

## **Entrapment neuropathies**

### **Discuss the symptoms and signs of common entrapment neuropathies:**

Martin-Gruber anastomosis between the ulnar and median nerve in the forearm can result in atypical symptoms

**Carpal tunnel syndrome:** F: M 2-3:1 usually occurs at the age 40-60. Most commonly in people using hand extensively (computer board etc...). It is bilateral in 10%.

CTS is most commonly idiopathic (possibly born with small tunnel, tenosynovitis from repeated microtrauma results in further narrowing and symptoms).

Conditions associated with CTS (RA, hypothyroidism, acromegaly, DM, pregnancy 70%, fractures dislocation scaphoid, hamate).

1. Pain in the hand and forearm worse at night and with activities involving the use of the hand, relieved by shaking the hand or hanging it off the bed
2. Numbness, paresthesia in the 3.5 radial fingers.
3. Later atrophy of thenar muscles
4. Provocative tests: Tinel, phalen and blood pressure cuff test.
5. Nerve conduction studies (**the most sensitive electrophysiological test is the palmar sensory conduction time and amplitude (conduction velocity, latency)**. Other tests include motor conduction velocity (normal is 50 m/s). Sensitivity and specificity 90%.
  - A. Median –ulnar midpalmar latency comparison: normal difference is < 0.3 msec.
  - B. Median-ulnar ring finger latency: normal difference < 0.4msec.
  - C. Median-radial thumb latency: normal difference < 0.5 msec. (page 3858)

Differential diagnosis:

1. Spinal cord lesions (syringomyelia)
2. Cervical radiculopathy (C6, C7)
3. Thoracic outlet syndrome
4. Proximal median neuropathy
5. Peripheral neuropathies

Treatment:

1. Conservative treatment is indicated for patients with mild symptoms and CTS of pregnancy.
2. Surgical decompression: open or endoscopic (80% excellent outcome, 10% partial improvement, 9% no improvement and 1% deterioration).

**Complications:**

1. Incomplete decompression

2. injury to recurrent muscular branch
3. injury to the palmar branch
4. Painful scar
5. infection
6. Recurrent disease due to scaring
7. Disuse atrophy (RSD, Sudeks atrophy)

### **Entrapment of the median nerve above the wrist:**

1. Entrapment of the median nerve by supracondylar process and **Struthers ligament**( not arcade).2% of population has supracondylar process with Struthers ligament connecting this process to the medial epicondyle with the brachial artery and median nerve running under this ligament. Clinically patient has weakness of pronator teres and flexion of the fingers (FDS and FDP to index and middle fingers) in addition to CTS. X-ray may demonstrate the process. Treatment is excision of the process and ligament.
2. Pronator teres syndrome: median nerve can be compressed between the 2 heads of pronator teres, under the tendinous origin of FDS and by lacertus fibrosis (fascial band extending from biceps tendon to the deep fascia of the forearm. Presentation is pain in the arm and numbness as in CTS. Local tenderness over pronator teres with positive Tinel's sign on percussion over PT. Nerve conduction studies exclude CTS. Treatment is conservative in most cases (avoid activities causing symptoms, local steroids). Surgical exploration for patients who do not improve by conservative treatment
3. Anterior interosseous syndrome: due to entrapment of anterior interosseous nerve (forearm fractures, supracondylar fractures). This syndrome is characterised by pain in the forearm , weakness of FPL , pronator quadratus and FDP to index and middle fingers ( no sensory symptoms). Conservative treatment initially and operative exploration for those who fail to improve.

### **Ulnar nerve entrapment at the elbow:**

- Atypical symptoms and signs can be due to anomalous innervation such as
- 1. The flexor digitorum profundus is supplied by ulnar and median nerve. The FDP to the ring and little finger can be from the median nerve
- 2. Martin-Gruber anastomosis between ulnar and median nerve in the upper forearm.
- 3. Anomalous motor connection between ulnar and median nerve in the palm (Richie-Cannieu anastomosis).
- The possible points and causes of ulnar nerve compression at the elbow are :
- 1. **Arcade of Struthers** (thick facial structure between the medial head of triceps and the medial intermuscular septum)
- 2. The medial intermuscular septum
- 3. Between the heads of FCU in the cubital tunnel (arcuate ligament of Osborne)
- 4. Subluxation of the ulnar nerve at the medial epicondyle (found in 16% of normal individuals)

