# 032

# Pages 776-800

Upper limb anatomy The information below contains selected facts which commonly appear in examinations: Nerve Motor Sensory Musculocutaneous nerve (C5-C7) Elbow flexion (supplies biceps brachii) and supination Axillary nerve (C5, C6) Shoulder abduction (deltoid muscle) Radial nerve (C5C8) Extension (forearm, wrist, fingers, thumb) Median nerve (C6, C8, T1) LOAF* muscles Features depend on the site of the lesion: • wrist: paralysis of thenar muscles, opponens pollicis • elbow: loss of pronation of forearm and weak wrist flexion Ulnar nerve (C8, T1) Intrinsic hand muscles except LOAF* Wrist flexion Long thoracic nerve (C5-C7) Serratus anterior Often during sport e.g. following a blow to the ribs. Also possible complication of mastectomy Damage results in a winged scapula *LOAF muscles • Lateral two lumbricals • Opponens pollis • Abductor pollis brevis • Flexor pollis brevis Notes & Notes for MRCP
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Typical mechanism of injury & notes Lateral part of the forearm Isolated injury rare - usually injured as part of brachial plexus injury Inferior region of the deltoid muscle Humeral neck fracture/dislocation Results in flattened deltoid Small area between the dorsal aspect of the 1st and 2nd metacarpals Humeral midshaft fracture Palsy results in wrist drop Palmar aspect of lateral 3 and half fingers Wrist lesion → carpal tunnel syndrome Medial 1and half fingers Medial epicondyle fracture Damage may result in a 'claw hand'

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Radial nerve Overview • arises from the posterior cord of the brachial plexus (C5-8) • It is susceptible to compression or traumatic damage as it winds around the humerus (including ‘Saturday night palsy’, a pressure palsy sustained while sleeping in an awkward position under the influence of alcohol), • may also be compressed in the axilla (eg from using a crutch). Regions innervated Motor (main nerve) • Triceps • Anconeus • Brachioradialis • Extensor carpi radialis Motor (posterior interosseous branch) • Supinator • Extensor carpi ulnaris • Extensor digitorum • Extensor indicis • Extensor digiti minimi • Extensor pollicis longus and brevis • Abductor pollicis longus Sensory • Dorsal aspect of lateral 3 1/2 fingers • The commonest site of sensory loss is at the anatomical snuffbox (small area between the dorsal aspect of the 1st and 2nd metacarpals)

Patterns of damage • wrist drop with hand pronation and thumb adduction • sensory loss to small area between the dorsal aspect of the 1st and 2nd metacarpals Axillary damage • as above • paralysis of triceps Features according to site of damage

Site of lesion Sensory symptoms Motor symptoms Axilla • All below • All below • Paralysis of triceps m Mid-arm • All below • Numbness, paresthesia, pain along lateral posterior arm extensors (hand, finger and wrist joint). Elbow (radial tunnel) • Pain and tenderness following extension or repetitive pronation/supination • Sometimes weakness of extension and supination, secondary to pain (not to missing innervation) Deep Forearm (posterior interosseous nerve) • None • Paralysis of the finger extensors (no true wrist drop) Superficial forearm and wrist (superficial radial nerve) • Deficits on the radial side of the dorsum of the hand (thumb, index finger, and the radial half of the middle finger) Common questions about radial nerve: Question Answer Rout? C5-8 Typical injury • Fractured midshaft of humerus/compression of axilla by chaircrutches. ‘Saturday night palsy’, Motor loss? extensor muscles (forearm, wrist, fingers, thumb) Sensory loss? • dorsal aspect of lateral 3 1/2 fingers • anatomical snuffbox The commonest site of sensory loss anatomical snuffbox (small area between the dorsal aspect of the 1st and 2nd metacarpals) Sign? wrist drop Notes & Notes for MRCP
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• All below • Wrist drop  weakness of • None

