

## Anatomy Revision - Upper Limb

### Axilla

- **Think of the axilla and a distorted four sided pyramid. What are its walls? Medial:** chest wall and serratus anterior. **Anterior:** pectoralis muscles. **Lateral:** bicipital groove of humerus. **Posterior:** latissimus dorsi and teres major. **What constitute the anterior (pectoralis muscles) and posterior (latissimus dorsi and teres major) axillary folds?**
- **List the contents of the axilla.** The main things are axillary vessels and branches, cords and branches of brachial plexus, but most importantly the lymph nodes.
- **List the parts and branches of the axillary artery.** First part (medial to pectoralis minor): one branch, superior (supreme, highest) thoracic - quite unimportant. Second part (posterior to pectoralis minor): two branches, lateral thoracic and acromiothoracic (thoracoacromial) - both moderately important in supplying the breast. Third part (lateral to pectoralis minor): three branches, the anterior and posterior circumflex humerals which form a ring around the surgical neck of the humerus, and the subscapular which passes down into the axilla. These three are also moderately important. The most important of these branches is probably the lateral thoracic which supplies about half the breast tissue.
- **Lymph nodes in the axilla are very important. Revise the lymph drainage of the breast. How are lymph nodes disposed in the axilla? What areas drain to these nodes?** There are several groups of nodes: anterior, deltopectoral, subscapular, lateral and so on, but they all drain to the central group whence the lymph passes to the chest.
- **Which nerves traverse the axilla? What is the function of each?** The important ones would be the long thoracic (which may be damaged by trauma or surgery resulting in winging of the scapula (why?), and the main branches of the brachial plexus (median, ulnar, radial, axillary, musculocutaneous).
- **Which nerves supply the anterior (flexor) muscles of the upper limb?** Remember that the anterior divisions of the plexus (giving median, musculocutaneous, ulnar, anterior cutaneous nerves) supply flexors and the anterior aspect of the upper limb, and that posterior divisions (giving radial, axillary, thoracodorsal, subscapular, posterior cutaneous) supply extensors and the posterior aspect.
- **Describe in detail the lymph drainage of the breast and thoracic walls.** Include most of breast to axillary nodes. From medial portion to parasternal nodes (alongside the internal thoracic artery) and may cross to other side. Also, lower part to nodes of anterior abdominal wall, possibly even the inguinal. Vessels which pierce the intercostal spaces may allow lymph to pass round in lymphatics with the main neurovascular bundle backwards to posterior intercostal nodes.
- **To which bones is serratus anterior attached? What, therefore, is its function? Give its motor innervation.** Serratus anterior is attached to the upper eight ribs and the medial side of the scapula. If you are a quadruped, it is one of the muscles that suspends the trunk from the limb girdle. If you are plantigrade, it is used in protraction of the upper limb - punching. Its motor supply is from the long thoracic nerve (C5-7) from the roots of the brachial plexus.
- **Which structures may be damaged by penetrating injuries immediately above the clavicle?** Apex of the lung, subclavian vessels, upper trunk and roots of brachial plexus.
- **Describe the sternoclavicular joint. When does it move?** It is a synovial joint which overlies the junction of the subclavian vein and the internal jugular vein to form the brachiocephalic vein. It moves every time you move your upper limb. It is, therefore, very disabling if this joint is diseased.

