Terminal Nerves of the Brachial Plexus

Anatomy
RHS 241
Lecture 17
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Musculocutaneous nerve

- C5,6,7
- Arises from the lateral cord
- Enters the arm by piercing the coracobrachialis
- Courses deep to the biceps brachii muscle
Musculocutaneous nerve

- **Motor** distribution: innervates all muscles of the *anterior compartment of arm* (biceps brachii, coracobrachialis, brachialis)

- **Sensory** distribution: the *lateral cutaneous nerve of the forearm* .........
Musculocutaneous nerve lesion sites / clinical conditions

• As the nerve courses within the axilla: uncommon

• **Motor** changes: weakened flexion & supination of the forearm

• **Cutaneous** changes: lateral forearm (part of the C6 dermatome)
Median nerve

- C5 – T1

- Arises as two roots from the lateral & medial cords

- Courses within the medial (protected) side of the arm
Median nerve

- Crosses the elbow joint just medial to the biceps tendon

- Courses within the **anterior compartment of the forearm** (deep to the flexor digitorum superficialis)

- Enters the hand by passing through the **carpal tunnel**
Median nerve

- **Motor** distribution:
  - Arm: none

  - Forearm: innervates all muscles of the anterior compartment except the flexor carpi ulnaris and ulnar half of the flexor digitorum profundus

  - Hand: thenar muscles and the lateral two lumbricals
Median nerve

- **Sensory** distribution:
  - Arm and forearm: none
  - Hand: lateral 2/3rds of the palm, plus the lateral 3 ½ fingers
Median nerve
Entrapment sites

• Elbow level: as the nerve enters the forearm by passing between the two heads of pronator teres

• Hand: as the nerve courses through the carpal tunnel
Median nerve
clinical conditions

- **Ape hand:**
  - due to unopposed pull by the extensors & long abductor of the thumb (innervated by..??)
  - the thumb is pulled dorsally and laterally to lie near the plane of the palm
  - wasting of the thenar muscles gives the lateral half of the hand a flattened’ ape-like appearance
Median nerve clinical conditions

- **Carpal tunnel syndrome:**
  - Painful hand condition caused by overuse (e.g., younger factory workers) or fluid/hormone changes (e.g., pregnancy)
  - Pain in the lateral side of the hand
Median nerve clinical conditions

• **Carpal tunnel syndrome:**
  
  - Muscle weakness (most noticeably of the thenar muscles and lateral two lumbricals)
  
  - Severe cases are treated surgically by releasing the flexor retinaculum
Ulnar nerve

• C7 – T1
• Arises from the **medial cord**
• Descends within the medial side of the arm
• Lies posterior to the medial epicondyle as it leaves the arm (compressing the nerve here is described as hitting one’s funny bone)
Ulnar nerve

- Enters the forearm by passing between the humeral and ulnar heads of the flexor carpi ulnaris

- Enters the hand by coursing superficial to the flexor retinaculum
Ulnar nerve

• **Motor** distribution:
  - Arm: none
  - Forearm: innervates the flexor carpi ulnaris and the ulnar ½ of flexor digitorum profundus
  - Hand: all muscles of the hypothenar eminence, all interossei, the 4\textsuperscript{th} & 5\textsuperscript{th} lumbricals, and the adductor pollicis
Ulnar nerve

- **Sensory** distribution:
  
  - Arm and forearm: none
  
  - Hand: skin of the medial 1/3\textsuperscript{rd} of the palm, plus the 5\textsuperscript{th} finger and ulnar half on dorsal and palmar aspects of the ring finger, plus all joints it crosses
Ulnar nerve
Entrapment sites

- Elbow level: as the nerve enters the forearm by passing between the two heads of the flexor carpi ulnaris

- Wrist: as a component of Guyon’s tunnel
Ulnar nerve
clinical conditions

• **Claw hand:**
  - Clawing of the ring and 5\textsuperscript{th} fingers
  - Clawed finger = one in which the MPJ is hyper-extended and both the PIPJ & DIPJ are pulled into flexion
  - Most severe when entrapments of the ulnar nerve occur at the wrist level
    
    Explain Why.........?
Radial nerve

- C5 – T1
- Arises from the posterior cord
- Courses laterally & inferiorly to enter the posterior compartment of the arm
- In the arm, the nerve lies within the spiral groove of the humerus
Radial nerve

- Lies anterior to the lateral condyle of the humerus as it enters the forearm
- Divides here into the superficial branch (sensory/cutaneous) and deep branch (motor)
- The deep branch enters the forearm by passing between the heads of the supinator muscle
Radial nerve

• **Motor** distribution:
  - Innervates all muscles within the posterior compartments of the arm & forearm (e.g., extensors of the elbow and wrist)
Radial nerve

• **Sensory** distribution: cutaneous
  - Arm: lower half- lateral arm
  - Forearm: central posterior
  - Hand: lateral half of the dorsum
  - 3 ½ fingers dorsally
Radial nerve
Entrapment sites

- Arm: as the nerve lies in the **spiral groove of the humerus** (e.g., mid-humeral fractures)

- Proximal forearm: as its deep branch passes between the heads of the **supinator muscle**

- Axillary damage of the radial nerve can result from extended use of long crutches
Radial nerve
clinical conditions