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Median nerve Overview • arises from lateral and medial cords of the brachial plexus (C6-8, T1) • Motor to (LOAF) When look at hand in this position, can see this makes an "L" shape, since L Lumbrical.  Lateral two lumbricals  Opponens pollicis →rotates and flexes the thumb  Abductor pollicis brevis →Abduction and opposition of the thumb  Flexor pollicis brevis →Flexes the thumb at the first metacarpophalangeal joint • the above three form the thenar eminence muscles • also supplies flexor muscles of the forearm • Sensory to → palmar aspect of lateral (radial) 3 1/2 fingers Patterns of damage • Damage at wrist  e.g. carpal tunnel syndrome  paralysis and wasting of thenar eminence muscles  sensory loss to palmar aspect of lateral (radial) 3 1/2 fingers • Damage at elbow, as above plus:  unable to pronate forearm  weak wrist flexion  ulnar deviation of wrist • Anterior interosseous nerve (branch of median nerve)  leaves just below the elbow  results in loss of pronation of forearm and weakness of long flexors of thumb and index finger Common questions about median nerve: Question Answer Rout C6-8, T1 Typical injury? Fracture of supracondylar humerus/ Carpal tunnel syndrome Motor deficit? Opposition of thumb/Lateral finger flexion (ulnar deviation of wrist)/wrist flexion /(LOAF) muscles Sensory deficit Dorsal-palmar lateral 3.5 fingers/thenar eminence Sign? Ape hand (loss of Opponens pollicis)/Pope's hand (open digits 1-3 when trying to make fist)

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Carpal tunnel syndrome Overview • Carpal tunnel syndrome is caused by compression of median nerve in the carpal tunnel. • More common in females (F:M, up to 8:1). • Commonly bilateral with dominant hand typically affected first. Causes • idiopathic • pregnancy • oedema e.g. heart failure • lunate fracture • rheumatoid arthritis History • pain/pins and needles in thumb, index, middle finger • unusually the symptoms may 'ascend' proximally • patient shakes his hand to obtain relief, classically at night Examination • weakness of thumb abduction (abductor pollicis brevis) • wasting of thenar eminence (NOT hypothenar →supplied by ulnar nerve ) • Tinel's sign: tapping causes paraesthesia • Phalen's sign: flexion of wrist for 60 seconds causes symptoms • Which area supplied by the median nerve will be spared if the problem is at the carpal tunnel? □ the skin over the thenar eminence □ The palmar cutaneous branch of the median nerve lies superficial to the flexor retinaculum and does not pass through the carpal tunnel. It supplies the skin over the thenar eminence, which is therefore spared in carpal tunnel syndrome. Electrophysiology • The most appropriate further investigation □ Electromyogram (EMG)/nerve conduction studies □ (EMG)/nerve conduction study is useful for confirming clinical diagnosis prior to actual surgery. □ nerve conduction studies show: □ decreased conduction velocity in the median nerve. □ prolongation of the action potential Treatment • In patients with mild carpal tunnel syndrome the management should be behavior modification. • corticosteroid injection • wrist splints at night • surgical decompression (flexor retinaculum division)

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Pronator teres syndrome Definition • entrapment of the median nerve between the two heads of the pronator teres muscle at the elbow Features • The characteristic physical finding is tenderness over the proximal median nerve, which is aggravated by resisted pronation of the forearm. Diagnosis • Examination involves excluding carpal tunnel syndrome and pronation of the affected forearm against resistance, which brings on the pain. □ Unlike carpal tunnel syndrome, the median nerve proximal to the wrist may be tender to palpation. Treatment • Injection of corticosteroids into the pronator teres muscle may produce relief of symptoms, but a strong response to a steroid injection would be more consistent with carpal tunnel syndrome

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Anterior interosseous syndrome Definition • Anterior interosseous syndrome or Kiloh-Nevin syndrome is a damage to the anterior interosseous nerve, a motor branch of the median nerve, which arises just below the elbow. • innervates the long flexor muscles of the thumb (Flexor pollicis longus), index and middle finger (flexor digitorum profundus). Causes • neuritis (inflammation of the nerve) in most cases, compression or Trauma Feature • Pain in the forearm • Characteristic weakness of the pincer movement of the thumb and index finger. • If asked to make the "OK" sign, patients will make a triangle sign instead. □ This 'Pinch-Test' exposes the weakness of the Flexor pollicis longus muscle and the flexor digitorum profundus leading to weakness of the flexion of the distal phalanges of the thumb and index finger. • Difficulty picking up a small item, such as a coin, from a flat surface Diagnosis • Electromyography (EMG) is generally most useful and will reveal abnormalities in the flexor pollicis longus, flexor digitorum profundus I and II and pronator quadratus muscles.