- **Why are these posterior muscles (except trapezius) supplied by anterior primary rami?** Because they are limb muscles - they attach the limb to the trunk - and only anterior rami supply limbs (don't be confused by the fact that the anterior rami divide into anterior and posterior divisions).
- **When does the scapula move? how? at which joints? Explain the role of the scapula in abduction of the shoulder joint.** The scapula glides over the surface of the chest as the arm moves. In particular, the scapula moves when the arm is abducted more than 90°. It is moved by serratus anterior and trapezius.
- **Follow the axillary nerve from the posterior cord of the brachial plexus. At what site is it in danger of damage and how do you test it?** Surgical neck of the humerus (so may be damaged in fractures here or dislocations of the shoulder). Test by skin sensation over the insertion of deltoid. Axillary nerve also supplies deltoid which is the main abductor. Depending on the nature of the injury, this may be a possible test. Serratus anterior would be affected. Protraction of the scapula (as in punching etc) would be weakened. Scapular rotation would be affected so abduction of the shoulder beyond 90° would be weakened.
- **What is the triangular space? Quadrangular space? What passes through them?** The triangular space is between long head of triceps, teres major and humerus and contains the radial nerve and profunda brachii artery as they enter the spiral groove. The axillary nerve passes through the quadrangular space just medial to the upper end of the humerus. The radial nerve passes through a triangular space just distal to the quadrangular space. The long head of triceps forms the medial boundary of both spaces.
- **Capsule of the shoulder joint - what are its attachments to the surrounding bones?** The capsule is loose (to allow for much movement). It is attached to the margins of the glenoid cavity above, in front and behind. This allows a certain laxity which can be taken up in extreme shoulder abduction. On the humerus the capsule is attached to the anatomical neck with its fibres arching in front between the margins of the bicipital groove (greater and lesser tuberosities). This allows the tendon of the long head of the biceps to emerge.
- **How are joints supplied with arterial blood?** Profuse arterial anastomoses with branches from all neighbouring main arteries.
- **How are bones supplied with arterial blood?** (1) a nutrient artery which generally enters mid shaft and passes into the marrow cavity for haemopoiesis and gives branches into the Haversian canals; (2) numerous small branches which penetrate the periosteum directly, especially at places where muscles are attached; and (3) branches which enter at the attachment of joint capsules - the capsular or retinacular vessels.
- **What movements take place at the shoulder joint? Which muscles produce them? How are these muscles innervated?** There are so many - it is a very mobile joint. Flexion: pectorals (pectoral nerves). Extension; posterior scapular muscles (branches of the posterior cord). Adduction: gravity and pectorals. Abduction: Deltoid, supraspinatus, trapezius, serratus anterior.
- **What is the function of the following muscles: triceps brachii (elbow extension), biceps brachii (forearm supinator, elbow and shoulder flexor), brachialis (elbow flexor)?**
- **How may blood in the first part of the subclavian artery may reach the axillary artery following occlusion of the 2nd and 3rd parts of the subclavian artery?** Scapular anastomosis - look it up.
- **What would result from pressure (a) in the arm on the radial nerve - weakness of forearm extensors and sensory loss on the extensor aspect; and (b) in the axilla on the long thoracic nerve (winging of the scapula because of weakness of serratus anterior)?**
- **Describe the lymphatic drainage of the upper limb. The important thing is that lymph from the medial (little finger) side passes to (medial) epitrochlear nodes at the elbow before arriving at the axillary nodes. From the lateral (thumb) side there are no nodes until those in the deltopectoral triangle are reached.**
- **Describe the venous drainage of the upper limb. Deep and superficial.** A plexus of deep veins run with the main arteries (venae comitantes) and unite to form the axillary vein. Superficial veins are visible under the skin and pass up to penetrate the deep fascia at some point before joining the axillary or subclavians veins.

- **True or False - Fracture of the anatomical neck of the humerus would damage the axillary nerve** (False - the nerve is related to the surgical neck).

- **What movements would be impaired and which region of the limb would show a sensory loss if the musculocutaneous nerve were injured in the axilla?** Elbow flexion would be impaired (biceps, brachialis). Supination would be impaired (biceps). The musculocutaneous nerve continues in the forearm as the lateral cutaneous nerve of the forearm and so a large area of skin on the lateral forearm would be affected.
- **What do the following terms mean when applied to muscles and movements: (1) prime mover** - the thing that does the job, (2) **antagonist** - another muscle that opposes it, (3) **fixator** - another muscle that fixes the joint so that the prime mover can do its job and (4) **synergist** - a muscle that helps the prime mover? Relate these to movements at the elbow.
- **What are the functions of biceps brachii?** Elbow flexion. Supination. Shoulder flexion (weak). **Why is it important in using a screwdriver?** If you are right handed, use of a screwdriver necessitates supination. Biceps is the most powerful supinator but only when the elbow is flexed to 90° (about).
- **Which muscle groups are supplied by the (a) median** - most forearm flexors and thumb muscles, **(b) ulnar** - a few forearm flexors and most hand muscles - **and (c) radial nerves** - all extensors? **At which sites in the upper limb are these nerves in danger from entrapment or trauma?** Radial - spiral groove and mid shaft humerus. Median - carpal tunnel. Ulnar - behind medial epicondyle.
- Describe the sensory nerve supply and dermatomes of the arm. **Where would you test for sensory loss after damage to C5, T2?** Key dermatomes to remember are: C5 over deltoid; C7 middle finger; T2 axilla.
- **Where can you palpate the head of the radius?** Just distal to the lateral epicondyle at the elbow.
- **Which of the two styloid processes is the more distal?** Radial.
- **What is Allen's test?** Get someone else to press over both radial and ulnar pulses. Make a fist and squeeze tight to empty the hand of blood. Then relax the hand - the palm should be quite pale. Then ask the other person to release one of the pulses and see how fast the palm becomes pink again. You can compare the ulnar supply with the radial and one hand with the other. It is useful in assessing palmar perfusion in peripheral arterial disease, particularly when planning to insert an arterial cannula which might obstruct one of the arteries.
- **Which carpal bones articulate with (a) the radius** - scaphoid and lunate - **and (b) the ulna** - none!
- **Carpal tunnel syndrome - What? Why?** The median nerve runs through the carpal tunnel which is the area deep to the flexor retinaculum (attached to scaphoid, trapezium, pisiform, hamate). The ulnar nerve does not. So if you get compression of structures in the carpal tunnel the median nerve will be affected leading to weakness in the thenar muscles and sensory changes in the lateral 3 and a half digits. But not over the thenar muscles - because the nerve that supplies here is given off from the median nerve in the forearm so it would not be affected by carpal tunnel syndrome.
- **Deep and superficial palmar arches - how are they formed? Surface markings?** You must know these. Deep: mainly radial. Superficial: mainly ulnar. But both contribute to both, usually. The deep arch is roughly level with the base of the extended thumb and the superficial with the tip of the extended thumb.
- **What are synovial sheaths? How are they supplied with blood?** Bags of synovial fluid that wrap themselves around tendons to reduce friction in places where the tendons pass through confined spaces. They are supplied with blood by small arteries that enter the tendon in the mesotendon. The synovial sheaths are arranged like the peritoneum so that the tendon has a 'mesentery' - the mesotendon.
- **Read an account of the fascial spaces of the palm. What are these spaces called and what forms their boundaries?** The spaces are potential spaces deep to the flexor tendons, between them and the interosseous muscles. Several versions exist and some there is variation from person to person. A useful average is that there is a midpalmar space and a thenar space. The midpalmar space is on the ulnar side and the thenar on the radial side. They are separated by a connective tissue septum more or less overlying the tendons to the middle finger. They can be the sites of infection.

