**PERIPHERAL NERVE LESIONS**

**UPPER LIMB**

- GENERAL PRINCIPLES
- BRACHIAL PLEXUS LESIONS
- PERIPHERAL NERVE LESIONS
  - Axillary n.
  - Median n.
  - Ulnar n.
  - Radial n.
- CASE STUDIES

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**GENERAL PRINCIPLES**

- **ETIOLOGY**
  - Direct trauma
  - Dislocation, falls, traction during birth
  - Entrapment/Compression
  - Neuritis

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**Distribution**

- Each nerve in a plexus contributes to several peripheral nerves.
- Each peripheral nerve of a plexus contains fibers from several spinal nerves.
- Motor fibers in a spinal nerve (ventral root) generally supply more than one muscle.
- Each muscle usually receives fibers from more than one spinal nerve.

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**Typical Spinal Nerves**

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Motor Deficit Principles

- Section of **spinal nerve** results in weakness.
- Section of **peripheral nerve** results in paralysis.
- If **completely severed**, all muscles supplied by that peripheral nerve will be paralyzed, flaccid, and will slowly atrophy.
- If **partial lesion**, muscles supplied by that nerve will be weakened (paresis). Some fibers die out, but remaining hypertrophy.
- **Position of limb** after injury depends on antagonistic action of intact muscles.

Sensory Deficit Principles

- Skin areas supplied by spinal nerves (dermatomes) are different from the skin areas supplied by the peripheral nerves.
- There will be partial or complete loss of sensation (anesthesia) in areas supplied by the injured nerve depending upon the amount of damage.
- Sensation can be manifested as: pain, paresthesia (abnormal sensation) or anesthesia.
Autonomic Deficit

- Loss of vasomotor supply to blood vessels leads to flushing of skin.
- Loss of innervation to sweat glands produces a dry skin (anhidrosis).

BRACHIAL PLEXUS INJURY
Upper Roots (C5,6) - Erb-Duchenne’s Paralysis

- **Causes** - Downward traction (widen neck angle) More common with birth injuries and falls
- **Motor** – Nerve to deltoid, supra & infraspinatus, teres minor, rhomboids, levator scapulae, and musculocutaneous n.
- **Deficit** - “*Waiter’s Tip*” Sign
  - Loss of abduction (Arm hangs close to body)
  - Loss of lateral rotation (Arm medially rotated)
  - Weakness of forearm flexors (Forearm extended)
  - Weakness of supination (Forearm pronated)

BRACHIAL PLEXUS INJURY
Lower Roots (C8,T1) – Klumpke’s Paralysis

- **Causes** - Upward traction - More common with breech deliveries, break fall, cervical ribs
- **Sensory** - Medial surface of arm and hand
- **Motor** - Median & ulnar n
- **Deficit** - "*Claw Hand*" of all digits
- **Deficit** - Loss of thenar & hypothenar muscles

Brachial Plexus Branches

- **Dorsal scapular** – Weakness of glenoid depression
- **Long thoracic** - Winged scapula
- **Suprascapular** - Weakness of abd.
- **Pectoral** – Weakness of add. and med. rotation
- **Subscapular** – Weakness of add. and med. rotation
- **Thoracodorsal** – Weakness of ext., add. and med. rotation
Axillary Nerve (C5,6)

- **Causes** - Most common by direct trauma, surgical head fracture, post. dislocation
- **Sensory** - Small area over deltoid
- **Motor** - Deltoid & teres minor
- **Deficit** - Weakness only (supraspinatus still produces some abduction and infraspinatus produces some lateral rotation).

Median Nerve ([C5],6,7,8,T1)

- **Causes** - Perforating wounds, cuts at wrist, carpal tunnel syndrome
- **Sensory** - Important loss is proprioception from digital branches (3 ½ digits)
- **Motor & Deficit** - Varies according to level

Median Nerve ([C5],6,7,8,T1) – Con’t

- **Above Elbow** *Benediction Sign*
  - Forearm flexion intact
  - Loss of pronation (Arm supinated)
  - Weakness of flexion and abduction of wrist (Radial deviation)
  - Loss of flexion of IP joints of radial 2 digits (Fingers extended)
  - Weakness of flexion of IP joints of ulnar 2 digits
  - Impairment of thumb movement (Loss of opposition)
  - At Wrist
    - Loss of intrinsic muscles of thumb

Ulnar Nerve (C7,8,T1)

- **Causes** - Gunshot, stab wounds, fractures of medial epicondyle
- **Sensory** - Important loss of proprioception on ulnar border of hand (ring & little fingers)
- **Motor & Deficit** - Varies according to level
Ulnar Nerve (C7,8,T1) – Con’t

• Above Elbow (“Partial Claw Hand”)
  • Weakness of wrist adduction and flexion
  • Loss of flexion of distal IP joints of ulnar 2 fingers (Profundus)
  • Loss of flexion of MP joints of ulnar 2 fingers (Lumbricals & Interosses – Hyperextension of MP joints)
  • Loss of extension of middle and distal IP joints of ulnar 2 fingers and weakness of extension of radial 2 fingers (Lumbricals)
  • Loss of adduction of fingers
  • Loss of adduction of thumb

• Wrist (“Exaggerated Partial Claw Hand”)
  • Clawing more marked - both long flexors intact producing hyperflexion of ulnar 2 fingers

Radial Nerve ([C5],6,7,8,[T1])