Ulnar nerve Overview • Root  arises from medial cord of brachial plexus (C8, T1) • Motor innervation  Third and fourth lumbricals (medial two lumbricals)  Flex at metacarpal phalangeal (MCP) joint  Extend at proximal interphalangeal (PIP) joint  Adductor pollicis: adducts the thumb  Abductor digiti minimi: abducts the little finger  Flexor carpi ulnaris: helps flex the wrist  Dorsal and palmar interossei: finger abduction and adduction respectively  Flexor digiti minimi brevis: flexes the MCP joint • Sensory innervation  medial 1 1/2 fingers (palmar and dorsal aspects) Causes • The ulnar nerve is most commonly compressed at or near the cubital tunnel of the elbow and Guyon canal of the wrist.  Cubital tunnel syndrome (ulnar nerve compression at the elbow)  Leaning on the elbow or prolonged elbow flexion during occupational activities (e.g., leaning on a desk), athletic activities, or surgical procedures (e.g., during general anesthesia)  Blunt trauma  Masses (e.g., tumors, hematomas)  Metabolic abnormalities (e.g., diabetes)  Guyon canal syndrome (ulnar nerve compression at the wrist in Guyon's canal)  Often associated with cycling, likely caused by direct pressure from the handlebars



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 Blunt trauma (e.g., hook of hamate fracture)  Masses (especially ganglion cysts) • The most common ulnar neuropathies are  cubital tunnel syndrome  the commonest site for entrapment of ulnar nerve  caused by ulnar nerve compression at the elbow  may be due to chronic pressure, leaning on the elbows, and direct trauma.  ulnar tunnel syndrome  caused by ulnar nerve compression at the wrist in Guyon's canal Risk factors • Ulnar neuropathy is a common complication with ill patients in hospital. Features • Wasting and paralysis of intrinsic hand muscles (except lateral two lumbricals) • Claw hand (where the little and ring fingers curl into the palm).  hyperextension of the metacarpophalangeal joints and flexion at the distal and proximal interphalangeal joints of the 4th and 5th digits • Weak pinch (Froment sign)  little finger in persistent abduction due to weak third palmar interosseous muscle • Radial deviation of wrist • Wartenberg sign: little finger in persistent abduction due to weak third palmar interosseous muscle • Froment sign: The thumb flexes at the interphalangeal joint while pinching a piece of paper to compensate for a weak adductor pollicis muscle. • Sensory loss to the medial 1 1/2 fingers (palmar and dorsal aspects) Proximal and distal lesions of the ulnar nerve lead to claw hand deformity. Diagnosis • Nerve conduction studies will confirm the site of the lesion. Common questions about ulnar nerve Question Answer Rout ? C8-T1 Typical injury? Fracture of epicondyle of humerus Motor deficit? Medial finger flexion/wrist flexion Sensory deficit? Medial 1.5 fingers/hypothenar eminence Sign? Radial deviation of wrist upon flexion/claw hand MRCPUK-part-1-sep 2017: H/O dropping things on a frequent basis and muscle wasting at the back of the right hand. On examination, you note wasting of the dorsal interossei. What is the nerve supply of the dorsal interossei?  C8/T1

Rotator cuff muscles Muscle Notes Supraspinatus aBDucts arm before deltoid Most commonly injured Infraspinatus Rotates arm laterally teres minor aDDucts & rotates arm laterally Subscapularis aDDuct & rotates arm medially

Klumpke’s palsy Definition • Injury to the lower trunk of the brachial plexus (C8–T1) • This root eventually supplies the median and ulnar nerves. • The ulnar nerve supplies all of the intrinsic hand muscles except for those of the thenar eminence and the first and second lumbricals which are innervated by the median nerve. Causes • Hyperabduction of the arm  Trauma (e.g., breaking a fall by grabbing a branch)  Birth injury: excessive upward traction on the arm during delivery • Compression of the lower trunk of brachial plexus (subacute to chronic onset)  Pancoast tumor  Cervical rib Features • Weakness of intrinsic hand muscles (thenar, hypothenar, lumbricals, interossei) → total claw hand (persistent flexion of the interphalangeal joints and extension of the metacarpophalangeal joints in the hand) • Preganglionic Horner syndrome if injury occurs proximal to the white ramus communicans • Decreased peripheral pulses if subclavian vessels are compressed by a Pancoast tumor or cervical rib. • Sensory loss in the C8 and T1 dermatomes (little finger and medial surface of the forearm and arm) Treatment • Splinting the hand to correct the claw hand • Physiotherapy • Surgery for severe nerve damage Stretch injury of the arm • Sudden upward movement of the abducted arm (fall that has been stopped by grasping a fixed object with one hand) → causes features of an ulnar nerve palsy which is supplied by the lower brachial plexus roots C8 and T1 (Klumpke's paralysis)

