quadrangular space in the axilla

Answers - Q17

D. radial nerve

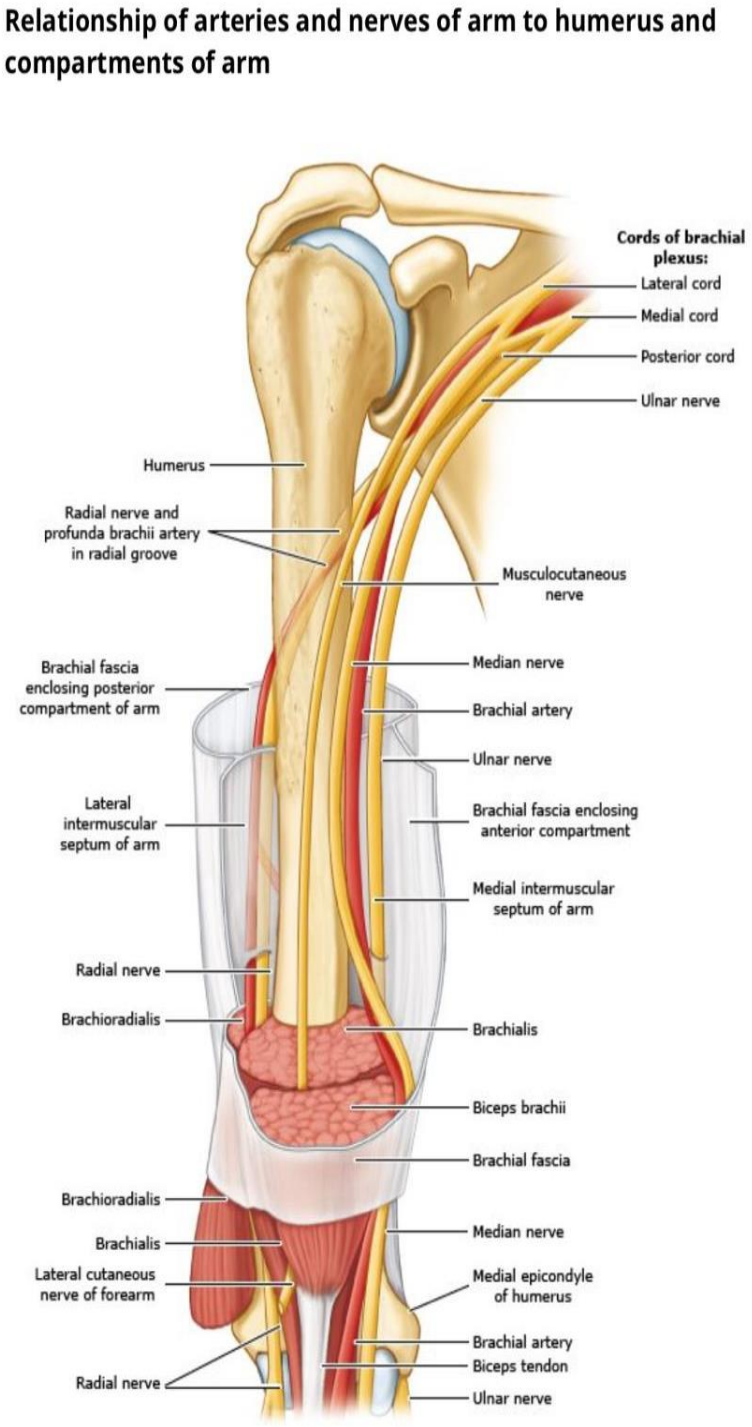


Figure 8: radial nerve and the profunda brachii artery runs in the radial groove.

Note the radial nerve and the profunda brachii artery running in the radial groove.

Radial nerve

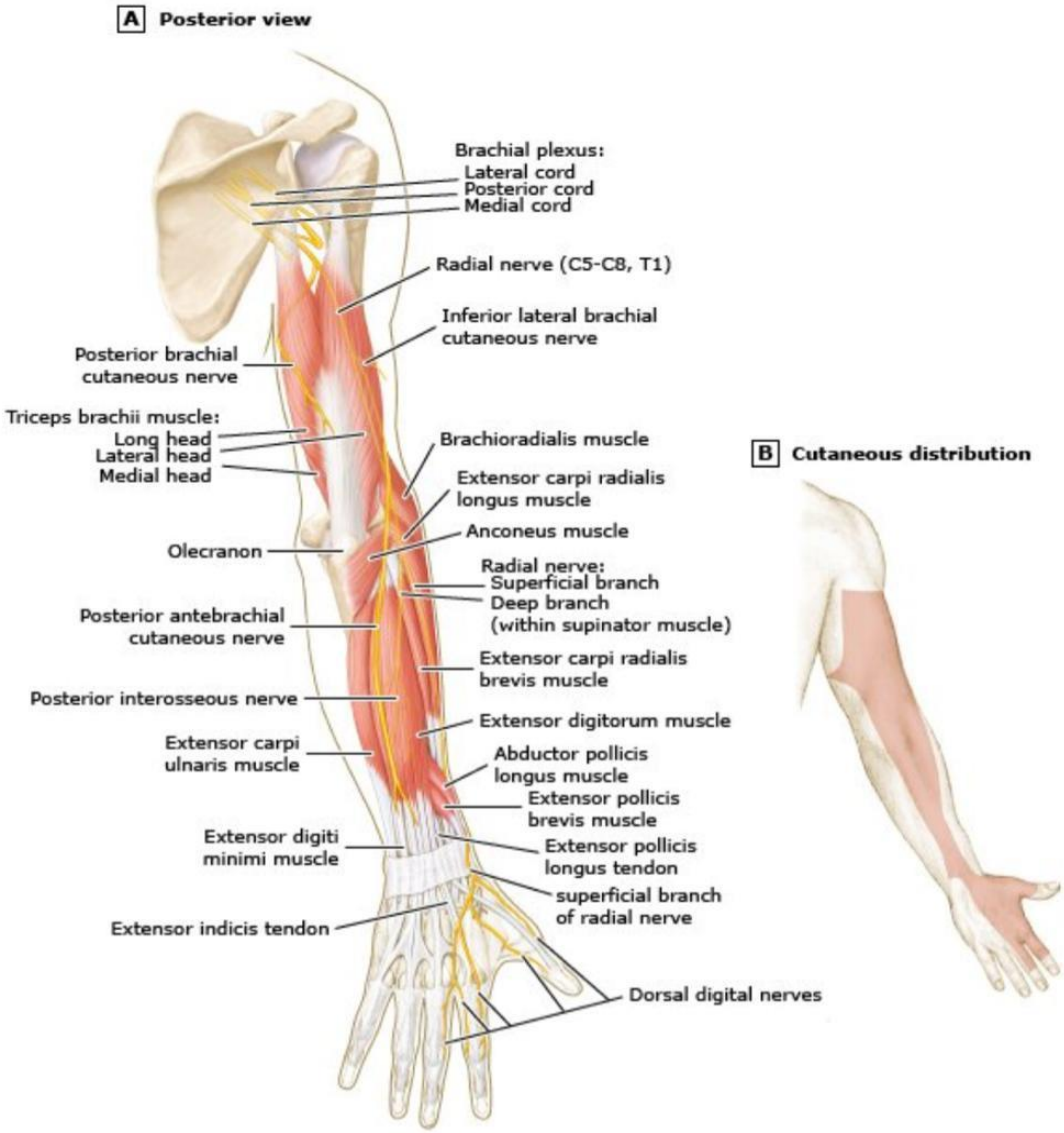


Figure 9: Course of the radial nerve and it's sensory distribution

Note that the radial nerve innervated the extensor muscle groups causing difficulty in wrist extension (wrist drop)

Answers - Q18

(A) T

(B) T

(C) T

(D) F

(E) F

- Axillary artery is the continuation of the subclavian artery from the outer edge of the 1st rib up to the lower border of teres major muscle, where it continues as the brachial artery.

- It is conveniently divided into 3 parts by pectoralis minor.
  Part 1 - above pec. Minor
  Part 2 - behind pec.minor
  Part 3 - below pec. Minor

- Its relations are as follows. (please relate this with a diagram and study)

1st part of axillary artery

- Anterior relations - Pec.Major muscle / subclavius / clavipectoral fascia / cephalic vein / loop of medal and lateral pectoral nerves
- Posterior relations - medial cord / long thoracic nerve / medial pectoral nerve / 1st intercostal space / 1st digitation of serratus anterior muscle
- Lateral relations - all three cords of brachial plexus
- Medial relation - axillary vein

2nd part of axillary artery

- Anterior relations - pec. Major / pec.minor
- Posterior relations - posterior cord / subscapularis
- Lateral relations - lateral cord
- Medial relations - medial cord / medial pectoral nerve / axillary vein

3rd part of axillary artery

- Anterior relations - pec. major / medial root of median nerve
- Posterior relations - subscapularis / latissimus dorsi / teres. Major / axillary nerve / radial nerve

- Lateral relations - musculocutaneous nerve / median nerve / humerus / short head of biceps / coracobrachialis
- Medial relations - axillary vein / ulnar nerve / medial cutaneous nerve of arm / medial cutaneous nerve of forearm

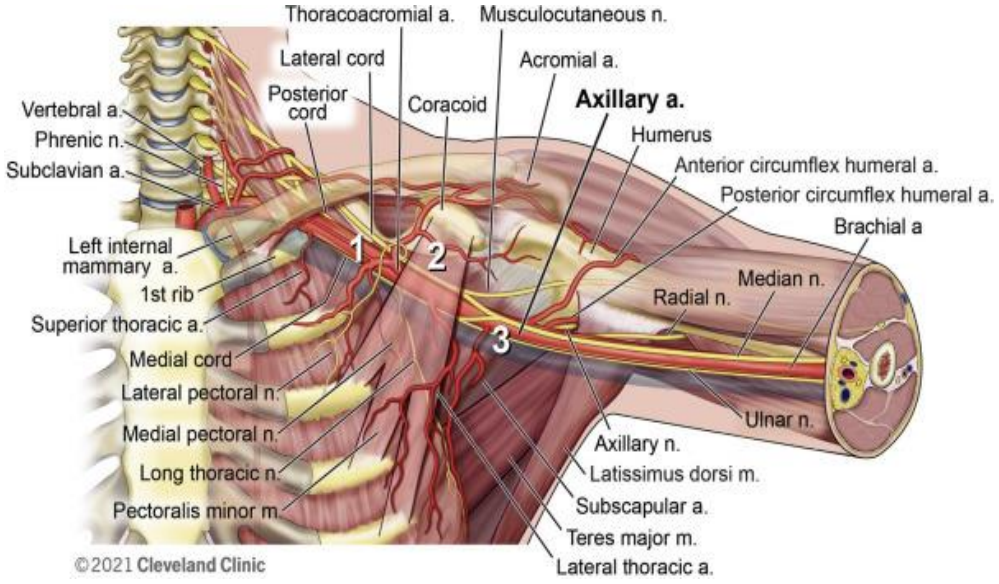


Figure 10: Brachial artery is divided into 3 parts by the pec. Minor muscle

Answers - Q19

(A) T

(B) T

(C) F

(D) F

(E) T

- Axillary nerve is a terminal branch of the posterior cord of the brachial plexus and is formed near the lower border of the subscapularis muscle. It then passes through the quadrangular space of the axilla with the posterior circumflex humeral artery (immediately inferior to the capsule of the shoulder joint). Then it divides into Anterior branch Posterior branch
  (both the anterior and posterior branches run behind the surgical neck of the humerus)

- Innervation of the axillary nerve -
  1. Shoulder joint
  2. Teres minor muscle
  3. Deltoid muscle
  4. Skin over the lower 1/2 of the deltoid (via cutaneous branches)

- Clinical significance

- The axillary nerve is at risk in downward dislocation of the head of the humerus and in the fractures of the surgical neck of the humerus.

- When it is damaged

1. There is weakness in abduction - due to paralysis of deltoid muscle
2. There is weakness in external rotation of humerus - due to paralysis of teres minor muscle
3. There is loss of sensation over the inferior deltoid area “regimental badge area)
4. There is loss of shoulder contour - due to paralysis of deltoid muscle

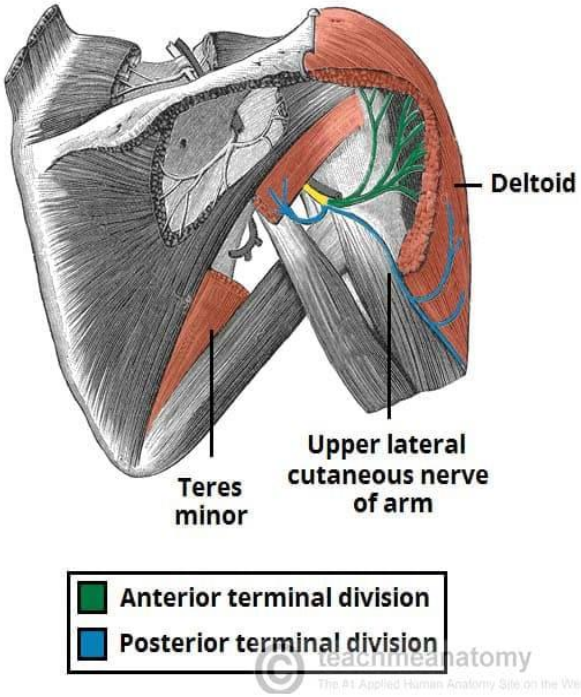


Figure 11: axillary nerve crossing through the quadrangular area of the axilla and divides into anterior and posterior branches

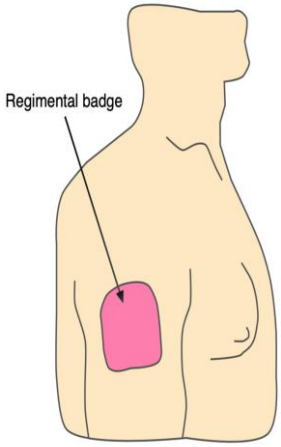


Figure 12: Regimental badge area is an anesthetic area due to an axillary nerve lesion.

Answers - Q20

(A) F - Anterior interosseous nerve: This is a branch of the median nerve that is given off in the forearm

(B) F - Posterior interosseous nerve: This is the continuation of the deep branch of the radial nerve as it passes through the supinator muscle. This nerve has no cutaneous innervation therefore it does not produce sensory loss over the first dorsal web space

(C) T - This is the answer

(D) F - Lesion at this level won't give rise to any of the signs mentioned in the mcq

(E) F - upper limb reflexes wouldn't be normal

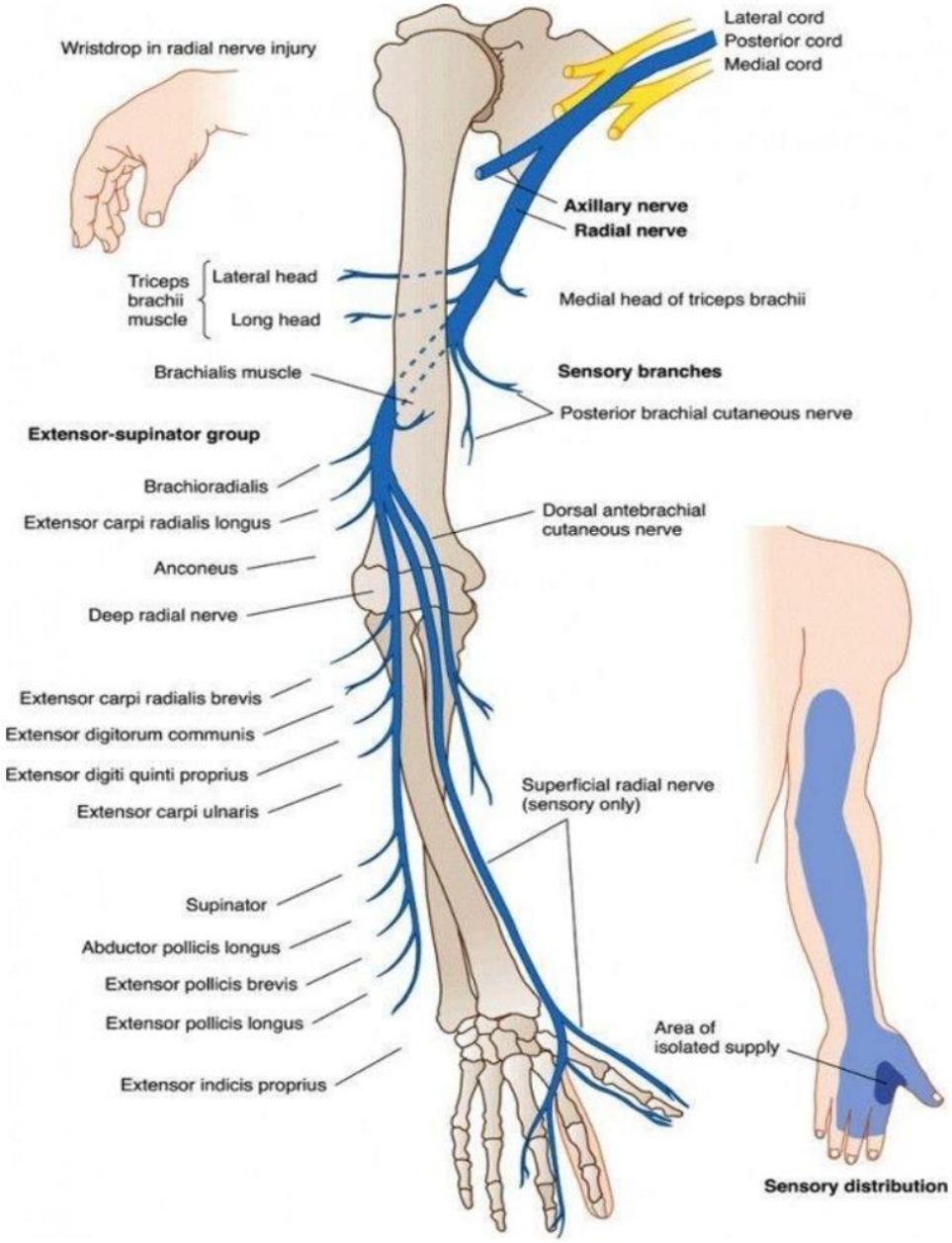


Figure13: course of the radial nerve and its sensory distribution

- If the radial nerve is damaged in the Axilla there will be,
    - Weak elbow extension,
    - Diminished Triceps Reflex,
    - Weakness in the Brachioradialis Muscle,
    - weak supination,
    - wrist drop and finger drop. and
    - Sensory loss in the posterior forearm and the first dorsal interosseous.

- If the radial nerve is damaged in the Spiral Groove there will be,
    - Normal elbow extension,
    - Normal Triceps Reflex Weakness in the Brachioradialis Muscle,
    - weak supination,
    - wrist drop and finger drop
    - Sensory loss in the first dorsal interosseous.

- If the radial nerve is damaged in the Proximal Forearm there will be,
    - Normal elbow extension,
    - Normal Triceps Reflex
    - No brachioradialis weakness,
    - supination spared,
    - No wrist drop but finger drop is present
    - Sensory loss in the first dorsal interosseous.

As the site of injury moves more distally the amount of neurological signs and deformities reduce and this can be used to localize lesions

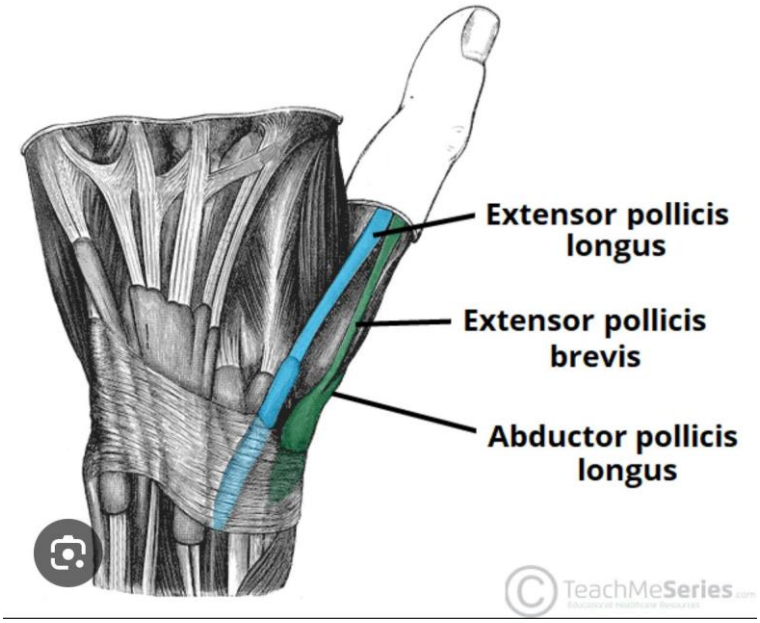


Figure 14: Area and boundaries of Anatomical snuffbox

Answers - Q21

(A) T - due to paralysis of adductor pollicis muscle

(B) T

(C) F - ulnar paradox is a phenomenon where, if the ulnar nerve lesion occurs more proximally (closer to the elbow) the degree of clawing of the hand reduces.

(D) T -

(E) F - biceps muscle innervated by the Musculocutaneous nerve.

- The muscles supplied by the ulnar nerve are,
    - Flexor carpi ulnaris
    - Medial 1/2 of the flexor digitorum profundus.
- Muscles innervated distal to the wrist joint,
    - Hypothenar muscles - abductor digit minimi / opponens digiti minimi / flexor digiti minimi
    - Medial 2 lumbricals
    - Adductor pollicis
    - Opponens pollicis / flexor pollicis brevis (has a shared innervation with median nerve)
- Deformity caused - Ulnar claw
- Sensory loss - palmar and dorsal aspect of both the medial 1/2 of the hand and medial 1 1/2 fingers

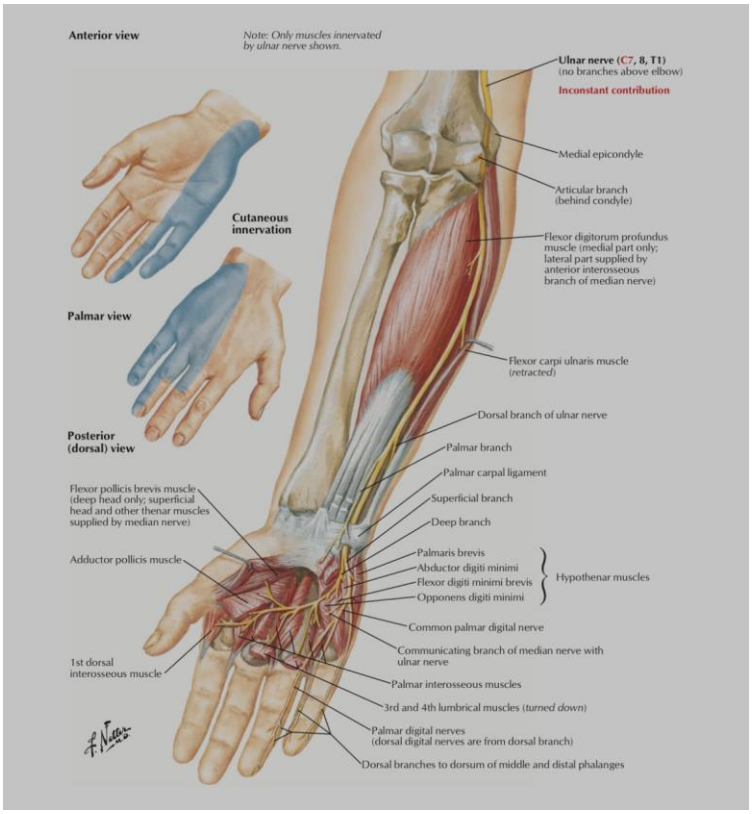


Figure15: Course of the ulnar nerve and its sensory distribution



Figure 16: ulnar claw deformity

Answers - Q22

(A) T

(B) F

(C) F

(D) F

(E) T

- Contents of carpal tunnel (10)
- flexor tendons of the fingers (flexor digitorum profundus [04] & flexor digitorum superficialis [04])
- flexor tendon of thumb [01] (flexor pollicis longus)
- median nerve [01]

- Carpal tunnel syndrome
- In tightly crowded flexor tunnels, the median nerve can be compressed by arthritic changes in the wrist joint, synovial sheath thickening, or oedema.

- Symptoms of Carpal tunnel syndrome
- Impaired sensation over 3 1/2 digits on the thumb side of the hand.
- Wasting and weakness of the thenar muscles.
- Ape's deformity of the hand
- Weak abduction of the thumb which results in poor grip.
- Treatment- surgical division of the flexor retinaculum

Answers - Q23

B. Scaphoid fracture

- Tenderness /pain in the anatomical snuff box is a characteristic feature of scaphoid fracture.
- Can get with a fall on an outstretched hand.
- Fracture can occur anywhere along the scaphoid.
    1. At the waist of the scaphoid (70 - 80%)
    2. At distal pole / scaphoid tubercle (20%)
    3. At proximal pole (10%)
- Blood supply of the scaphoid bone

- primarily by radial artery via 2 major vascular pedicles.
    1. Dorsal branch - enter through numerous small foramina (holes) along the spiral groove and dorsal ridge and supply 70-80% of the scaphoid in proximal direction
    2. Volar branch - enters via scaphoid tubercle supplying the remaining distal 20-30% of scaphoid.
- The vascular foramina are more numerous distally and the blood supply to the proximal part is retrograde. Therefore a fracture near the proximal pole of the scaphoid may result in avascular aseptic necrosis of the proximal fragment.
- Radiographic features

- Initially, the fracture line may be difficult to appreciate. Therefore if the patient has clinical features of scaphoid fracture, should repeat x ray in 2 weeks' time. By then the fracture line is usually visible because of the reabsorption of the bone along the fracture line.
- Treatment

- prolonged cast immobilization for 8 - 10 weeks.

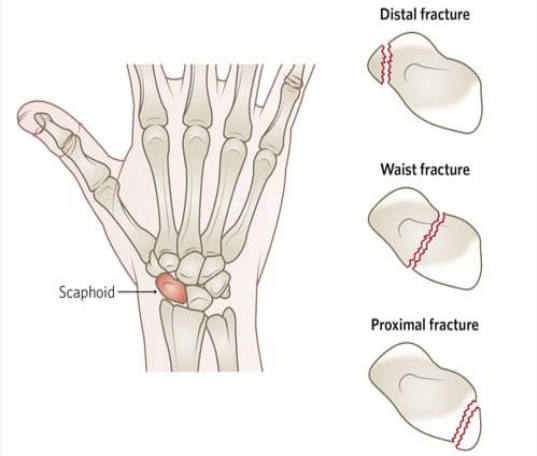


Figure 17: Scaphoid fracture

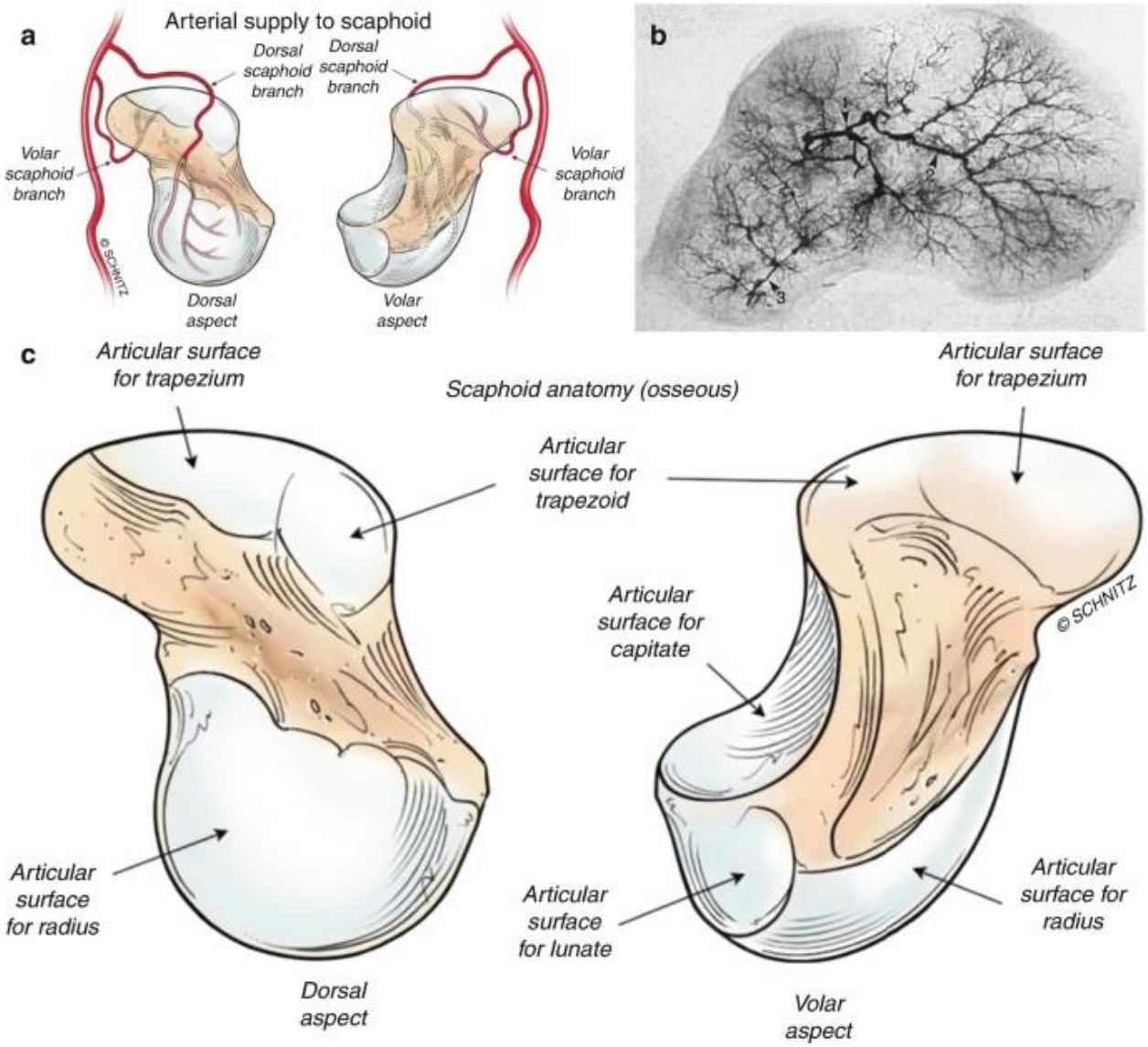


Figure 18: Arterial supply of the scaphoid bone



Figure 19: Cast put in scaphoid fracture



Figure 20: Scaphoid fracture in an X-ray

Answers - Q24

(A) F

(B) F

(C) F

(D) T

(E) T

- Mid palmar space lies behind the flexor tendons and ulnar bursa in the palm and in front of the 3rd , 4th and 5th metacarpals with the attached interossei.

- Boundaries as follows,

- Ulnar border; septum from ulnar border of flexor retinaculum dips and attaches to the palmar border of the 5th metacarpal bone.
- Radial border; septum from the radial border of the flexor retinaculum dips obliquely between the tendons of middle and ring finger tendons and then attaches to 3rd metacarpal bone.
- Anterior boundary; palmar aponeurosis, flexor tendons of medial 3 fingers,

Posterior boundary; fascia over the 3rd and 4th lumbricals and metacarpal bones.

- Proximal boundary; the space extends upto the level of distal margin of the flexor retinaculum, where normally it is closed but sometimes may extend deep to the retinaculum.

- Distal boundary; the space extends upto the level of distal palmar crease.

- Clinical significance
- Closed space infection of the palmar space results,
    1. Loss of normal hand concavity
    2. Tenderness of central palm.
    3. Pain with movements of 3rd and 4th digits.
- Proximally it communicates with the forearm space of Parona through the carpal tunnel which creates a pathway for spreading of infection.

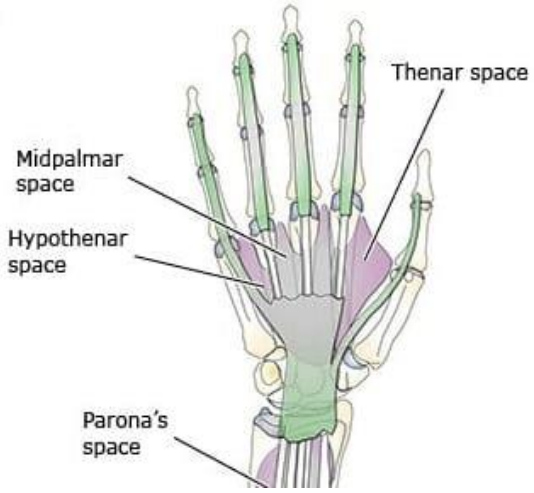


Figure 21: Arrangement of the palmar spaces and the bursa. Purple area are palmar spaces and the green areas are bursa

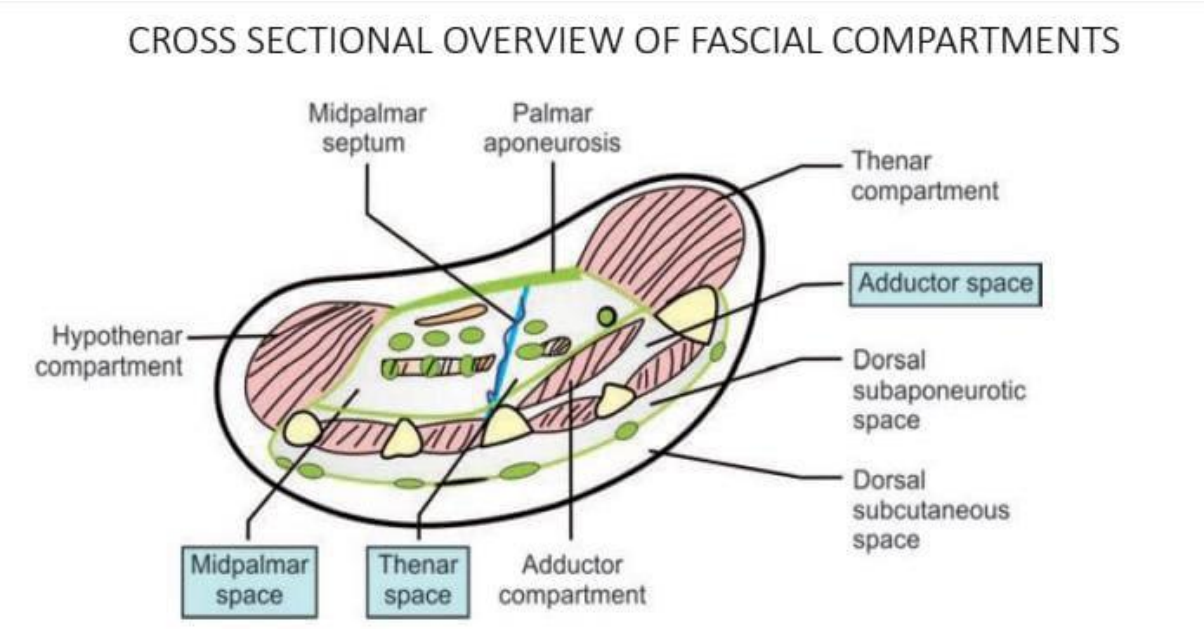


Figure 22: cross sectional view of palmar spaces

Answers - Q25

(A) T

(B) F - common palmar digital arteries are given off by the superficial palmar arch. The palmar metacarpal arteries are given off by the deep arch

(C) T - ulnar and radial arteries are considered as the main blood vessels which supply the hand. In certain cases, radial arteries predominate the blood supply to the hand.

(D) F - summit of the deep arch is 1 cm proximal to the superficial arch

(E) T - vincula longa is a structure that connects the which connect the flexor tendons to the phalanx and via that blood is supplied to the tendon.

- Arrangement of the blood supply of the hand in brief
  - The main blood supply to the hand is via the ulnar and radial artery.
  - Forms 3 main arterial arches
    1. Superficial palmar arch
    2. Deep palmar arch
    3. Dorsal metacarpal arch

1. Superficial palmar arch
   - Formed by the ulnar artery
   - This is an incomplete arch in 2/3rd of cases, therefore completed by a branch from the radial artery.
   - Lies superficial to the long flexor tendons and deep to the palmar aponeurosis.
   - This arch gives of palmar digital arteries which later divide into proper digital arteries
   - Summit is at the distal border of fully extended thumb

2. Deep palmar arch
   - Formed by the radial artery.
   - This is a complete arch.
   - Lies 1 cm proximal to the superficial arch and runs along with the ulnar nerve in the hand.
   - Gives off palmar metacarpal arteries.

3. Dorsal metacarpal arch
   - Formed by both radial and ulnar arteries.
   - Lies dorsal to the wrist.
   - Gives off dorsal metacarpal arteries which finally branch to form digital arteries in the dorsal aspect of the digits.