## Hand

- **List the structures of the hand supplied by the ulnar, median and radial nerves.**
  - Ulnar: hypothenar muscles, adductor pollicis, possibly some other thenar muscles, all interossei, ulnar two lumbricals, skin over palmar and dorsal aspects of little and half of ring finger.
  - Median: radial two lumbricals, most thenar muscles, skin over palmar aspect of thumb, index, middle and half ring fingers.
  - Radial: skin over dorsal aspect of radial 3 and a half digits.
- **Draw the cutaneous distribution of the ulnar, median and radial nerves in the hand. How is this related to dermatomes of C6, 7 and 8?** You need to appreciate once again that several nerves can contribute to one dermatome, and any nerve can give fibres to more than one dermatome. So if, for example, sensory symptoms are confined to dermatome boundaries, the lesion is one of spinal nerve roots or spinal cord. If sensory symptoms are not confined to dermatomes, but to nerve distributions, the lesion is of the peripheral nerve.
- **Which of the muscles of the hand may be innervated by either the ulnar or median nerves?** Flexor pollicis brevis may be supplied by either the ulnar, the median or both. Opponens pollicis is usually supplied by both – this is a small muscle but important, but the ability to oppose the thumb is what makes the hand useful.
- **Define flexion, extension, abduction and adduction of the fingers and thumb. At which joints do these movements take place?** The thing is that these movements in the fingers are defined as being at right angles to those in the thumb. They take place at the carpometacarpal joints.
- **Which movement of the thumb is most significant in testing for integrity of the median nerve?** Abduction.
- **Find the deep branch of the ulnar nerve. How is it related to the hook of the hamate?** It is medial (ulnar side) to the hook. **What artery accompanies it?** Deep branch of ulnar. **How do you test it?** Test the interossei.
- **What is meant by (a) the pulp space of the finger?** The fleshy part of the palmar aspect of the finger tips. Infections here are very painful because there are numerous small compartments. (b) the midpalmar space - see above.
- **Why may a tenosynovitis of the thumb sometimes spread to the fingers?** Because the synovial sheath of flexor pollicis longus may communicate with those of the other digits.
- **What is the extent of the digital flexor synovial sheaths?** They extend a couple of centimetres or so back into the forearm.
- **Dislocated lunate - why? what effect?** Fall on the outstretched hand. Compresses median nerve.
- **Fractured scaphoid - why? what effect?** Fall on the outstretched hand. Avascular necrosis of the proximal segment of scaphoid - tenderness in anatomical snuff box.
- **Explain the attachments and action of the lumbricals.** They pass from flexor tendons to extensor tendons. They pull on extensor tendons so extend the proximal and distal interphalangeal joints. But they pass distal to the axis of the carpometacarpal joints, so they flex this one. Straight finger flexion, in short.
- **What would be the effect in the hand of an apical lung tumour invading the neck of the first rib? Why? What would the patient notice?** T1 fibres interrupted. Small muscles of the hand (lumbricals, interossei, thenar, hypothenar) weakened (digital dexterity affected). ALL SMALL MUSCLES OF THE HAND ARE SUPPLIED BY T1 SPINAL SEGMENT. IT DOES NOT MATTER WHETHER T1 FIBRES ARRIVE IN THE MEDIAN OR ULNAR NERVES. Also, sensory loss over medial surface of arm (T1 dermatome).
- **Note the pattern of the veins on the dorsum of the hand and the formation of the basilic and cephalic veins. How does the cephalic vein drain? What fascia does it perforate?** Through the clavipectoral fascia into the axillary/subclavian veins.
- **Describe the course of the radial nerve from axilla to wrist. Behind** humerus in spiral groove. Emerges laterally in cubital fossa between brachialis and brachioradialis. At head of radius divides into deep branch (aka posterior interosseous nerve) which supplies extensor forearm muscles) and superficial branch which continues down lateral side of forearm to terminate in cutaneous branches of the lateral three and a half digits of the back of the hand. Some variability but first interosseous space always radial.