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Neurology

Commonly tested nerves of the lower limbs The information below contains selected facts which commonly appear in examinations: Nerve Motor Sensory Typical mechanism of injury & notes Femoral nerve Knee extension, thigh flexion Anterior and medial aspect of the thigh and lower leg Obturator nerve Thigh adduction Medial thigh Anterior hip dislocation Lateral cutaneous nerve of the thigh None Lateral and posterior surfaces of the thigh Tibial nerve Foot plantarflexion and inversion Sole of foot • Not commonly injured as deep and well protected. • Popliteal lacerations, posterior knee dislocation Common peroneal nerve Foot dorsiflexion and eversion Extensor hallucis longus Dorsum of the foot and the lower lateral part of the leg Superior gluteal nerve Hip abduction None • Misplaced intramuscular injection • Hip surgery • Pelvic fracture • Posterior hip dislocation • Injury results in a positive Trendelenburg sign Inferior gluteal nerve Hip extension and lateral rotation None • Generally injured in association with the sciatic nerve • Injury results in difficulty rising from seated position. Can't jump, can't climb stairs Notes & Notes for MRCP
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• Hip and pelvic fractures • Stab/gunshot wounds Compression of the nerve near the ASIS → meralgia paraesthetica, a condition characterised by pain, tingling and numbness in the distribution of the lateral cutaneous nerve • Injury often occurs at the neck of the fibula Tightly

applied lower limb plaster cast • Injury causes foot drop



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Sciatic nerve palsy Nerve root • L4–S3 • Sciatic nerve splits into tibial nerve and common peroneal nerve Causes • Total hip arthroplasty  known complication of a total hip replacement (femoral nerve palsy can occur but is much less common). • Herniated lumbar disc • Posterior hip dislocation • Iatrogenic (misplaced intragluteal injection) Feature • Motor  Impaired knee flexion and hip adduction  Global weakness of the ankle due to the involvement of both of its branches: tibial nerve (plantaflexion and inversion) and common peroneal nerve (dorsiflexion and eversion).  Absent ankle jerk is due to tibial nerve involvement. • Sensory  Sensory loss is variable but most commonly occurs around the dorsum of the foot and lateral aspect of the leg  Tibial nerve injury → Sensory loss over sole of the foot  The skin over the medial malleolus and medial border of the foot is innervated by the saphenous nerve and is therefore spared.

Chapter 4

Neurology

Injuries of sciatic nerve branches Common peroneal nerve injury Tibial nerve injury Nerve root L4–S2 L4–S3 Common causes • Fracture of the fibular head • Compression: tight casts, sitting cross-legged, lithotomy position during surgery Motor deficit • Superficial peroneal nerve: paralysis of peroneus longus and peroneus brevis → impaired eversion of the foot • Deep peroneal nerve: paralysis of foot and toe extensors (dorsiflexors) (e.g., tibialis anterior), leading to: • Foot drop • Steppage gait Sensory deficit • Superficial peroneal nerve: lateral surface of the lower leg, dorsum of the feet and toes, except for the space between the first and second toe • Deep peroneal nerve: area between the first and second toes (flip-flop zone)

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Common peroneal nerve lesion The commonest cause of acute foot drop after prolonged bed rest is entrapment common peroneal neuropathy at the neck of fibula. Overview • The sciatic nerve divides into the tibial and common peroneal nerves in the popliteal fossa. • Nerve root → L4–S2 • Common peroneal nerve divides into a superficial and a deep branch  Deep peroneal nerve supplies muscles, which dorsiflex the foot and toes:  tibialis anterior  extensor hallucis longus  extensor digitorum longus  Superficial nerve supplies the muscles, which evert the foot  peroneus longus and brevis Notes & Notes for MRCP
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• Trauma of the knee or leg (e.g., tibial fracture) • Baker cyst (causes proximal lesion) • Tarsal tunnel syndrome (causes distal lesion) • Paralysis of biceps femoris (long head) • Paralysis of foot flexors (e.g., triceps surae) → inability to stand on or curl toes and to invert foot • Proximal lesions: eversion of the foot at rest • Sensory loss over sole of the foot

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• Injury often occurs at the neck of the fibula. Causes • Fracture of the fibular head • Compression: tight casts, sitting cross-legged, lithotomy position during surgery Features • Foot drop (the most characteristic feature)  Superficial peroneal nerve: paralysis of peroneus longus and peroneus brevis → impaired eversion of the foot  Deep peroneal nerve: paralysis of foot and toe extensors (dorsiflexors) (e.g., tibialis anterior), leading to: Foot drop and Steppage gait • Sensory loss over the dorsum of the foot and the lower lateral part of the leg with sparing of the fifth toe.  Superficial peroneal nerve: lateral surface of the lower leg, dorsum of the feet and toes, except for the space between the first and second toe  Deep peroneal nerve: area between the first and second toes (flip-flop zone)