5. Epitrochleoanconeus muscle (found in 30% of individuals unilaterally and in 12% bilaterally)
  6. Space occupying lesions at the elbow (synovitis, arthritis, valgus deformity, ganglion, lipoma etc...)
  7. Chronic microtrauma (resting on the elbows during computer work)
    - Clinical diagnosis:
      1. Pain in the forearm and ulnar side of the hand.
      2. Numbness and paresthesia in the ulnar side of the hand
      3. Later weakness and atrophy of the hypothenar and intrinsic muscles of the hand (interossei and the 2 ulnar lumbrical muscles). McGowan classified ulnar entrapment into three grades (1-nomuscular weakness, 2-weakness but no atrophy, 3-weakness and atrophy). Signs to look for (**Froment's** sign-fexion of the thumb on holding object between index and thumb due to adductor pollicis weakness, **Wartenberg's sign**-abducted position of the small finger due to weakness of 3d palmar interosseous muscle and **clawing** due to interossei and lumbricalis weakness (weak interphalangeal extension of the small and ring fingers and unopposed flexion of PIJ due to flexor digitorum superficialis (median nerve)
      4. Provocative tests( Tinel's sign, elbow flexion with ulnar nerve compression for 30 s is the most sensitive provocative test)
      5. Nerve conduction studies: motor nerve conduction velocity at the elbow is the most useful electrophysiological test. Normal test does not exclude clinical diagnosis ( accepted normal velocity is 50m/s)
    - Differential diagnosis:
      1. Spinal causes (syringomyelia, glioma, amyotrophic lateral sclerosis)
      2. Cervical disc (C8, T1 radiculopathy)
      3. Thoracic outlet syndrome
      4. Compression of ulnar nerve in Guyon's canal (sensation over the dorsum of the hand is intact and FDP to the ring and little fingers are normal)
- Double crush syndrome when there is entrapment of the nerve at 2 levels (thoracic outlet and cubital tunnel. In this case the nerve distal to the first compression becomes more sensitive to mechanical and vascular injury.
- Treatment;
    1. Conservative: (avoid activities that exacerbate the symptoms and elbow splints): for mild cases.
    2. Surgical decompression: Literature is controversial regarding the best surgical procedure
      - A. In situ decompression. Simple, no trauma to the vascular supply of the nerve, similar results to more extensive procedures with fewer complications. 70-90% of patients has good results
      - B. Decompression with interposition of the nerve (subcutaneous, intermuscular and submuscular). These procedures require circumferential mobilisation of the nerve above and below the elbow and neurolysis of the muscular branches (injury to vascular supply). Higher complication rates. May be indicated for recurrent disease.
      - C. Medial epicondylectomy: may be indicated in patients with valgus deformity secondary to old fractures. Disadvantages are medial elbow instability, pain at the operation site and flexion contractures.
    - Complications:

1. Residual or recurrent symptoms (inadequate decompression or scarring)
2. Infection
3. Injury to medial cutaneous antibrachii nerve
4. Injury to the ulnar nerve or its muscular branches
5. Wound haematoma.

**Entrapment of the ulnar nerve at the wrist:** Guyon's canal is bound inferiorly by transverse carpal ligament, superiorly by volar ligament, proximally medially by pisiform bone and laterally and distally by the hook of the hamate. In the canal the nerve divides into superficial and deep branches. Deep branch runs in the hiatus between pisohamate ligament and tendinous sling between the hamate and pisiform bone.

Shea and McClain described three types

1. Type 1: entrapment of the nerve before division into superficial and deep branches. Weakness of intrinsic hand muscles and sensory changes on the ulnar side of the hand and ulnar 2 fingers (dorsal ulnar branch which is given 6-8 cm above the wrist is spared)
2. Type 2 : which is the most common (entrapment of deep branch)spares sensation but results in motor weakness of the intrinsic muscles supplied by the ulnar nerve except the hypothenar muscles
3. Type 3 (entrapment of superficial branch) : purely sensory symptoms in the palmar surface of the ulnar 2 fingers (sensation over the dorsum and hypothenar surfaces are intact).