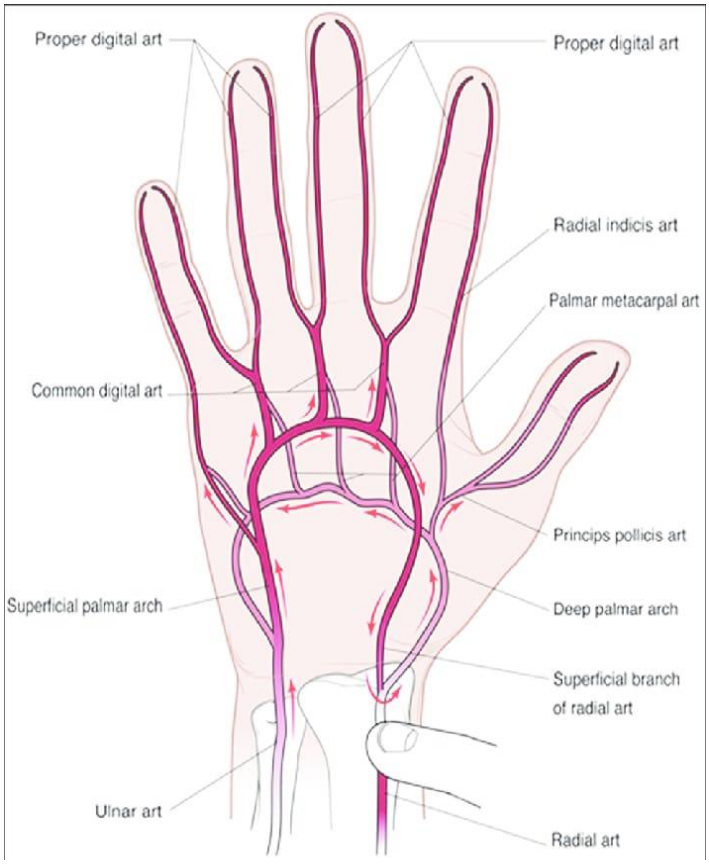


Figure 23: Superficial palmar arch and deep palmar arch

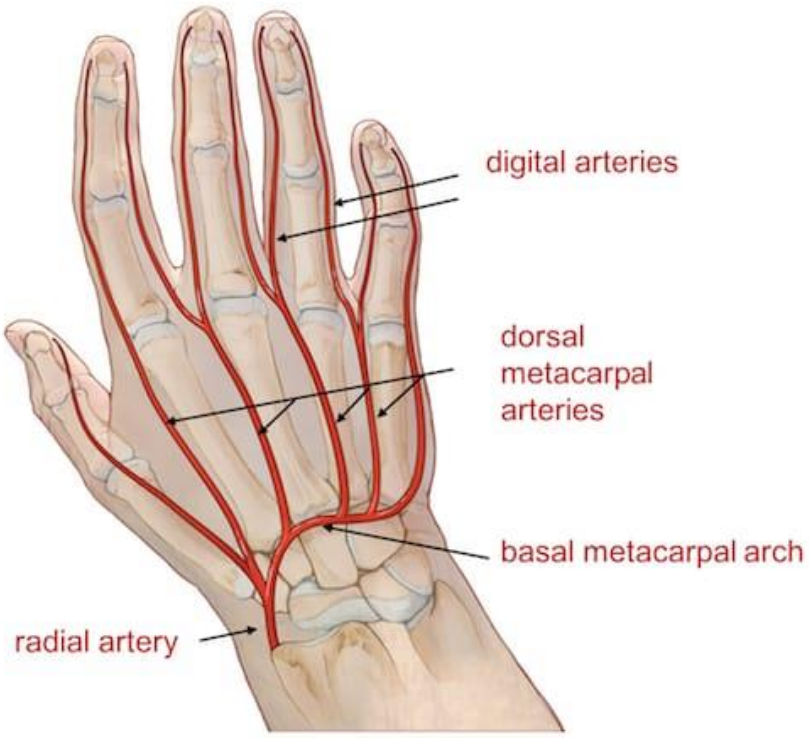


Figure 24: Dorsal metacarpal arch

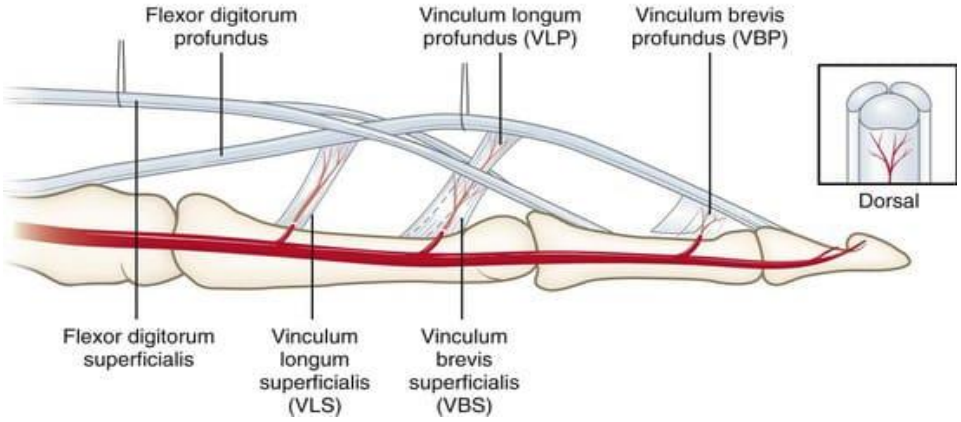


Figure 25: blood supply to the long tendons at the fingers is via the vinculum.

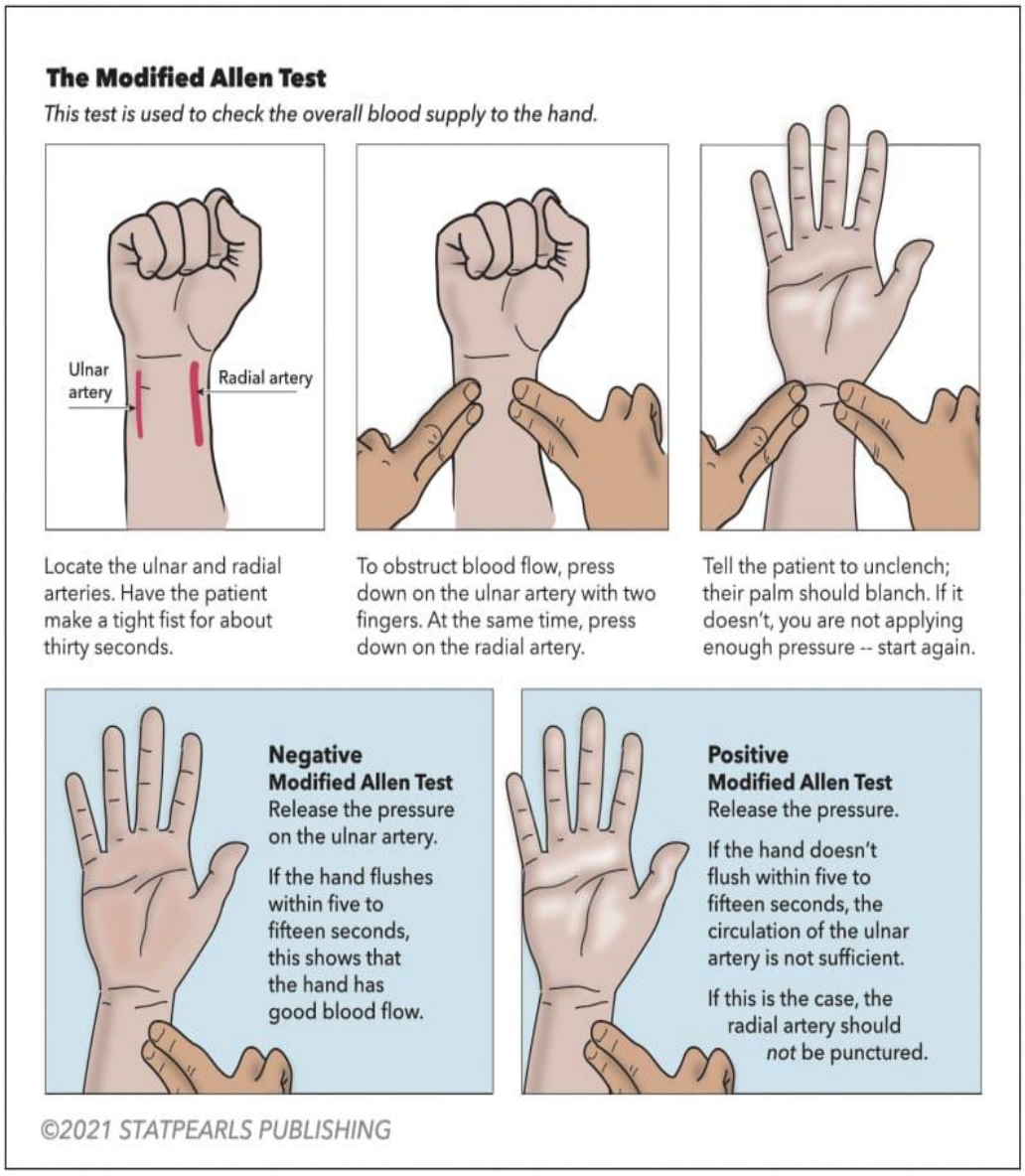


Figure 26: Allen test

Answers - Q26

C. Right Cervical rib

Cervical rib

- This is an accessory rib arising due to congenital over development of the transverse process of the 7th cervical vertebra.
- It may have a

1. free end OR
2. may be connected to the 1st rib by a fibrous band OR
3. May articulate with the 1st rib

- Clinical importance

- It can cause pressure on the lower trunk of the brachial plexus and produce pain down the medial side of the forearm and hand & wasting of the small muscles of the hand (due to the involvement of T1 root)
- It can exert pressure on the overlying subclavian artery and interfere with the circulation of the upper limb resulting in cold limbs and also gangrene.

This clinical presentation is THORACIC OUTLET SYNDROME

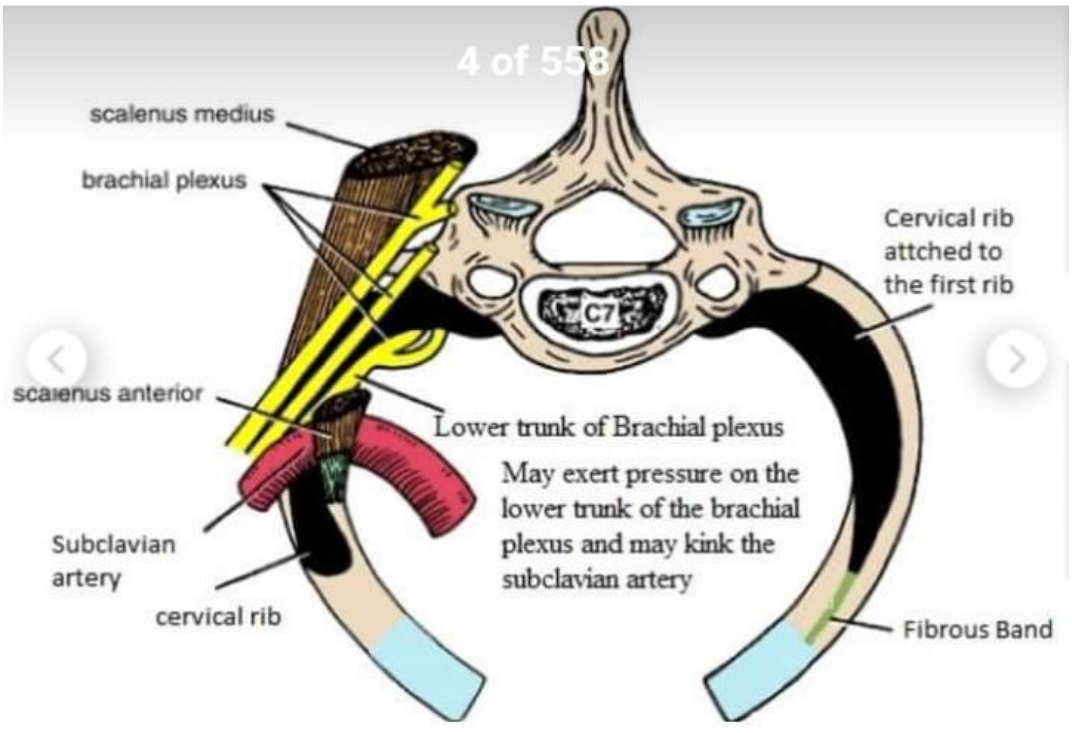


Figure 27: Cervical rib and its relation with brachial plexus and the subclavian artery.

ANSWER - Q27

(A) F - Biceps brachii → musculocutaneous nerve

(B) F - Supinator → deep branch of the radial nerve

(C) T - Pronator teres

(D) T - Abductor pollicis brevis

(E) F - Medial 2 Lumbricals → Ulnar nerve

The M structure seen in brachial plexus is a common specimen you will see in most OSCEs.

It is made up of musculocutaneous nerve, median nerve, and ulnar nerve.

The radial nerve and axillary nerve are not involved in these structures.

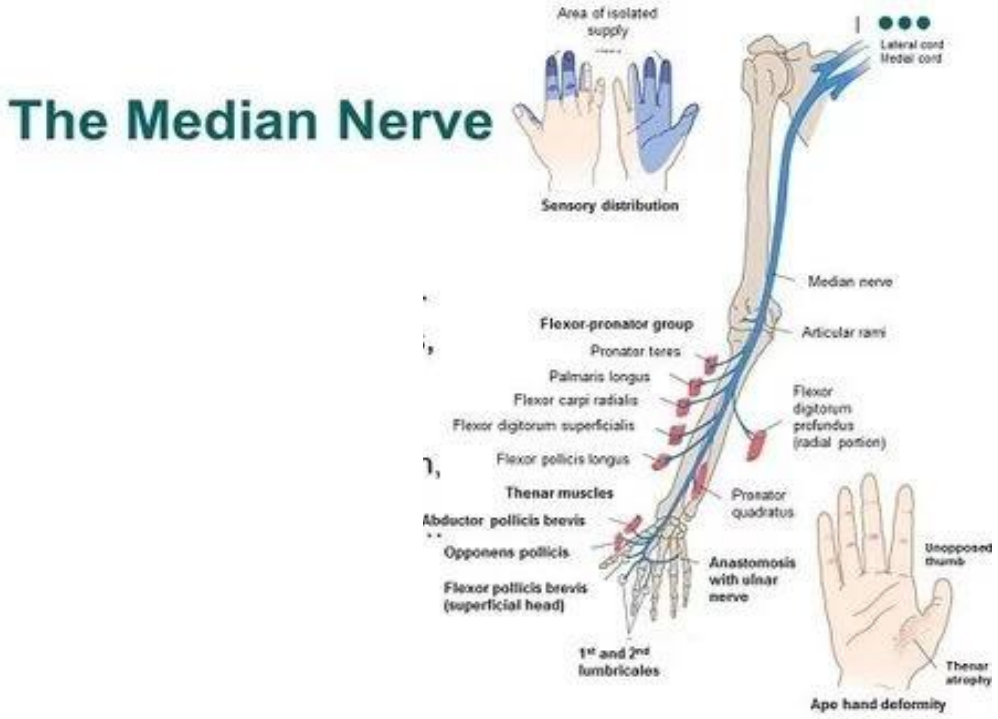


Figure 28: Course of Median nerve and its sensory distribution

- Muscles innervated by the median nerve
    - Flexor carpi radialis
    - Palmaris longus
    - Pronator quadratus
    - Pronator teres
    - Digital flexors

- Motor functions of median nerve
    - Thumb flexion and opposition
    - Flexion of digits 2 & 3
    - Wrist flexion and abduction
    - Forearm pronation

- Sensory distribution of the median nerve
    - Skin over anterolateral surface of the hand

	Elbow	Wrist
Key features	Weakness – thumb muscles Long flexors of the fingers, thumb and lateral 2 fingers Pronation and wrist flexion Sensory – median nerve distribution	Weakness of the thumb muscles Sparing of the sensory of the thenar eminence in CTS
Pathology	Trauma, fracture, compression	CTS Acromegaly, RA, Hypothyroidism, amyloidosis, DM

Table 42: Lesion Localization of median nerve palsy

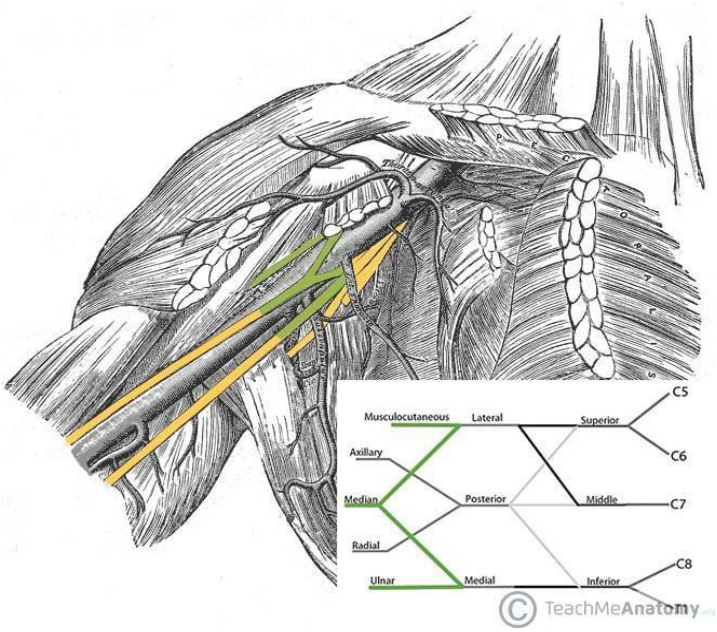


Figure 29: Arrangement of the brachial plexus in the axilla

THORAX

Answers - Q28

(A) T -

(B) T - lower trunk of the brachial plexus runs inferior to the subclavian artery in the subclavian groove.

(C) F - rib fractures in children are less likely since the ribs are more elastic than in adults.

(D) F - Manubriosternal joint is at the level of the 2nd costal cartilage.

(E) F -

- Types of ribs
  1. True ribs (1-7) - attach directly to the sternum
  2. False ribs (8-10) - attaches to the 7th costal cartilage via the costal margin
  3. Floating ribs (11-12) - no anterior attachment with the sternum or the costal margin

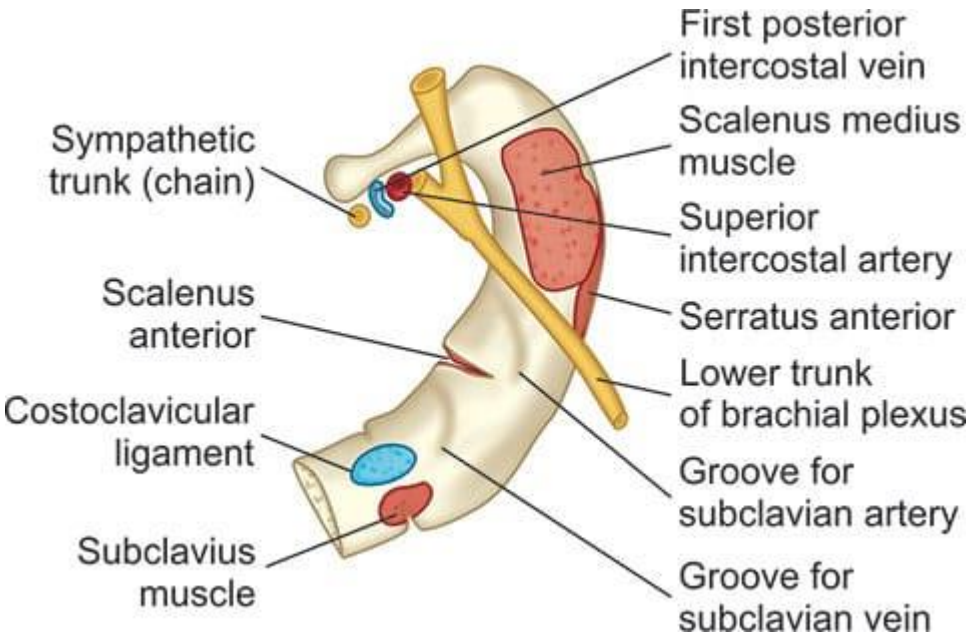


Figure 30: relations of the 1st rib

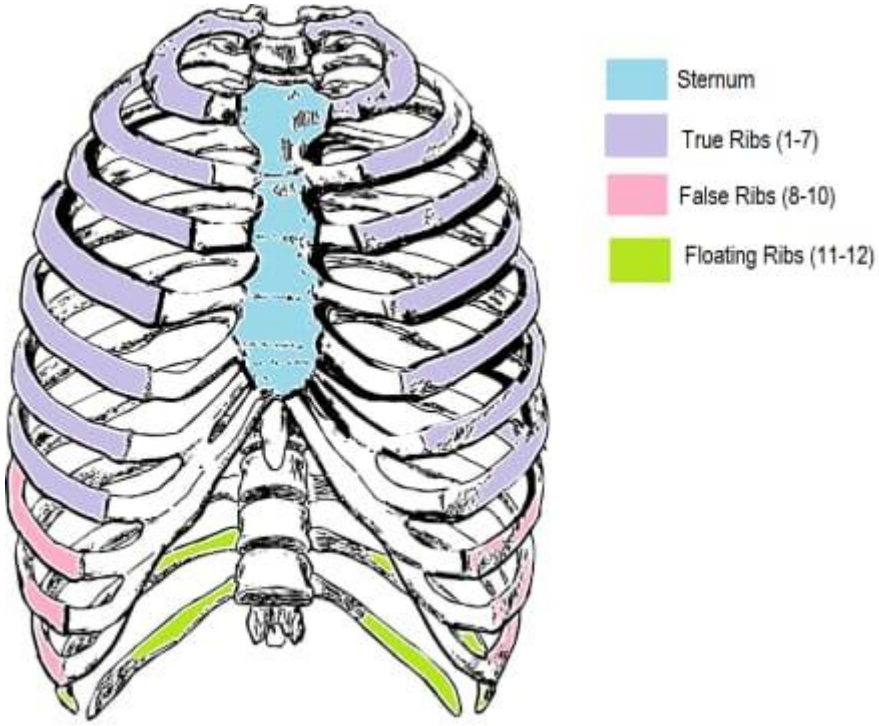


Figure 31: Different types of ribs

Answers - Q29

(A) F - the sympathetic trunk lies in contact with the anterior border of the neck alongside the head.

(B) T - the 1st rib has a prominent tubercle which is a fusion of the tubercle and the angle.

(C) T - inner border of the 1st rib and costal cartilage, transverse process of C7 vertebra, not attached to the neck of the 1st rib

(D) T -

(E) T -

- Why is the 1st rib considered as an atypical rib?
    1. Head carries only a single facet for the T1 vertebra.
    2. Shorter and wider (flattened) than other ribs.
    3. In contrast to other ribs, it has outer and inner borders along with superior and inferior surfaces.
    4. The superior surface is marked by 2 grooves for the subclavian vessels.

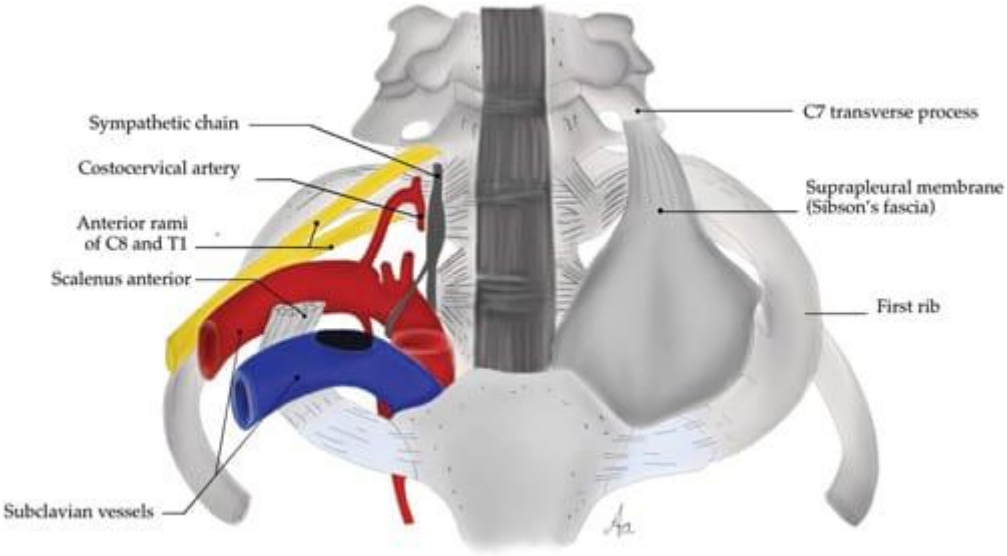


Figure 32: Arrangement of the supra-pleural membrane

Answers - Q30

(A) F - internal intercostal muscle extend from the edge of the sternum upto the angle of the rib

- In the innermost muscle group there are 3 muscles

1. Subcostalis muscles - found mainly in the paravertebral gutter.
2. Innermost intercostal muscle - usually it extends further posteriorly than the internal intercostal and not so far anteriorly as the external intercostal.
3. Transversus thoracis/sternocostalis msucle - found behind the sternum as a spider

(B) T

(C) T

(D) T - specially the subcostalis muscles cross more than one intercostal space.

(E) F - serratus posterior superior - aids for inspiration
serratus posterior inferior - aids for expiration.

Answers - Q31

(A) T - intercostal nerves are mixed nerves (carry both sensory and motor fibers)
Motor supply → intercostal muscles / subcostal muscles / transversus thoracic muscle/ abdominal wall muscles

Sensory supply → skin of thoracic and abdominal wall / parietal pleura / peritoneum

(B) F - collateral branch arises beyond the angle of the rib

Lateral cutaneous branch is given off beyond the angle of the rib

(C) T - the 1st intercostal nerve has no lateral or anterior cutaneous branches but crosses the 1st rib to join the brachial plexus

(D) T - the 2nd intercostal nerve gives off a large lateral cutaneous branch to the floor of the axilla and the medial side of the arm (Intercostobrachial nerve)

(E) T - The intercostal nerve is the lowest structure found in the VAN arrangement of the neurovascular bundle in the intercostal space. The intercostal nerve is found just below the costal groove. Therefore, when there is a need to anesthetize the intercostal space, the anesthetic agent should be injected around the nerve. Therefore, the needle should be introduced just below the lower border of the rib.

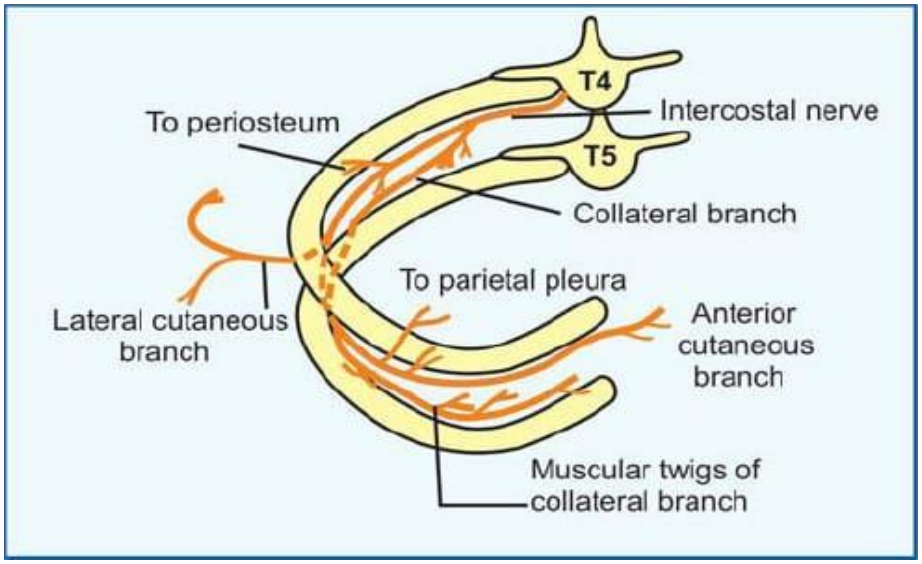


Figure 33: Arrangement of the intercostal nerve along an intercostal space

Answers - Q32

(A) T

(B) T

(C) T

(D) T

(E) F

- Regarding posterior intercostal arteries.

  - There is one in each of the 11 spaces.
  - 1st and 2nd arises from superior intercostal artery of the costocervical trunk of 2nd part of subclavian artery.
  - The lower 9 arteries and subcostal artery arise from descending thoracic aorta.

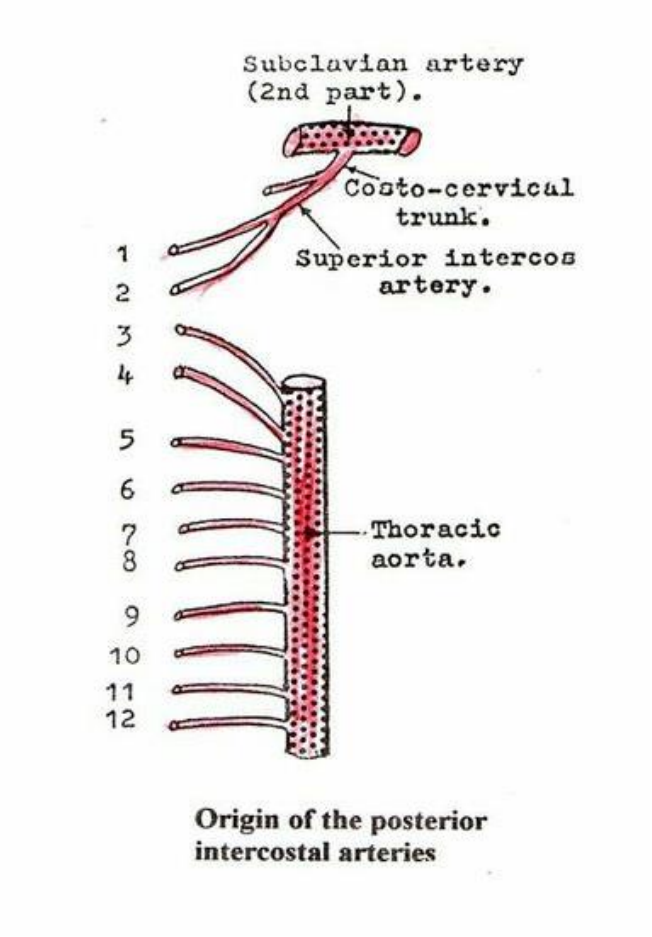


Figure 34: Posterior intercostal arterial arrangement

- Regarding anterior intercostal artery.

  - There are 2 anterior intercostal arteries in each space except the last 2 intercostal spaces.
  - Upper 6 spaces supplied by the branches of internal thoracic artery while the 7th, 8th and 9th space is supplied by the branches of the musculophrenic artery

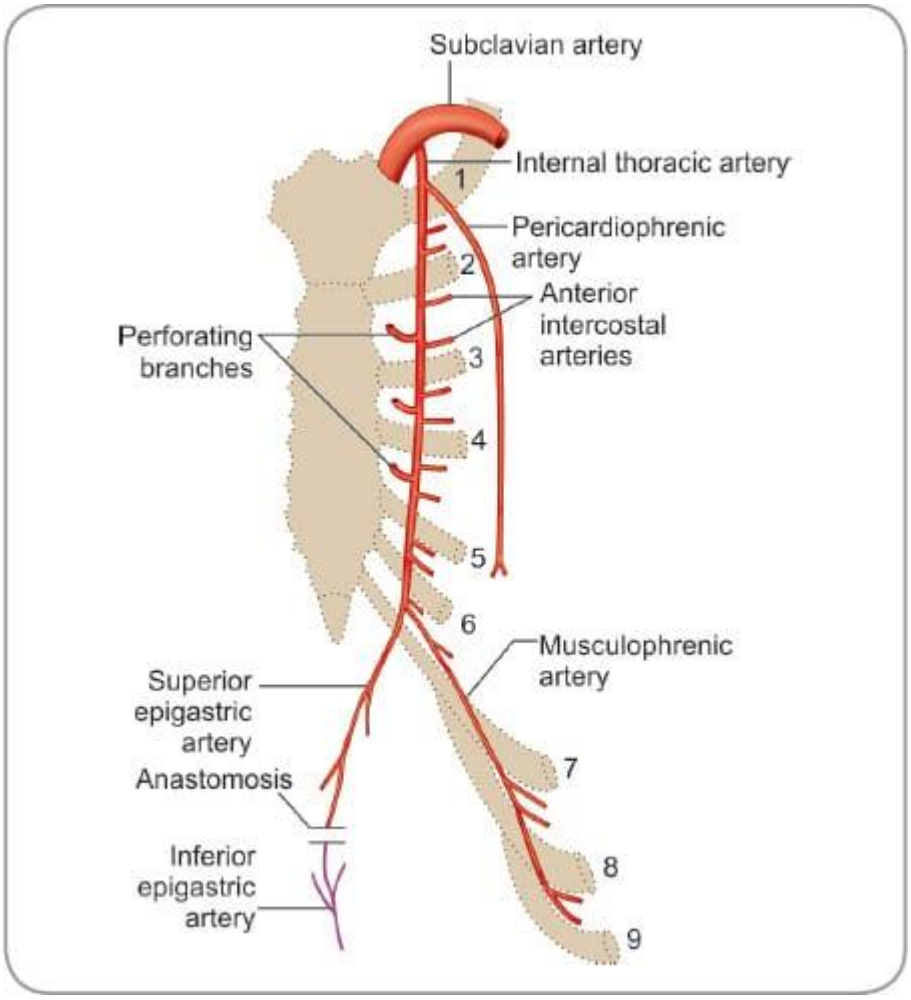


Figure 35: Anterior intercostal arterial arrangement

- Regarding the venous drainage of the intercostal spaces.

- Venous drainage via the posterior intercostal veins as above.
- Lower 8 spaces drain into the azygos system. Azygos vein in right and hemi-azygos and accessory hemi-azygos veins in left.

- The anterior intercostal veins in the upper 9 spaces accompany the arteries and drain into musculophrenic and internal thoracic veins. The internal thoracic vein drains into the brachiocephalic vein.

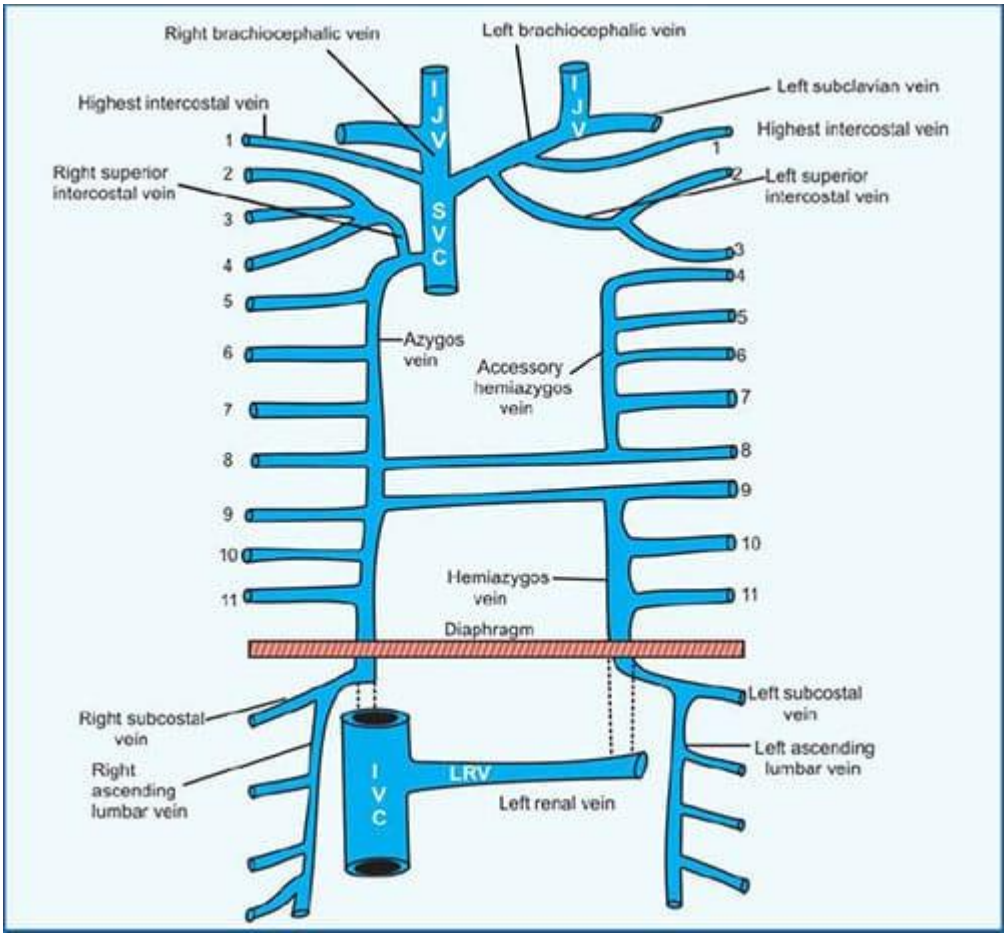


Figure 36: Posterior intercostal arterial arrangement

Answers - Q33

(A) T

(B) F

(C) F

(D) T

(E) F

- T4/T5 level is the sternal angle level. (level at the manubrio-sternal junction)
- The sternal angle is also named as the ANGLE OF LOUIS.