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Femoral nerve palsy Nerve root • L2–L4 Causes • Compression: Prolonged pressure on the nerve:  Psoas haematoma (due to anticoagulant therapy or haemophilia), Psoas abscess  Tumours - eg: Synovial cyst, Sarcoma  Aortic or iliac aneurysms • Trauma: Direct injury to the nerve  Hip or pelvic fractures  Iatrogenic: eg: Hip arthroplasty, pelvic surgery, femoral line placement, coronary angiography). • Diabetic amyotrophy (proximal neuropathy, in diabetic patients, causes burning pain in the hip and thigh and wasting of thigh muscles) • Foot-drop • Weakness of eversion + dorsiflexion + inversion →L4 - 5 radiculopathy • Weakness of eversion + dorsiflexion →common peroneal nerve palsy (ankle inversion is spared with common peroneal nerve palsy) Differences between tibial nerve and peroneal nerve injuries: • Tibial → impaired foot Inversion and Plantarflexion • Peroneal → impaired foot Eversion and Dorsiflexion

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Neurology Feature • Motor  Paralysis of iliopsoas, pectineus, rectus femoris, and sartorius muscles → impaired hip flexion  Paralysis of quadriceps femoris muscle →  Impaired knee extension: instability of the knee (often described as 'buckling') on climbing stairs.  Decreased patellar tendon reflex (absent knee jerk) • Sensory  Decreased sensation in anterior thigh (meralgia paraesthetica) and medial distal leg (saphenous nerve) Obturator nerve injury • Root: L2–L4 • Common causes: Pelvic surgery, pelvic ring fractures • Motor deficits: Paralysis of hip adductors (adductor longus, adductor brevis, adductor magnus, obturator externus, gracilis, pectineus) • Sensory deficits: Howship-Romberg sign: pain and paresthesia over the inner aspect of the thigh.

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Meralgia paraesthetica Nerve root • L2–L4 Pathology • compression of lateral cutaneous nerve of thigh Causes of compression • Most likely causes→ entrapment at the lateral inguinal ligament:  Increased intra-abdominal pressure (e.g., pregnancy, obesity, ascites)  External compression (e.g., tight belts, pants, or compression dressings)  Local compression (e.g., tumors, hematomas) • Less likely causes →trauma, ischaemia, or a retroperitoneal lesion. Burning thigh pain - ? meralgia paraesthetica - lateral cutaneous nerve of thigh compression Hip weakness: • Weakness of hip Abduction (Gluteus medius) → superior gluteal nerve palsy • Weakness of hip adduction (Adductor magnus and minimus)  Obturator nerve palsy • Weakness of hip flexion (iliopsoas muscle) →Femoral nerve palsy • Weakness of hip extension (Gluteus maximus) →inferior gluteal nerve

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Features • typically burning sensation over antero-lateral aspect of thigh • pure sensory loss • numbness when tapping on the inguinal ligament
Treatment • Can be improved by wearing looser clothing and/or losing weight Healthy patient came with burning thigh pain. What is the next step in management? □ Advice the patient to wear loose pant MRCPUK-part-1- May 2006 exam: A patient presents with a burning sensation over anterolateral aspect of thigh. Which nerve is most likely to be affected? □ Lateral cutaneous nerve of thigh

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Saphenous nerve injury
Overview • Saphenous nerve is a terminal cutaneous branch of the femoral nerve. • It is supplies the skin over the anteromedial side of the knee, leg and medial malleolus. • It is strictly a sensory nerve; it has no motor component. • It is commonly blocked to complement anesthesia of the lower leg.
Causes • Saphenous vein harvest for coronary artery bypass grafting (CABG) (most common). • Femoral artery catheterization for angiography. • Trochanter placement during knee arthroscopy. • Long saphenous vein stripping for varicose veins. Features • Loss of sensation over the medial aspect of the lower leg.