Electrophysiology shows prolonged distal ulnar sensory latency in type 1 and 3 and prolonged distal motor latency in type 1 and 2

Compression can be due to ganglions of triquetrohamate and triquetropisiform joints, lipomas and repeated microtrauma (pipe-fitters, metal-polishers, cyclists )

Initial treatment is conservative (avoid activities causing the symptoms and local steroids. Surgery is indicated for persistent symptoms.

### **Entrapment of the radial nerve:**

1. Entrapment above the elbow: produces complete wrist drop, fingers drop and sensory disturbance over the dorsal surface of radial fingers and a anatomic snuffbox. Causes are crutch injury, Saturday nerve palsy-good prognosis for full recovery with conservative treatment (clinical and NCS follow up with delayed exploration if no recovery within 6 months) and humerus fractures either immediately or postreduction which require early exploration and release of the entrapped nerve between the end of the bone fragments.
2. Posterior interosseous nerve entrapment: produces pain and tenderness over the lateral aspect of the elbow, partial wrist drop with radial deviation on extension (preserved BR, extensor carpi radialis longus and brevis, loss of fingers extension and no sensory symptoms. Compression is caused by the arcade of Frohse (fibrous band over the point of entry of PIN between the 2 heads of supinator), lipomas, and ganglion from elbow joint. Patients who do not respond to conservative treatment are treated with exploration and release

- of the compressive element (incision from above the elbow between biceps and BR to 5 cm below the elbow with neurolysis of the radial nerve and its branches).
3. Entrapment of the superficial radial branch (Wartenberg's syndrome): pain in the lateral forearm w/wo sensory symptoms in the nerve distribution. Caused by cast, band or repeated trauma. Exploration and neurolysis if conservative treatment fails.

#### **Thoracic outlet syndrome:**

- Thoracic outlet is a triangular space (the base of the triangle is the first rib, the anterior limb is scalenus anterior and the posterior limb is scalenus posterior). The brachial plexus and the subclavian arteries pass through this space. These neurovascular structures can be compressed by cervical rib, fibrous band between a long TP of C7 and first rib, scalene muscle abnormalities. This is a rare syndrome.
- Patients may present with **vascular syndromes** from aneurysmal dilatation of SC artery w/wo embolisation (pain in the arm with exercise and abduction, cramps, coldness, cyanosis, and trophic changes) or **neurological syndrome** usually involving the lower trunk C8-T1 (pain in the medial forearm arm and ulnar fingers increased by arm abduction). Examination shows positive Adson's sign (loss of radial pulse with arm abduction), sensory loss over C8, T1 dermatomes, weakness and atrophy in the intrinsic hand muscle.
- Diagnosis is difficult because nerve conduction studies can be normal, the presence of cervical rib (found in 1% of the population) does not confirm the diagnosis (the majority of patients with cervical ribs are asymptomatic). MRI is helpful in excluding spinal pathology. Many patients with such symptoms have secondary gain (work compensation)
- Initial treatment is conservative: weight reduction, exercises to strengthen shoulder muscles. Surgical treatment is controversial. It is useful in small selected group of patients and can be done through supraclavicular or transaxillary approaches with excision of the first rib. The procedure involves division of scalenus anterior and any fibrous bands, excision of the cervical rib. Complications include phrenic nerve injury, thoracic duct injury, brachial plexus and vascular injury and other general complications. Results are variable.

#### **Suprascapular nerve entrapment:**

Patients present with pain in the shoulder during abduction and external rotation. On examination there is atrophy of supraspinatus and infraspinatus muscles (depends on the site of entrapment) with weakness of shoulder abduction. EMG demonstrates denervation potentials in SP and IS muscles the nerve is usually trapped in the suprascapular notch under the ligament (the suprascapular artery runs over the ligament) or at the lateral edge of scapular spine. Conservative treatment consists of shoulder exercises and local steroid injections. Surgical decompression by dividing the suprascapular ligament is indicated in patients with persistent symptoms and those with muscle atrophy.