- Following mnemonic can be used to remember the main structures at the level of the sternal angle. RATPLANT

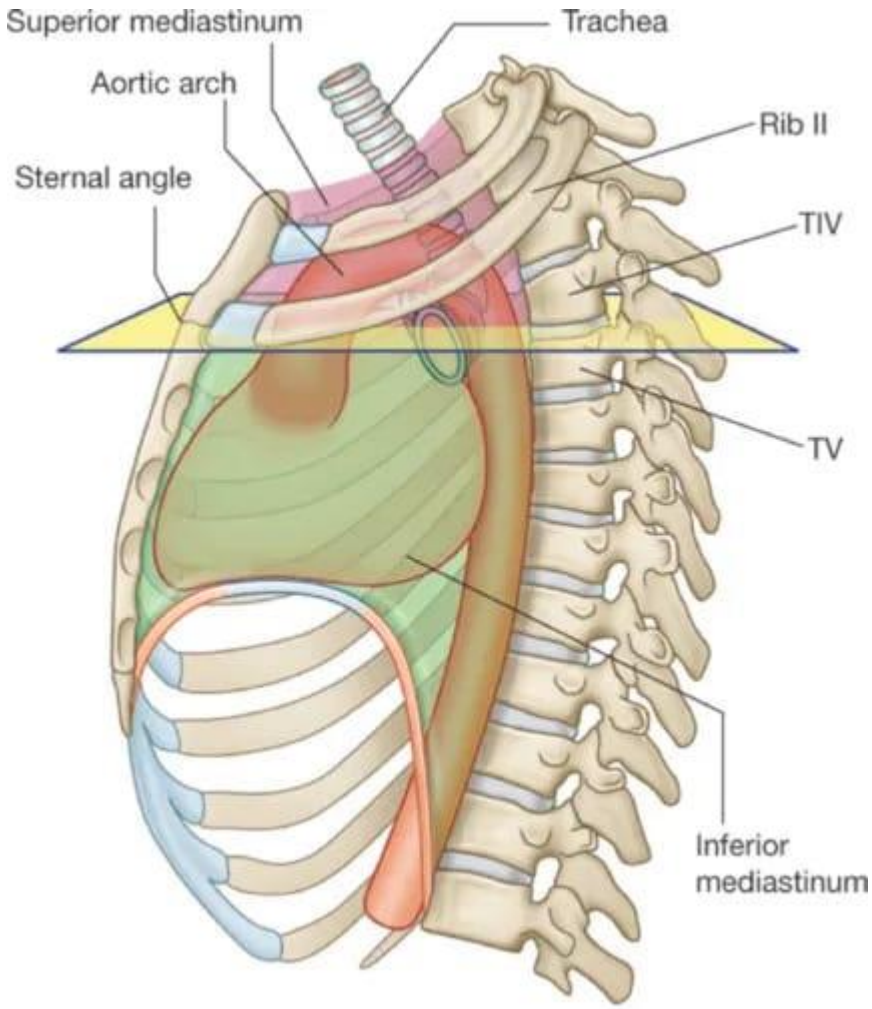


Figure 37: plane running across the T3-T4 level

R → 2nd Rib and costal cartilage

A → beginning and the termination of the Arch of aorta

T→ Tracheal bifurcation

P → Pulmonary trunk bifurcation

L → Left recurrent laryngeal nerve hooks around Ligamentum arteriosum

A → Azygos vein drains into SVC

N → cardiac plexus (Nerve)

T → Thoracic duct crossing from right to left

Answers - Q34

Answer A and C

- Aspiration pneumonia is caused by a direct chemical insult due to the entry of a foreign substance, solid or liquid, into the respiratory tract.
- Aspiration may be clinically silent or present with dyspnea, cough, or fever.
- The clinical and radiographic features depend on the aspirated volume, pH, and chronicity.
- The diagnosis of aspiration pneumonia typically requires radiological evidence of alveolar infiltrates. The presence of infiltrates in dependent areas highly indicates aspiration pneumonia, especially in older adults.
- However, the specific location of the dependent regions can vary depending on an individual's mobility status
- In most cases of aspiration pneumonia, the right lung is more frequently affected than the left
- In Supine position (in bedridden patients) superior segments of the lower lobes or posterior parts of the upper lobes are the most dependent segments and aspiration pneumonia is commoner in these segments.
- In upright position, basal segments of the lower lobes and the right middle lobe are the most dependent segments.

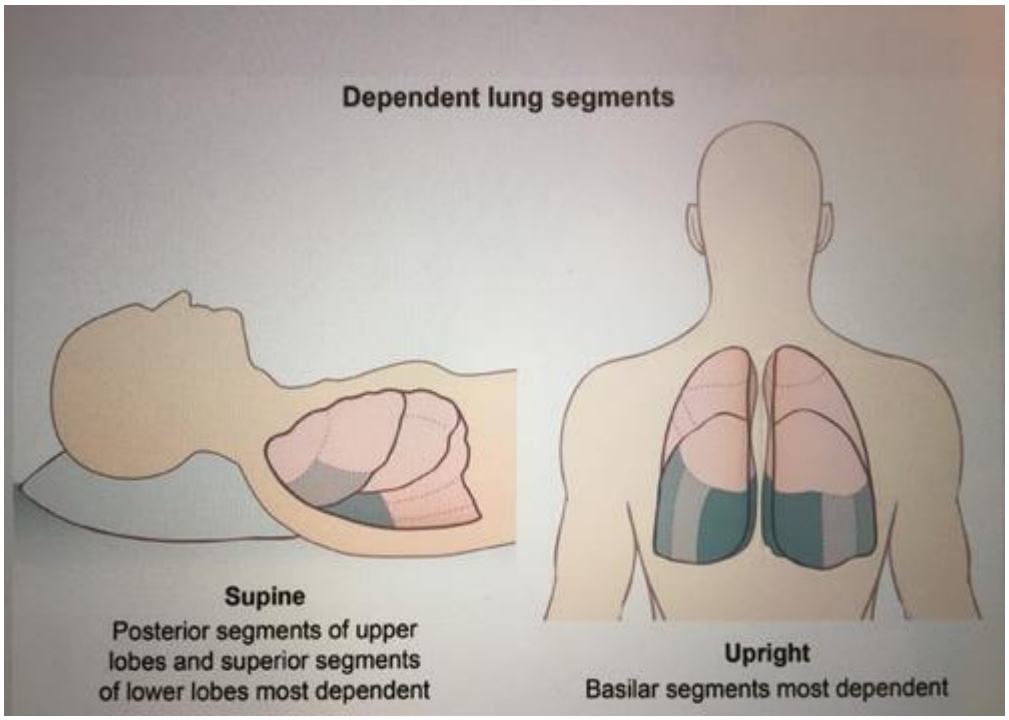


Figure 38: Dependent parts of the lung according to the position of the lungs

Answers - Q35

(A) T

(B) T

(C) F - it is at the commencement of the oesophagus

(D) F

(E) T

- Oesophagus is a muscular tube
  - starting at the lower border of the cricoid cartilage level (C6)
  - passes through the diaphragm at T10 level
  - end at the cardiac orifice of the stomach at T11 level.

- Muscle arrangement is as follows
  - upper 1/3rd → skeletal muscle
  - middle 1/3rd → smooth + skeletal muscle
  - lower 1/3rd → smooth muscle

- There are 4 main constrictions
  1. At cricopharyngeal junction → 15 cm from the incisor teeth (NARROWEST)
  2. When crossed by the aortic arch → 22cm from the incisor teeth
  3. When crossed by the left main bronchus → 27 cm from the incisor teeth
  4. When passing through the diaphragm → 38 cm from the incisor teeth

***When the left atrium is enlarged, it can also cause indentation of the oesophagus.

- BLOOD SUPPLY
  - upper 1/3rd → inferior thyroid artery
  - middle 1/3rd → branches from of aorta, branches of the bronchial artery
  - lower 1/3rd → branches of left gastric artery

- LYMPH DRAINAGE
  - cervical oesophagus → to deep cervical nodes
  - thoracic oesophagus → to tracheobronchial and posterior mediastinal nodes.
  - abdominal oesophagus → left gastric and coeliac nodes

** But the lymphatic drainage from any given area does not strictly follow the above pattern

- NERVE SUPPLY

- upper part → recurrent laryngeal nerve and sympathetics from middle cervical ganglia and motor fibers from the vagus
- middle and lower part → sympathetics from the thoracic sympathetic trunk and greater splanchnic nerves + parasympathetics from vagus nerve

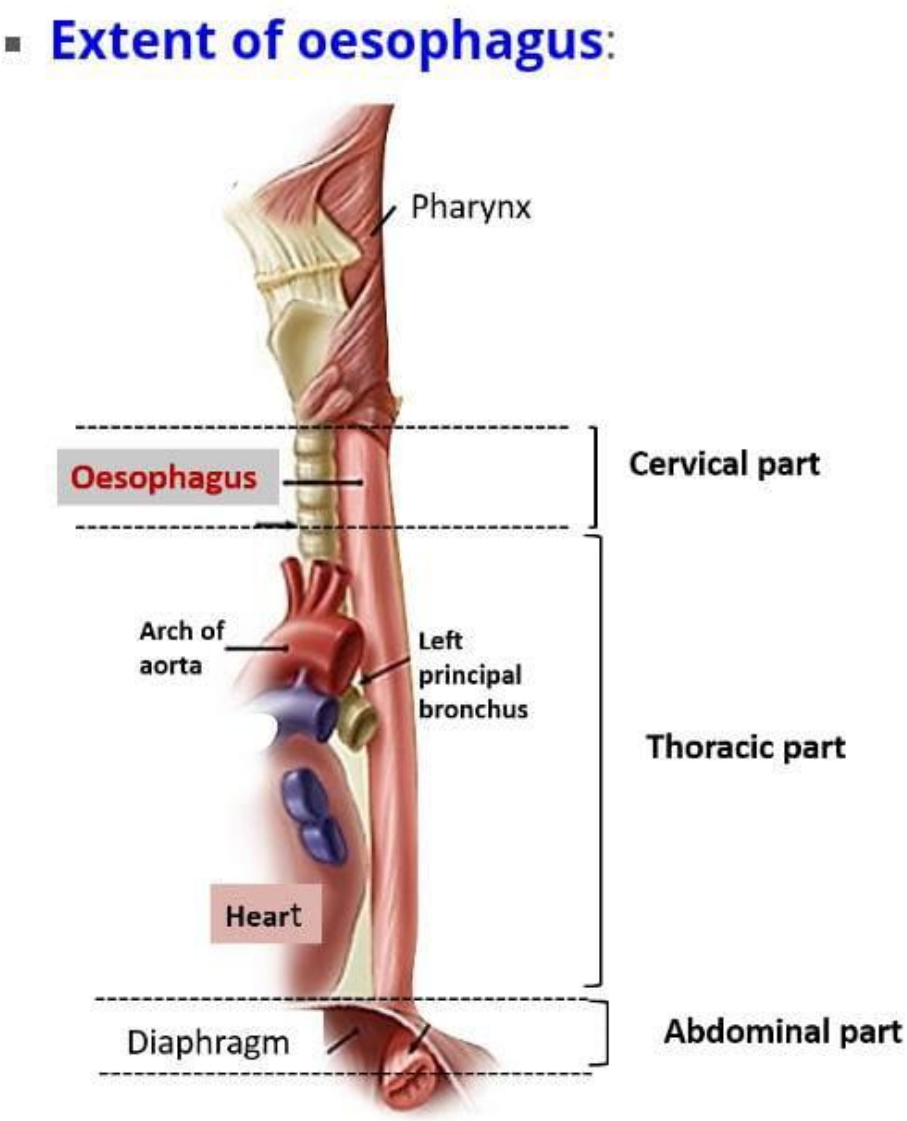


Figure 39: Constrictions of the oesopahgus

Answers - Q36

(A) T - This is the continuation of the larynx below the cricoid cartilage at the C6 level. And bifurcate at sternal angle level (T4/T5).

(B) T - in full inspiration the bifurcation descends to the level of T6 vertebra.

(C) F - the tracheal cartilage is hyaline and incomplete.

(D) T - the left recurrent laryngeal nerve runs around the ligamentum arteriosum and runs up in the recurrent laryngeal nerve.

(E) T - Tracheostomy is a procedure to help air and oxygen reach the lungs by creating an opening into the trachea from outside the neck. Here, a small plastic tube is inserted through a surgically created opening.

- Indications for a tracheostomy are,
  1. Laryngeal obstruction
  2. For evacuation of excessive secretions in patients who are too weak to cough.
  3. For prolonged continued artificial respiration.

- Procedure,

- Head is fully extended.
- Vertical incision is made downwards from the cricoid cartilage, passing between the anterior jugular veins.
- A hook is thrust under the lower border of the cricoid cartilage to steady the trachea and pull it forwards.
- The pre tracheal fascia s split longitudinally, the isthmus of the thyroid either pushed upwards or divided between clamps and the cartilage of the trachea clearly exposed.
- A circular opening is then made into the trachea to admit the tracheostomy tube.

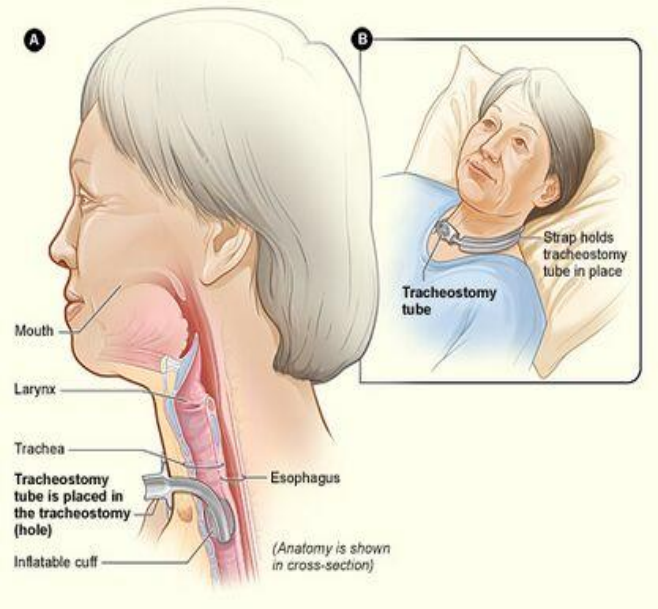


Figure 40: Placement of the tracheostomy tube

Surgery: Routine Adult Surgical Tracheostomy: Watch the Step-by-Step Placement! [105B]

Surgery

Answers - Q37

(A) F - It is a cyanotic congenital heart disease.

(B) T - Characterized with 4 heart anomalies

1. Pulmonary stenosis
2. Right ventricular hypertrophy
3. VSD
4. Overriding aorta

(C) T - these children will have both central and peripheral cyanosis

(D) F - there is an ejection systolic murmur best heard at the 2nd left intercostal space (this is due to the turbulence of the blood when it passes across the stenosed pulmonary valve)

(E) F - the direction of the blood shunt across the VSD is RIGHT to LEFT.

- Congenital heart defects can be divided into 2 classes as
  1. Cyanotic heart defects
  2. Acyanotic heart defects

<u>CYANOTIC Heart Disease</u>

- In these types of heart disease, there is mixing of oxygenated with the deoxygenated blood. As a result, the blood has less than normal oxygen level.
- As a result they exhibit central and peripheral cyanosis.

<u>ACYANOTIC Heart Disease</u>

- The oxygen levels in blood is normal in these conditions.

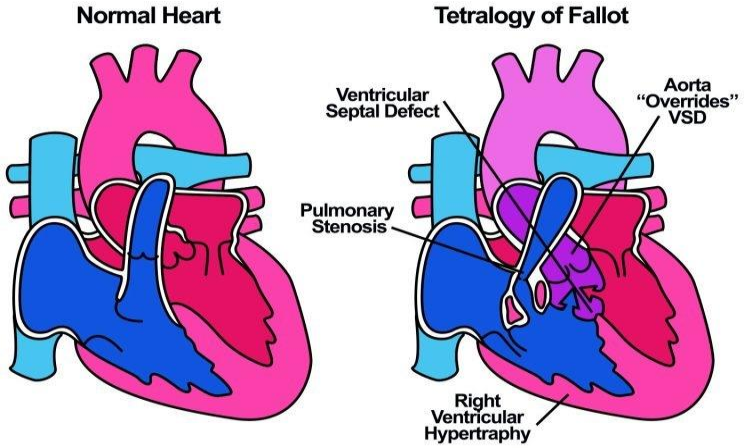


Figure 41: The changes in the heart in Tetralogy of Fallot



Figure 42: This baby has both central and peripheral cyanosis

Answers - Q38

(A) T

(B) T

(C) T

(D) F

(E) T

- The ventricular septum is formed through a coordinated development process involving multiple embryonic structures.
- The muscular part of the septum, which forms the bulk of the septum, arises from the walls of the primitive ventricle and the lower part of the bulbus cordis.
- The membranous part, which is smaller but equally important, is formed by the fusion of the conotruncal ridges and the contributions from the endocardial cushions.
- The primitive atrium, while essential for the development of the atria, does not contribute to the formation of the interventricular septum.
- The complex interplay ensures that the heart develops into a fully functional organ capable of efficiently pumping blood throughout the body.

Ventricular Septal Defect- normal speed

Answers - Q39

(A) T - in 60% of the population, the SA node is supplied by the right coronary artery.

(B) F - right ventricle is supplied by the Right coronary artery and the Left coronary artery as well (by the anterior interventricular artery)

(C) T - coronary arteries arise from aortic sinuses at the root of the ascending aorta.

Left coronary artery - left posterior/left aortic sinus

Right coronary artery - anterior/right aortic sinus.

* There are 3 aortic sinuses.

1. Anterior sinus
2. Right posterior sinus
3. Left posterior sinus

(D) T - the veins which drain to right atrium are

1. SVC (superior vena cava)
2. IVC (inferior vena cava)
3. Coronary sinus
4. Anterior cardiac veins
5. Venae cordis minimae

(E) F

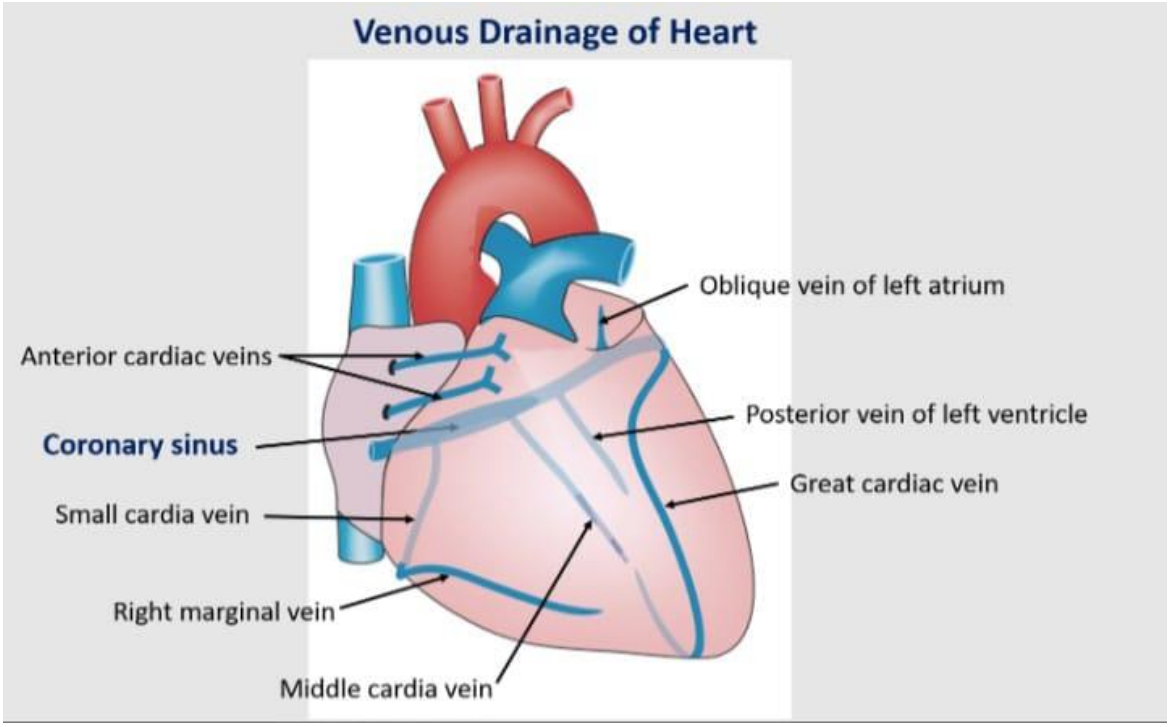


Figure 43: venous drainage of the heart

Answer - Q40

(A) F - the transverse sinus runs between the venous system posteriorly (SVC) and the arterial system anteriorly (Ascending aorta and pulmonary trunk).

(B) T -

(C) F - pericardial fluid lies in the pericardial cavity which is between the visceral and parietal layers of the serous pericardium.

(D) T -

(E) T - pericardial tamponade is compression of the heart due excessive blood/fluid accumulation in the pericardial cavity.

Pericardial tamponade results

- impaired cardiac filling --> reduction in stroke volume
- Compression of epicardial coronary arteries --> myocardial ischemia

The treatment option for pericardial tamponade is pericardiocentesis - this is a procedure done to remove the excessive fluid in the pericardial cavity using a needle and a catheter. The needle is passed slowly in a 300 angle to pass beneath the costal margin and directed towards tip of left shoulder.

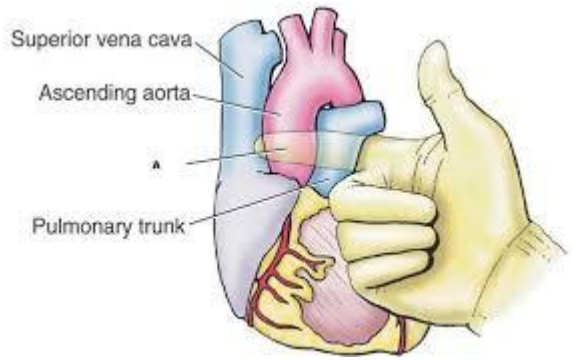


Figure 44: The site of the finger indicates the transverse sinus

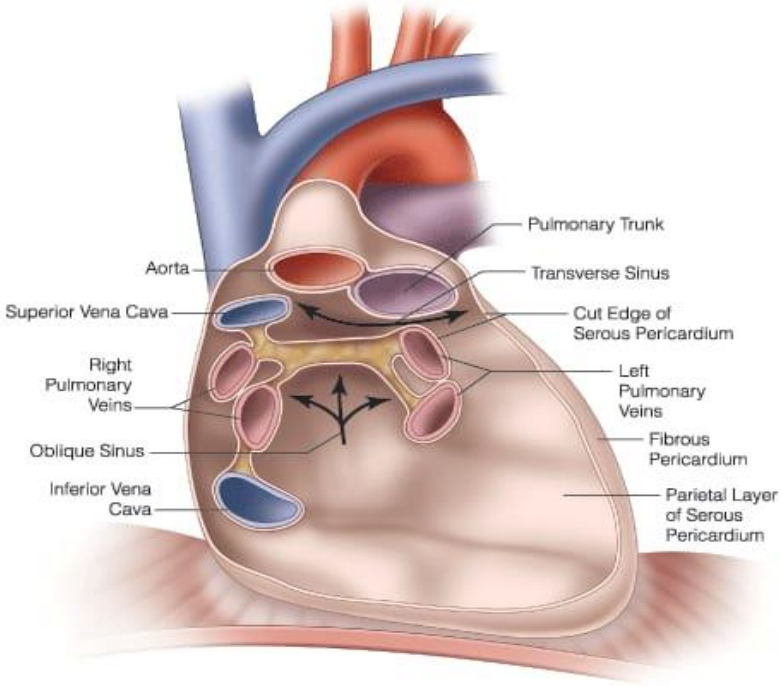


Figure 45: The area indicated by the arrows is the oblique sinus

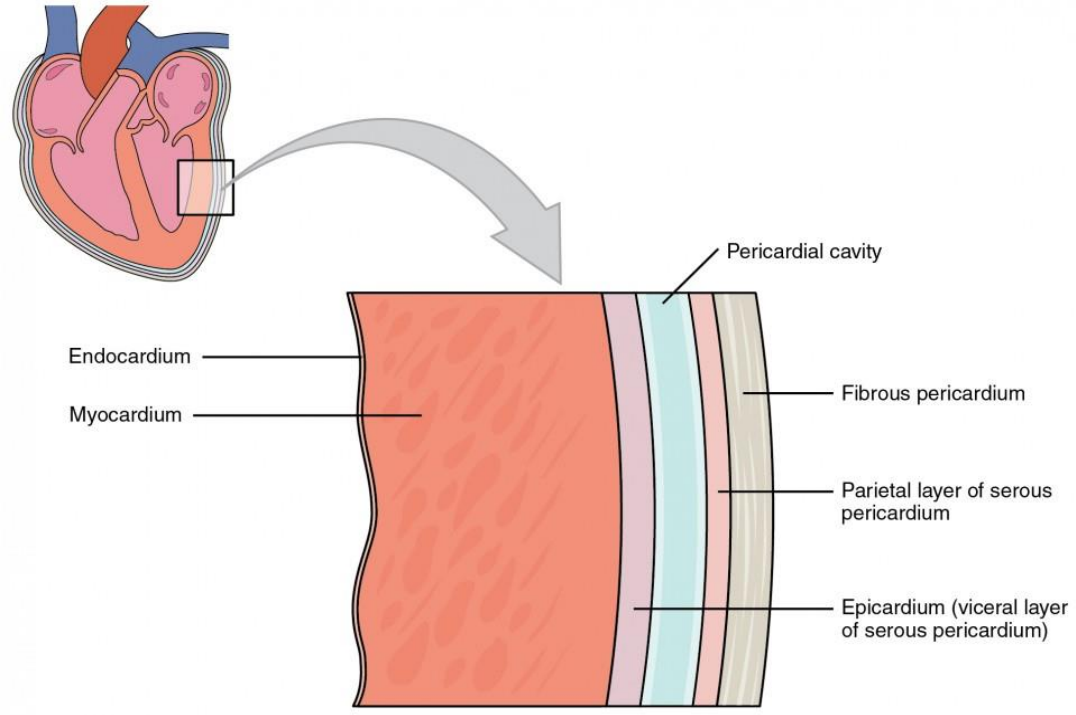


Figure 46: Layers of the heart

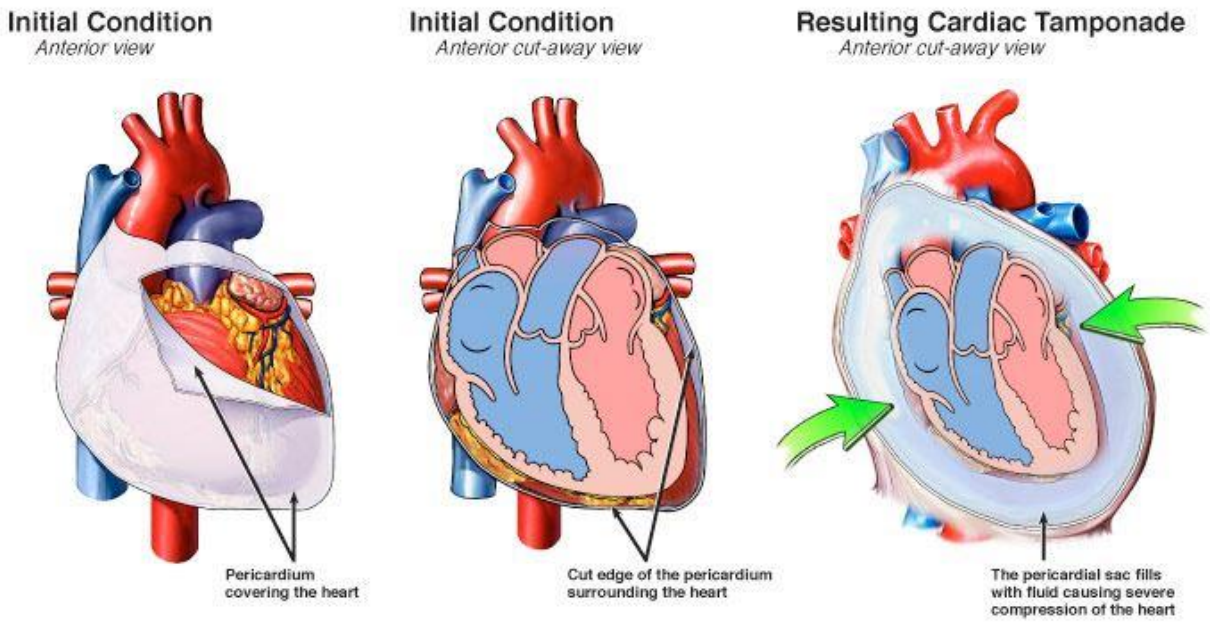


Figure 47: Cardiac tamponade

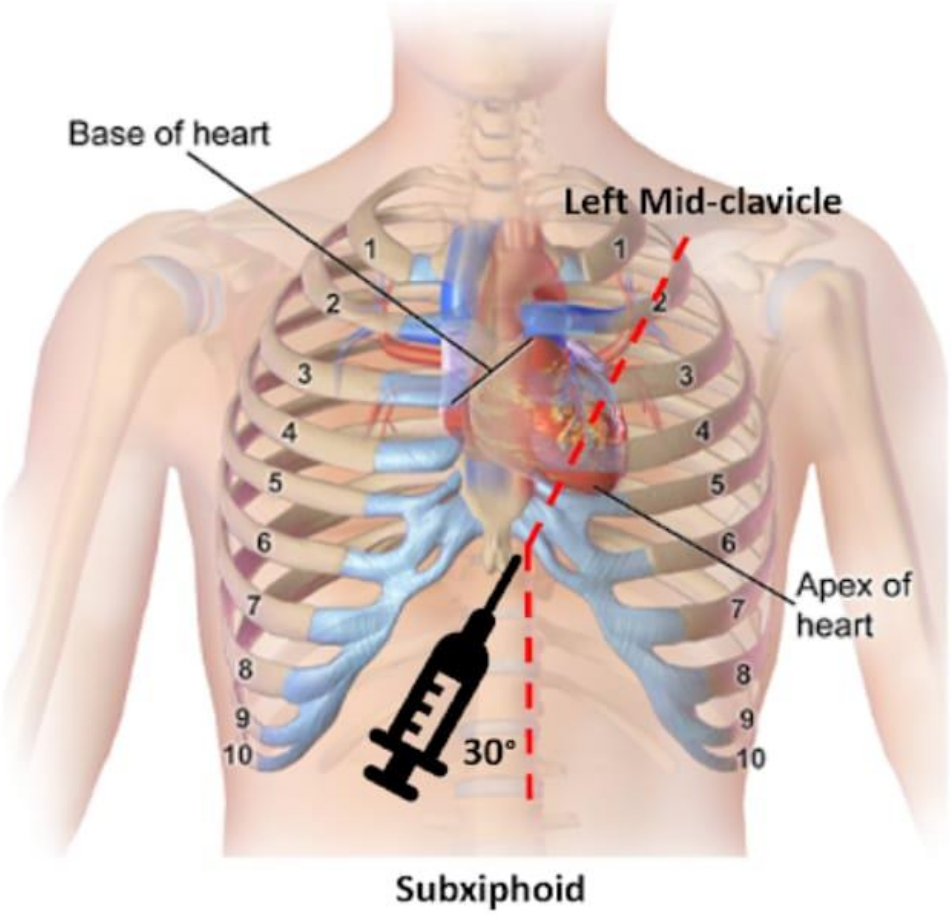


Figure 48: Diagrammatic representation of the direction of entering the needle in Pericardiocentesis

Answers - Q41

(A) F - pulmonary valve has three cusps

(B) F - papillary muscles are muscles located in the ventricles of the heart. They attach to the cusps of the AV valves via the chordae tendineae and contract to prevent inversion or prolapse of the valves during ventricular contraction.

(C) F - musculi pectinati is found in the rough / trabeculated part of the atrium.

(D) T - smooth and rough parts of the atrium are divided by the sulcus terminalis externally and crista terminalis internally.

(E) T - moderator band is muscular bundle crossing the ventricular cavity from the interventricular septum to the anterior wall and is of some importance since it conveys the Right branch of the atrioventricular bundle to the ventricular muscle.

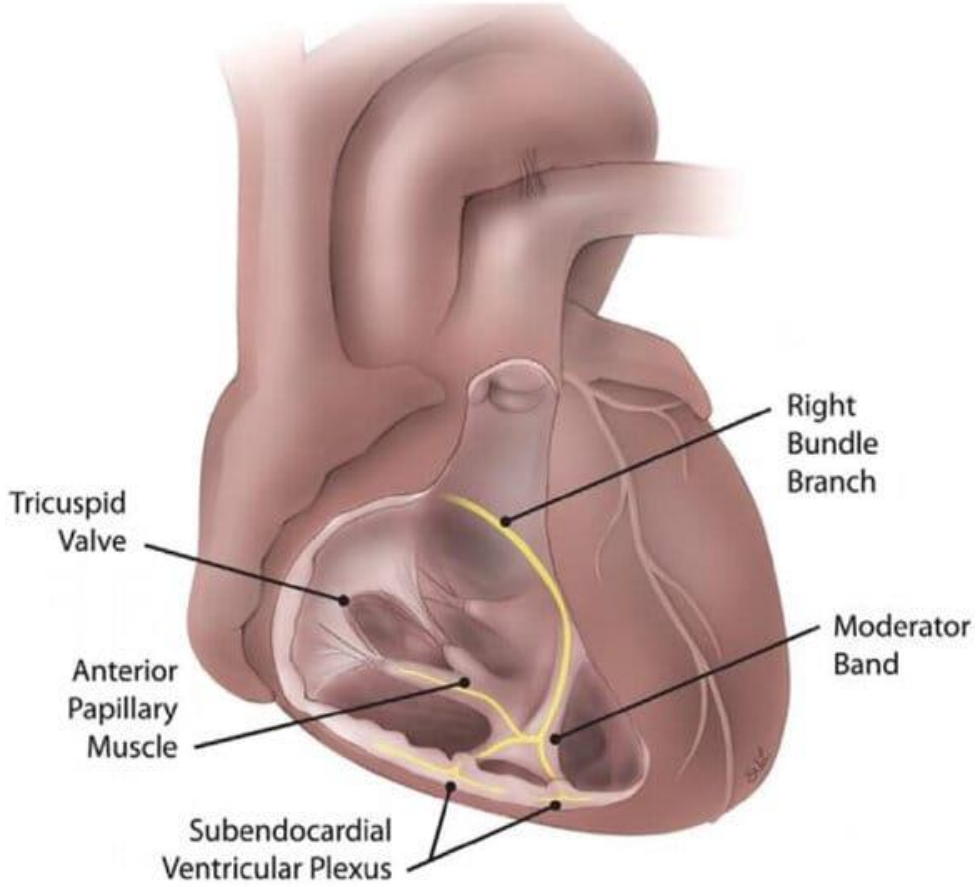


Figure 49: moderator band of the heart

Answers - Q42

(A) T

(B) F - left vagus hools around ligamentum arteriosum while the right vagus hooks around the right subclavian artery

(C) T

(D) T - both recurrent laryngeal nerves supply the whole trachea and the adjacent oesophagus and then proceed to supply the larynx

(E) T

Thoracic route if the vagus nerve

- Right vagus

Along in contact with trachea → cross medial to the arch of azygos vein → runs behind the lung root → gives branches to the pulmonary and oesophageal plexus

The right recurrent laryngeal nerve is given off at the root of the neck and it hooks around the right subclavian artery.

- Left vagus

Appears in between the left common carotid and left subclavian artery and runs down along the arch of aorta → cross medial to the left superior intercostal vein → runs behind the lung root → gives branches to the pulmonary plexus and oesophageal plexus

The left recurrent laryngeal nerve is given off at the level of the arch of aorta and it hooks around the ligamentum arteriosum.

Answers - Q43

(A) F - root of the aorta lies posterior to the pulmonary trunk.

(B) T - the commencement and the termination of the arch of aorta is at the sternal angle level. The summit of the arch reaches the level of the middle of the manubrium.