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Tarsal tunnel syndrome Overview • also, known as posterior tibial neuralgia • It is analogous to carpal tunnel syndrome of the wrist. Definition • peripheral neuropathy caused by compression of the tibial nerve by the flexor retinaculum of the foot at the medial ankle Tarsal tunnel syndrome entrapment of the posterior tibial nerve as it travels through the tarsal tunnel, this tunnel is found along the inner leg behind the medial malleolus →painful foot

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Neurology Causes • Trauma (most common): fracture or sprain of the ankle (talus, calcaneus, medial malleolus) • Rheumatoid arthritis Features • Symptoms develop in areas innervated by the tibial nerve (distal to the medial malleolus): □ Neuropathic pain and paresthesia in the heel, sole of the foot, and first three toes □ Weakness and atrophy of intrinsic foot muscles (severe cases) • Symptoms worsen with walking, prolonged standing, and at night Diagnosis •
• Usually a clinical diagnosis • Positive Tinel sign: radiating paresthesia triggered by tapping the flexor retinaculum posterior to the medial malleolus • Pain upon foot dorsiflexion with eversion • Diminished sensation on the plantar area of the foot • Nerve conduction studies: slow conduction velocity in the medial and lateral plantar nerves Treatment • Initially conservative (Rest, NSAIDs, physiotherapy, use of orthotic shoes) • Local injection of steroids into the tarsal canal (if no improvement) • Surgical decompression

Third edition Notes & Notes For MRCP part 1 & 11 By Dr. Yousif Abdallah Hamad Cardiology Updated

Notes & Notes for MRCP
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Cardiology Coronary arteries: anatomy and clinical correlation • Right coronary artery (RCA)  supplies:  AV node, so heart block following inferior MI is common. However, heart block following anterior MI is a grave prognostic marker as this indicates a large anterior wall infarct. RCA supplies SA node in 60%, AV node in 90%  Right ventricle, hence, problems relating to a right ventricular infarct are commonly associated with an inferior MI.  Inferior myocardium and occlusion causes ST elevation in II, III and aVF.  Posterior descending artery a branch of the right coronary artery in 85% of people (a branch of the circumflex in the remaining population).  supplies the posterior left ventricular myocardium  occlusion causes posterior MI (ST depression in V1-V4 with a dominant R wave in V1).  The concept of coronary dominance refers to which coronary artery supplies the posterior descending coronary artery (PDA).  85% of patients having a dominant right coronary artery  15% of patients having a dominant left circumflex. • Left main stem left coronary artery (LCA)  Supplies most of the left ventricle.  Complete left main stem occlusion is invariably fatal. It would produce extensive ST elevation across all the chest leads, I and aVL and possibly aVR, too.  LCA branches into → Left Anterior Descending (LAD) + Left Circumflex artery (LCX)  Left Anterior Descending (LAD) artery  supplies : anterior and septum  Occlusion →ST segment elevation in leads V1-V4  Right bundle branch block in acute anterior myocardial infarction suggests obstruction prior to the first septal branch of the left anterior descending coronary artery  Left Circumflex artery (LCX)  Supplies : lateral  Occlusion produces ST elevation in V5, V6, I and aVL. • ECG localization of STEMI ECG leads with ST elevation Infarction location V1 – V2 Anteroseptal (LAD) V3- V4 Antero-apical (distal LAD) V5- V6 Antero-lateral (LAD or LCX) I, aVL Lateral (LCX) II, III, aVF Inferior (RCA) V7 – V9, ST depression V1- V3 with tall R waves Posterior (PDA) ST-segment elevations or Q waves in leads II, III, and aVF on ECG signify a likely inferior MI, supplied by the right coronary artery.

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Coronary arterial dominance • Right-dominant (~85% of the population): posterior descending artery (PDA) supplied by the RCA • Left-dominant (~8% of the population): PDA supplied by the left circumflex artery (LCX) • Codominant (balanced; ~7% of people): PDA supplied by both RCA and LCX Coronary circulation The left atrium is the posteriormost part of the heart, located directly in front of the esophagus. It can be visualized using TEE. The right ventricle is the anteriormost part of the heart and is at greatest risk of injury following chest trauma.

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Jugular venous pulse (JVP)

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Cardiology

Clinical importance of JVP • providing information on right atrial pressure, • may provide clues to underlying valvular disease. • A non-pulsatile JVP is seen in superior vena caval obstruction. • Kussmaul's sign describes a paradoxical rise in JVP during inspiration seen in constrictive pericarditis.