- **Which group of lymph nodes may be associated with (1) a septic thumb - deltopectoral (see above) and (2) infection of the remaining fingers - epitrochlear - see above).**
- **Which carpal bone lies in the floor of the anatomical snuff box? - scaphoid. Why may this bone be slow to repair?** Blood vessels enter distally and it usually fractures at the waist, so the proximal part may be poorly supplied with blood in these circumstances. Poor blood supply = poor healing.
- **Note how the radial nerve is related to supinator. Is the superficial branch of the radial nerve at the wrist sensory or motor or mixed?** Sensory only.
- **Which muscles in the extensor compartment of the forearm are supplied by the posterior interosseous branch (= deep branch) of the radial nerve?** All except those that get branches of the radial proximal to its division into deep and superficial branches. These would be brachioradialis, and extensor carpi radialis longus and brevis.
- **What can you feel in the anatomical snuff box?** Scaphoid, styloid process of radius, radial artery. **What are the tendons which form its boundaries?** EPL, EPB and APL. Revise the surface anatomy of the anterior aspect of the carpal region.
- **What is the nerve supply of the first dorsal interosseous muscle? - Ulnar. What is the nerve supply of the skin over the first dorsal interosseous muscle? - Radial.**
- **What is tennis elbow?** Inflammation of the common extensor origin (lateral epicondyle).
- **What is the mechanism of (a) brachioradialis, and (b) biceps tendon reflexes?** Involves spinal segments C5, 6. Brachioradialis flexes the elbow from the midprone position. Biceps is a powerful flexor and supinator.
- **How do the extensors insert into the phalanges?** Extensor expansion. It matters to orthopaedic surgeons dealing with traumatic injuries to the backs of the fingers.
- **Which joints do the extensors extend?** All of them
- **What is the difference between Klumpke's paralysis and Volkmann's contracture?** Volkmann's is a result of damage to the artery (eg the brachial artery after an supracondylar humeral fracture) - the muscle supplied by the artery atrophies and is replaced by fibrous tissue. Klumpke's is a lower trunk brachial plexus injury (C8, T1).
- **What limits movement at each joint?** Shape of bones, attachment of muscles, tendons, capsules, ligaments.
- **Are articular discs, bursas or sesamoid bones present in relation to each joint?** Think of other joints at which these features may be present. Articular discs are present in the sternoclavicular and acromioclavicular joints, but not elsewhere in the upper limb. Bursae are important at the shoulder: subacromial (subdeltoid), subscapular, supraspinatus bursae.
- **Which carpal and forearm bones are commonly fractured and dislocated?** A fall on the outstretched hand may result in: fractured radius (Colles' fracture - common), fractured clavicle (common), fractured scaphoid, fractured humerus (mid shaft), dislocated lunate.
- **What are spinal root values for movements at these joints: glenohumeral, elbow, radioulnar, radiocarpal, MCP, IP?**
  - Glenohumeral: extension, abduction C5; flexion, adduction C6,7,8.
  - Elbow: flexion C5,6; extension C7,8.
  - Radioulnar: supination; pronation C6.
  - Fingers: flexion and extension (long tendons) C7,8.
  - Fingers: abduction, adduction, small muscles: T1.
- **How do you test flexor digitorum profundus?** Flexion of distal IP joint.
- **How do you test flexor digitorum superficialis?** Flexion of proximal IP joint with the other fingers fixed in extension.
- **What is the action of the lumbricals?** Flexion of the MCP and extension of the IP.
- **Which is the most useful digit? Why?** Thumb. Grip. Or index finger.

- **What is the blood supply to the middle finger?** Branches of palmar arches.
- **Nail, hair, hoof, antler, tooth, cornea, shell (of tortoise, not egg). What is the connexion?** All epidermal appendages with some connective tissue components on some.