(C) F - the branches of the ascending aorta are right and left coronary arteries.

(D) T - the left recurrent laryngeal nerve hooks around the ligamentum arteriosum in the arch.

(E) T

Answers - Q44

(A) T - During inspiration, intra thoracic pressure reduces and allows expansion of the IVC. Since the caval opening is in the central fibrous part at T8 level, behind the right 6th costal cartilage, during inspiration it does not get constricted (since the fibrous part does not contract)

(B) T - oesophageal opening is at T10 level, usually 2.5cm left of the midline behind the 7th costal cartilage. Sling of right crus fibers loop around it.

(C) F - Aortic opening is at T12 level, in the mid-line,behind the median arcuate ligament. The aorta does not show a wide dilatation during inspiration, in contrast to the IVC opening.

(D) T - During inspiration, the diaphragm moves down and decrease the intra-abdominal volume. This results in increase in intra-abdominal pressure.

(E) T

Answers - Q45

(A) T – even though the right crus fibers are looping around the oesophageal opening, these fibers are innervated by the left phrenic nerve.

(B) T – motor supply to the diaphragm is by phrenic nerve. Proprioception (sensory) supply to the central part is by phrenic nerve while the periphery is by the lower intercostal nerves.

(C) F – phrenic nerve (c3,c4 and c5 but predominantly c4 supplies the diaphragm. Since it is predominantly supplied by c4 level, hemi section (lesion) at c5 level will not cause significant paralysis of the diaphragm.

(D) T – on reaching the abdominal surface of the diaphragm, both nerves divide into anterior, lateral, posterior branches which run radially, giving off branches that enter the diaphragm muscle from below.

(E) T

Answers - Q46

C. Left sided pneumothorax

X ray findings are hyper translucency without bronchoalveolar markings with collapsed lung margins on the left side.

Answers - Q47

(A) T -

(B) F - in 1% of the population, the azygos vein traverses the lung before entering the SVC resulting in the azygos fissure. The azygos lobe is not a true segment.

(C) F - they are in the left

(D) T - hemiazygous, accessory hemiazygos, oesophageal, mediastinal, pericardial and right bronchial veins drain into the azygos system.

(E) T - in the azygous continuation of the IVC, the azygos is a large structure, but otherwise the anatomy is unaltered. This may be confused with a mediastinal mass.

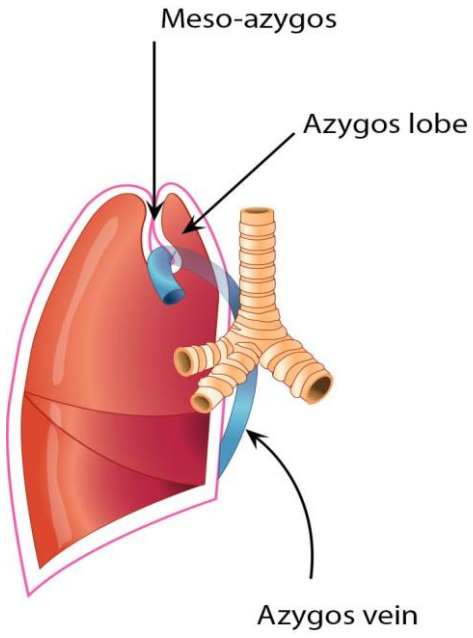


Figure 50: Azygos lobe of the lung

Answers - Q48

(A) T - The apex of the lung is .5 cm above the medial 1/3rd of the clavicle.

(B) T - the lungs are filled with air. Even after exhaling, a healthy lung retains some residual air making it less dense than water.

(C) T - surface marking of the oblique fissure is as follows

- starts at the level of the T3 spine and runs obliquely, inferiorly and anteriorly.
- crosses the mid axillary line at 5th rib level.
- meet the inferior border at 6th costal cartilage/rib level.
- corresponds to the vertebral border of the scapular when the upper limb is fully abducted.

(D) F - transverse fissure corresponds with the 4th costal cartilage and rib.

(E) T -

Answers - Q49

(A) F - passes anterior to the anterior scalene muscle

(B) F - crosses the arch of aorta in the left side

(C) T - there are 2 nerves related to the lung root.

Anterior to the root - phrenic nerve

Posterior to the root - vagus nerve

(D) F - the nerve lies lateral to IVC in contact with the mediastinal pleura

(E) F - right phrenic nerve runs through the tendinous part while the left phrenic nerve runs through the muscular part.

- Course of the phrenic nerve is as follows

- Arise principally from C4 (include C3 and C5 as well) in the neck.
- Nerve then passes on the anterior scalene muscle across the dome of the pleura.
- Run behind the subclavian veins.
- Each nerve then runs in contact with mediastinal pleura laterally, throughout its thoracic course.

- Regarding the RIGHT phrenic nerve.

- Is related medially with venous structures throughout its intra-thoracic course.
- Right brachiocephalic vein → SVC → pericardium over the Right atrium → IVC

Then passes through the central tendon alongside the IVC.

- Regarding the LEFT phrenic nerve.
- Arterial structures throughout its intra-thoracic course.
- Between commencement of left common carotid and the left subclavian arteries → arch of aorta → pericardium over the left ventricle → apex of the heart

Then it pierces the muscular part of the diaphragm just to the left of the pericardium.

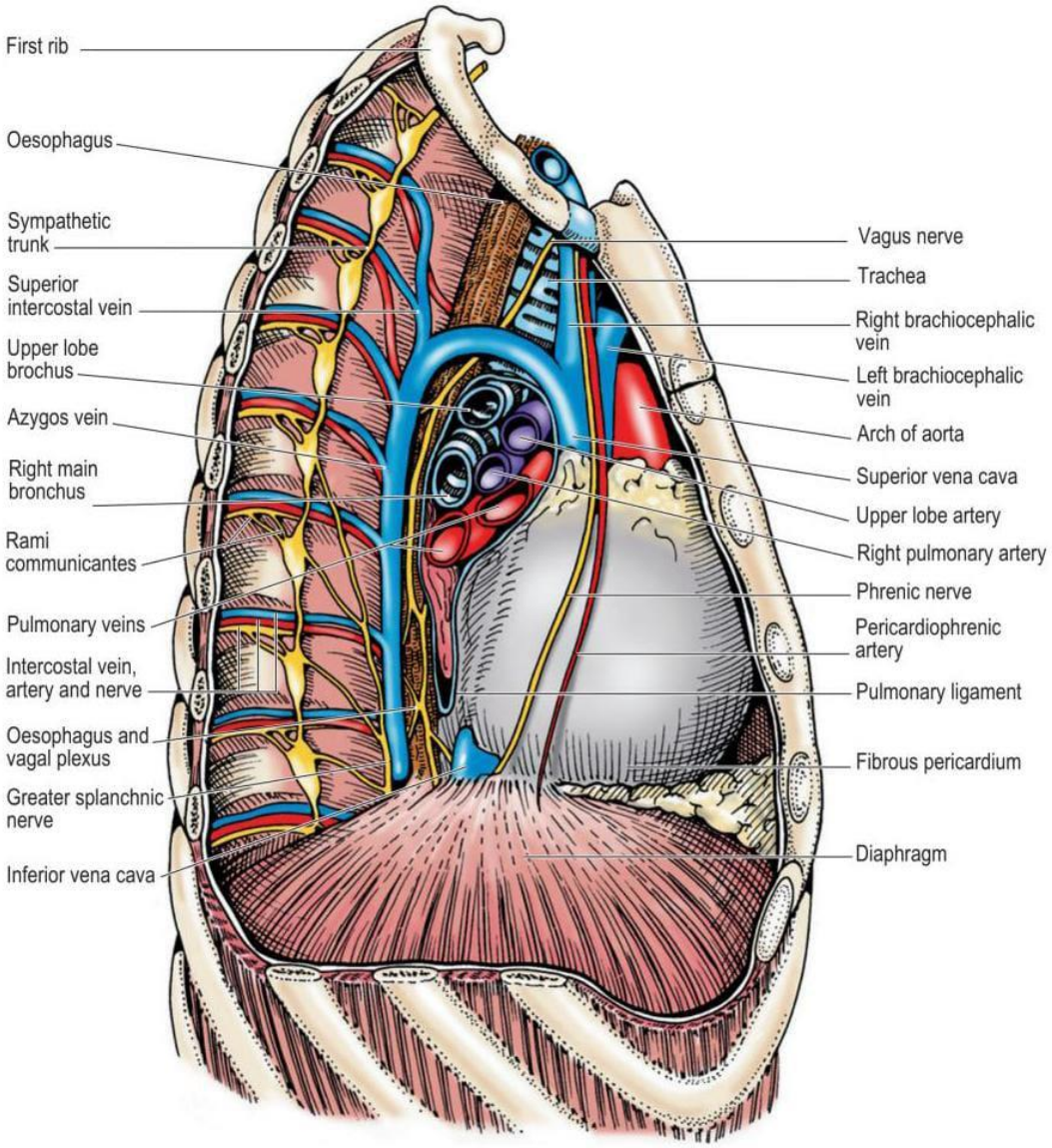


Figure 4.12 Mediastinum: right aspect.

Figure 51: Course of the right phrenic nerve

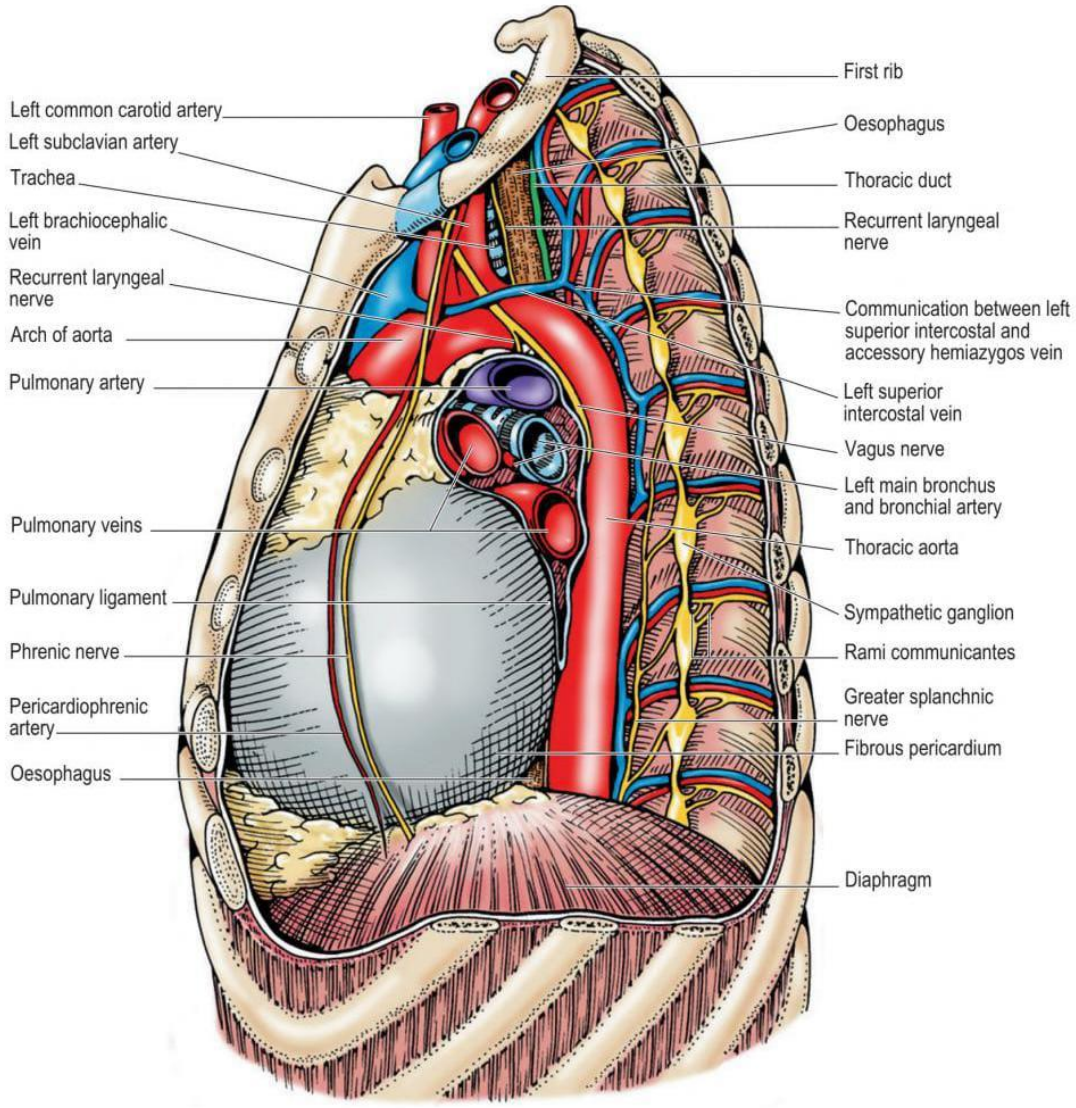


Figure 4.13 Mediastinum: left aspect.

Figure 52: Course of Left phrenic nerve

Answers - Q50

C. posterior intercostal

- The anterior intercostal arteries anastomose with the posterior intercostal arteries. Ligation of the anterior arteries would not affect the supply of the intercostal spaces because the posterior arteries would provide collateral arterial supply. Branches of the musculophrenic artery provide supply for the lower seventh, eighth, and ninth intercostal spaces. The superior epigastric artery passes into the rectus sheath of the anterior abdominal wall. The lateral thoracic artery arises from the second part of the axillary artery, and the thoracodorsal artery is a branch of the subscapular artery, a branch of the third part of the axillary artery.

Answers - Q51

D. Arch of aorta

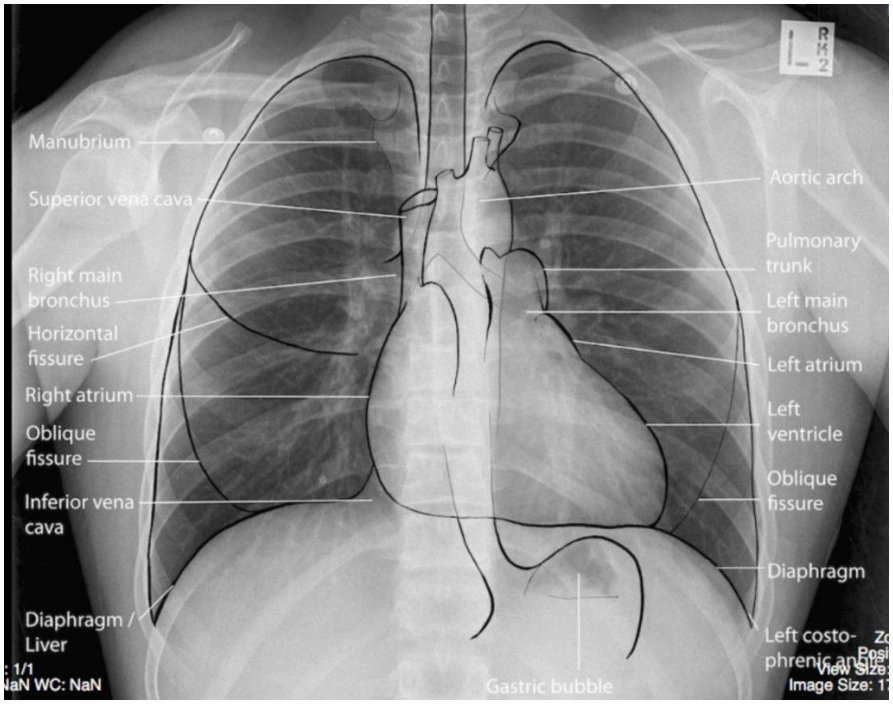


Figure 53: Internal organs identifiable in Chest X-ray

Answers - Q52

(A) T - BPS (Broncho pulmonary segment) is a pyramidal structure where its apex lies towards the root of the lung and the base lies towards the periphery.

(B) F - the venules are in the intersegmental septa. Therefore, there is no dedicated single vein for a segment.

(C) T - there are 10 segments on each side.

(D) T - Since each segment is separated from each other by layers of connective tissue that forms them into discrete anatomical and functional units. Therefore, diseased segments can be removed surgically without affecting the function of the other segments.

(E) T- Each segment has a separate segmental artery (of both pulmonary and bronchial arteries), tertiary bronchus, lymph vessels and autonomic nerves. The lymphatics start at the bronchiolar level and follow the bronchopulmonary segment upto hilum.

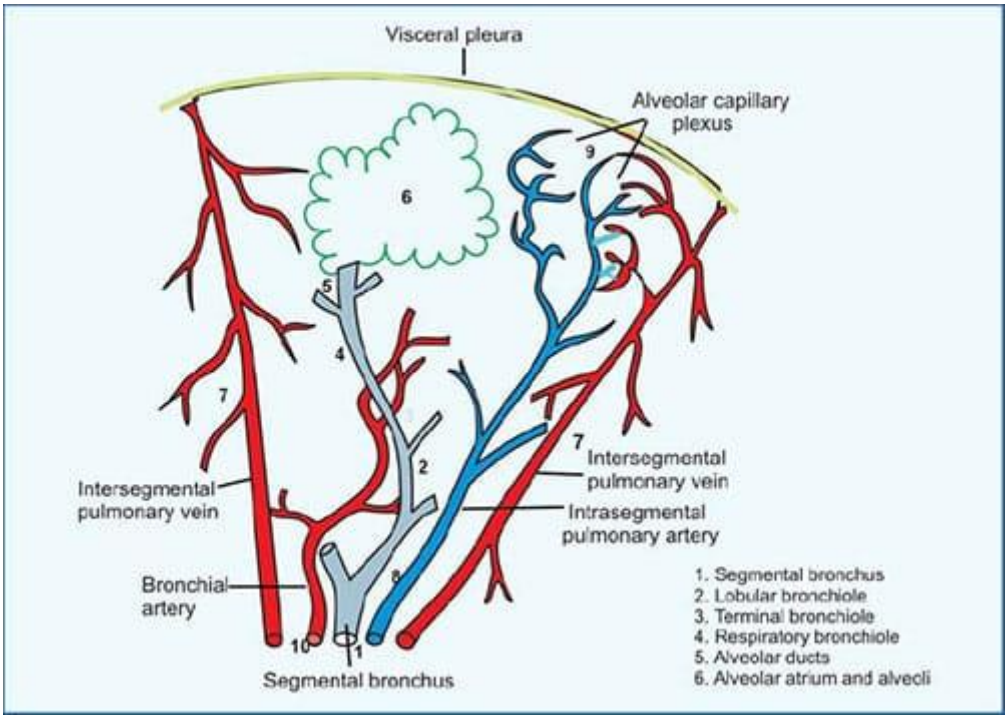


Figure 54: Anatomy of a Bronchopulmoanry segment

Answers - Q53

(A) T - these fibers assist in the action of the lower oesophageal sphincter

(B) T -

(C) F - opening of the IVC is in the central tendon

(D) F - it transmits the Right phrenic nerve

(E) F - subcostal nerve enters the abdomen posterior to the lateral arcuate ligament

Structures passing through the diaphragm can be summarized as follows.

- Through Inferior vena caval opening

    1. IVC
    2. Right phrenic nerve
    3. Some lymphatic vessels from the liver

- Through the oesophageal opening

    1. Oesophagus
    2. Anterior and posterior vagal trunks
    3. Oesophageal branch of the left gastric artery
    4. Communications between veins of stomach and thoracic oesophagus

- Through the aortic hiatus

    1. Descending aorta
    2. Thoracic duct
    3. Azygos vein
    4. Lymphatic vessels descending to cisterna chyli

- Left phrenic nerve → pierces the left hemi diaphragm lateral to the pericardium
- Superior epigastric vessels → between the sternal and costal origin of the diaphragm.
- Musculophrenic vessels →between the 7th and 8th costal origin slips of the diaphragm
- Lower 5 intercostal nerves → between the slips of origin from the lower 6 costal cartilages
- Subcostal vessels and nerve →posterior to the lateral arcuate ligament
- Sympathetic trunk → posterior to the medial arcuate ligament.

ANATOMY ESSAY QUESTIONS & ANSWERS

1. INTRODUCTORY MODULE
2. PECTORAL REGION AND UPPER LIMB
3. THORAX

INTRODUCTORY MODULE

Q1

Epithelium, Skin, Gland, Connective tissues

1) List the types of epithelial tissues and briefly correlate its histological arrangement with its clinical importance.
2) Categorize the types of connective tissues and give 2 examples for sites in the body where they are found.
3) Draw a labeled diagram of the skin briefly explain 4 of its functions.

1) **List the types of epithelial tissues and briefly correlate its histological arrangement with its clinical importance.**

simple squamous epithelium

- This is a single layer of flattened cells.
- Since this is a thin layer it allows passage of materials by diffusion and filtration in sites where protection is not important.
- Location; kidney glomeruli / lining of blood vessels / serosa / alveoli

Simple cuboidal epithelium

- Single layer of cube like cells
- Function; secretion and absorption
- Location; kidney tubules / small excretory ducts of salivary and pancreas

Simple columnar epithelium

- Single layer of tall cells with cilia and may contain mucus secreting goblet cells.
- Function; absorption, secretion of mucus, enzymes etc. And propulsion by ciliary action. (increased surface area relative to volume)
- Location; digestive tract / fallopian tubes

Pseudostratified columnar epithelium

- Single layer of cells of differing heights, some not reaching the free surface. May contain mucus secreting cells and cilia.
- Function; secretion of mucus and propulsion
- Location; upper respiratory tract (ciliated)
- Spermatic cord (non-ciliated)

Stratified squamous epithelium

- Thick membrane composed of several cell layers, in the keratinized type - the surface cells are full of keratin.
- Function; protect underlying tissues in areas subjected to abrasions.
- Location; epidermis of skin (keratinized - dry)
- Oesophagus, oral cavity, vagina (non keratinized - moist)

Stratified cuboidal epithelium

- 2-3 layers of cuboidal cells
- Function; protection
- Location; lining of large ducts; mammary gland, pancreatic duct

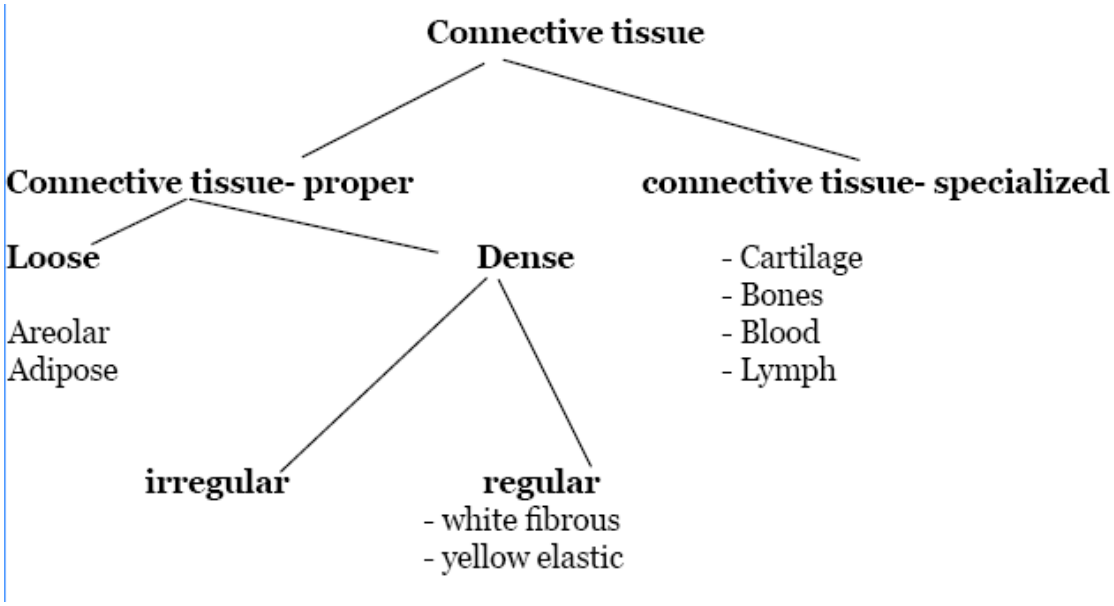
Stratified columnar epithelium

- Multiple layers
- Function; protection and secretion
- Location; parts of pharynx, vas deferens, male urethra

Transitional epithelium

- Surface cells are dome shaped or squamous depending on the degree of stretch.
- Function; stretch readily, withstand toxicity of urine
- Location; ureter, bladder, part of urethra

2) **Categorize the types of connective tissues and give 2 examples for sites in the body where they are found.**



Areolar tissue

- around blood vessels
- around wall of gut
- in and around mucous membranes
- in matrix of muscles

Adipose tissue

- hypodermis
- around kidneys
- around heart

White fibrous

- tendons
- cartilages
- periosteum

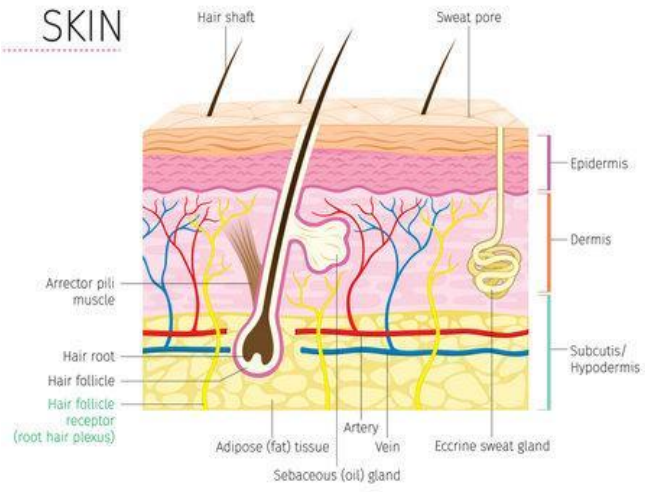
Yellow elastic

- in the smooth muscle layer in arteries
- walls of the alveoli of lungs

Dense irregular

- dermis
- walls of tubular organs such as the alimentary canal.

3) Draw a labeled diagram of the skin briefly explain 4 of its functions.



Protection

- provide protection against
- external damage → acts as a shock absorber, acts as a thick layer
- UV light → by melanocytes, which produce the pigment melanin. These cells are scattered in the basal layer of the epidermis.
- chemical, thermal and mechanical insults (friction, shearing forces)
- excessive dryness → by the epidermal skin appendages.
- by sebaceous glands which secrete a lipid sebum
- by eccrine sweat glands (found all over the body and open directly on to the skin surface)

- By apocrine sweat glands (found in areas with many hair follicles like armpit, perianal area and open into the hair follicle)
- bacterial and fungal invasions. → by langerhan cells which are present in the epidermis. Act as antigen recognizing cells.

Sensation

- have receptors for touch, pressure, pain, temperature, vibration
- Free nerve endings
- Specialized encapsulated nerve endings (Meissner's corpuscle / pacinian corpuscle / Ruffini corpuscle / Krause end bulbs)
- Free nerve ending → for pain and temperature detection
- Meissner's corpuscle → for touch
- Pacinian corpuscle → for deep pressure and vibration
- Ruffini corpuscle → mechanoreceptors sensing skin stretch
- Krause end bulbs → for temperature

Thermoregulation

- subcutaneous adipose tissue acts as an insulator for heat. Reduces heat loss by conduction.
- when the temperature is low, the blood flow increases to dermis by vasodilation, resulting in heat loss by radiation. When the temperature is high, the blood flow reduces to dermis by vasoconstriction resulting in reduced heat loss.
- when temperature is low, the errector pili muscles contract resulting in pilo-erection. This causes accumulation of an air layer over skin. This reduces heat loss by convection
- when the temperature is high the sebaceous and sweat glands secretions are released onto skin resulting in a cooling effect.

Metabolic function

- synthesis of Vit D
- the adipose tissue acts as a major store of energy.

Sexual attraction

Q2.

General embryology

1) Briefly explain the process and the changes that a sperm undergoes from the time of entering the vagina upto fertilization?
2) What are the events which the embryo passes through when transitioning from a bilaminar germ disk to a trilaminar germ disk?
3) Describe the formation of neural tube.

1) Briefly explain the process and the changes that a sperm undergoes from the time of entering the vagina upto fertilization?

- sperms deposited in the vagina move from the cervix to the uterine tube by muscular contractions of the uterus and the uterine tubes and also by its own propulsion.
- duration 30 min - 6 days
- some get destroyed during this migration.
- after reaching the isthmus, sperms become less motile and cease their migration.
- during ovulation, sperms again become motile due to chemo attractants released by the ova. This helps the sperm to move into ampulla.
- before fertilization, they undergo

Capacitation

- a period of conditioning.
- a glycoprotein coat and seminal plasma proteins are removed from the plasma membrane that overlies the acrosomal region of the spermatozoa.
- then it becomes capable of passing through the corona cells.

Penetration of corona radiata

Acrosomal reaction

- this happens after binding to the zona pellucida.
- induced by the zona proteins and ZP3 proteins.
- release of digestive enzymes needed for penetration of zona pellucida

Penetration of Zona Pellucida

- comes into contact with the plasma membrane of oocyte and activates zona reaction

Fusion of the oocyte and sperm cell membranes

- head and the tail of the spermatazoon enter the cytoplasm of the oocyte, but the plasma membrane is left behind.

2) What are the events which the embryo passes through when transitioning from a bilaminar germ disk to a trilaminar germ disk?

- The embryo is differentiated into Bi-laminar germ disc by the end of the 2nd week of gestation.
- It is composed of 2 layers namely, Hypoblast and the Epiblast.

- During the third week it transforms into a tri laminar germ disc with three layers namely ectoderm, mesoderm and endoderm. This process is named as Gastrulation.

The steps of gastrulation are as follows.

- The primitive streak appears on the surface of the epiblast, with a primitive node (a slightly elevated area surrounding the primitive pit) at its cephalic end.
- Then the cells of the epiblast layer start migrating towards and through the primitive streak.
- This is known as invagination.
- It starts from the primitive node and then moves along the primitive streak.
- These cells displace the cells in the hypoblast to form the endoderm.
- Some cells remain between the forming endoderm and the epiblast. This is known as the mesoderm.
- The remaining cells in the epiblast become the ectoderm.
- The ectoderm is continuous with amino blasts.
- The mesoderm is continuous with the extra embryonic mesoderm.
- And the endoderm is continuous with cells of the secondary yolk sac.

3) Describe the formation of neural tube.

- By the end of the third week.
- Neural plate becomes elevated to form neural folds.
- And depressed forming a neural groove in ectoderm.
- Gradually the neural folds approach each other in the midline. First in the cervical region.
- Completes cranially and caudally Forming neural tube.
- Cells in the edge of the groove develop separately and leave the neuroectoderm by active migration into underlying mesoderm
- Neural tube contains two neuropores in its cranial and caudal ends
- Closure of cranial neuropore is on 25th day (after fertilization) Caudal neuropore is on 27th day
- Neural tube develops into CNS

extra cranial part - brain,

Caudal part ´ spinal cord

- Neurulation is induced by notochord.

PECTORAL REGION AND UPPER LIMB

Q1

ANATOMY OF BONY THORAX

Briefly explain the following

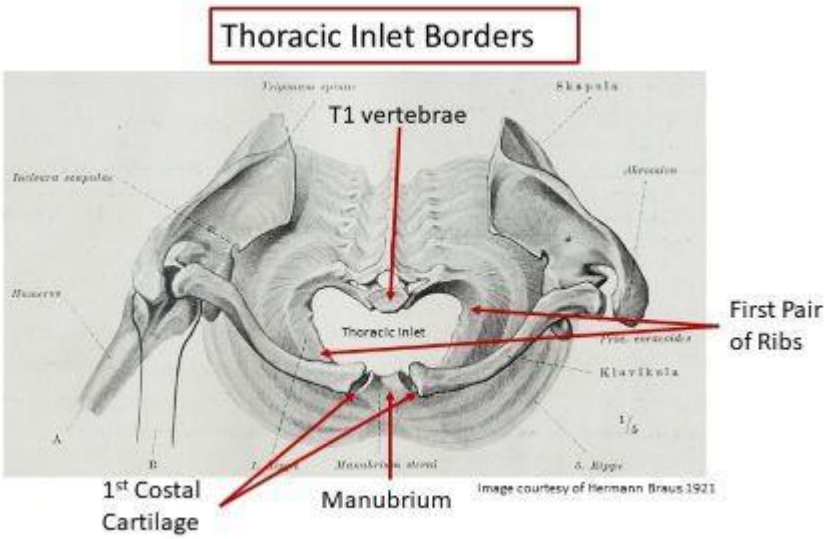
1) Boundaries of thoracic inlet
2) Illustrate (transverse section) structures passing through thoracic inlet
3) Briefly describe the relations of first rib.

1) Boundaries of thoracic inlet:

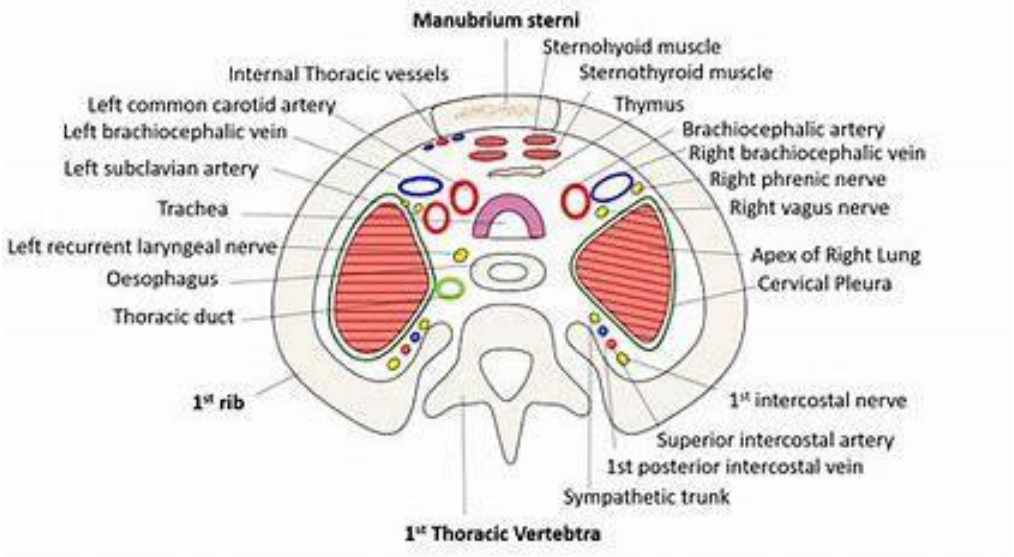
Posteriorly: first thoracic vertebra

Laterally: first pair ribs and their costal cartilage.

Anteriorly: superior border of manubrium sterni.



2) Illustrate (transverse section) structures passing through thoracic inlet



- Oesophagus
- Thoracic duct
- Nerves

- Vagus
- Phrenic
- Left recurrent laryngeal
- Sympathetic trunks
- Vessels
- Arteries
- Left and right common carotid arteries
- Left and right subclavian arteries
- Veins
- Internal jugular veins
- Brachiocephalic veins
- Subclavian veins
- Lymph nodes and lymphatic vessels

3) Briefly describe the relations of first rib

• Anteriorly the neck is related from medial to lateral side by
  - o The sympathetic chain
  - o 1st posterior intercostal vein
  - o superior intercostal artery
  - o The first thoracic nerve

• These vessels are held against the front of the neck of the rib by the cervical dome of the pleura and apex of the lung.

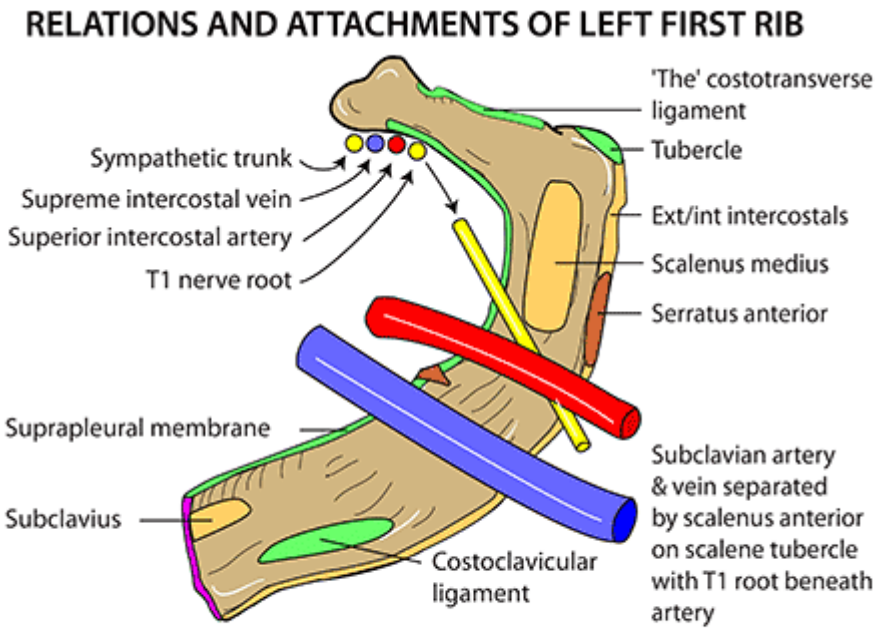
• Superiorly the neck is related to
  - o The deep cervical vessels
  - o The eighth cervical nerve

• Anterior groove on the superior surface of the shaft lodges the subclavian vein and the posterior groove lodges the subclavian artery and lower trunk of the brachial plexus.