JVP waves and abnormalities Wave Description Abnormalities a wave • The first peak caused by atrial contraction c wave • The second peak caused by tricuspid valve closure, contraction of the right ventricle, and bulging of the tricuspid valve into the right atrium x descent • A drop in JVP caused by atrial relaxation during ventricular systole • Absent in: o Tricuspid valve regurgitation o Right heart failure v wave • The third peak caused by venous refilling of the right atrium against the closed tricuspid valve • Prominent in: o Tricuspid valve regurgitation o Right heart failure y descent • A drop in JVP caused by decreased right atrial pressure as blood flows into the right ventricle after opening of the tricuspid valve Cannon 'a' waves • Caused by atrial contractions against a closed tricuspid valve • Causes  Regular cannon waves  ventricular tachycardia (with 1:1 ventricular-atrial conduction)  atrio-ventricular nodal re-entry tachycardia (AVNRT)  Irregular cannon waves  complete heart block A left sided internal jugular central venous catheter has been inserted and you are reviewing the chest radiograph to check the position of the tip of the catheter. What is the safest position to leave the catheter tip?  In the lower superior vena cava

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Central venous access of the Subclavian Vein Anatomy • Each subclavian vein is a continuation of the axillary vein and runs from the outer border of the first rib. • The subclavian and internal jugular vein unite to form the brachiocephalic vein, subsequently the left and right brachiocephalic veins unite to form the superior vena cava. Procedure • Left-sided subclavian access is associated with lower rates of catheter malposition and vessel trauma. It is preferred when immediate cardiac access is needed (eg, temporary transvenous pacer and pulmonary artery catheter insertion) since the guidewire and catheter are more easily directed into the superior vena cava and right heart. • The optimal point of needle insertion :  1 cm inferior to the junction of the middle and medial third of the clavicle. Notes & Notes for MRCP
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• Absent in atrial fibrillation • cv wave : severe tricuspid valve regurgitation • Prominent in: o Tricuspid valve regurgitation o Constrictive pericarditis • Absent in: o Cardiac tamponade o Tricuspid valve stenosis

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Cardiology

Advantages • the cleanest site for central venous access (lower potential for infection). • It also the most tolerated by patients. • consistent landmarks (lower potential for arterial injury compared with other sites of access). Complications • Arrhythmias (e.g. premature atrial and ventricular contractions) caused by contact of the guidewire to the right atrium. • Venous air embolism, pneumothorax, and pneumomediastinum are other common complications of central line placement. • subclinical pneumothorax even in the hands of experienced clinicians. Central venous access • Ultrasound guidance improves initial cannulation success. • Obtain a postprocedural chest x-ray to confirm catheter position and exclude pneumothorax in jugular and subclavian catheters. Femoral catheters do not require radiographic confirmation and can be used immediately following insertion. • The internal jugular vein are a commonly used site for central venous access. The distal tip of jugular catheters should lie in the lower superior vena cava. Carotid artery puncture is a well-

recognized complication. • Femoral site cannulation is often recommended as a secondary site due to higher rates of delayed complications.

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Subclavian steal syndrome Brainstem features (vertigo, diplopia, dysarthria, and drop attacks) with disparity in BP > 15 mm Hg and pain precipitated by exercise →Subclavian steal syndrome Pathophysiology • Stenosis of the subclavian artery proximal to the origin of the vertebral artery → hypoperfusion distal to the stenosis → reversal of blood flow in ipsilateral vertebral artery → compensation through collateral arteries → reduced blood flow in the basilar artery → reduced cerebral perfusion upon exertion involving the affected arm • characterized by retrograde flow into the vertebral or internal thoracic arteries, due to stenosis and/ or occlusion of the subclavian artery. What is the most likely mechanism that maintains blood flow to the affected extremity? • Blood from the contralateral vertebral artery is shunted away from the basilar artery (away from the brainstem) and retrograde into the ipsilateral vertebral artery to supply the affected arm . Causes • Atherosclerosis • Takayasu's arteritis Symptoms • The most common symptoms are those related to upper limb ischemia (arm pain and numbness, especially during exertion and exercise with the arm above the head, such as painting a wall.)

Notes & Notes for MRCP
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• brainstem features due to vertebrobasilar insufficiency such as: Vertigo, Diplopia, Dysarthria, and Drop attacks. • blood pressure is different between the upper limbs by at least 15 mmHg. Diagnosis • Duplex ultrasound is the best initial radiological test  shows reversal of blood flow (retrograde flow in the ipsilateral vertebral artery) • Angiography of the subclavian vessels (MRA) is the most accurate test. Management • Most patients require no intervention • Symptomatic patients: angioplasty and stenting or surgical revascularization Pathophysiology of subclavian steal syndrome Under normal conditions, the subclavian artery distributes blood equally to the arteries in the brain and arms (A). If there is stenosis of the subclavian artery proximal to the origin of the vertebral artery, this leads to hypoperfusion of the upper extremities on the affected side (B). This is compensated by a contralateral circulation, in which there is increased blood flow from the unaffected side to the affected side via the vertebral arteries. As a result, there is hypoperfusion of the vertebrobasilar territory and corresponding central nervous system symptoms.

