Radial Nerve Lesion (C5-C8)

There are three posterior divisions of the brachial plexus that form the posterior cord. The largest and most frequently injured part of both the posterior cord and the brachial plexus is the radial nerve. The segmental origin is C5-C8 but there is also a sensory component from T1.

Radial nerve compression or injury may occur at any point along the course of the nerve. The most frequent site of compression is the proximal forearm in the area of the supinator muscle and involving the posterior interosseous branch (posterior interosseous nerve syndrome). Problems may also occur proximally as a result of fractures of the humerus at the junction of the middle and proximal thirds, as well as distally on the radial aspect of the wrist (radial nerve palsy).

Anatomy

- In the axilla, the nerve gives off the posterior cutaneous nerve of the arm, a branch to the long and medial heads of triceps and then to the lateral head of triceps. It may travel in or near the spiral groove of the humerus.
- The nerve passes between the brachialis and brachioradialis and about 10 cm above the lateral epicondyle, on the anterior side of the arm, it gives branches to the brachioradialis and extensor carpi radialis longus.
- It divides in front of the radial head to become the posterior interosseous nerve and passes backwards through the supinator to supply the extensor muscles of the forearm.
- The nerve also supplies sensory fibres:
  - A sensory branch passes into the forearm deep to the brachioradialis and, about 8 cm from the radial head, it emerges between the tendons of the brachioradialis and extensor carpi radialis longus.
  - It supplies sensation to the dorsum of the thumb, with the exception of the subungual region that is supplied by the median nerve.
  - It also supplies the dorsum of the fingers as far distal as the proximal interphalangeal (PIP) joint and as far medial as the middle of the ring finger.

Causes of injury

- The radial nerve may be damaged by trauma or entrapped, especially between the heads of muscles.
- In the axilla:
  - With features of weak triceps, wrist drop and possibly also median and ulnar nerve involvement. The most common cause is compression.
  - The radial nerve may be damaged in the axilla by fracture or dislocation of the head of the humerus.
  - Saturday night syndrome (so named because it can be acquired by sleeping with the arm over the back of a chair whilst in a drunken stupor, so compressing the plexus):
    - Is due to compression of the lower part of the brachial plexus. As this is really a brachial plexus injury, the median and ulnar nerves may also be involved.
    - It may also be compressed by the use of shoulder crutches.
    - Nerve function usually fully recovers within a few weeks.

- In the upper arm (triceps and brachioradialis are often spared):
  - May be due to a compression lesion but fracture is the usual cause. Injections given in the arm of small babies can damage the radial nerve.
  - As the nerve often passes down in the spiral groove of the humerus, it may be injured with a fracture of the shaft of the humerus.

- At the elbow:
  - The radial nerve may be entrapped at the elbow at a number of sites but the most common is the proximal border of the tendon of supinator called the arcade of Frohse.
  - Check for tenderness over the radial tunnel. There may be pain when the fingers are extended against resistance.
  - Supination from a pronated position along with flexion of the wrist may reproduce the symptoms.

- Lesions at the wrist:
  - Cause finger drop with a normal wrist and intact sensation.
  - Causes include fracture of the radius, elbow deformity, soft-tissue masses and compression by the extensor carpi radialis brevis.

- Lesions of the superficial nerves (cause pain and sensory loss but no motor loss):
  - At the elbow, ruptured synovial effusion is the most common cause. In the forearm there may be an aberrant course through the muscles.
  - At the wrist, causes include compression from plaster casts, wristbands or handcuffs, especially the type that get tighter with struggling. Other causes are surgery, injections and nerve tumours.
Examination

A thorough neurological history and examination are required.

- The extent of loss of muscle power will depend upon the level of the lesion.
- Gowers described the typical posture that accompanies radial nerve lesions, especially Saturday night syndrome. There is wrist drop with slightly flaccid flexion of the wrist and the hand is pronated with the thumb adducted.
- The following lists the muscles supplied by the radial nerve and how to test each:
  - C7, C8: triceps - ask the patient to extend the elbow against resistance.
  - C5, C6: brachioradialis - ask the patient to flex the elbow with the forearm half way between pronation and supination.
  - C6, C7: extensor carpi radialis longus - ask the patient to extend the wrist to the radial side with the fingers extended.
  - C5, C6: supinator - with the arm by their side, ask the patient to resist hand pronation.
  - C7, C8: extensor digitorum - ask the patient to keep the fingers extended at the metacarpophalangeal (MCP) joint.
  - C7, C8: extensor carpi ulnaris - ask the patient to extend the wrist to the ulnar side.
  - C7, C8: abductor pollicis longus - ask the patient to abduct the thumb at 90° to the palm.
  - C7, C8: extensor pollicis brevis - ask the patient to extend the thumb at the MCP joint.
  - C7, C8: extensor pollicis longus - ask the patient to resist thumb flexion at the interphalangeal (IP) joint.

- Sensation:
  - The cutaneous branches of the radial nerve supply the dorsal aspect of the forearm from below the elbow down over the lateral part of the hand to include the thumb to the IP joint and the fingers to the distal interphalangeal (DIP) joint.
  - This includes the index and middle fingers but not the little finger. It usually includes the lateral side of the ring finger but may include all or none of it.
From examination of power and sensation, it is possible to determine the site of the lesion:

- Compression of the brachial plexus gives the typical picture seen with the lower segmental levels affected. Paralysis affects the forearm extensor muscles whilst the triceps is unaffected. Impaired sensation is limited to the dorsum of the hand.
In the upper arm, the triceps is supplied above the spiral groove and below the groove originate branches to the brachioradialis, extensor carpi radialis longus and brevis and the posterior cutaneous nerves of the arm and forearm. The last supply the lateral and dorsolateral arm and forearm. Around the elbow at the arcade of Frohse, the superficial radial nerve originates to supply the dorsolateral part of the hand and the first three digits. The posterior interosseous nerve also arises to supply the extensor carpi radialis brevis and supinator. Beyond the arcade of Frohse, the posterior interosseous nerve gives its terminal branches to supply the supinator, extensors of the fingers and thumb, extensor carpi ulnaris, abductor pollicis longus and branches to the wrist joint.

Investigations[1]
- A department of neurophysiology will be able to arrange nerve conduction studies.
- High-contrast ultrasound helps to identify the location, severity and cause of the condition. In some cases it may be more useful than nerve conduction studies.
- MRI scan may help to visualise a lesion such as a ganglion or a lipoma.

Management[1]
- Lesions from compression such as Saturday night syndrome and simple fractures usually recover spontaneously.
- General measures to reduce inflammation, such as splints and anti-inflammatory drugs, may be helpful.
- Complex trauma needs exploration with a view to surgical repair. Entrapment requires surgical decompression.

Further reading & references
- An interactive online guide to the Neurologic Examination; Neuroexam.com
- Radial Nerve; Wheeless’ Textbook of Orthopaedics
- Clinical Anatomy of the Radial Nerve; Anatomy Primer, Advances in Clinical Neuroscience and Rehabilitation (ACNR)


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