**Musculocutaneous nerve entrapment:** rare syndrome characterised by pain over the lateral forearm with sensory changes in the distribution of LCA nerve. Initial treatment is conservative treatment (local steroid injection). Surgical decompression at the lateral margin of biceps tendon if conservative treatment fails.

**Meralgia paresthetica:** LFC nerve –L2-L3 emerges from lateral margin of psoas, runs over the iliacus muscle deep to the fascia and sometimes within the fascia. The nerve exits the pelvis below or through the inguinal ligament just medial to ASIS. It runs under fascia lata for 4 cm and divides into large anterior and small posterior branches which pierce fascia lata.

MP is characterised by pain and numbness over the lateral aspect of the thigh. It is more common in men and associated with obesity, pregnancy, ascites, and compression of lateral femoral cutaneous nerve by harnesses, belts etc. In 20% the disease is bilateral.

Investigations include MRI to exclude radicular and pelvic pathology (malignancy), sensory conduction velocity by stimulating the lateral thigh and recording beneath the inguinal ligament (potentials are usually absent on the affected site).

Treatment is conservative (weight loss; avoid belts and harnesses that cause inguinal compression, local steroid injections). Surgery is indicated in refractory cases.

Treatment options are neurolysis (high recurrence rate) and sectioning of the nerve (produces permanent numbness over the lateral thigh).

### **Entrapment of the peroneal nerve:**

1. **Common peroneal nerve:** characterised by weakness of the foot dorsiflexors and evertors and sensory symptoms over the anterolateral leg and dorsum of the foot.. The lesion results from nerve compression near the head of the fibula (cross leg palsy, plaster casts, prolonged squatting, it can be part of peripheral neuropathy). The nerve can be compressed by a ganglion arising from tibiofibular joint. Treatment depends on the cause if no cause is found and peripheral neuropathy excluded the nerve should be explored.
2. **Entrapment of the deep branch:** characterised by weakness and atrophy of dorsiflexors and numbness and paraesthesia in the first web space. The nerve is compressed in the anterior tarsal tunnel where the nerve and anterior tibial vessels run between the fascia running between the talus and navicular bone dorsally and EHL ventrally. Initial treatment is conservative (local steroid injections, wedged orthosis for the shoe to correct over pronation). Surgical decompression if conservative treatment fails
3. **Entrapment of superficial branch:** characterised by pain and numbness over the lower lateral leg and dorsum of the foot and is due to trauma or compression of the nerve 10 cm above the ankle where the nerve passes through the deep fascia. Diagnosis is confirmed by diagnostic nerve block. Treatment is by incising the deep fascia and neurolysis

### **Entrapment of posterior tibial nerve in the tarsal tunnel:**

Compression of the tibial nerve in the tarsal tunnel can be at the level of the medial malleolus or medial foot and is due to ganglion, hypertrophied abductor hallucis, fracture, varus heels. The condition is characterised by pain and paresthesia over the plantar surface of the foot. Tinel's sign may be positive and decrease in sensory conduction velocity may help in establishing the diagnosis. Differential diagnosis includes plantar fasciitis, achillis tendonitis. Treatment –division of flexor retinaculum and decompression of the nerve (preserve calcaneal branch which is given just proximal to the tunnel)

#### **Morton's neuroma (entrapment of the digital nerve in the foot):**

This syndrome is characterised by pain in the forefoot particularly over the 4<sup>th</sup> digit associated with exquisite tenderness over the 4<sup>th</sup> metatarsal head. It is more common in women and is due to chronic entrapment and injury of the digital nerves between the metatarsal heads. Some patients improve with local injections and shoe modifications. Surgical treatment consists of excision of the neuroma through dorsal incision in the web space.

#### **Entrapment of sciatic, saphenous and sural nerves:**

- Piriformis syndrome (entrapment of sciatic nerve in the infrapiriform foramen) is controversial and characterised by pain, numbness and weakness in the muscles innervated by sciatic nerve. Nerve conduction studies are disappointing. Some surgeons explore the nerve and divide the pyriform muscle.
- Entrapment of saphenous nerve in the subsartorial hunter's canal is well recognised syndrome characterised by pain and numbness in the nerve distribution. The diagnosis is confirmed by diagnostic block. Treatment is decompression of the nerve in the subsartorial canal.