• The structures related to the upper surface of the shaft are;
  - The origin of the subclavius muscle at the anterior end
  - The attachment of the costoclavicular ligament at the anterior end at behind the subclavius
  - Insertion of the scalenus anterior to the scalene tubercle
  - Insertion of the scalenus medius to the elongated rough area behind the groove for subclavian artery

• The lower surface of the rib is covered is covered with costal pleura and is related near its outer border to the small first intercostal nerve

• Outer border gives origin to the
  - The external intercostal muscle
  - Upper part of first digitations of serratus anterior
  - thick portion of outer border is covered by scalenus posterior
• Inner border gives attachment to the supra-pleural membrane
• The tubercle gives attachment to lateral costotransverse ligament.



The under surface of the 1st rib is smoother. When the rib is laid on a flat surface, the head touches the flat surface when the rib is the correct way up

Q2.

Axilla and Shoulder joint

1) Explain the boundaries of axilla.
2) Write a short note on Axillary lymph nodes and its lymph drainage.
3) Describe the course and branches of the Axillary artery and its relation with the brachial plexus.
4) Write a short note about the stability of the shoulder joint.

1) Explain the boundaries of axilla.

Axilla is a pyramidal region situated between upper part of arm and chest wall
Therefore it has an apex, base with 4 walls as anterior, posterior, lateral & medial

- The Apex → directed towards the root of the neck. Its boundaries are as follows truncated
- Anteriorly → clavicle,
- Posteriorly → superior border of the scapula,
- Medially → outer border of 1st rib
- The Base → directed downwards. It is covered by skin and axillary fascia

The components of its wall are as follows.

- Anterior wall → From the external to internal aspect the layers are as follows
    - Pectoralis major
    - Clavipectoral fascia enclosing pec. minor &
    - subclavius deep to that
- Posterior wall → From above to below, the layers are as follows
    - Subscapularis
    - Teres Major
    - latissimus dorsi
- Medial wall→ Upper 4 ribs with intercostals muscle and serratus anterior muscle
- Lateral wall → Upper part of the shaft of the humerus with coracobrachialis and short head of biceps.

2) Explain the arrangement of Axillary lymph nodes including their lymph drainage.

Axillary lymph nodes are scattered in the fibrofatty tissue within the axilla as 5 groups.

- Anterior / pectoral group
- posterior/ subscapsular group
- lateral/humeral group
- central group
- apical group

Anterior(pectoral) group

They lie deep to the pectoralis major along the lower border of the pectoralis minor

Posterior (Subscapular)

They lie along the subscapular vessels

Lateral group

They lie Medial to axillary vein along upper part of humerus

Central group

They lie in the axillary fat

Apical

They lie immediately behind the clavicle at the apex of the axilla above the upper border of pectoralis minor (Deep to clavipectoral fascia) and along the medial side of the axillary vein.

The lymph drainage is as follows

- Lymph from the upper ½ of the anterior wall of trunk and major part of the breast → anterior group → central group → apical group
- Lymph from the upper ½ of the posterior wall of the trunk and axillary tail of the breast → posterior group → central group → apical group
- Lymph from the upper limb → lateral group → central group → apical group

3) Describe the course and branches of the Axillary artery and its relation with the brachial plexus.

- Axillary artery is the continuation of third part of subclavian artery at the outer border of first rib upto the inferior border of teres major muscle, where it continues as the brachial artery.
- It runs within the axillary sheath together with the cords of brachial plexus.
- it lies posterolateral to the axillary vein throughout its course
- it is divided into 3 parts by pectoralis minor which crosses in front of it.
- First part above, second part behind & third part below pectoralis minor muscle.

The branches of the artery are as follows:

- First part: Superior thoracic artery (01 branch)

- Second part: Thoracoacromial artery (pierces clavipectoral fascia, four terminal branches-clavicular, deltoid, acromial & pectoral) & Lateral thoracic artery (02 branches)
- Third part: Subscapular artery, anteriorcircumflex humeral artery and posterior circumflex humeral artery (03 branches)

The relations with the brachial plexus are as follows;

- 1st part → Lateral and posterior cords are superolateral & medial cord posterior to the artery
- 2nd part → 3 cords of the plexus are around the artery
- Medial root of median nerve crosses in front of the 3rd part of the artery to join the lateral root to form the Median nerve.

4) Write a short note about the anatomical basis of the stability of the shoulder joint.

- The shoulder joint is formed by articulation of the glenoid cavity of scapula with the head of the humerus
- The head of humerus is about 1/3 of a sphere while the glenoid fossa is a shallow, where the head is four times the size of the glenoid cavity.
- Therefore, it is a weak joint.

This joint's stability is provided by

- muscles
- ligaments and capsule
- bony structures

<u>Muscles</u>

- mainly the stability is provided by the rotator cuff muscles which has both the muscles and the tendons surrounding the joint.
- They are subscapularis anteriorly, supraspinatus superiorly, teres minor and infraspinatus posteriorly
- These muscles strengthen the lax capsule by fusion with it.
- Since there is no muscle inferiorly, the capsule is least supported inferiorly.
- The splinting effect of the long head of biceps provide support superiorly.

- The splitting effect of the long head of triceps provide support inferiorly.

ligaments and capsule

- Capsule is a fibrous structure attached to the to the labrum and aling the anatomical neck of the humeral except inferiorly, where it is attached to the surgical neck.
- The capsule is thick and strong but lax.
- The following ligaments provide stability to the joint
- glenohumeral ligament reinforce the capsule anteriorly.
- coracohumeral ligament also blend with the capsule
- coracoacromial ligament is above the head of humerus which helps in preventing superior dislocation.
- the transverse humeral ligament stabilize the long head of biceps in the bicipital groove.

bony structures

- The labrum deepens the glenoid cavity.
- The upward displacement is prevented by the overhanging corocoid process and the acromion process. These 2 bony processes are bridged by the coraco-acromial ligament. this together forms the coracoacromial arch.

The dislocations of the shoulder joint are most common infero-anteriorly.

Q3.

Brachial Plexus and Innervation of the Upper limb.

1. Draw a labeled diagram of the brachial plexus and describe the formation & relation of the brachial plexus.

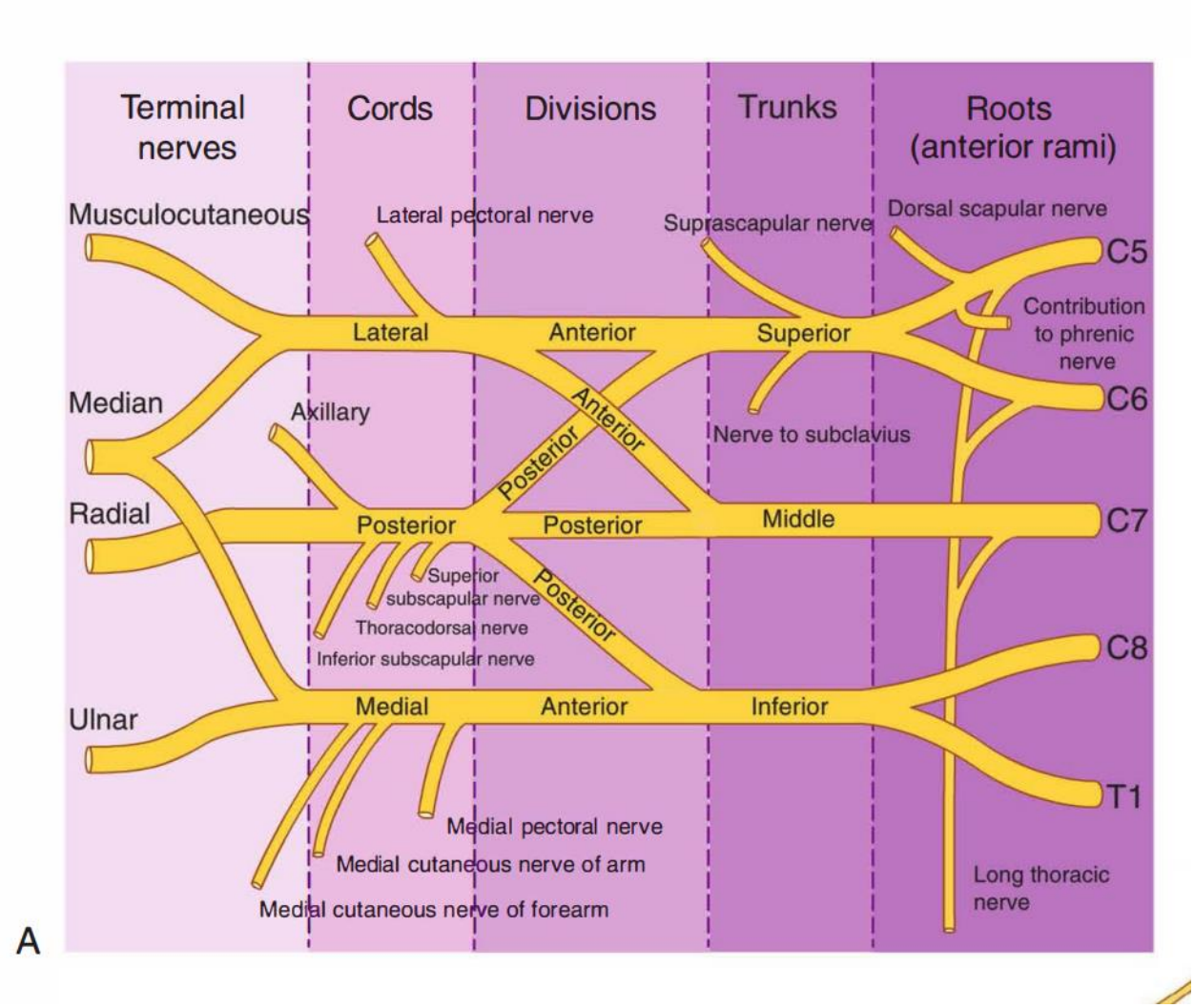
2. Regarding Erb's Palsy.
   a. What are the common causes of Erb's palsy?
   b. What are the nervous structures damaged in Erb's Palsy?
   c. What are the neurological Deficits in Erb's Palsy?

3. Regarding Klumpke's Paralysis.
   a. What are the common causes of Klumpke's Paralysis.?
   b. What are the nervous structures damaged in Klumpke's Paralysis.?
   c. What are the neurological Deficits in Klumpke's Paralysis.?

4. A 39yrs old female patient diagnosed with hypothyroidism presented to the clinic with pain in her hand which increased at night. She also complains that it worsens when trying to sweep the floor with a broom. What is the above clinical condition?
   a. What is the above clinical condition?
   b. What are other disabilities and deformities may present in this patient and explain the reasons.
   c. On examination, the sensation sensation of the thenar and hypothenar eminence of the palm was preserved. Explain the anatomical basis for this

5. A 22-year-old male from Slave Island presented to the OPD with discoloration of his skin over right arm since 4 months and weakness of right hand fingers since 1 month. On further evaluation it was found that there was sensory loss over the hypopigmented patch, multiple healed cut injuries on his 4th and 5th digits on his right hand, multiple lumps in both ear lobes and a palpable nerve in his right upper limb medial epicondyle. After initial evaluation skin biopsies were taken and the patient was diagnosed to have Leprosy.
   a. What is the palpable Nerve in this patient?
   b. What are the muscles affected due to damage of the above nerve at the level of Elbow?
   c. What is Ulnar Paradox?

1. **Draw a labeled diagram of the brachial plexus and describe the formation & relation of the brachial plexus.**



Formation

- the brachial plexus is formed by the anterior primary rami of C5, C6, C7, C8, T1 spinal nerve.
- they join to form trunks as follows
- upper trunk formed by → C5 and C6 nerves
- middle trunk →C7 nerve alone
- lower trunk → C8 and T1 nerves
- Then each trunk divides into anterior and posterior divisions
- Divisions get together to form cords as follows
- Anterior division of the upper and middle trunke join to form lateral cord.
- Anterior division of the lower trunk alone forms medial cord.
- Posterior divisions of 3 trunks join to form posterior cord.

Relations

- Roots are found between the anterior and middle scalene muscles in the neck.
- Trunks are found in the posterior triangle of the neck.
- Divisions are found behind the middle third of the clavicle.
- Cords are related to three parts of the axillary artery.
- 1st part of the artery → Lateral and posterior cords lie superolaterally, medial cord lie posteriorly
- 2nd part of the artery → cords arranged in a way that their name imply
- 3rd part of the artery → terminal branches of the cords lie around this part of the artery.

2.Regarding Erb's Palsy.

a. What are the common causes of Erb's palsy?

Birth injuries: Shoulder Dystocia

Adults: violent falls on side of the head and shoulder

b. What are the nervous structures damaged in Erb's Palsy?

Upper trunk of brachial plexus (C5, C6 roots)

c. What are the neurological Deficits in Erb's Palsy?

- Arm: Hangs limply
- Forearm: Pronated with palm facing backwards. (Porter hinting for a tip.)
- Sensory: lateral aspect of the upper arm and radial side of forearm

3. Regarding Klumpke's Paralysis.

a. What are the common causes of Klumpke's Paralysis.?

Undue abduction (birth injuries breech delivery), clutching something when falling from height

b. What are the nervous structures damaged in Klumpke's Paralysis.?

Lower trunk of brachial plexus Affected nerve roots - C8, T1

c. What are the neurological Deficits in Klumpke's Paralysis.?

Complete claw hand

Sensory loss on along the medial aspect of forearm and hand

Vasomotor changes- Dry and warm skin in the area with sensory loss

Trophic changes-Scaly skin, easily cracking nails

4.

A 39yrs old female patient diagnosed with hypothyroidism presented to the clinic with pain in her hand which increased at night. She also complains that it worsens when trying to sweep the floor with a broom.

a. What is the above clinical condition?

Carpal tunnel syndrome

b. What are disabilities and deformities that may present in this patient and explain the reasons.

- In carpal tunnel is a fibro-osseous compartment in hand
- increased pressure inside this compartment can compress the Median nerve
- Median nerve provides motor innervation to the muscles in the thenar eminence (abductor pollicis brevis, flexor pollicis brevis & opponens pollicis) of the hand.
- Therefore, in carpal tunnel syndrome, de-innervation for the thenar eminence muscles can leads to wasting of the thenar eminence. And it can also result Aps's hand deformity due to the unopposed action of the adductor pollicis which is supplied by the ulnar nerve.
- Median nerve also supplies sensory innervation to the palmar aspect of radial 31/2 fingers including nailbeds.
- Therefore, in carpal tunnel syndrome, sensation over the palmar aspect of radial 3 1/2 fingers including nailbeds is lost.
- Median nerve also supplies the autonomic (Sympathetic and parasympathetic) supply for the glands & vessels in the hand.
- Therefore in carpal tunnel syndrome, vasomotor changes can resultwarm reddish dry and scaly skin,& tropic changes such as infections of pulp spaces and cracking of nails.

c. On examination, the sensation of the thenar and hypothenar eminence of the palm was preserved. Explain the anatomical basis for this.

- The palmar cutaneous nerve of the median supply sensory innervation over the thenar eminence of the palm.
- the nerve is given off proximal to the flexor retinaculum and then it runs above the flexor retinaculum to supply the palm.

- Therefore, the palmar cutaneous nerve of the median nerve is not affected in carpal tunnel syndrome.
- As a result, the sensation over the thenar eminence is preserved.
- The cutaneous supply over the hypothenar eminence is by the ulnar nerve.
- Ulnar nerve is also not a content of the carpal tunnel. Therefore, in carpal tunnel syndrome, the sensation over the hypothenar eminence is also preserved over hypothenar eminence.

5.

A 22-year-old male from Slave Island presented to the OPD with discoloration of his skin over right arm since 4 months and weakness of right hand fingers since 1 month. On further evaluation it was found that there was sensory loss over the hypopigmented patch, multiple healed cut injuries on his 4th and 5th digits on his right hand, multiple lumps in both ear lobes and a palpable nerve in his right upper limb medial epicondyle. After initial evaluation skin biopsies were taken and the patient was diagnosed to have Leprosy.

a. What is the palpable Nerve in this patient?

Ulnar Nerve

b. What are the muscles affected due to damage of the above nerve at the level of Elbow?

Motor:

In the Arm

- flexor carpi ulnaris
- medial ½ of the flexor digitorum profundus

In hand

- deep branch supplies
- muscles of hypothenar eminence
- all interossei
- medial 2 lumbricals:
- adductor pollicis

c. What is Ulnar Paradox?

Damage to ulnar nerve proximal to its innervation of the FDP causes less apparent deformity compared to damage to ulnar nerve distal to its innervation of FDP despite more neurological damage.

Q4.

Female breast

1. **Describe the blood supply of the breast.**
2. **Describe the lymphatic drainage of the breast**
3. **Briefly explain the reasons for following clinical features regarding breast cancers**
   a. **Peau d' orange appearance of the breast.**
   b. **Spreading of cancer from one breast to the opposite breast**.

1. **Describe the blood supply of the breast.**

- Mammary gland is a highly vascular organ
- It is supplied by the following arteries
    - perforating branches of the internal thoracic artery
    - lateral thoracic artery (it is the main arterial supply)
    - acromiothoracic artery
    - lateral perforating branches of the posterior intercostal arteries

- these supplying vessels form and anastomosing network.
- The posterior surface is relatively avascular.
- There is superficial and venous drainage in the breast.
- the deep veins run with the main arteries to internal thoracic and axillary veins while some drain into the posterior intercostal veins.
- superficial veins drain into internal thoracic artery.
- The venous blood from breast also communicates with the vertebral venous plexus through posterior intercostal veins Which are valveless

2. **Describe the lymphatic drainage of the breast**

Lymph drainage of breast is of considerable importance due to the development of breast cancers in the gland and the subsequent spread of malignant cells along the lymph vessels to the lymph nodes.

<u>Lymph drainage by plexuses</u>

- There is a superficial and deep lymph drainage where the drainage occurs through 2 plexuses.
    1. Subareolar/ Sappey plexus
    2. Deep plexus
- Sappey plexus drains the lymph from the lobules of the gland, nipple and areola.
- Deep plexus found on the pectoral fascia drains the deeper aspects of the breast.

- Superficial lymphatics of breast have connections with those of opposite breast and the anterior abdominal wall, from the extra peritoneal tissues of which there is drainage through diaphragm to posterior mediastinal nodes.
- Therefore, cancer can spread from breast to the abdominal organs.

- From these plexuses the lymph drainage follows the pathway of its blood supply and therefore travels;
    1. Along the tributaries of axillary vessels to the axillary lymph nodes. About 75% of breast lymph drainage occurs to the axillary nodes
    2 Along the tributaries of internal thoracic vessels to lymph nodes along internal thoracic artery (internal mammary/ parasternal nodes). About 20% drainage occur in this pathway. These also receive lymphatics penetrating along the lateral perforating branches of the intercostal vessels.

- The lymph vessels lying between the lobules of the breast communicate freely but the lateral and superior part of breast as well as axillary tail has a tendency to drain to the axillary nodes while the medial part drains to the parasternal nodes.

<u>Axillary lymph drainage</u>

- There are 5 groups of axillary lymph nodes.
    - Anterior-lying deep to pectoralis major along the lower border of the pectoralis minor
    - Posterior- along the subscapular vessels
    - Lateral- along the axillary vein
    - Central- in the axillary fat
    - Apical-immediately behind the clavicle at the apex of the axilla above the pectoralis minor and along the medial side of the axillary vein.

- Axillary lymph nodes are surgically classified into level I, II & III, which lies proximal to, at the level of & distal to pectoralis minor muscle respectively.

- Most lymphatics drain to the anterior group and some to posterior group. - These then drain to central and lateral group which will in turn drain to apical nodes.

- Direct drainage to the central and apical nodes is also possible.
- The axillary tail drains to the posterior nodes.

- From the apical nodes emerges the subclavian lymph trunk. This on the right drains directly into the subclavian vein or joins the jugular trunk and on the left it usually drains directly into the thoracic duct.
- A few efferents from the apical nodes drain into the supraclavicular nodes.

Parasternal lymph drainage

- The lymphatics that follow internal thoracic artery drain into parasternal nodes. From the parasternal lymph nodes, lymph drains into the bronchomediastinal lymphatic trunks
- About 5% of the drainage occurs into posterior intercostal nodes along the intercostal arteries.
- Occasionally some lymph from breast may drain into infraclavicular nodes in the deltopectoral groove or into small inconstant interpectoral nodes between Pectoralis major and minor.

- Direct drainage from the breast to supraclavicular nodes is possible.
- Occasionally some lymph drains into infraclavicular nodes in the deltopectoral groove.

- The minor pathways convey lymph from the breast only when the major channels are obstructed by malignant disease.

3. Briefly explain the reasons for following clinical features regarding breast cancers

a. Peau d' orange appearance of the breast.

- The lymphatic vessles get obstructed by the cancer cells, resulting lympoedema.

- subcutaneous tissue is prevented from swelling uniformly by the shortened suspensory ligaments which are also invade by the disease. These results pitting of the skin.

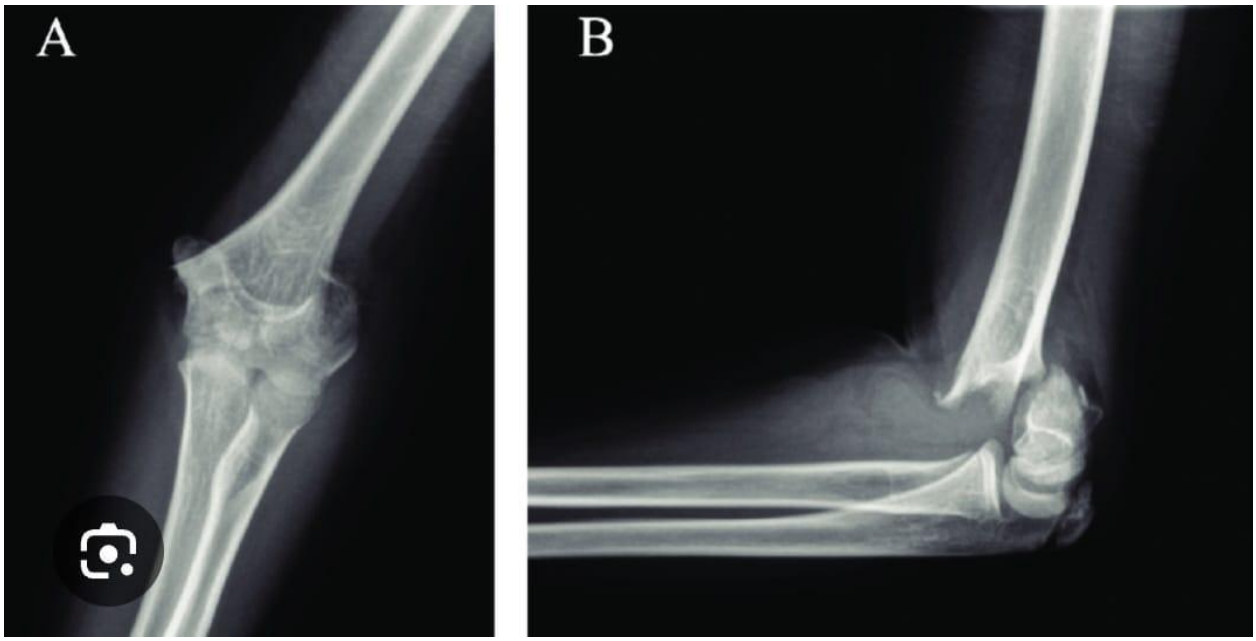
b. Spreading of cancer from one breast to the opposite breast.

- There are communications of the superficial lymphatics connecting both the breasts. Therefore, cancer can spread from one breast to the opposite breast.

Q5.

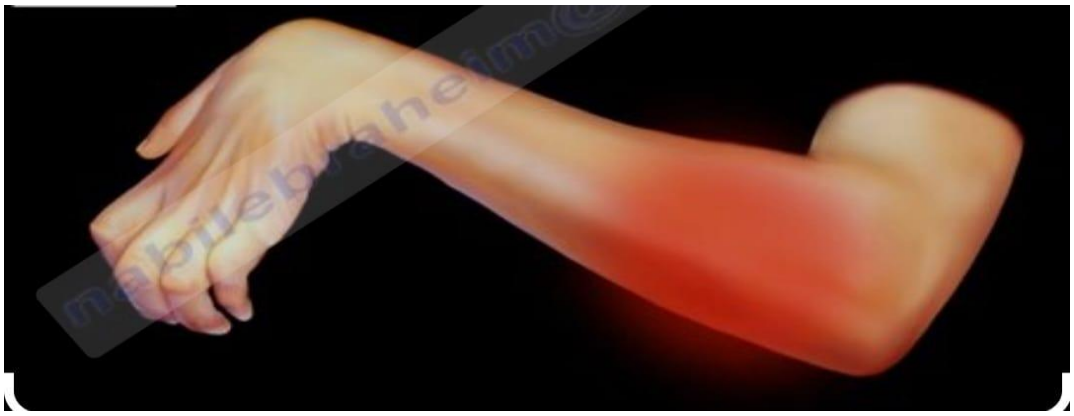
Bone Fractures of Upper Limb

1. **A 7-year-old boy was admitted to the surgical casualty ward following a fall on outstretched hand. He had pain, swelling and reduced movement at right elbow joint. His elbow x-ray is as follows.**



The child had complained of unremitting pain overnight which didn't resolve with pain killers.

The following day the child was noticed to have the following deformity.



Explain the reason for the deformity.

2. A 45-year-old man who was hospitalized following a fall on outstretched arm was found to have a proximal radius and ulna fracture.

He subsequently underwent open reduction and plating with screws under general anesthesia.

His post operative x rays are as follows.



Following day at the ward round the patient had developed Following deformity.



Explain the reason for such deformity.

3. 21-year-old cricketer, who had a fall and impact to his right wrist developed severe wrist pain, tenderness at anatomical snuff box.

His x ray wrist is as follows.



He was managed with a cast for 6 weeks.

Unfortunately, 3 months following the injury he had persistent pain at the wrist. A repeat X-ray showed following.



Explain the reason.

1.

- This child is presenting with a claw like deformity of the hand most probably due to a Volkmann's ischemic contracture.
- The X ray reveals a anteriorly displaced supracondylar fracture of the humerus.
- The displaced proximal bone can impinge the artery on the sharp ends of the fracture end.
- This results ischemia and subsequent fibrosis of the muscles.
- The deformity is caused by the contraction of the long flexor and extensor muscles of the forearm.
- since the flexors of the wrist are bulkier than the extensors, their fibrous contraction is greater and the wrist is therefore flexed.
- the long extensors of the fingers are inserted into the proximal phalanges, there contracture extends the metacarpo-phalangeal joints.
- the long flexors are inserted into the distal and middle phalanges and therefore flex the interphalangeal joints.
- there is, therefore, flexion at the wrist, extension at the metacarpophalangeal joint and flexion at the interphalangeal joints.

2.

- The patient has developed a finger drop.
- This deformity is a result of the radial nerve lesion distal to the wrist joint.
- by the proximal radial and ulnar fracture, the posterior interosseous nerve (which is branch of the radial nerve) is at risk of damage.
- The posterior interosseous nerve supply motor innervation to the long extensors of the hand.
- When there is a lesion in this nerve, the long extensors of the fingers get denervated.
- The inter-phalangeal joint remains in flexed position due to the unopposed action of the long flexors of the hand.
- The wrist joint can be extended, since the innervation of the brachioradialis and the extensor carpi radialis muscles are preserved.

- This is because the motor branches of these 2 muscles are are given off proximal to the wrist joint.

3.

- The fall on out-stretched hand, tenderness at the anatomical snuffbox is clinically suggestive of the scaphoid fracture.
- The X ray also reveal a fracture of the scaphoid bone through its waist.
- Normally the scaphoid has 02 nutrient arteries, one entering the palmar surface of the tubercle and the other the dorsal surface of the body of the scaphoid.
- In 13% of cases, both vessels enter through the distal half of the bone.
- In such cases, facture may deprived the proximal half of the bone of its blood supply leading to avascular necrosis.
- in the repeat X-ray, the proximal segment is comparatively radio dense, since the necrosed segment has undergone sclerosis and calcium deposition.
- This avascular necrosis of the proximal fragment can be the most likely reason for the persisting wrist pain.

THORAX

Q1

Structures of thoracic wall

1.
   a. Write a short note about the anatomy of a typical rib
   b. Describe the anatomy of a typical intercostal space.
   c. Briefly explain what the safety triangle of the thorax is and it's clinical importance.

2. Explain the movements of the thoracic cage during quiet respiration.

3. Briefly explain the anatomical basis of paradoxical breathing in spinal cord injury

1.

a. Write a short note about the anatomy of a typical rib

- Rib 3-9 are considered as the typical ribs.
- It has a head, neck and a shaft. And the anterior end continues with its costal cartilage.
- Head - it has 2 articular facets. Lower facet articulates with its own vertebra while the upper facet articulate with the vertebra above.
- Neck - flattened with a sharp crest forming the upper border. The neck inclines backwards when traced from head to tubercle.
- Tubercle - this is a projection found at the junction of the neck with the shaft. Its medial facet makes a synovial joint with transverse process of its own vertebra. The lateral facet gives attachment to lateral costotransverse ligament.
- Shaft - slopes down and back to the angle and there twists forward in its characteristic curvature resulting the heads of ribs lie at a higher level than their anterior ends.
- Upper borer of the rib is blunt.
- Lower border of the shaft is sharp and hangs down to produce a costal groove on the inner surface.
- The neurovascular bundle lie deep to the costal groove in between external and internal intercostal muscles.

b. Describe the anatomy of a typical intercostal space.

- It is the space between adjacent ribs and costal cartilages.
- There are 3 layers of muscles in an intercostal space.
- External group → external intercostal muscle
- internal group → internal intercostal muscle
- innermost group → innermost intercostal muscle, transversus thoracic muscle, subcostalis muscle.

External intercostal muscle

- Fibers run downwards, medially and forward from the sharp lower border of the rib above to the smooth upper border of the rib below.
- muscle extends from the superior costotransverse ligament posteriorly as far forwards as the costochondral junction.
- from that point upto the sternal margin is the anterior intercostal membrane.

Middle intercostal muscle

- Fibers run downwards and backwards, from the floor of the costal costal groove of rib above to the upper border of the rib below.
- It extends from the angle of the rib posteriorly, as far forwards as the sternal margin.
- posteriorly from the angle upto the superior costotransverse ligament is the posterior intercostal membrane.

Innermost muscle layer

- The muscles in this layer cross more than one intercostal space.
- innermost intercostal muscle - Fibers run downwards, laterally and backwards (same direction of the internal intercostal muscle) mainly found in the lateral part of the thoracic wall.
- subcostalis muscle - found in the paravertebral gutter

Neuro vascular bundle

- lies first between pleura and the internal intercostal membrane posteriorly, then between internal intercostal muscle and innermost intercostal muscle.
- Lies in the costal groove of the higher rib
- the neurovascular bundle is arranged as vein, artery and nerve from above downwards.
- Single intercostal space has 2 arteries.
- 02 anterior intercostal arteries and a posterior intercostal artery. There are veins accompanying the arteries.
- posterior and anterior intercostal arteries anastomose at the costochondral junction.
- In the upper 06 spaces anteriorly, intercostal artery is a branch of internal thoracic artery and in the 7th - 9th spaces, it is given off by the musculophrenic artery.
- 1st and 2nd posterior intercostal arteries arise from the superior intercostal artery which is a branch of the costocervical trunk. (from the 2nd part of the subclavian artery)
- The rest of the posterior intercostal from 3rd to 11th spaces, arteries arise from the descending thoracic aorta.
- Posterior intercostal artery gives collateral branches, which runs in the upper border of lower rib.
- in each intercostal space, there are one anterior and 02 posterior intercostal veins.
- the anterior intercostal veins drain to musculophrenic and internal thoracic vein.

- posteriorly, the lower 8 spaces drain to the azygous system. (The azygous vein in the right and hemiazygous and accessory hemiazygous on the left.
- the 1st posterior intercostal vein drains into the vertebral vein or the brachiocephalic vein of its owns ide.
- The 2nd and 3rd posterior intercostal veins and sometimes 4th form a single trunk as superior intercostal vein that on right drain into the azygous vein and on the left drain into the left brachiocephalic vein.

Intercostal Nerves

- The intercostal nerves are the anterior primary rami of thoracic spinal nerves. They terminate as anterior cutaneous nerve (which divide into medial and lateral branches) which supply overlying skin
- At the angle of the rib, the collateral and the lateral cutaneous nerve is given off.
- The lateral cutaneous nerve pierces the mid axillary line which supply the overlying skin of the lateral aspect of the thoracic wall.

lymphatics drain

- from posterior part drains into -posterior intercostal nodes
- from anterior part drains into - anterior intercostal nodes (internal mammary nodes)

c. Briefly explain what the safety triangle of the thorax is and it's clinical importance.

- This is a triangular area in the axilla that forms a guide to the safe position for intercostal tube placement.
- The boundaries are as follows;
- Anteriorly Is the anterior axillary fold formed by pectoralis major muscle
- Posteriorly Is the lateral edge of latissium dorsi
- Inferiorly is the 5th intercostal space

Clinical importance

- insertion of emergency chest drain is performed through the 5th Inter costal space, just anterior to the mid axillary line to avoid damage to long thoracic nerve.

- This tube is inserted over the lower edge of intercostal space to prevent any damage to the neurovascular bundle in the coastal groove.
- there are comparatively few layers of muscles for insertion of tube or needles.
- this area also minimize the ris of damage tot he visceral organ such as liver, spleen, stomach.

2. Explain the movements of the thoracic cage during quiet respiration.

- Respiration consists of two main processes: inhalation and exhalation.
- Inhalation (Inspiration) is an active process that involves the expansion of the lungs. This expansion occurs due to an increase in negative intrapleural pressure, resulting from the expansion of the thoracic cavity in 3 dimensions.
- Dimensional Expansion: The lung volume increases in three dimensions—anteroposterior, transverse, and vertical:
- The vertical diameter increases as the diaphragm contracts and moves downward.
- The anteroposterior diameter increases due to movements of the thoracic cage in pump handle movement.
- The transverse diameters increase due to movements of the thoracic cage in bucket handle movement.
- these movements are facilitated by the structural arrangement of the thoracic cage.

Thoracic Cage Structure:

- The thoracic cage is composed of the sternum at the front, the ribs on the sides, and the vertebral column (T1-T12) at the back.
- The sternum is shorter than the T1-T12 vertebral column, causing the ribs to be positioned obliquely downward, with the anterior ends lower than the posterior ends, especially in ribs 1-6.
- And in the lower ribs the lowest point is at its lateral curvature.

Pump Handle Movement:

- The joint between the manubrium and the body of the sternum functions as a hinge joint.

- When ribs 2-6 are elevated through movements at the costovertebral and costotransverse joints, their anterior ends, attached to the body of the sternum lift and move forward.
- This action increases the anteroposterior diameter, resembling the movement of a pump handle.
- The ribs act as efficient levers, allowing even a small force from the external intercostal muscles to cause significant elevation.

Bucket Handle Movement:

- The middle of the ribs lies lower than their two ends.
- Elevating these lower ribs through the costovertebral and costochondral joints increases the transverse diameter, similar to the movement of a bucket handle.
- Additionally, the rib below is longer and wider than the one above. Elevating the lower rib to the level of the upper rib further increases the transverse diameter. This action is also facilitated by the force exerted by the external intercostal muscles.

3. Briefly explain the anatomical basis of paradoxical breathing in spinal cord injury

- Paradoxical breathing in the spinal cord injury is where the rib cage moves inwards during inspiration with visible outward movement of the abdomen during inspiration.
- This phenomenon takes place when there is a cervical spinal cord injury below C5 level.
- In such a lesion, the phrenic nerve is spared (C3, C4, C5). Therefore, the diaphragm movements are intact during respiration while the intercostal muscles are in a state of flaccid paralysis due to spinal shock.
- Because of this flaccidity, the rib cage gets pulled in during inspiration, due to the negative intra thoracic pressure created by the downward movement of the diaphragm.
- this results inward movement of the of the rib cage during inspiration.
- with the contraction of the diaphragm, the intra-abdominal pressure increases resulting the outward movement of the abdomen.