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Atrial natriuretic peptide (ANP) Secretion • Released from atrial myocytes (right > left) in response to blood volume and atrial pressure. • Acts via cGMP

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Cardiology

ANP secretion pathway and actions • ↑ Volume → ↑ atrial stretch receptors stimulation→ release of ANP from atrial cardiomyocytes which results in:  ↑ Excretion of NaCl and water by the kidneys (via afferent arterioles dilations and efferent arterioles constriction)  ↓ Na+ reabsorption at the renal collecting tubule (via ↑ cGMP)  Inhibition of renin  Vasodilation of veins and arteries (↓

preload and ↓ afterload) • ↓ Volume → ↓ atrial stretch receptors stimulation → ↓ Release of ANP → ↓ excretion of NaCl and water by the kidneys How is the "aldosterone escape" mechanism mediated by atrial natriuretic peptide (ANP)? • ANP causes cGMP-mediated dilation of the afferent arteriole and constriction of the efferent arteriole, promoting diuresis and counteracting the effects of aldosterone

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B-type (Brain) Natriuretic Peptide (BNP) Definition • B-type natriuretic peptide (BNP) is a hormone produced mainly by the left ventricular myocardium in response to strain (myocyte stretch). Mechanism of action • Similar physiologic action to ANP with longer half-life. • ↑ intracellular smooth muscle cGMP →arterial and venous smooth muscle vasodilatation →↓ pre-load → ↓BP • ↓ sodium reabsorption, leading to natriuresis and diuresis. • suppresses both sympathetic tone and the renin-angiotensin-aldosterone system Causes of raised BNP levels • heart failure is the most obvious cause • age over 70 years, • ventricular hypertrophy, ischaemia, tachycardia, hypoxaemia [including pulmonary embolism], chronic obstructive pulmonary disease, • renal dysfunction [eGFR less than 60 ml/minute/1.73 m2] • sepsis, • diabetes • cirrhosis of the liver • BNP synthesis is increased by thyroid hormones as well as glucocorticoids, endothelin-1, angiotensin-II, and tachycardia, independent of the haemodynamic effects of these factors. Factors which reduce BNP levels

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• Obesity • African or African–Caribbean family origin • treatment with diuretics, angiotensin-converting enzyme (ACE) inhibitors, beta- blockers, angiotensin II receptor blockers (ARBs) or mineralocorticoid receptor antagonists (MRAs) Clinical uses of BNP • Diagnosing patients with acute dyspnoea (very good negative predictive value for heart failure). (NICE guidelines - 2018). NT-proBNP level Note ˃ 2,000 ng/litre Refer urgently to specialist and echocardiography within 2 weeks. Between 400 and 2,000 ng/litre Refer to specialist and echocardiography within 6 weeks. ˂ 400 ng/litre makes a diagnosis of heart failure less likely • Prognosis in patients with chronic heart failure: very high levels of NT-proBNP carry a poor prognosis • Guiding treatment in patients with chronic heart failure: effective treatment lowers BNP levels Brain natriuretic peptide (BNP) • BNP a hormone secreted from ventricular myocytes in response to ventricular volume overload, as seen in congestive heart failure. • BNP acts on the renal collecting duct to decrease sodium reabsorption and increases glomerular filtration rate, leading to urinary sodium loss. • BNP has a good negative predictive value, so a patient with a normal BNP likely does not have heart failure.

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Cardiovascular physiology • The basic muscle unit of the myocardium  Sarcomere • The normal resting cell membrane potential of a cardiac myocyte  - 90 Mv • Left ventricular ejection fraction (LV EF) = ( Stroke volume/end diastolic volume ) * 100% • Cardiac output (CO) measure how much blood ejected by the heart in one minute. CO = Stroke volume (SV) x Heart rate (HR) • Stroke Volume (SV) volume of blood ejected per heart beat = CO/HR = End-Diastolic Volume (EDV) - End-Systolic Volume (ESV) • Stroke volume is decreased by hypovolaemia • normal ejection fraction is more than 55% of the blood volume. • In systolic dysfunction, EF is low. In diastolic dysfunction, EF is normal (called HF with preserved LV EF) e.g. hypertrophic heart failure • Pulse pressure = Systolic Pressure - Diastolic Pressure  Factors which increase pulse pressure  less compliant

aorta (this tends to occur with advancing age)  increased stroke volume  Factors which reduced pulse pressure  Reduced stroke volume,  high aortic compliance,

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