• **Wrist drop:**

  - Due to lost innervation to the extensors of the wrist
  - Sensation of the dorsal skin of the hand (lateral side) is unchanged with lesions of only the deep branch of the radial nerve
Axillary nerve

- C5 – C6
- Arises from the posterior cord
- Courses laterally to pass through the quadrangular space
- Closely related to the surgical neck of humerus
Axillary nerve

- **Motor** distribution:
  - Innervates the deltoid & teres minor muscles

- **Sensory** distribution:
  - Cutaneous to the skin over the lower half of the deltoid muscle (the vaccination area)
Axillary nerve
Entrapment sites

- As the nerve passes through the quadrangular space to innervate muscles of the posterior shoulder

- Loss of function usually occurs with anterior dislocation of the shoulder

- The nerve is stretched by the downward and medial displacement of the proximal end of the humerus
Axillary nerve clinical conditions

- Weakened / lost abduction of the arm (particularly beyond $30^\circ$

- Sensory changes within the vaccination area
Secondary motor nerves arising from the brachial plexus

**Long thoracic nerve:**
- Arises from roots C5-C7
- Descends on the surface of the serratus anterior muscle (near the mid-axillary line)
- Motor to the serratus anterior

- Damage of this nerve: “winging of the scapula”
Secondary motor nerves arising from the brachial plexus

Suprascapular nerve:
• Arises from roots C5-C6 (superior trunk)
• Passes across the superior boarder of scapula
• Innervate the supraspinatus & infraspinatus
Secondary motor nerves arising from the brachial plexus

**Thoracodorsal nerve:**
- Arises from roots C6-C8 (posterior cord)
- Descends vertically to innervate the lattisimus dorsi
Secondary motor nerves arising from the brachial plexus

**Lateral pectoral nerve:**

- Arises from roots C5-C7 (lateral cord)
- Passes anteriorly to innervate pectoralis major (superior half) and medial fibers of pectoralis minor
Secondary motor nerves arising from the brachial plexus

**Medial pectoral nerve:**

- Arises from roots C8-T1 (medial cord)

- Passes anteriorly to innervate pectoralis major (inferior half) and pectoralis minor
Cranial nerves

• Take their origin from the brain which is located in the cranium “cranial nerves”

• Leave the CNS via foramina in the cranium

• Numbered in a way that indicates the order in which they leave the brain
Olfactory – **CNI**- special sensory (smell)
Optic – CNII- special sensory (sight)
Oculomotor – CNIII - motor, PS (eyeball)
Trochlear – CNIV- motor (eyeball)
Abducent – CN VI - motor (eyeball)
Facial – **CN VII** - motor, sensory, PS

(a) Parasympathetic efferents and sensory afferents

(b) Motor branches to muscles of facial expression and scalp muscles

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Vestribulocochlear – CN VIII
special sensory (hearing/equilibrium)
Glossopharyngeal – CN IX - motor, sensory, PS

- Pons
- Parotid gland
- Parasympathetic fibers
- Glossopharyngeal nerve (IX)
- Jugular foramen
- Superior ganglion
- Inferior ganglion
- Otic ganglion
- Stylopharyngeus
- Carotid sinus and body
- Pharyngeal muscles
- Common carotid artery

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Vagus – CNX- PS, motor, sensory
Accessory – CNXI - motor

- Jugular foramen
- Vagus nerve (X)
- Cranial root diverges and joins vagus nerve
- Accessory nerve (XI)
- Sternocleidomastoid muscle
- Trapezius muscle
- Pons
- Medulla oblongata
- Cranial root
- Spinal root
- Foramen magnum
- Cervical region of spinal cord (C₁ - C₅)
Hypoglossal – CNXII- motor (tongue)
Clinical questions on the UL

• Q: Where in the arm is the radial nerve at most risk of injury?

• A: risk of crushing injury where it lies next to the bone in the spiral groove at the back of the humeral shaft
Clinical questions on the UL

• Q: How does the motor nerve supply to the primary pronators & supinators of the forearm differ?

• A: the primary supinators (the supinator muscle) is innervated as an extensor via the radial nerve. The primary pronators (pronator quadratus & pronator teres) are innervated as flexors via the median nerve
Clinical questions on the UL

• Q: If the musculocutaneous nerve is severed, is elbow flexion still possible?

• A: yes, weak elbow flexion is still possible. The muscle responsible for this action is brachioradialis (since the biceps and brachialis would be paralyzed)
Clinical questions on the UL

• Q: what would be the motor deficit if the median nerve was cut at the elbow?

• A: loss of pronation, weakness in wrist flexion, loss of thumb mobility, and ulnar deviation of the hand
Clinical questions on the UL

- What is “student elbow”?

- Friction bursitis affecting the superficial olecranon bursa
Clinical questions on the UL

• What motions of the elbow would be hindered if the ulnar nerve were severed in the arm?

• None, because the ulnar nerve does not innervate any prime movers of the elbow
Clinical questions on the UL

• Where in the forearm and wrist are the ulnar nerve and median nerve most at risk of entrapment?

• A patient can pick up a suitcase but can’t pick up a dime. Speculate on the underlying mechanical problem.
Clinical questions on the UL

• Q: what are the palpable bony landmarks of the distal radius and ulna?

• Q: describe how the radial, ulnar, and median nerves enter the forearm

• Q: if the radial nerve is severed at the wrist, what would be the motor deficit?