Q2.

Normal development and Developmental abnormalities of the respiratory system.

1.
   a. Describe the formation of the trachea.
   b. Describe the embryological basis of tracheoesophageal fistula.
   c. What is the most common type of Tracheoesophageal Fistula?

2. A baby born at 27 weeks of gestation to a diabetic mother developed difficulty in breathing within 4 hours of birth associated with tachypnoea, chest wall recessions and expiratory grunting, there was no cyanosis.
   a. Explain the mechanism of action of Surfactant in newborn lungs.
   b. What is the cell in the surface epithelium of the respiratory system that secretes surfactant?
   c. Above child was clinically diagnosed to have surfactant-deficient lung disease. Explain the embryological basis for this condition.

3. Briefly explain the embryological basis of the common congenital diaphragmatic hernia

1.

a. Describe the formation of the trachea.

- Respiratory system is an outgrowth of the ventral wall of the foregut. This outgrowth is named respiratory diverticulum / lung bud.
- Gradually the lung bud starts expanding caudally.
- However, 2 longitudinal ridges, the trachea - oesophageal ridges appear and start separating the lung bud from the foregut.
- Subsequently the ridges fuse to form the trachea - oeshophageal septum, where the ventral portion is trachea while the dorsal portion is the oesophagus.
- the respiratory primordium maintains its communication with the pharynx through the laryngeal orifice.
- The epithelium is of endodermal origin
- Cartilaginous, muscular and connective tissue component is of mesodermal (visceral/splanchnic mesoderm) origin.

b. Describe the embryological basis of tracheoesophageal fistula.

- This is due to abnormalities in partitioning of the esophagus and trachea by the tracheoesophageal septum.

c. What is the commonest type of Tracheoesophageal Fistula?

- 90% has TEF where proximal end of the oesophagus is blind and the lower segment of the oesophagus forms the fistula with the trachea.

2. A baby born at 27 weeks of gestation to a diabetic mother developed difficulty in breathing within 4 hours of birth associated with tachypnoea, chest wall recessions and expiratory grunting, there was no cyanosis.

a. Explain the mechanism of action of Surfactant in newborn lungs.

- Surfactant is a phospholipid coat on the alveolar membrane which is secreted by the alveolar epithelium.
- It reduces the surface tension inside the alveoli (in the air-blood capillary interface) and thereby prevents collapse of the alveoli during expiration.

- Laplace's law states that the tension of the wall of a sphere is equal to the product of the pressure of the chamber and the radius of the chamber. Therefore, when the surface tension is higher due to inadequate surfactant higher pressure has to be generated to keep the alveoli open leading to increased work of breathing which will ultimately lead to respiratory distress.

b. What is the cell in the surface epithelium of the respiratory system that secretes surfactant?

Type II alveolar cells

c. Above child was clinically diagnosed to have surfactant-deficient lung disease. Explain the embryological basis for this condition.

- This newborn is at high risk due to 2 reasons
  - ✓ Being premature
  - ✓ Mother having gestational diabetes.
- Surfactant secretion begins after 34 weeks gestation and it is synthesized most abundantly after 34th week of gestation.
- Since this premature child lack adequate surfactant, the surface tension at the air-blood capillary interface increase. These results collapse of the lungs at birth.
- This causes the respiratory distress syndrome in the newborn. Also, children born to mothers with gestational diabetes mellitus are at a higher risk of developing surfactant deficient lung disease.

3. Briefly explain the embryological basis of the common congenital diaphragmatic hernia

- Hernia is an abnormal protrusion of a viscus or a part of viscus through an opening/ defect/ weakness in the wall of the cavity in which it is normally contained. The diaphragm is formed by fusion in the embryo of
- The septum transversum (forming the central tendon)
- The peripheral body wall muscle (forming the muscular part)
- Pleura-peritoneal membranes which close the fetal communication between the pleural and peritoneal cavity/pericardioperitoneal canal (forming the muscular part)
- The dorsal oesophageal mesentry (forming the crura)

- When the fusion of these components does not take place correctly, it gives rise to congenital hernia through the diaphragm. These may be;
- Through the foramen Morgagni
    - This is found anteriorly between the xiphoid and the costal origins./ parasternal hernia
    - This type less common
    - the diaphragm in this area is formed primarily from the septum transversum and the body wall musculature. A defect in the fusion of these two components can result hernia through foramen Morgagni
- Through the foramen Bochdalek
    - this is found in the posterolaeral part of the diaphagm and more common in left side.
    - this is the commonest type
    - the diaphragm in this area is formed primarily from the pleuraperitoneal membranes which closes the pericardioperitoneal canals. If there is a failure of pleuroperitonial canal closure, this hernia can develop.
- Through the deficiency of the whole central tendon
- Through a congenitally large oesophageal hiatus

Q3.

Anatomy of the lungs – 1

1. Surface mark the
    a. Borders of the pleura
    b. Borders of the lung
    c. Fissures

2. Explain briefly the anatomical basis of why the right sided lobar pneumonia being commoner than left sided lober pneumonia.

3. A 25-year-old male was brought to the emergency department following a road traffic accident. He complained of rapidly worsening difficulty in breathing and severe chest pain. There was on a wound on left chest at 3rd -4th intercostal spaces anteriorly. A clinical diagnosis of tension pneumothorax was made.
    a. Briefly explain what is tension pneumothorax
    b. Name the other types of pneumothorax
    c. What are the therapeutic measures that can be performed to treat this.?

Later the surgeon decided to insert an intercostal tube to the left pleural cavity with an underwater seal.
    d. Where would you insert this tube and why?
    e. Name the tissue layers that the intercostal tube has to cross when it is inserted.
    f. Explain the reason for using an underwater sealed drain.

1. Surface mark the

a. Borders of the pleura

- The pleura is a thin membrane lining the lungs and the thoracic cavity.
- The parietal pleura can be surface marked.
- The anterior border can be surface marked as below
    - It starts 2.5 cm above the junction of the middle ans medial thirds of the clavicle.
    - It runs down and medially behind the sternoclavicular joint.
    - Then it meets its fellow at the 2nd rib level (sternal angle level)

- Then they pass vertically behind sternum down to 4th costal cartilage.
- Here the right pleura continues vertically upto 6th costal cartilage.
- But the left arches put and descend lateral to the border of the sternum, halfway to the apex of the heart.

- Each turns laterally at the 6th costal cartilage to form the lower border.
  - it passes around the chest wall crossing the
- Mid-clavicular line - at 8th rib
- Mid-axillary line - at 10th rib
- Lateral border of erector spinae - at 12th rib
- Then passes to the lower border of the 12th thoracic vertebra
  - Then the posterior border runs upwards from that point upto apex.
  - The visceral pleura envelops the lung.

Borders of the lung

- The anterior border of the lung coincides with the anterior border of the pleura.
- In the left lung, once it reaches the level of 4th costal cartilage, it curves laterally out to the 5th intercostal space just medial to the mid-clavicular line.
- The inferior border is 2 ribs higher than that of the inferior border of the parietal pleura. it crosses the
- Mid-clavicular line - at 6th rib
- Mid-axillary line - at 8th rib
- Lateral border of erector spinae - at 10th rib
- Then passes to the lower border of the 10th thoracic vertebrae

Fissures

- The fissure separates the lungs into lobes.
- The right lung has 2 fissures as oblique and transverse while the left lung has only an oblique fissure.
- Surface marking of oblique fissure
  - start from the tip of the spine of T3 vertebra., which is opposite the posterior end of the 5^{th} rib
  - then it runs inferiorly and anteriorly to cross the mid-axillary line 5th rib

- this fissure meets the inferior border behind the 6th rib in the midclavicular line (6^{th} costo - condral junction)
- approximately this fissure runs over the 5th rib / coincide with the vertebral border of the scapula when the arm is fully abducted above the head.

- Transverse fissure runs over the 4th costal cartilage and rib to meet the oblique fissure at mid-axillary line at 5th rib level.

2. Explain briefly the anatomical basis of why the right sided lobar pneumonia being commoner than left sided lober pneumonia.

- At the lower border of the T4 vertebra, the trachea divides into the right and left principal bronchi.
- the following reasons contribute for right sided lobar pneumonias to be commoner than the left side.
- The right bronchus is wider, shorter, and more vertical,
- The right main bronchus closely aligning with the trachea.
- In contrast, the left bronchus is narrower, longer, and more oblique.
- The dependent position of the lung varies according to the position
  - when erect → foreign body move into basilar segment of the lower lobe
  - when supine → foreign body move into posterior segment of upper lobes / superior segment of lower lobe.

- Therefore, aspirational pneumonia in right lung is commoner than in left lung.

2. A 25-year-old male was brought to the emergency department following a road traffic accident. He complained of rapidly worsening difficulty in breathing and severe chest pain. There was on a wound on left chest at 3rd - 4th intercostal spaces anteriorly. A clinical diagnosis of tension pneumothorax was made.

a. Briefly explain what is tension pneumothorax

- This is a progressive intra pleural accumulation of air resulting hemodynamic compromise.
- The wound in the chest forms a one-way valve which makes the air enetering the pleural cavity, unable to escape.

- Therefore, pressure in the left side (side of injury) increase.
- This causes a mediastinal shift and kinking of great vessels (venous system)
- Hence the venous return to the heart reduces.
- This creates a hemodynamic compromise
- This is life - threatening.

b. Name the other types of pneumothorax

- According to the cause
    - ❖ Spontaneous pneumothorax
    - ❖ Post traumatic
    - ❖ Iatrogenic
- Spontaneous pneumothorax can be further divided into
    - ❖ Primary spontaneous
    - ❖ Secondary spontaneous
- Traumatic pneumothorax
    - ❖ Open pneumothorax
    - ❖ Closed pneumothorax
- Simple pneumothorax

c. What are the therapeutic measures that can be performed to treat this.?

- This is an emergency.
- A wide bore cannula is placed in the 2nd intercostal space, in the mid-clavicular line.
- Once this tension pneumothorax is converted into a simple pneumothorax, a chest drain can inserted.

Later the surgeon decided to insert an intercostal tube to the left pleural cavity with an underwater seal.

d. Where would you insert this tube and why?

- Ideal site for chest tube insertion is the 5th intercostal space in the safety triangle, just anterior to the midaxillary line
- Safety triangle is chosen as this area has minimal muscle layers in the thorax.
- And tube insertion through this triangle avoids possible damage to stomach.

- It is inserted just anterior to the mid axillary linen to avoid damage to the long thoracic nerve.
- Also, the tube should be inserted at the upper border of the rib, to avoid the damage to the neurovascular bundle.

e. Name the tissue layers that the intercostal tube has to cross when it is inserted.

- Skin
- Superficial fascia
- Serratus anterior muscle
- External intercostal muscle
- Internal intercostal muscle
- Innermost intercostal muscle
- Endothoracic fascia
- Parietal pleura

f. Explain the reason for using an underwater sealed drain.

- Here the distal end of the tube is submerged under water about 2 cm.
- It creates a one-way mechanism that allows air to escape from the pleural space with each exhalation and to prevent that return flow with each inhalation.

Q4.

Anatomy of lungs – 2

1. Write a short note on blood supply of the lungs.
2. Briefly explain about broncho-pulmonary segments and its clinical importance.
3. Outline the sensory supply of pleura.
4. Explain the reason how lower lober pneumonia results pain at tip of the shoulder.
5. Explain the reason for why inflammation in pleura can mimic acute abdominal emergency
6. Describe the course of trachea and its relations.
7. Write a short note on tracheostomy.
8. Outline the innervation of the diaphragm.

1. Write a short note on blood supply of the lungs.

- Lung is the organ which is rich in its blood supply as it is the site, where the gas exchange takes place in our body.
- It has a dual blood supply
- Pulmonary arterial system
- Bronchial arteries
- Pulmonary arteries return the mixed venous blood to the alveolar level for gaseous exchange.
  - pulmonary artery supplies the alveoli and supply everything required except Oxygen.
- Bronchial arteries maintain the blood supply to bronchial tree.
  - There are usually 3 arteries. 2 in left and 1 in right.
  - in the left these arteries are direct branches of descending thoracic aorta
  - In the right, from the 3rd right posterior intercostal artery of the left superior bronchial artery.
  - They supply the bronchi from the carina to the respiratory bronchioles and visceral pleura.
- There are anastomoses between the bronchial and pulmonary arteries.
- If there is pulmonary embolism, the bronchial arteries supply the lung parenchyma, so that, if the patient recovers lung functions return to normal.

- Superior and inferior pulmonary veins return the oxygenated blood to the left atrium.
- Bronchial veins drain into the azygous vein in right and accessory hemi azygous in left.

2. Briefly explain about broncho-pulmonary segments and its clinical importance

- Each lobe of the lung is subdivided into a number of broncho-pulmonary segments.
- These segments are wedge shaped with the apex at the hilum and the base at the lung surface.
- Typically, there are 10 in each lung
- Each is supplied by a segmental bronchus, artery and vein.
- Pulmonary veins are found in the inter-segmental septa.

- Clinical importance

- The infections are focal since they are confined to the affected segment and spread across segment is also minimal.
- When surgical excision of diseased lung tissue is indicated, segment resection can be performed. This will minimize the damage to the healthy lung tissue.

3. Outline the sensory supply of pleura

- The pleura can be divided into 2 as parietal pleura and visceral pleura.
- The peripheral pleura is segmentally innervated by the somatic nerves as follows
  - Costo-vertebral pleura --> intercostal nerve
  - diaphragmatic pleura --> over the dome by the phrenic nerve and over the periphery by the intercostal nerves
  - mediastinal pleura --> phrenic nerve

- The visceral pleura has an autonomic innervation but insensitive to ordinary stimuli.

4. Explain the reason how lower lobar pneumonia results pain at tip of the shoulder.

- Lower lobar pneumonia can cause irritation of the diaphragmatic pleura.
- This part of the pleura specially over the domes is innervated by the phrenic nerve which has origin from C3, C4 and C5 nerve roots.
- When the diaphragmatic pleura is irritated, the pain can get referred to the C4 dermatome over the shoulder tip.

5. Explain the reason for why inflammation in pleura can mimic acute abdominal emergency.

- The lower intercostal nerve which supplies the parietal pleura ends by supply the anterior abdominal wall.
- Therefore, when there is an involvement of the costovertebral pleura or the peripheral part of the diaphragmatic pleura, the pain can get referred to the anterior abdominal wall.
- This can mimic ac acute abdominal emergency.

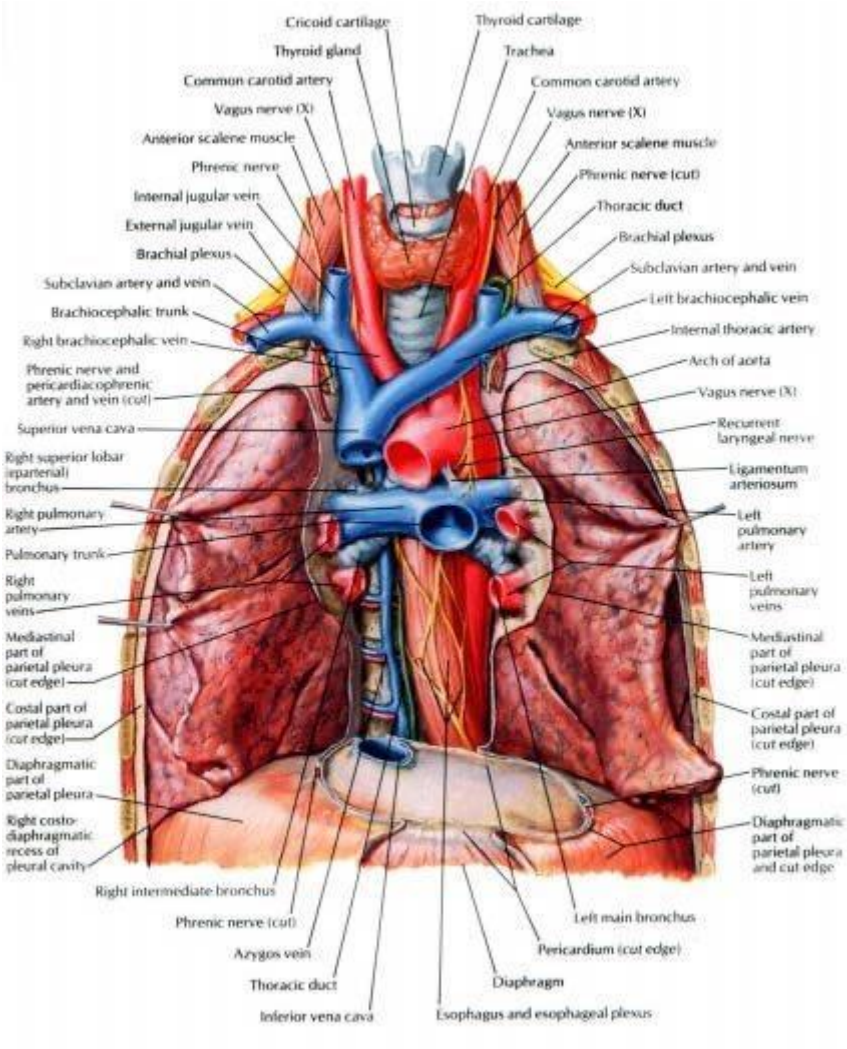
6. Describe the course of trachea and its relations.

- Trachea is a part of the respiratory tract distal to larynx.

- It is approximately 10cm in length and nearly 2 cm in diameter.
- It has both cervical and thoracic course.
- It commences at the lower border of the cricoid cartilage (C6 level / 5cm above the Jugular notch) and terminates by bifurcation at sternal angle level.
- In deep inspiration the bifurcation descends upto T6 and can rise upto T4 in deep expiration.
- Cervical part of the trachea lies in the mid-line. It passes backwards and downwards when entering the thorax. And then moves to the right of the mid-line to bifurcate into left and right main bronchi.
- Relations are as follows
  - in the cervical part
- Anteriorly
  - isthmus of the thyroid gland--> adherent to 2nd, 3rd, and 4th tracheal rings.
  - inferior thyroid veins, thyroidea ima artery
  - anterior jugular venous arch
  - sternohyoid and sternothyroid muscles
- Laterally
  - lobes of the thyroid gland --> as far as 6th tracheal ring.
  - carotid sheath (common carotid artery + internal jugular vein)
- Posteriorly
  - oesophagus
  - recurrent laryngeal nerve in the tracheo-oesophageal groove
  - In the thoracic part
- Anteriorly
  - commencement of the brachiocephalic artery and left carotid artery
  - left brachiocephalic cross the midline to drain to SVC
  - inferior thyroid veins
  - remnant of thymus
- Posteriorly
  - oesophagus
  - left recurrent laryngeal nerve run superiorly in tracheo-oesophageal groove.
- Left
  - arch of aorta arches posteriorly and laterally to left over the left bronchus

- left common carotid and left subclavian artery.

- Right
  - right vagus nerve runs along the trachea
  - azygous vein arches above the right bronchus to drain to SVC
  - right brachiocephalic vein with the SVC is anterolateral to the trachea.
  - brachiocephalic trunk
  - pleura

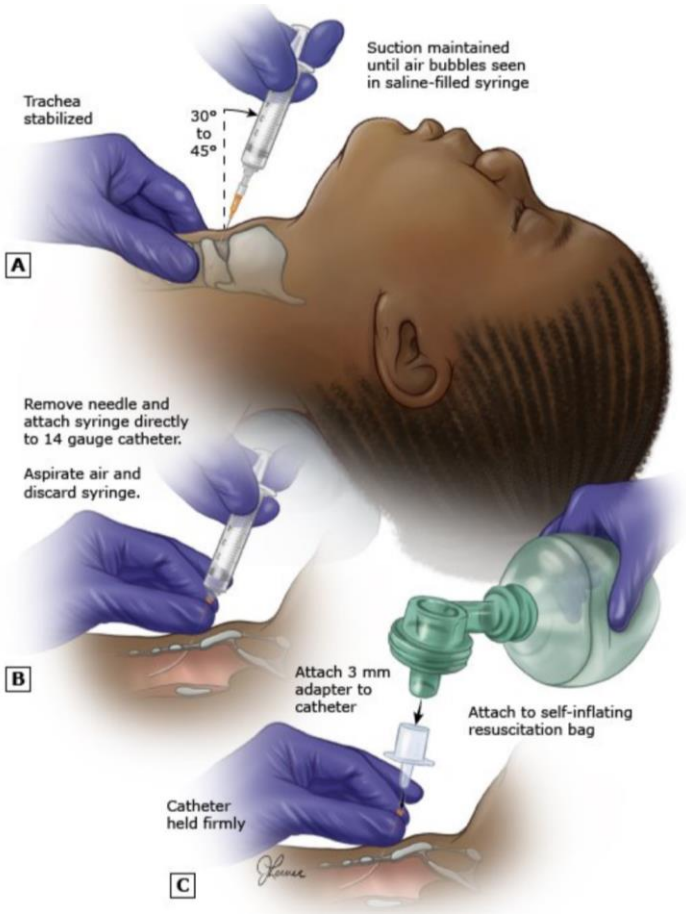


7. Write a short note on cricothyroid puncture

- This is an emergency procedure done to secure airway.
- Indications are
  - obstruction of upper airway (ex; epiglottitis, angio-oedema, chemical and thermal burns)

- laryngeal foreign body that cannot be removed expeditiously
- severe maxillo-facial trauma

- Procedure is as follows
  - puncture site is cleaned with povidone iodine.
  - stretch the skin over the neck with fingers
  - hold a syringe half filled with saline attached to a needle. (this should be an over the needle catheter)
  - puncture in the middle of the neck at the cricothyroid membrane.
  - direct the needle at a 45 0 angle caudally.
  - apply negative pressure on the syringe until air bubbles are seen, to confirm intra-tracheal placement.
  - remove the needle and syringe while advancing the catheter to the hub.
  - attach the Oxygen catheter and secure the airway



1. **Outline the innervation of the diaphragm**

- Diaphragm is fibro-muscular structure separating the thoracic cavity from the peritoneal cavity.
- The motor supply is solely by the phrenic nerve
- Sensory supply of the central part (central tendon) is by the phrenic nerve (C3, 4, 5 but predominantly C4)
- Sensory supply of the peripheral muscular part is by the lower intercostal nerves.
- Clinical importance - peritoneal irritation beneath the diaphragm can cause referred pain at the shoulder tip

Q5.

Anatomy of the heart

1. Describe the anatomy of right atrium.
2. Write a short note on what are the border of the heart and how to surface mark it.
3. A 60 yrs. old female admitted to the hospital, complained of a chest pain, radiating to the medial aspect of the left arm. ECG and further investigations confirmed a myocardial infarction due to an obstruction in a branch of the right coronary artery.
    a. Briefly describe anatomical basis for the radiating pain.
    b. Explain the anatomical basis of why cardiac arrhythmias are more common following occlusion of right coronary artery than the left coronary artery
4. How does the collateral circulation develop in coarctation of aorta?

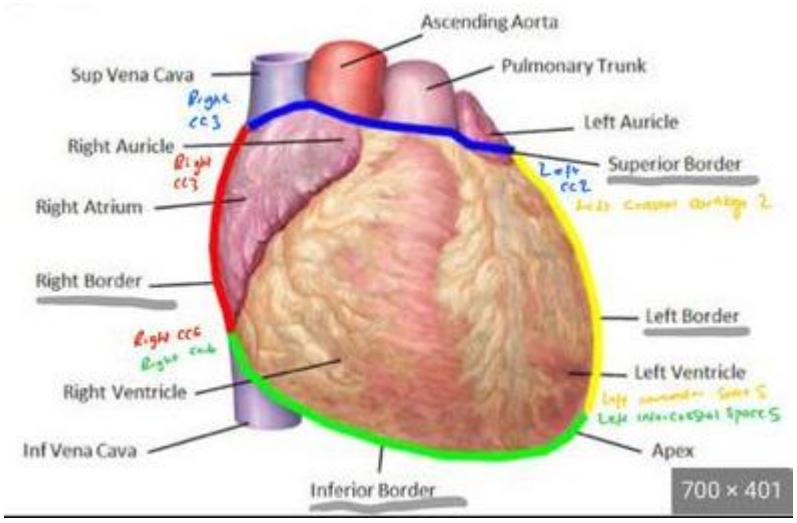
1. Describe the anatomy of right atrium.

- The right atrium is the upper right chamber of the heart, responsible for receiving venous blood from the entire body.
- It forms the right border, part of the upper border, and contributes to the base and sternocostal surface of the heart.
- The chamber is vertically elongated, with its upper end extending to form the right auricle, which partially covers the ascending aorta and the infundibulum of the right ventricle.
- The chamber has rough and a smooth part.
- These 2 areas are separated by ridge called crista terminalis.
- Along the right border, the atrium features a shallow vertical groove called the sulcus terminalis,
- This forms the internal muscular ridge known as the crista terminalis.
- The upper part of the sulcus contains the sinoatrial (SA) node, which is crucial for initiating the heart's rhythm.
- The right atrium is separated from the right ventricle by the right atrioventricular groove.
- Blood flows out of the right atrium through the right atrioventricular (tricuspid) orifice into the right ventricle. The tricuspid orifice is guarded by the tricuspid valve, ensuring unidirectional blood flow.
- There are tributaries to the right atrium which drain venous blood
- superior and inferior vena cava,
- Inferior vena cava,
- coronary sinus, (The opening of the coronary sinus is guarded by the valve of the coronary sinus.)
- the anterior cardiac veins,
- venae cordis minimae.
- The smooth part of the right atrium is derived from the sinus venosus, where most of the tributaries open.
- The rough part of the atrium, located anteriorly, consists of transverse muscular ridges called musculi pectinati.
- The interatrial septum, which separates the right atrium from the left atrium, develops from the septum primum and septum secundum.

- The fossa ovalis, a remnant of the foramen ovale, is present in the septum, with its edge known as the limbus of the fossa ovalis.

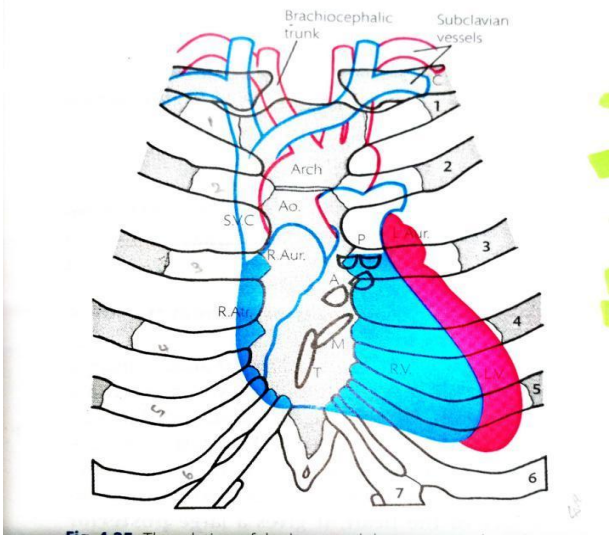
2. Write a short notes on,

a. borders of the heart



- Heart is a vital organ in our body.
- It has 4 borders of the heart and they are formed by following structures.
- Superior border - upper margins of the atria
- Right border - right atrium
- Inferior border - mainly by the right ventricle and a small part on the left by the left ventricle.
- Left border - left ventricle and a small part superiorly by the left auricle

b. surface mark the borders of the heart and the valves of the heart.



- Surface marking is having a significant clinical importance when it comes to auscultation of heart sounds and as well as procedures like pericardiocentecis.
- The surface marking is as follows
- Superior border
    - from the upper part of the left 3rd costal cartilage, 1-2 cm from the margins of the sternum,
    - to the3rd costal cartilage, close to the margin of the sternum.
    - line joining these 2 points mark the upper border of the pulmonary artery.

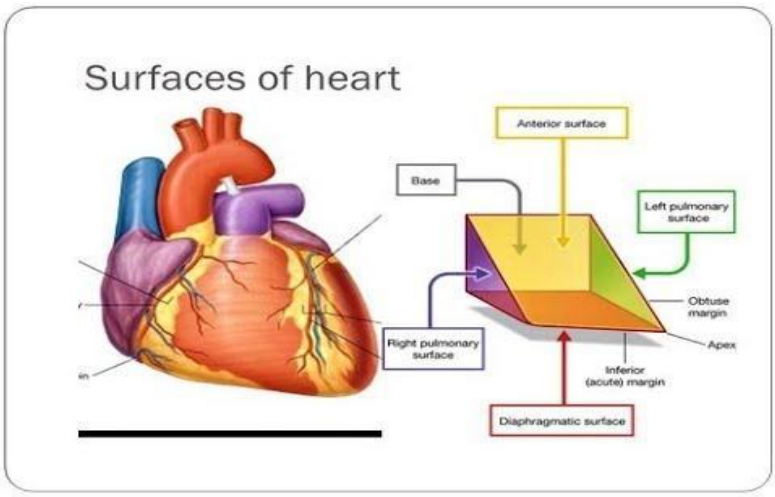
- Right border
    - from the right end of the superior border
    - to a point in 6th costal cartilage, 1-2 cm away from the margin of the sternum.
    - convex in shape.

- Inferior border
    - extends from the lower point of the right border to the apex of the heart.
    - apex lies at 5th left intercostal space immediately medial to the mid-clavicular line.
    - it is slightly concave.

- Left border
    - from the left end of the superior border
    - to left end of the inferior border.

- The valves can be surface marked as follows.
- Aortic valve - posterior to the sternal end of the 3rd left costal space.
- Pulmonary valve - posterior to the sternal end of the 3rd left costal cartilage.
- Mitral / bicuspid valve - posterior to the left half of the sternum at the level of 4th costal cartilage.
- Tricuspid valve - posterior to the middle of the sternum at the level of the 4th intercostal space.
- ** these surface markings are only approximate because the heart is a mobile organ where these positions vary with the diaphragmatic movements and with venous return.

c. Surfaces of the heart



- There are 3 surfaces to the heart as
- Sterno-costal surface (Right pulmonary + anterior + Left pulmonary surface)
- Diaphragmatic surface
- Base

- The content of each of the above borders is as follows.
- Sterno-costal surface -
- Diaphragmatic surface -
- Base - right ventricle and the right atrium +

3.

a. Briefly describe anatomical basis for the pain felt radiating along the medial border of left arm & over the chest wall. (20)

- The heart is innervated by pain-transmitting sympathetic afferent fibers, which relay signals to the spinal cord segments T1 to T5.
- Pain fibers from the medial side of the arm also sends signals to these same spinal segments.
- As a result, ischemic cardiac pain is often referred to the corresponding dermatomes, specifically those of T1 to T5, leading to the sensation of pain in the medial aspect of the arm.

b. Explain the anatomical basis of why cardiac arrhythmias are more common following occlusion of right coronary artery than the left coronary artery

- Arrhythmia is defined as an irregular rhythm.
- Arrhythmia develop as a result of a defective conducting system of the heart.
- The normal heart beat is initiated in the SA node and spreads through the atrial muscles to the AV node. These impulses then run in the trunk of AV bundle and are disseminated rapidly through the ventricle via the crura of the AV bundle and their branches.
- When the nodes or other parts of the conducting system of the heart are affected by the blockage, the ventricles may continue to contract at their own slow rate, independent of atrial contraction.

- It is more common with the right coronary artery involvement due to various reasons

- In majority of the individuals SA node is supplied by the Right coronary artery. SA node is the pacemaker. Therefore, ischemia of the SA node can cause sinus bradycardia or sinus arrest.

- The AV node and the bundle is supplied by the posterior inter-ventricular branch of the right coronary artery. This can lead to 1st degree 2nd degree or 3rd degree heart blocks.

4. How does the collateral circulation develop in coarctation of aorta?

- In coarctation of the aorta, is a condition where there is narrowing of the aorta usually distal to the origin of the left subclavian artery.
- Since blood supply distal to the obstruction is minimal, the body develop collateral circulation to create an alternate route for the flow of blood distal to the obstruction.
- There are 5 main collateral systems. The route of blood flow is as follows
    1. subclavian artery → internal thoracic artery and thereby musculophrenic artery → anterior intercostal arteries from 3rd - 9th intercostal space → posterior intercostal arteries (via the anastomoses) → descending thoracic aorta
    2. subclavian artery → internal thoracic artery → superior epigastric artery → inferior epigastric artery via the anastomoses → external iliac artery

3. subclavian artery → scapular anastomoses → posterior intercostal arteries (via the anastomoses) → descending thoracic aorta
4. subclavian artery → vertebral artery → anterior spinal artery → posterior intercostal arteries (via anastomoses) → descending thoracic aorta
5. axillary artery → lateral thoracic artery → posterior intercostal arteries (via anastomoses) → descending thoracic aorta.

- This network provides principal collateral circulation between the aorta segments above and below the coarctation/ obstruction.

- As a result of this collateral circulation, the intercostal arteries undergo dilatation and tortuosity. This can lead to erosion of the lower borders of the corresponding ribs, producing the characteristic irregular notching of the ribs seen in this condition.

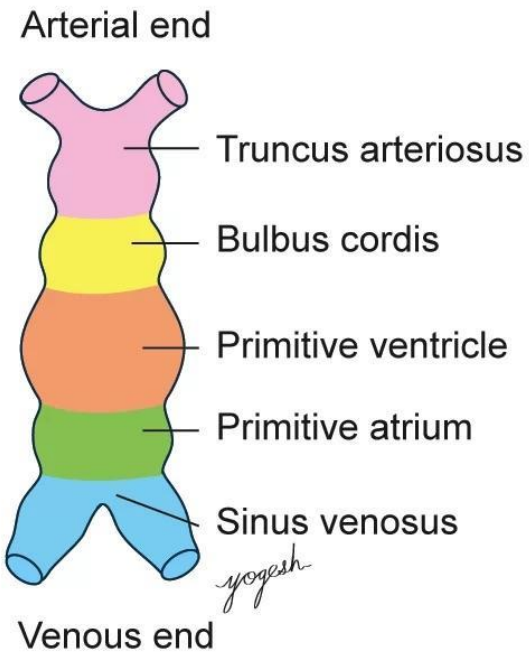
Q6.