Axilla

Causes - Direct trauma, pressure of crutches, “Sat. Night” paralysis
Sensory - Loss of strip along back of arm (not significant due to overlap) and hand
Motor & Deficit
  • Loss of forearm extension (Elbow flexed)
  • Weakness of forearm flexion (Loss of brachioradialis)
  • Loss of wrist extension (“Wrist Drop”)
  • Loss of extension of proximal phalanges
  • Weakened Ab/Adduction of hand
  • Limited thumb movements (Thumb flexed and adducted)
  • Weakness of supination (Hand pronated)

Radial Nerve ([C5],6,7,8,[T1]) – Con’t

Arm (Spiral Groove)

Causes - Fracture of shaft
Sensory - Similar to Axilla
Motor & Deficit - Similar to Axilla except Triceps OK or only weakened

Cubital Fossa

**Terminology consistency**
  • 2 br. from radial, 2 br. from deep radial & rest from post. Inteross
Causes - Direct trauma
Sensory - If lesion includes superficial branch then loss on dorsum of hand (2 ½ digits)
Motor & Deficit
  • Wrist extensors (radial side) unaffected or only weakened (Little wrist drop)
  • Loss of extension at MP joint
  • Weakness of thumb movements
  • Weakness of supination
Case #1

• Presenting symptoms (Chief Complaint):
  • Numbness and tingling of all fingers of left hand
  • Ulceration of tips of fingers on same hand
  • Uselessness of the hand

• Presenting signs:
  • Dropped shoulder
  • Weak radial pulse
  • Flat, weak hand

• Previous history:
  • Biopsy of lymph node in the neck

• Diagnosis & explanation ?

Case #1 – Diagnosis & Explanation

• The surgical biopsy of the cervical lymph nodes severed the spinal accessory nerve which resulted in a dropped shoulder on the affected side due to paralysis of the trapezius muscle. This resulted in two problems: 1) The dropped shoulder stretched the lower trunk of the brachial plexus which affected the intrinsic muscles of the hand by both ulnar and median nerves; and 2) The dropped shoulder compressed the subclavian artery as it crossed the 1st rib resulting in weak pulse and ulcerations.

Case #2

• Presenting symptoms:
  • Difficulty in reaching things on high shelves

• Presenting signs:
  • Square shoulder
  • Weakness of abduction

• Previous history:
  • Fractured ankle

• Diagnosis & explanation ?

Case #2 – Diagnosis & Explanation

• Damage to the axillary nerve was produced by a malfitting crutch used during the treatment of a fractured ankle. The square shoulder and difficulty in abduction is due to paresis of the deltoid muscle. There would also probably have been pain and paresthesia of the skin over the deltoid muscle with significant weakness of lateral rotation of the humerus.
**Case #3**

- **Presenting symptoms:**
  - Difficulty in driving home screws and in lifting 2 x 4's
- **Presenting signs:**
  - Weak but still present are flexion and supination of forearm
- **Previous history:**
  - Has just had the plaster cast removed from his arm which he broke "high up" two months ago

**Diagnosis & explanation?**

**Case #3 – Diagnosis & Explanation**

- Weakness of biceps and brachialis as a result of damage to the musculocutaneous nerve either by pressure from the plaster cast or during the initial injury. The musculocutaneous nerve can also undergo entrapment as it pierces the coracobrachialis.

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**Case #4**

- **Presenting symptoms:**
  - Increasingly useless hand, but grip fairly normal
- **Presenting signs:**
  - Wasted hand
  - Metacarpals very prominent on the back
  - Fingers partially flexed but not clawed
  - Some radial deviation of the wrist
- **Previous history:**
  - Severe arthritis of the elbow

**Diagnosis & explanation?**

**Case #4 – Diagnosis & Explanation**

- Entrapment of the ulnar nerve posterior to the medial epicondyle. The paralysis of the ulnar half of flexor digitorum profundus together with the continued activity of the lateral two lumbricals, innervated by the median nerve, reduces the amount of clawing significantly and often the deformity is limited to only partial flexion of the fingers. One of the first signs is paralysis of the 3rd palmar interosseous leading to abduction of the 5th digit which causes the patient to get finger caught when trying to put hand into pocket.
**Case #5**

- **Presenting symptoms:**
  - Painful wrist
  - Has difficulty in picking up small objects

- **Presenting signs:**
  - Partial clawing of index and middle finger
  - Cannot oppose thumb

- **Previous history:**
  - Painted the house yesterday

- **Diagnosis & explanation?**

**Case #5 – Diagnosis & Explanation**

- Repetitive use entrapment of the median nerve in the carpal tunnel. This syndrome is the most common and studied entrapment neuropathy. The clawing is only partial as the interossei are normal. The thenar muscles are supplied by the median nerve.

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**Case #6**

- **Presenting symptoms:**
  - Progressive loss of grip

- **Presenting signs:**
  - Hand somewhat dorsiflexed, thumb flat
  - Ulnar deviation on wrist flexion
  - Forearm rests in partial supination

- **Previous history:**
  - Had a painful elbow for about six weeks after wrenching his arm whilst changing a tire some two months ago

- **Diagnosis & explanation?**

**Case #6 – Diagnosis & Explanation**

- Entrapment of the median nerve as it passes through the pronator teres which was torn in the injury to the arm and is now healing. Ulnar deviation on wrist flexion is due to loss of flexor carpi radialis. Supination is due to loss of pronator quadratus.
Musculocutaneous Nerve (C5,6,7)

- **Causes** - Isolated lesions rare
- **Sensory** - Unimportant loss over area of lateral antebrachial cutaneous nerve.
- **Motor** - Paralysis of three anterior arm muscles.
- **Deficit** - Severe weakness of forearm flexion, weakness of supination ("Waiter’s Tip")