Development of cardiovascular system

1. Draw a labelled diagram of a heart tube and outline the fate of each part of the heart tube.
2. Explain the process of the development of the inter-atrial septum
3. Explain the embryological basis of the following heart defects of a newborn
    a. Ostium secondum defect
    b. Ostium primum defect
4. What is embryological basis of Tetralogy of Fallot and list the cardiovascular alterations found in this condition.
5. Briefly explain the
    a. fetal circulation
    b. the changes in the fetal circulation at birth.
6. A 13-year-old girl complains of getting ‘out of breath’ faster than the other students in her class. She has no other complains. On examination a continuous murmur was heard below the left clavicle. A thrill (vibration) was also felt in the same area. Other findings were normal.
    - ❖ ECG indicates a moderate degree if left ventricular hypertrophy
    - ❖ Chest X-ray revealed a slight ventricular enlargement. Slight prominence in the pulmonary artery.
    - ❖ Cardio angiography was performed and presence of patent ductus arteriosus was confirmed.

    a. Briefly explain what is ductus arteriosus
    b. What caused the murmur and the left ventricular enlargement?
    c. Over time, the blood started shunting from right to left. What is this clinical scenario

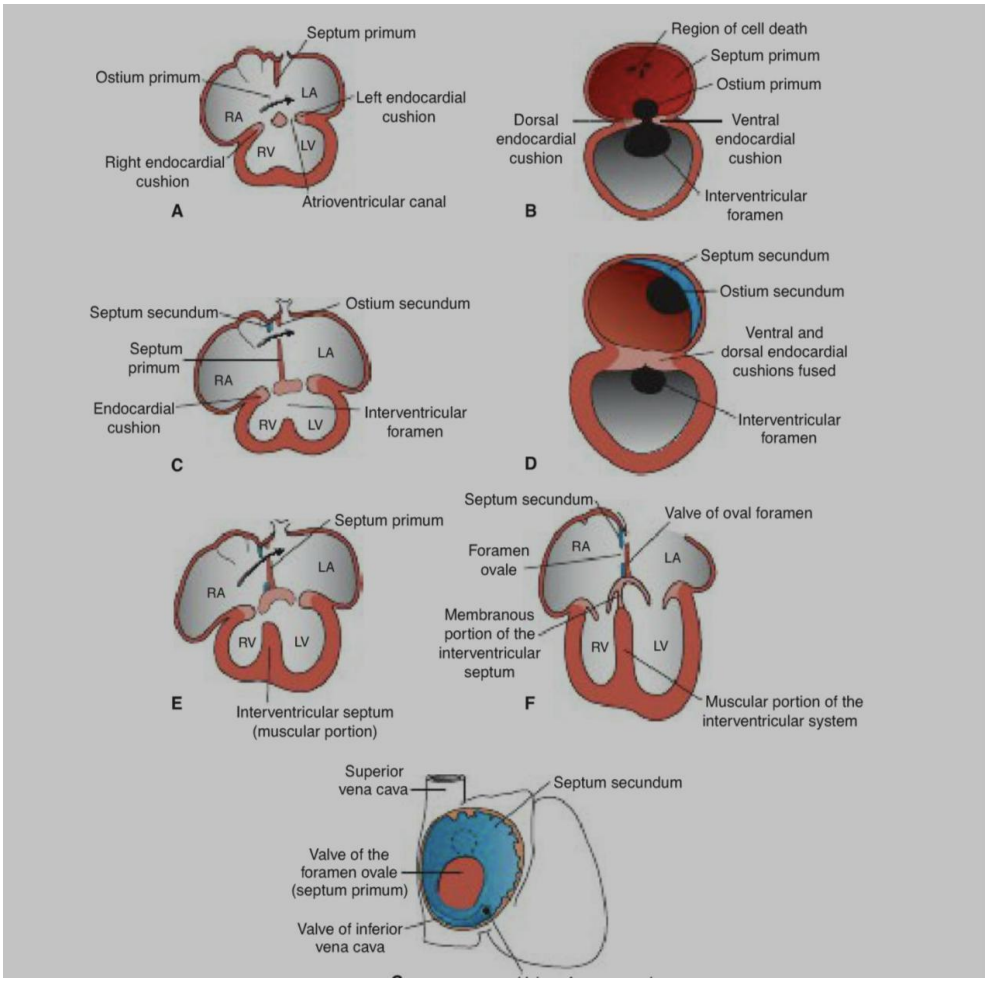
1. **Draw a labelled diagram of a heart tube and outline the fate of each part of the heart tube.**



- Fate of each of the parts is as below
- Sinus venosus - smooth part of right atrium / coronary sinus / oblique vein of the left atrium
- Primitive atrium - trabeculated part of right atrium / trabeculated part of left atrium
- Primitive ventricle - trabeculated part of left ventricle
- Bulbus cordis
- proximal 1/3rd --> trabeculated part of right ventricle
- mid portion (conus cordis) --> outflow tract of both ventricles
- distal 1/3rd (truncus arteriosus) --> root and proximal portion of both aorta and pulmonary trunk

2. **Explain the process of the development of the inter-atrial septum**
   - The septum primum, a sickle shaped crest descends from the roof of the common primitive atrium.
   - It divides the atrium into 2 but leaves a lumen, ostium primum at its lower edge.
   - Later ostium primum is obliterated by the fusion of septum primum with the endocardial cushion.

- Towards the upper end of this septum, cells undergo apotosis and create ostium secondum.
- Then a new crescent shaped fold appear in the right side of the septum primum, overlapping the ostium secondum, called the septum secondum.
- Septum secondum is always an incomplete septum.
- The opening left by the septum secondum os called the foramen ovale creating a shunt from right to left atrium.
- When the upper part of the septum primum gradually disappears, the remaining part becomes the valve of the foramen ovale.



3. Explain the embryological basis of the following heart defects of a newborn

a. Ostium secundum defect

- This is the commonest reason for the ASD (Atrial septal defect)
- It can be mainly due to 2 reasons

- Excessive cell death and resorption of the septum primum
- Inadequate development of the septum secundum.
- Because of any of these reasons, the obliteration of the foramen ovale at birth fails resulting ostium secundum defect.

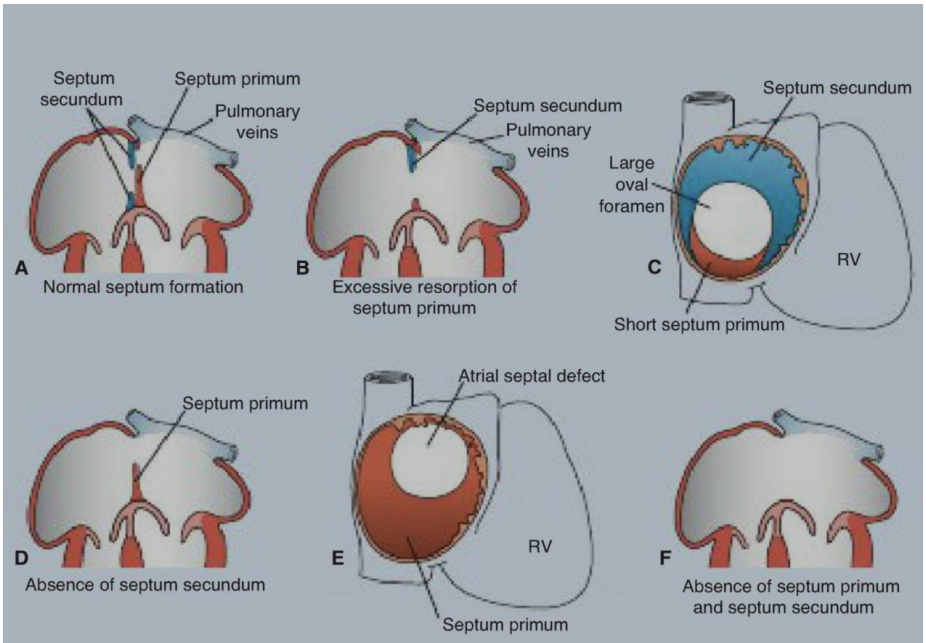


FIGURE 13.23 **A.** Normal atrial septum formation. **B,C.** Ostium secundum defect caused by excessive resorption of the septum primum. **D,E.** Similar defect caused by failure of development of the septum secundum. **F.** Common atrium, or cor triloculare biventriculare, resulting from complete failure of the septum primum and septum secundum to form. *RV*, right ventricle.

b. Ostium primum defect

- This is the 2nd commonest cause for ASD
- It is due to defect in the endocardial cushion
- This commonly associated with tricuspid valve defects

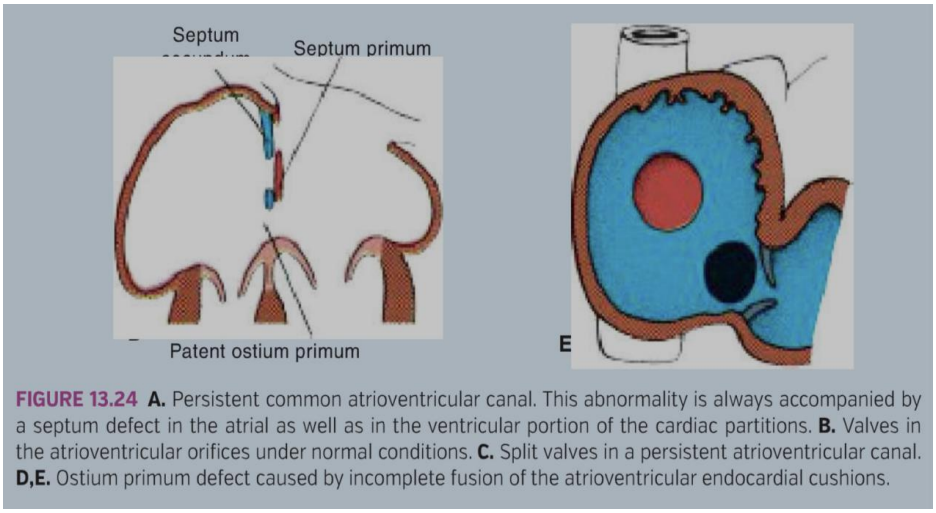
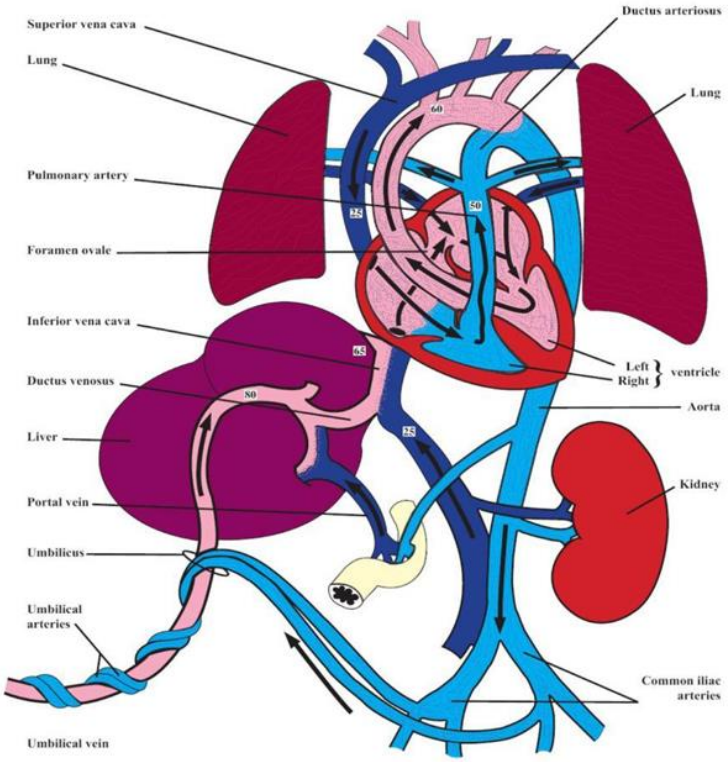


FIGURE 13.24 **A.** Persistent common atrioventricular canal. This abnormality is always accompanied by a septum defect in the atrial as well as in the ventricular portion of the cardiac partitions. **B.** Valves in the atrioventricular orifices under normal conditions. **C.** Split valves in a persistent atrioventricular canal. **D,E.** Ostium primum defect caused by incomplete fusion of the atrioventricular endocardial cushions.

4. **What is embryological basis of Tetralogy of Fallot and list the cardiovascular alterations found in this condition.**
    - Most frequently this is due to an abnormality in the conotruncal region
    - This is due to an unequal division of the conus resulting from anterior displacement of the conotruncal septum.
    - Cardiovascular alterations
    - Pulmonary infundibular stenosis
    - Large defect in inter-ventricular septum
    - An overriding aorta that arises directly above the septal defect.
    - Hypertrophy of the right ventricular wall

5. **Briefly explain the**
    a. **fetal circulation**
    - Fetal circulation is an arrangement with major adaptations to ensure good oxygenation of fetal blood and perfusion of the vital organs of the fetus.
    - The main organ which oxygenates the fetal blood is placenta.
    - About 80% O2 saturated blood returns to the fetus via the umbilical vein.
    - That blood 1st approaches the liver and short circuit the liver using ductus venosus.
    - Ductus venosus directly opens into the IVC (inferior vena cava)



The fetal circulation

- While in the IVC the oxygenated blood mixes with the deoxygenated blood coming from the limbs.
- Then blood enters the right atrium.
- This blood from inferior vena cava is mainly directed to the left atrium via foramen ovale.
- But a small amount remains in the right atrium and get mixed with desaturated blood returning from the head and upper limbs, via the superior vena cava (SVC). This blood enters the right ventricle and then into the pulmonary artery.
- This blood in the left atrium mixes with a small amount of desaturated blood returning from the lungs.
- This blood then enters into the left ventricle and then into the ascending aorta.
- As the coronary arteries and the carotid arteries are the 1st branches of the ascending aorta, the heart and brain are supplied with well oxygenated blood.
- The blood which entered the pulmonary trunk is mainly shunted into the descending aorta via the ductus arteriosus due to very high resistance in the pulmonary vasculature.
- This desaturated blood then mixes with the blood coming from the proximal aorta.
- After coursing through the descending aorta, blood flow as into the placenta for by way of 2 umbilical arteries. Oxygen saturation in umbilical arteries is approximately 58%.

b. the changes in the fetal circulation at birth.

- The changes in the vascular system at birth are caused by cessation of the placental blood flow and the beginning of respiration.
- The main changes that occur are as follows
- Closure of the umbilical arteries
- Closure of the umbilical vein and ductus venosus
- Closure of the ductus arteriosus
- Closure of foramen ovale
- Closure of the umbilical arteries
    - Functionally these arteries close a few minutes after birth by smooth muscle contraction.
    - But actual fibrous obliteration of the lumenin its distal part occurs after 2 -3 months. This is then known as the medial umbilical ligament.
    - The proximal portion remains open as the superior vesical arteries.

- Closure of the umbilical vein and ductus venosus
  - With the cessation of the blood supply from the placenta, the umbilical veins obliterate and turns into ligamentum teres hepatis in the lower margin of the falciform ligament.
  - The ductus venosus obliterate and forms the ligamentum venosum.
- Closure of the ductus arteriosus
  - Functional closure happens by musclular contraction during the initial inflation of the lungs.
  - Complete obliteratioin of the lumen takes 1-3 months and forms the ligamentum arteriosum.
- Closure of foramen ovale
  - This happens with the increased pressure in the left atrium (due to increased pulmonary circulation. And the decreased pressure in the right atrium. (due to reduced blood flow from placenta)
  - The septum primum presses against the septum secondum and closes foramen ovale.

6. A 13-year-old girl complains of getting 'out of breath' faster than the other students in her class. She has no other complains. On examination a continuous murmur was heard below the left clavicle. A thrill (vibration) was also felt in the same area. Other findings were normal.

- ❖ **ECG indicates a moderate degree if left ventricular hypertrophy**
- ❖ **Chest X-ray revealed a slight ventricular enlargement. Slight prominence in the pulmonary artery.**
- ❖ **Cardio angiography was performed and presence of patent ductus arteriosus was confirmed.**

a. Briefly explain what is ductus arteriosus

- Ductus arteriosus is an embryological vessel.
- It connects the left branch of the pulmonary trunk to the aorta, distal to the origin of the three branches of the aortic arch.
- In fetal circulation this pathway is used to short circuit the blood flow through the airless lungs.

- The deoxygenated which is sent to the pulmonary trunk from the right ventricle is thus passed distally along the aorta.
- After both, the ductus arteriosus is closed by the muscular contraction of its muscular wall.
- It persists as a fibrous band; ligamentum arteriosum.
- When this closure of this vessel is failed, it is named patent ductus arteriosus.

b. What caused the murmur and the left ventricular enlargement?

- Murmur is an abnormal heart sound heard which is produced due to turbulence of the blood.
- This turbulence is produced when blood is flowing from the patent ductus artriosus from the aorta to the left branch of the pulmonary trunk. (left to right shunt)
- Therefore, we can hear this murmur below the left clavicle which is close to the location of PDA.
- Since the pressure inside the aorta is higher during both systole and diastole, blood continuously flows across the PDA.
- This results a continuous murmur.
- Since there is a left to right shunt, the blood returning to the left atrium and then into the left ventricle increases.
- As a result, the workload on the left ventricle increases
- This results hypertrophy of the left ventricle.

c. Over time, the blood started shunting from right to left. What is this clinical scenario

- This phenomenon is called Eisenmenger syndrome.
- If the PDA remains open for an extended period, the increased blood flow to the pulmonary circulation can lead to pulmonary hypertension.
- This pulmonary hypertension can cause irreversible damage and remodeling of the pulmonary vessels.
- Overtime the pulmonary vascular resistance increases resulting the pulmonary blood pressure to surpass the systemic blood pressure.
- When this happens, the shunt reverses its direction of blood flow from right to left.
- This is called Eisenmenger syndrome.

Q7.

Anatomy of the heart and mediastinum

1. Describe the coronary circulation.
2. Outline the structures in the mediastinum
3. Draw a cross section at the level of the sternal angle level

1. Describe the coronary circulation.

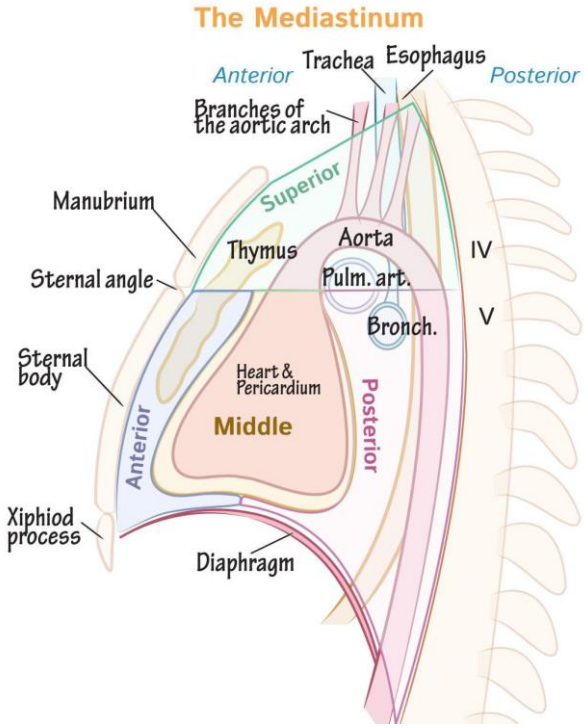
- The heart is supplied by two main coronary arteries: the right coronary artery (RCA) and the left coronary artery (LCA).
- Right Coronary Artery (RCA):
- Origin:
  - The RCA, which is smaller, originates from the anterior aortic sinus at the root of the ascending aorta.
- Course:
  - It passes forward, emerging between the pulmonary trunk/infundibulum and the right auricle.
  - It then descends in the right anterior atrioventricular (AV) sulcus, reaching the junction between the right and inferior borders of the heart.
  - After winding around the inferior border, it enters the diaphragmatic surface and runs in the right posterior AV groove, moving backward and to the left.
  - Before reaching the posterior interventricular groove, it gives off the right marginal artery.
  - In the posterior interventricular groove, it gives off the posterior interventricular artery.
  - The RCA terminates by anastomosing with the circumflex branch of the left coronary artery.
- Branches:
    - SA nodal artery
    - Right atrial branches
    - Conus branches
    - Right marginal artery
    - AV nodal artery
    - Posterior interventricular artery
- Areas Supplied:
    - Right atrium
    - Most of the right ventricle
    - Part of the left ventricle near the posterior interventricular groove
    - Posterior part of the interventricular septum
    - The entire conduction system, except for part of the left branch of the AV bundle

- Left Coronary Artery (LCA):
- Origin:
  - The LCA, which is larger, arises from the left posterior aortic sinus.
- Course:
  - It passes forward and to the left, emerging between the pulmonary trunk and the left auricle.
  - It gives off the left atrial and conus branches.
  - The LCA then divides into two major branches:
  - The anterior interventricular branch (left anterior descending artery or LAD), which runs in the anterior interventricular groove toward the apex of the heart and anastomoses with the posterior interventricular artery.
  - The circumflex artery, which runs in the left anterior AV groove, winding around the left border of the heart and continuing in the left posterior AV groove. It gives off the diagonal artery before anastomosing with the terminal branches of the RCA.
- Branches:
    - Left atrial artery
    - Conus artery
    - Anterior interventricular artery (LAD)
    - Circumflex artery
    - Diagonal artery
- Areas Supplied:
    - Left atrium
    - Most of the left ventricle
    - A small area of the right ventricle near the anterior interventricular groove
    - Part of the left branch of the AV bundle
    - Anterior part of the interventricular septum
- Venous Drainage:
  - The heart's venous drainage is mainly carried out by veins that accompany the coronary arteries and drain into the right atrium.
- Coronary Sinus:
  - The largest vein of the heart, the coronary sinus.

- Most veins of the heart first drain into the coronary sinus, which then empties into the posterior wall of the right atrium, between the opening of the inferior vena cava (IVC) and the right AV orifice.
- A valve guards the coronary sinus opening.
- following veins drain into the coronary sinus.

- Great Cardiac Vein: Accompanies the anterior interventricular artery and the circumflex branch of the LCA, opening into the left end of the coronary sinus.
- Middle Cardiac Vein: Accompanies the posterior interventricular artery, draining into the middle of the coronary sinus.
- Right Marginal Vein: Accompanies the marginal artery of the RCA, draining either into the small cardiac vein or directly into the right atrium.
- Oblique Vein of the Left Atrium: Opens into the left end of the coronary sinus.
- Posterior Vein of the Left Ventricle: Opens into the middle of the coronary sinus.
- Venae Cordis Minimae: These small and numerous veins are present in all four chambers of the heart and drain directly into the heart's cavities.
- Anterior cardiac veins: These veins drain directly into the right atrium.

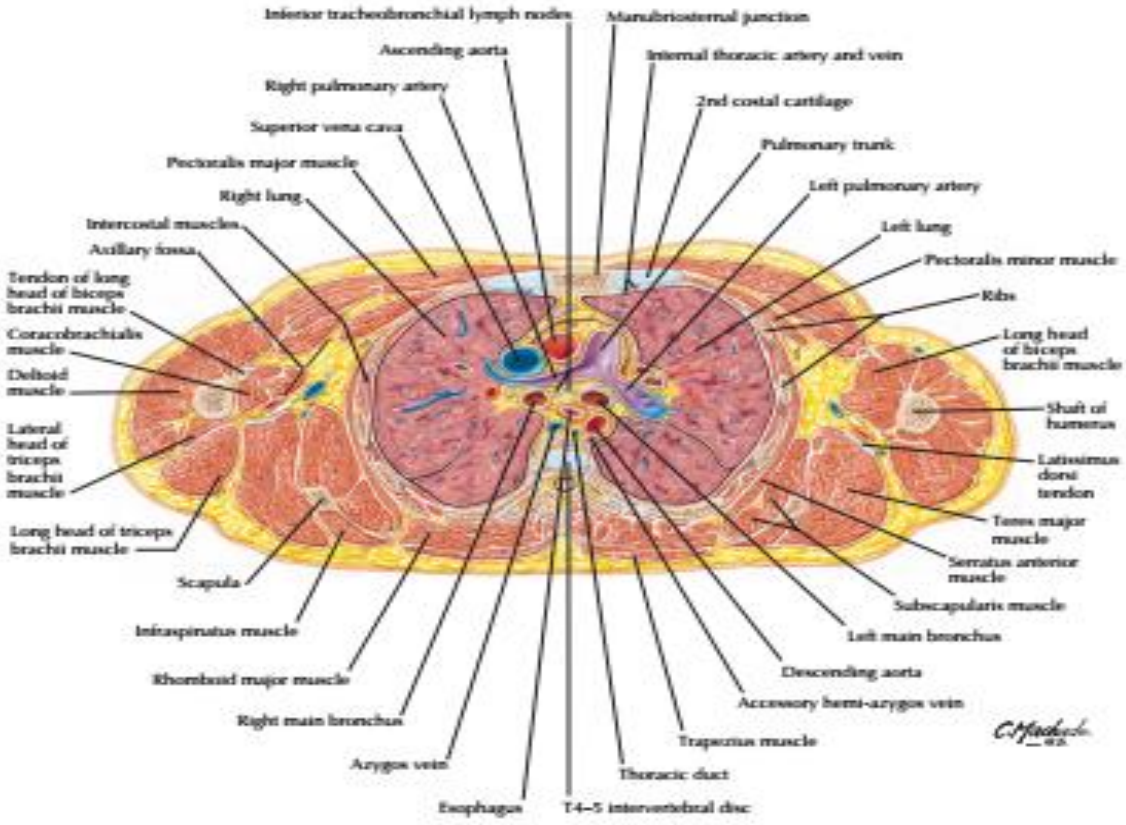
2. Outline the structures in the mediastinum



- Mediastinum is the broad mid-line septum which extends from the vertebral column behind to the sternum in front, between the 2 mediastinal pleura.
- Mediastinum ca be subdivided into superior and inferior mediastinum at the sternal angle level (T3/T4 level)
- The inferior mediastinum can be further divided into 3 parts as follows
  - Anterior
  - Middle
  - Posterior
- Contents of the mediastinum is as follows
- Superior mediastinum -
  - bordered by the thoracic outlet superiorly, sternal angle level inferiorly, medial border of the pleural sac laterally, dorsal surface of the sternum anteriorly and ventral surface of the T1 vertebral bodies posteriorly.
  - Brachiocephalic vein
  - Arch of aorta and its branches; brachiocephalic trunk, left common carotid artery, left subclavian artery
  - Pulmonary arteries
  - Ligamentum arteriosum
  - Thoracic part of the trachea
  - Oesophagus
  - Thoracic duct
  - Phrenic nerve
  - Vagus nerve and left recurrent laryngeal nerve
  - Sympathetic trunk
- Inferior mediastinum -
  - Bordered by the sternal angle level superiorly, diaphragm inferiorly, pleural sacs laterally, body of the sternum anteriorly, vertebral column posteriorly.
- Anterior mediastinum -
  - Bordered by the pericardium posteriorly, the sternum, transversus thoracic muscle, 5th 6th 7th left costal cartilages anteriorly.
  - Thymus
  - Sterno-pericardial ligament
  - Inferior para-thyroidal gland

- Middle mediastinum -
  - Bordered by the pericarial sac anteriorly and posteriorly,
  - Pericardium
  - Heart
  - SVC, IVC, Pulmonary veins
  - Ascending aorta & pulmonary trunk
  - Superficial and deep cardiac plexus
  - Bronchi
  - Phrenic nerve and pericardiophrenic vessels
- Posterior mediastinum
  - Bordered by the pericardium anteriorly, vertebral bodies of T5-T12 thoracic vertebrae.
  - Oesophagus
  - Thoracic duct
  - Vagus nerve
  - Sympathetic trunk
  - Oesophageal plexus
  - Pulmonary plexus
  - Descending aorta
  - Azygous system

3. Draw a cross section at the level of the sternal angle level



Q8.

Applied anatomy and valvular defects of the heart

1. Surface mark the following
    a. Pulmonary orifice
    b. Aotic orifice
    c. Mitral valve
    d. Tricuspid valve
    e. Coronary sulcus
2. Enumerate the auscultatory areas
3. Briefly explain about the murmurs heard in following conditions
    a. Mitral regurgitation
    b. Mitral stenosis

c. Aortic regurgitation
d. Aortic stenosis
e. Patent ductus arteriosus

4. A 68-year-old male with a history of hypertension and hyperlipidemia presents to the emergency department with acute onset chest pain radiating to the left arm and shortness of breath. He was diagnosed with a ST segment elevation myocardial infarction (STEMI) and was promptly taken for primary cutaneous coronary intervention (PCI).
   Despite successful treatment, the patient continued to experience shortness of breath, orthopnea, and fatigue over the next few days. On physical examination he had a new pan-systolic murmur best heard at the apex, radiating to the axilla.

   a. What is the responsible valvular defect for the newly developed murmur?
   b. Explain the anatomical basis for developing the above mentioned valvular defect following a myocardial infarction?

5. A 66-year-old woman with a history of rheumatic heart disease presents to the clinic with dysphagia, particularly for solid foods. On examination, she had a diastolic murmur best heard at the apex. Chest X-ray revealed a enlarged left atrium.

   a. Explain the anatomical relation of this woman to develop dysphagia as a complication of her heart condition.

1. **Surface mark the following**
    a. **Pulmonary orifice**

       Posterior to the sternal end of the 3rd left costal margin

    b. **Aortic orifice**

       Posterior to the left sternal margin at the level of 3rd intercostal space.

    c. **Mitral valve**

       Posterior to the left half of the sternum at the level of 4th costal cartilage.

    d. **Tricuspid valve**

       Posterior to the midline of the sternum at the level of 4th intercostal space.

    e. **Coronary sulcus**

       It is an oblique line joining the sternal ends of the 3rd left and 6th right costal cartilages.

2. **Enumerate the auscultatory areas**

Auscultatory area of

- Pulmonary valve --> left 2nd intercostal space, close to the sternal margin.
- Aortic valve --> right 2nd intercostal space, close to the sternal margin
- Mitral valve --> left 5th intercostal space, in mid clavicular line.
- Tricuspid valve -->left 5th intercostal space, close to the sternal margin.

3. **Briefly explain about the murmurs heard in following conditions**
    a. **Mitral regurgitation**
        - Pan systolic murmur
        - Best heard in the apex
        - Radiate to the axilla

    b. **Mitral stenosis**
        - Mid diastolic murmur
        - Best heard at the apex in the left lateral position in expiration

    c. **Aortic regurgitation**
        - Early diastolic murmur
        - Best heard at the left lower sternal edge in the seated and leaning forward position

    d. **Aortic stenosis**
        - Ejection systolic murmur

- Best heard at the upper right sternal edge.
- It can radiate to the neck.

e. Patent ductus arteriosus

- Continuous murmur (machinery)
- Best heard below the left clavicle.

4. A 68-year-old male with a history of hypertension and hyperlipidemia presents to the emergency department with acute onset chest pain radiating to the left arm and shortness of breath. He was diagnosed with a ST segment elevation myocardial infarction (STEMI) and was promptly taken for primary cutaneous coronary intervention (PCI).
Despite successful treatment, the patient continued to experience shortness of breath, orthopnea, and fatigue over the next few days. On physical examination he had a new pan-systolic murmur best heard at the apex, radiating to the axilla.

a. What is the responsible valvular defect for the newly developed murmur?

Mitral regurgitation

b. Explain the anatomical basis for developing the above-mentioned valvular defect following a myocardial infarction?

- Mitral regurgitation is considered to be a complication of myocardial infarction.
- Here the valves become incompetent to remain closed during ventricular systole.
- This can be due various reasons
- Papillary muscle dysfunction; ischemia and infarction of papillary muscles in the left ventricles can lead to dysfunction or rupture of the papillary muscles leading to failure in mitral valve closure.
- Chordae tendinae rupture; structural damage from the infarction can lead to chordal rupture, resulting in failure in mitral valve closure.
- Left ventricular remodeling; this is a chronic complication of myocardial infarction. This can lead to left ventricular dilatation, resulting annular dilatation. this results failure in mitral valve closure.

5. A 66-year-old woman with a history of rheumatic heart disease presents to the clinic with dysphagia, particularly for solid foods. On examination, she had a diastolic murmur best heard at the apex. Chest X-ray revealed a enlarged left atrium.

a. Explain the anatomical relation of this woman to develop dysphagia as a complication of her heart condition.

- Diastolic murmurs best heard at the apex with the enlarged left atrium suggests that this patient is suffering from mitral stenosis.
- When there is severe mitral stenosis, the left ventricular filling is impaired. And the pressure in left atrium increases.
- As a result, overtime, the left atrium dilates.
- This dilated left atrium can compress the oesophagus which is found in the posterior mediastinum and posteriorly related to the left atrium.
- This compression on the oesophagus results difficulty in swallowing; dysphagia.

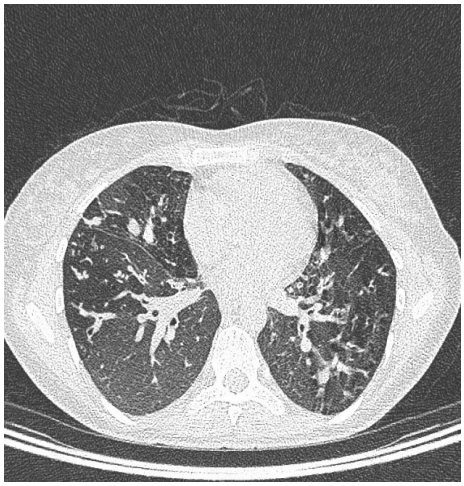
Q9.

Radiological Surface Anatomy of the Respiratory System with Clinical Correlations.

1. Identify the following imaging modalities.



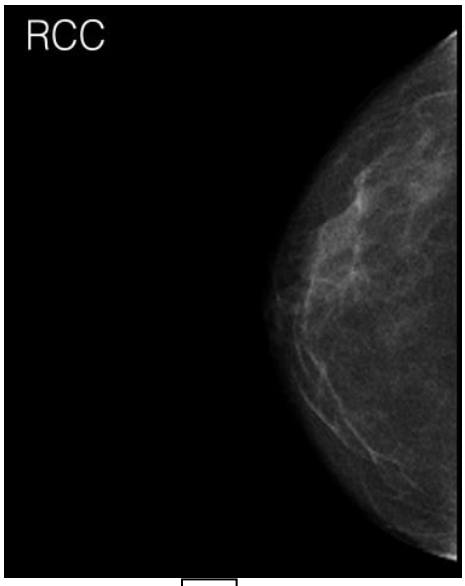
A



B



C



D

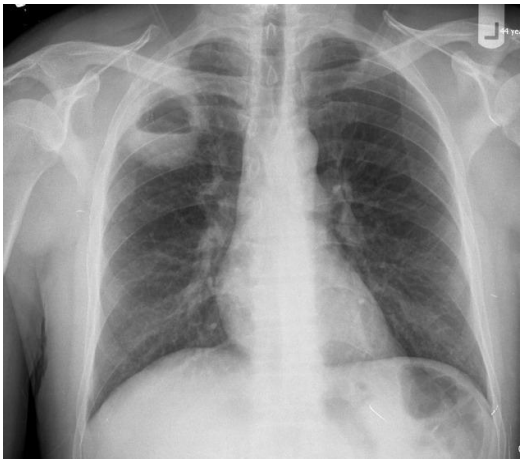
2. What are the different projections of a chest x-ray?
3. In a PA chest X-ray,
    a. What are the components seen in the right heart border and the left heart border?
    b. How do you identify cardiomegaly?
    c. How do you differentiate right-sided lower lobe pneumonia from middle lobe pneumonia?
    d. Identify the pathologies seen in the following chest X-rays



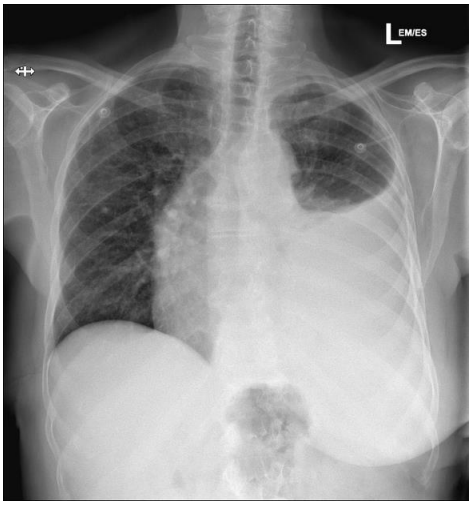
A



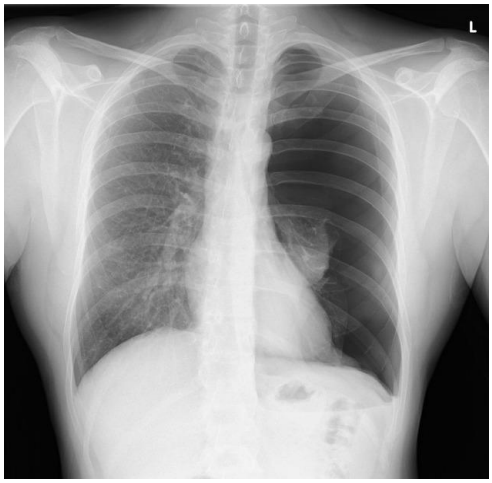
B



C



D



F

a. What are the 2 views a Mammogram is taken?
b. Name one group of individuals in which mammogram is contraindicated.
c. What are the Features of a malignant breast lesion in a mammogram?
d. Why are mammograms more sensitive in the elderly population compared to the young population in the detection of Malignant Breast cancers?

1. **Identify the following imaging modalities.**

    A. X ray

    B. HRCT

    C. CTPA

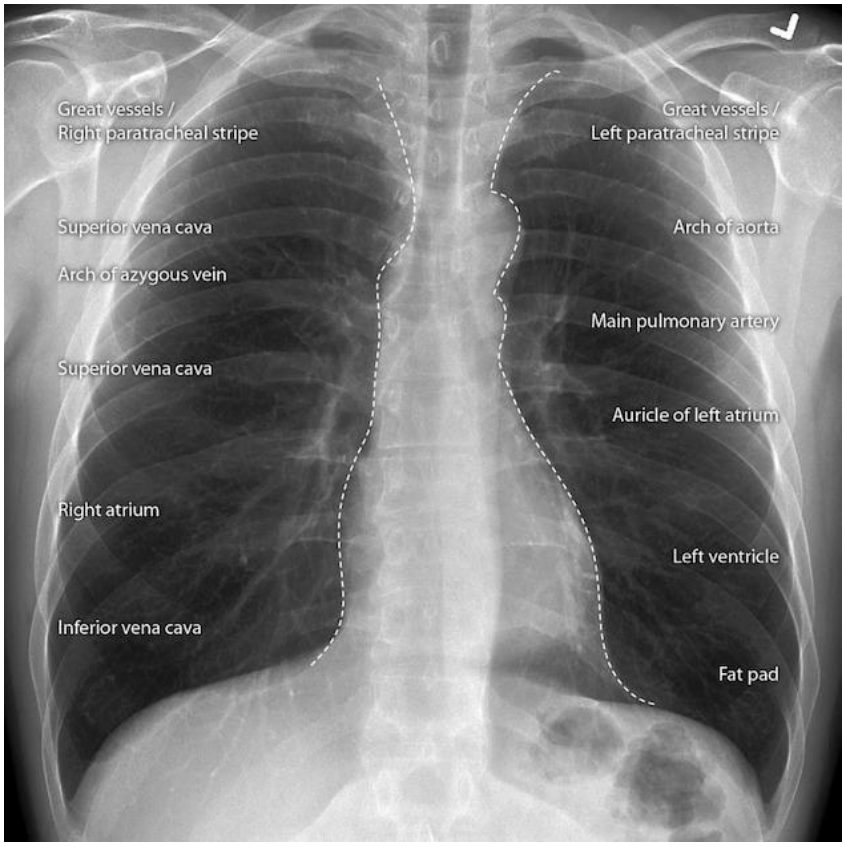
    D. Mammogram

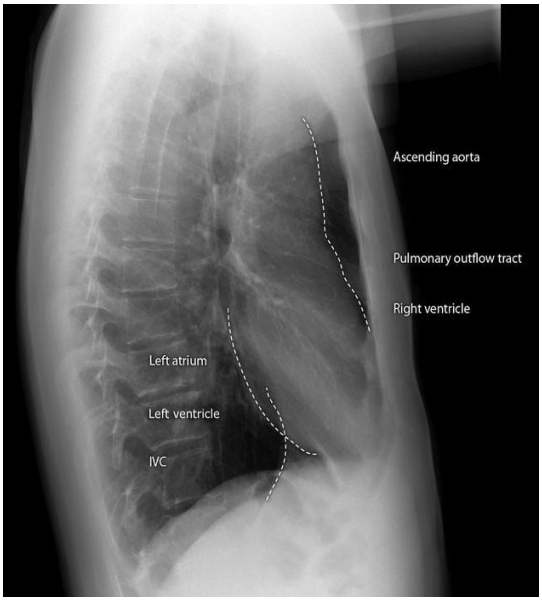
2. **What are the different projections of a chest x-ray?**

- Mainly: AP, PA, Lateral.
- Additionally: Lateral decubitus, Expiration view, lordotic view, prone view, etc.

3.

a. In a PA chest X-ray,What are the components seen in the right heart border and the left heart border?



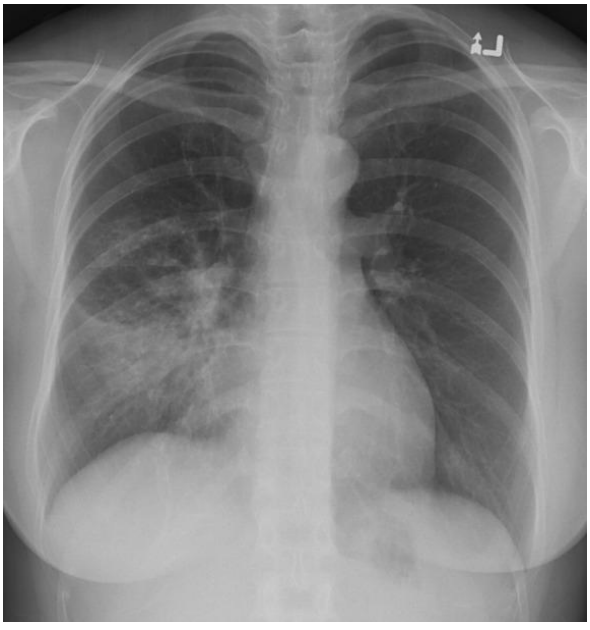


b. How do you identify cardiomegaly?

Cardiomegaly means enlargement of the heart. The definition is when the transverse diameter of the cardiac silhouette is greater than or equal to 50% of the transverse diameter of the chest (increased cardiothoracic ratio) on a posterior-anterior projection of a chest radiograph or a computed tomography.

c. How do you differentiate right-sided lower lobe pneumonia from middle lobe pneumonia?

In right Middle lobe Pneumonia right margin of the right heart border is obscured.



In right Lower lobe pneumonia, the diaphragmatic margin is obscured.



d. Identify the pathologies seen in the following chest X-rays

A: Right Middle Lobe Pneumonia/Lobar Pneumonia

B: Atypical Pneumonia

C:Abscess

D: Pleural Effusion

E: Pneumothorax

4.

a. What are the 2 views a Mammogram is taken?

CC (cranio caudal) and MLO (medio lateral oblique)

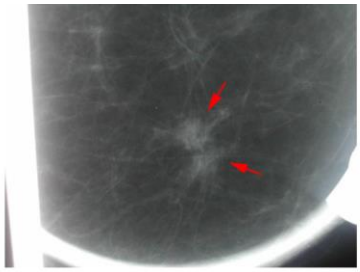
b. Name one group of individuals in which mammogram is contraindicated.

Pregnant individuals

c. What are the Features of a malignant breast lesion in a mammogram?

- There are two general categories of mammographic findings suggestive of a breast cancer: soft tissue mass or asymmetry and suspicious microcalcifications.

The most specific mammographic feature of malignancy is a spiculated soft tissue mass nearly 90 percent of these lesions represent invasive cancer.



Spot magnification view of a mammogram showing 2 small adjacent interconnected spiculated masses (red arrows). Pathology revealed tubular carcinoma. Tubular carcinoma characteristically appears spiculated on mammogram and is often associated with satellite lesions.

FOR YOUR INTEREST…

Specific patterns of calcifications are associated with different likelihoods of underlying malignancy:

●Linear branching microcalcifications are most commonly associated with the comedo histologic subtype and have a higher predictive probability for malignancy when compared with coarse, heterogeneous (ie, nonlinear irregular calcifications of varying size and shape) microcalcifications. This pattern is usually associated with high-grade ductal carcinoma in situ (DCIS).

●Grouped coarse heterogeneous calcifications have a likelihood of malignancy of just under 15 percent, while amorphous calcifications have a likelihood of malignancy of 20 percent. Both would be assessed as BI-RADS 4B

●Grouped round and punctate calcifications at baseline have a probability of malignancy of less than 2 percent

●Calcifications that are not suspicious for malignancy and considered benign include vascular and skin calcifications, rim calcifications, large and coarse calcifications, and smooth round or oval calcifications

d. Why are mammograms more sensitive in the elderly population compared to the young population in the detection of Malignant Breast cancers?

- The sensitivity of mammography is the percentage of women with breast cancers detected by mammographic screening. Sensitivity depends on tumor size, conspicuity, hormone sensitivity, breast tissue density, patient age, timing within the menstrual

cycle, overall image quality, and interpretive skill of the radiologist. Overall sensitivity is approximately 79% but is lower in younger women and in those with dense breast tissue

- Dense breasts may obscure the detection of small masses on mammography, thereby reducing the sensitivity of mammography.For women of all ages, high breast density is associated with 10% to 29% lower sensitivity
- Dense breast tissue is not abnormal. Breast density describes the proportion of dense versus fatty tissue in a mammographic image.[62] The American College of Radiology's BI-RADS classifies breast density as follows:
    - Almost entirely fatty.
    - Scattered fibroglandular densities.
    - Heterogeneously dense.
    - Extremely dense.
    - The latter two categories are considered dense breast tissue

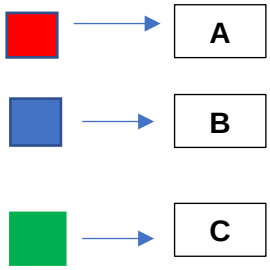
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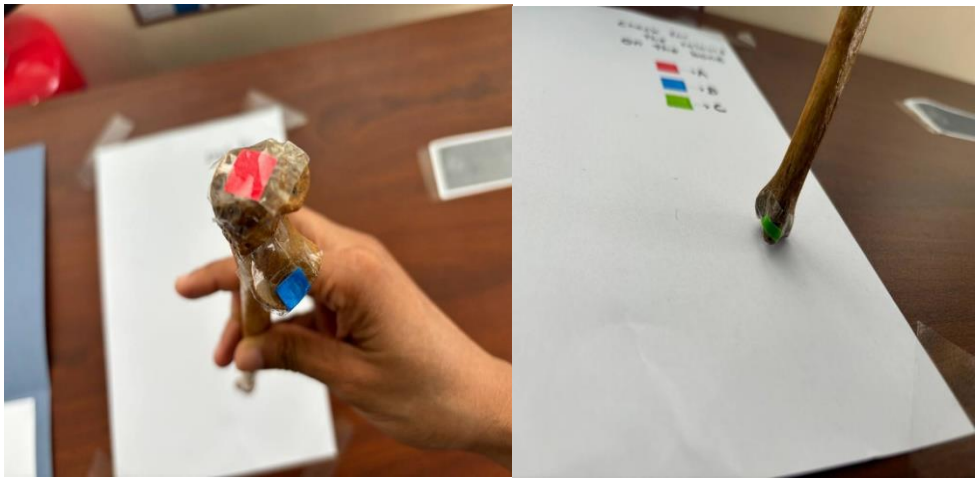
Q1

A. **Identify the given bone**

B. **Name the areas given A, B, C**

Check for the colors on the bone





Q2

A. What is the abnormality detected in the given X-ray?



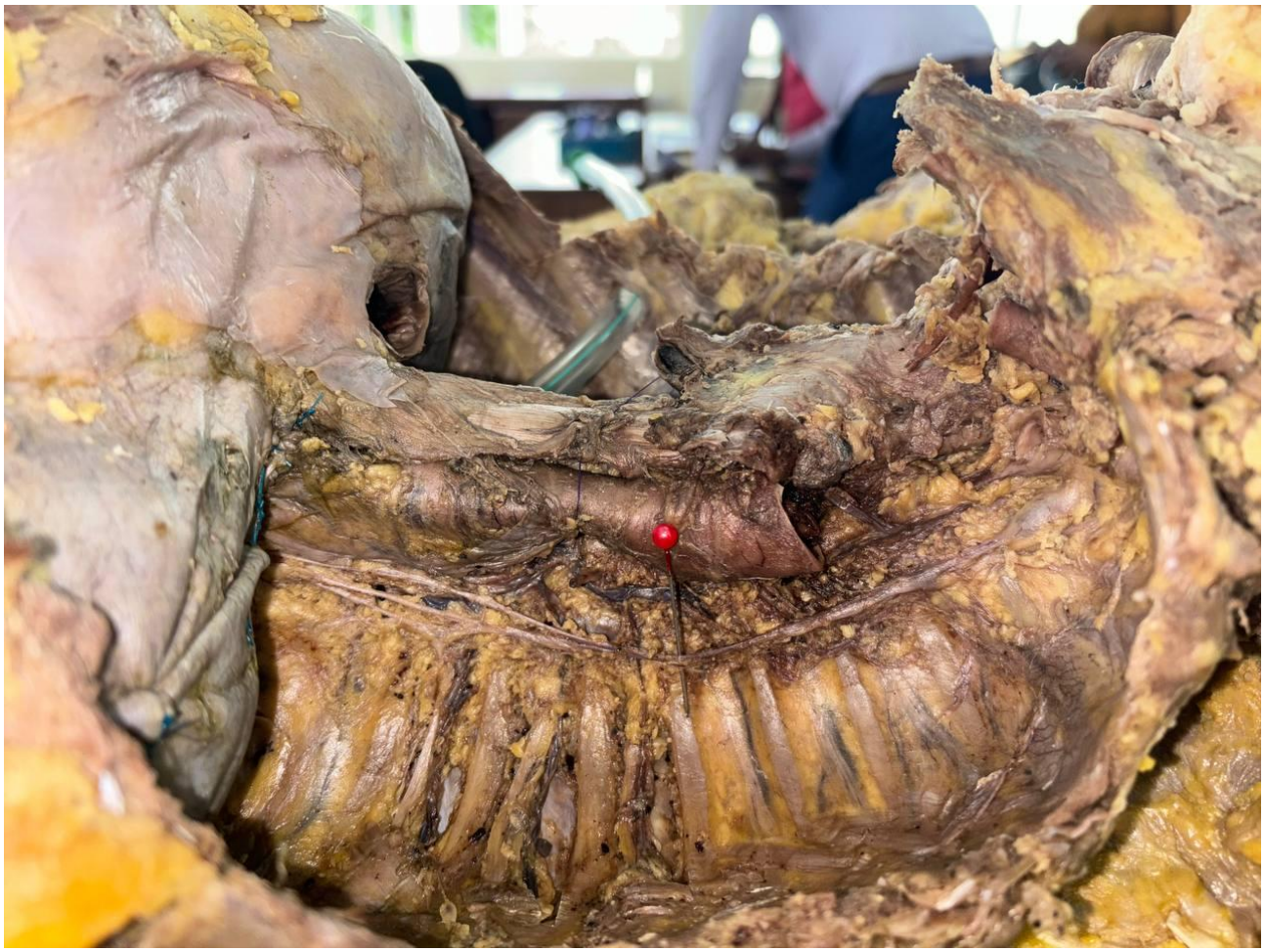
B. This patient is treated with a dynamic splint to reduce the deformity and the disability. What is the most likely deformity and disability in this patient



Q3

A. **Name the structure lying on the red pin.**

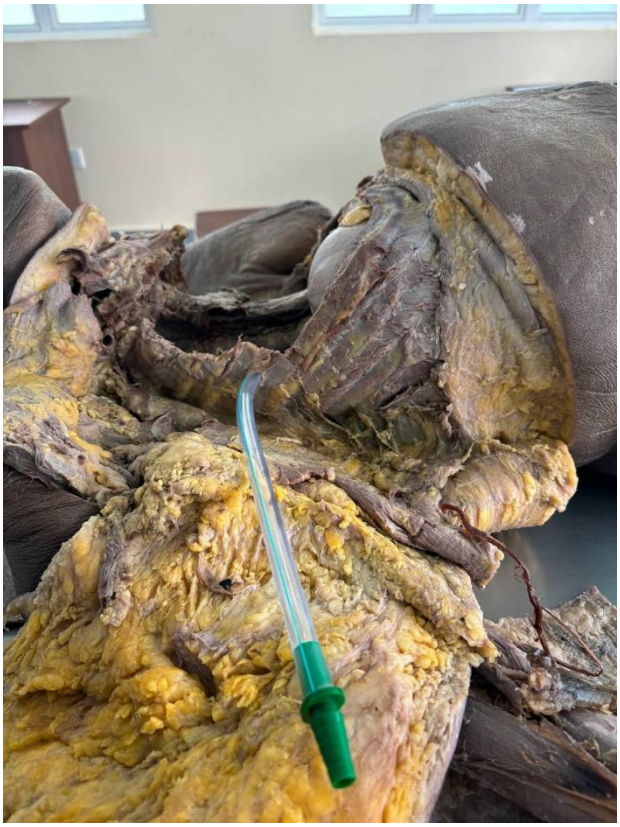
B. **Posterior to which ligament does the above structure travel to enter into the abdomen?**



Q4

Here an intercostal tube (IC tube) is inserted to the cadaver.

A. **Name 02 neural structures which are spared from damage, by inserting the tube at this safe triangle.**



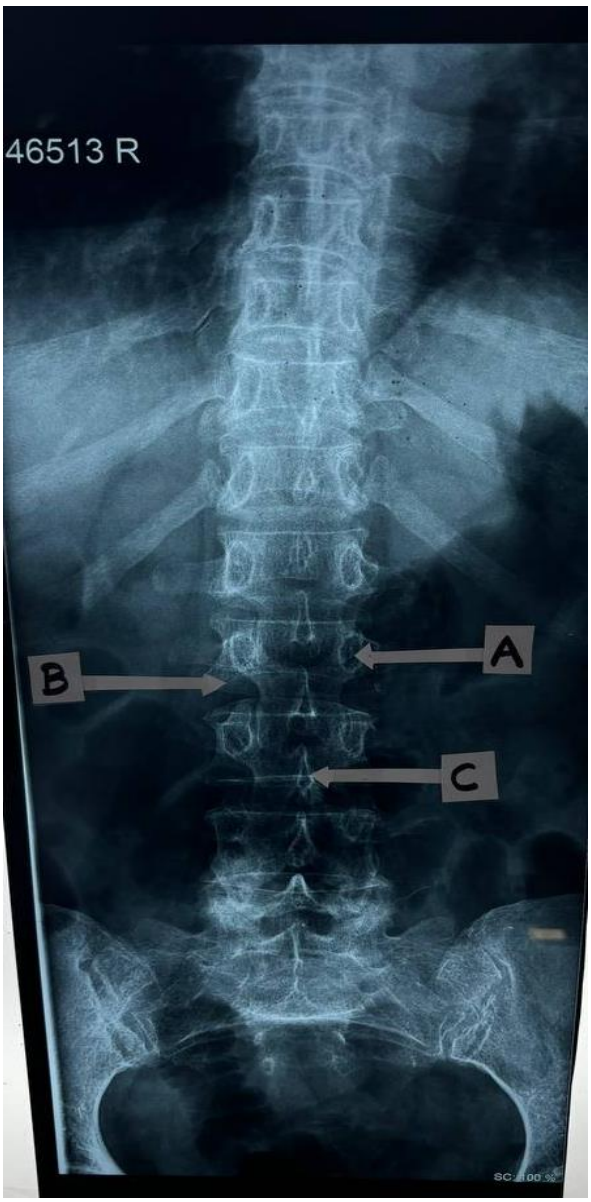


Q5

A. Identify the area colored in green in the given vertebra

B. In the X ray out of A,B,C what is corresponding to the answer given in A?

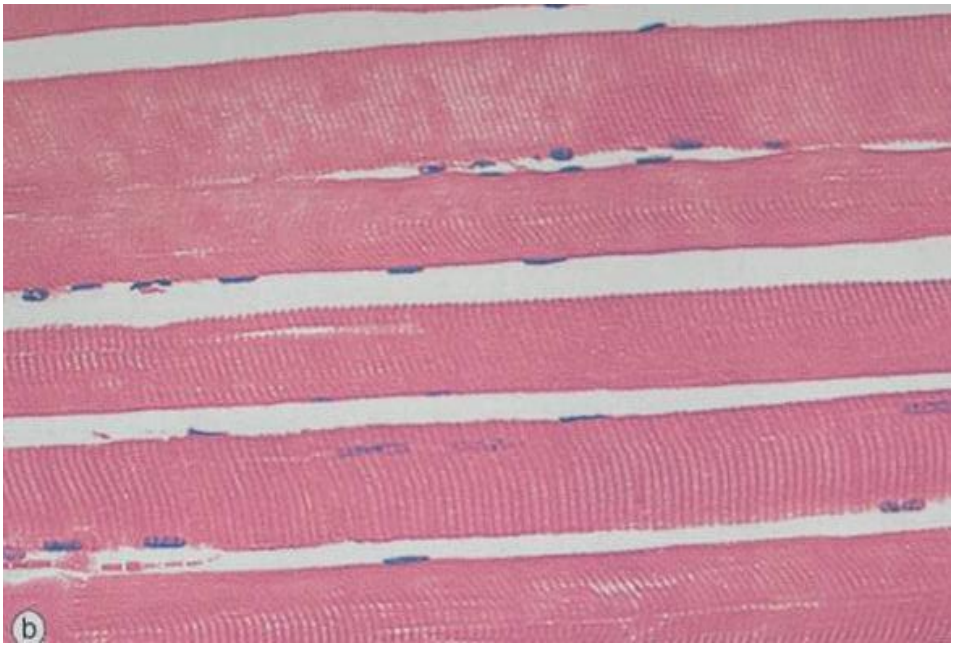




Q6

A. **Identify the type of muscle in the given image.**

B. **Write 3 characteristic features you used to identify the above muscle.**

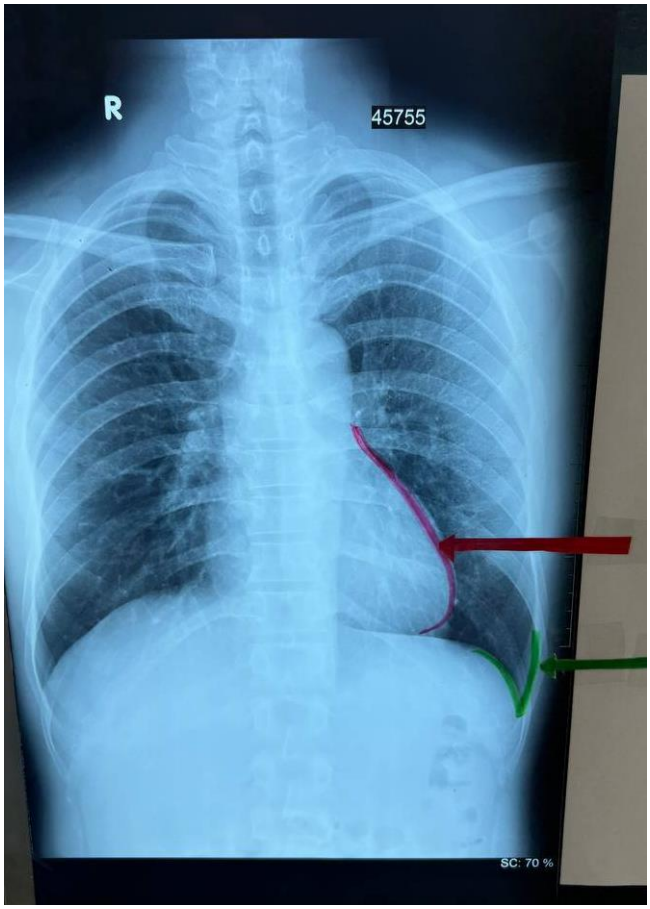


Q7

A. **What anatomical structure makes the heart border colored in red?**

B. **What is marked by green?**

C. **Name 02 clinical conditions where the angle marked in green is obscured/blunted.**



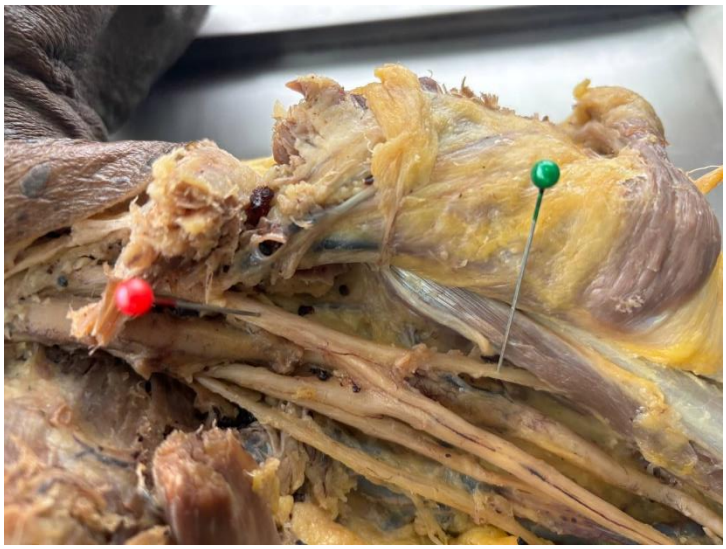
Q8

A. **Name the structure pierced by the red pin.**

B. **Name the structure pierced by the green pin.**

C. **Which movements will be impaired in damage to the structure in B?**



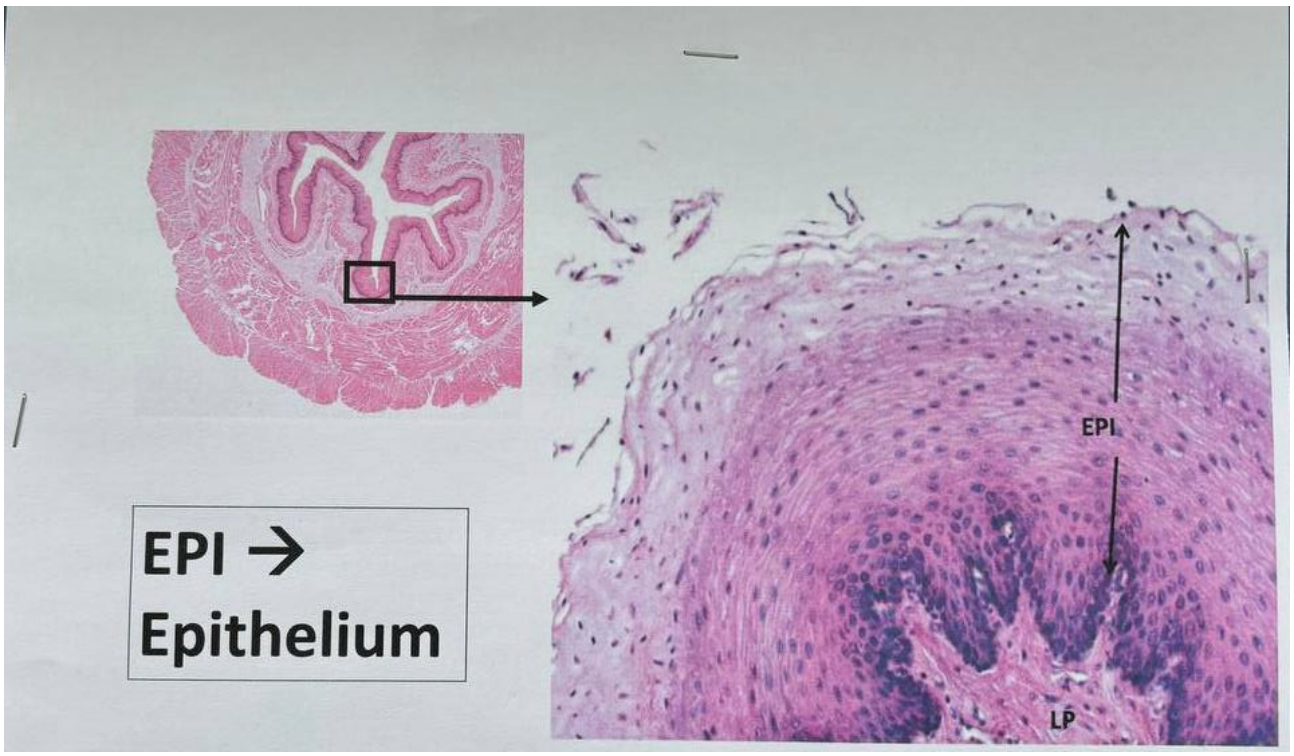


Q9

This is a histological slide of a part of the alimentary tract. Alimentary tract malignancies are common in Sri Lanka.

A. **Identify the given epithelium.**

B. **Write 01 functional advantage of this epithelium to this organ.**



Q10

A. **Name the structure lying on the blue pin.**

B. **Name the branch of the above structure that travels back through the root of the neck.**



Q11

A. **Name the structure pierced by the green pin.**

B. **What is the nerve innervating the above structure.**



Q12

A. **Name the structure lying on the red pin.**

B. **This structure is used to create arterio-venous fistula for dialysis purposes. What is the other vascular structure anastomosed to create the fistula?**



Q13

A. **What is the structure pierced by the red pin?**

B. **Name a common site where the nerve innervating the above structure can get injured.**



Q14

A 64-year-old male with a history of diabetes mellitus presented to the emergency department with tightening type central chest pain. On Examination he was bradycardic.

A. **What is the structure pierced by the yellow pin?**

B. **Briefly explain the anatomical basis for developing bradycardia due to an obstruction of the above mentioned structure.**



Q15

A. **Identify the joint marked A and B.**

B. **What are the movements of the above A and B?**



OSPE Answers

Q1.

A. Ulnar bone
B. A → Olecranon process
   B → Coronoid process
   C → Styloid process

Q2.

A. Mid shaft fracture of the humerus
B. Deformity → Wrist drop
   Disability → Poor grip / weakness in extension of the Wrist and fingers

Q3.

A. Sympathetic trunk
B. Medial arcuate ligament

Q4.

A. Intercostal nerve
   Long thoracic nerve

Q5.

A. Pedicle
B. A

Q6.

A. Skeletal muscle
B. Striated
   Unbranched
   Multinucleated
   Nucleus in the periphery of the cell
   No intercalated discs

Q7.

A. Left ventricle
B. Costophrenic angle / costo-diaphragmatic recess
C. Pleural effusion
   Empyema
   Haemothorax

Q8.

A. Lateral cord of the brachial plexus
B. Musculocutaneous nerve
C. Flexion of the elbow joint
   Supination of the forearm

Q9.

A. Non keratinized Stratified squamous epithelium
B. Withstand chemical and mechanical irritation

Q10.

A. Vagus nerve
B. Recurrent laryngeal nerve

Q11.

A. Pronator quadratus
B. Anterior interosseous nerve (branch of median nerve)

Q12.

A. Bacilic vein
B. Brachial artery

Q13.

A. Adductor pollicis
B. Posterior to the medial epicondyle
In supracondylar fractures
In between the two heads of the flexor carpi ulnaris

Q14.

A. Right coronary artery
B. It supplies the conduction system of the heart mainly the SA node and the AV nide in the majority of the population.

Q15

A. A → pivot joint
B → Saddle joint

B. A → supination and pronation
B → flexion, extension, abduction, adduction

ANATOMY CONTINUOUS ASSESSMENT - 01

Question numbers 01 to 10 are True or False type questions. Mark your answer for each of the 5 responses (A to E).

1. Which of the following is/are True or False regarding morphogenesis?
   A. During organogenesis, all organs develop independently of each other.
   B. Gastrulation is the process by which the blastula rearranges itself to form two layers of cells.
   C. Morphogenesis is the process by which tissues develop their shape and size.
   D. Organogenesis occurs after the formation of the primary germ layers.
   E. The cells in the blastula increase in mass during cleavage.

2. Which of the following is/are True or False regarding the human genome?
   A. Nuclear genome contains 10,000 genes.
   B. Pharmacogenomic variants predict how individuals will respond to certain drugs.
   C. Single nucleotide variants are the commonest.
   D. Somatic genetic variants are transmitted to the next generation.
   E. Twenty percent codes proteins.

3. Which of the following is/are True or False regarding the innervation of the upper limb?
   A. Radial nerve innervates flexor muscles of the wrist.
   B. Median nerve innervates fifteen intrinsic muscles of the hand.
   C. Axillary nerve innervates the deltoid and teres minor muscles.
   D. Ulnar nerve passes posterior to the medial epicondyle of the humerus.
   E. Long thoracic nerve innervates the pectoralis major muscle.

4. Which of the following is/are True or False regarding the shoulder joint?
   A. Adducted by Pectoralis major muscle.
   B. Mainly stabilized by glenohumeral ligaments.
   C. Part of the capsule is attached to the diaphysis of the humerus.
   D. Situated superior to the axillary nerve.
   E. When dislocated inferiorly, the head of the humerus lies inferior to the glenoid fossa.

5. Which of the following is/are True or False regarding the blood vessels in the hand?
   A. Absence of the radial artery pulse is a known phenomenon in fracture lower end humerus.
   B. Cephalic vein starts from the lateral end of the dorsal venous arch.
   C. Radial artery passes deep to the flexor retinaculum.
   D. Superficial palmar arch is the continuation of ulnar artery in the hand.
   E. Ulnar artery is palpable at the base of the anatomical snuff box.

6. Which of the following is/are True or False regarding the cell division?
   A. Cell division occurs through binary fission in prokaryotic cells.
   B. During mitosis, the number of chromosomes in a cell remains constant.
   C. During the S phase of the cell cycle, DNA is replicated.
   D. In cytokinesis the cytoplasm of a cell is divided into two daughter cells.
   E. Meiosis results in the production of four genetically identical daughter cells.

7. Which of the following is/are True or False regarding the thoracic wall?
   A. Anterior intercostal arteries originate from the internal thoracic artery.
   B. Intercostal neurovascular bundle is located at the lower border of a rib.
   C. Posterior intercostal veins drain directly into the inferior vena cava.
   D. Spinous processes of thoracic vertebrae project horizontally.
   E. Thoracic wall receives its innervation from autonomic nervous system.

8. Which of the following is/are True or False regarding the X linked dominant genetic disorders?
   A. Affected mother has a 50% chance of passing it to each of her children, regardless of sex.
   B. Heterozygous female will always pass the disorder to her offspring.
   C. Males are more severely affected than females.
   D. More common in females than in males.
   E. They are passed from affected fathers to their sons.

9. Which of the following is/are True or False regarding the embryo implantation?
   A. An allantois is visible at the caudal end.
   B. It has a prominent primitive streak.
   C. Endometrium is highly vascular.
   D. Slight bleeding occurs at the implantation site.
   E. Trophoblast begins to differentiate.

10. Which of the following is/are True or False regarding the notochord?
   A. It is the precursor for the development of spinal cord.
   B. It is located between the cephalic end and the prechordal plate.
   C. It is an ectodermal derivative.
   D. It is formed during the process of gastrulation.
   E. Its remnants present as annulus fibrosis in the intervertebral discs

Questions number 11 to 20 are Single Best Response (SBR) type. Select the best response to each question.

11. Following is a group of structures that are found during organogenesis.
Which developmental structure most likely gives rise to the kidneys during organogenesis?
A. Ectodermal placode.
B. Intermediate mesoderrn.
C. Lateral mesoderm.
D. Neural tube.
E. Paraxial mesoderm.

12. A patient has a karyotype of 45, XX, rob (14;21). What is the most probable diagnosis?
A. Balanced translocation carrier for Down Syndrome
B. Balanced translocation carrier for Patau Syndrome
C. Down Syndrome
D. Edward Syndrome
E. Patau Syndrome

13. "Tennis elbow" (lateral epicondylitis) results from repetitive strain and overuse of the anatomical structures around elbow.
What is the most likely anatomical structure involved in this condition?
A. Extensor carpi radialis brevis tendon
B. Flexor digitorum profundus tendon
C. Lateral collateral ligament
D. Medial collateral ligament
E. Pronator teres muscle

14. A 60-year-old man attended a surgical clinic complaining of pain in his right shoulder. On examination, it was noted that his pain become more intense when abducting the arm from 60° to 120°. The surgeon identified the pain as being due to an inflammation of a tendon at the shoulder.
What is the muscle tendon most likely to be inflamed?
A. Infraspinatus
B. Long head of the biceps
C. Pectoralis
D. Supraspinatus
E. Teres minor

15. A 40-year-old man was admitted to the surgical casualty with pain and deformity of the right arm following a fall from height. On examination, there was evidence of radial nerve palsy. X-ray images of the arm showed a fracture of the humerus.
What is the most likely site of the fracture?
A. Lateral condyle of the humerus
B. Medial epicondyle of the humerus

C. Shaft of the humerus
D. Supracondylar fracture of the humerus
E. Surgical neck of the humerus

16. A young man was admitted to the surgical casualty with a cut injury to the forearm. During the surgical exploration, a complete cut of the most medial muscle of the anterior compartment of the forearm and the nerve passing deep to it were noted. What is the most likely nerve injured?
A. Anterior interosseous nerve
B. Deep branch of the radial nerve
C. Medial cutaneous nerve of the forearm
D. Median nerve
E. Ulnar nerve

17. A 58-year-old male patient presented to the emergency department with chest pain, shortness of breath, and diaphoresis. An electrocardiogram (ECG) and blood tests confirmed the diagnosis of an acute myocardial infarction (MI). Coronary angiogram was performed and revealed an occlusion in the left anterior descending (LAD) artery. Which of the following statements best describes the anatomical area of the heart most affected by this type of myocardial infarction?
A. The anterior wall of right and left ventricle.
B. The anterior wall of the left ventricle and the interventricu1ar septum.
C. The left atrium and the left ventricle.
D. The posterior wall of the left ventricle and the right ventricle.
E. The right atrium and the left ventricle.

18. A47-year-old woman presented with a right breast lump and examination revealed Peau d'orange characteristics.
What is the most likely cause for this sign?
A. Blockage of cutaneous lymphatic vessels.
B. Contraction of the retinacula cutis of the areola and nipple.
C. Invasion of pectoralis major muscle.
D. Lymphatic metastasis of tumour to the axillary lymph nodes.
E. Shortening of suspensory ligaments of cooper.

19. Following morphological features are used to differentiate vertebrae from different levels. Which of the following morphological features is unique to cervical vertebrae?
A. Costal facet.
B. Foramen Transversarium.
C. Kidney-shaped vertebral body.
D. Odontoid process.
E. Thick, broad spinous process.

20. Following are combination of muscles used in respiration.

Which of the following includes only the accessory muscles of respiration used for deep inspiration?

A. Internal intercostal muscle, external intercostal muscle and innermost intercostal muscle
B. Internal intercostal muscle, external intercostal and diaphragm.
C. Stemocleidomastoid muscle, external intercostal muscles and pectoralis major.
D. Stemocleidomastoid, latissimus dorsi and serratus anterior.
E. Subcostalis, transversus thoracis and innermost intercostal muscles.

CONTINUOUS ASSESSMENT - 01 ANSWERS

1. FFTTF
2. FTTFF
3. FFTTF
4. TFTTT
5. TTFTF
6. TTTFF
7. TTFFF
8. TFTFF
9. FFTTT
10. FTFTF
11. B
12. A
13. A
14. D
15. C
16. E
17. B
18. A
19. B
20. D