Brachialplexus Injuries

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Brachial plexus injury
Structure and Function
Structure and Function

- Bondels aksone
- Gelei efferente impulse na spiere vanaf die anterior horingsel
- Gelei sensoriese impulse van perifere reseptore na die spinaalkoord

**MIXED NERVE**
Structure and Function

• Major motor and sensory axons are protected by MYELIN sheath
Pathology
Pathology

• Ischemia – acute nerve compression
  – Tingling within 15 minutes
  – Loss of sensation 30 minutes.
  – Motor weakness within 45 min.
• Relief of compression causes parasthesia.
• Temporary neural hypoxia. (Less than 4 hours)
Pathology  SEDDON

• Neuropraxia.
  – Axon intact no conduction –segmental loss of myelin.
  – Temporary lesion- recovers within days to weeks
  – Never longer than 8 weeks
  – Recovery spontaneous
Pathology

- Axonotmeses.
  - Perineurium stays intact
  - Proximal degeneration up to 1\textsuperscript{st} node of ranvier
  - Distal total degeneration only Schwann cell sheath left.
Pathology

• Neurotmeses
  – Nerve totally severed
  – No regeneration possible without surgery.
  – Never return to full function.
  – Without suturing – neuroma.
Note: Usual composition shown.
Prefix plexus has large C4 contribution but lacks T1.
Posterolateral plexus lacks C5 but has T2 contribution.

- 3 anterior divisions
- 3 posterior divisions
- 3 trunks
- Superior
- Middle
- Inferior
- Lateral pectoral nerve (C5, 6)
- Musculocutaneous nerve (C5, 6, 7)
- Axillary nerve (C5, 6)
- Radial nerve (C5, 6, 7, 8, T1)
- Median nerve (C5, 6, 7, 8, T1)
- Ulnar nerve (C7, 8, T1)
- Terminal branches
- 1st rib
- Long thoracic nerve (C5, 6, 7)
- Inconstant contribution

5 roots (ventral rami of spinal nerves)
- Dorsal scapular nerve (C5)
- To phrenic nerve
- To subclavius muscle (C5, 6)
- Contribution from C4
- Contribution from T2
- To longus colli and scalene muscles (C5, 6, 7, 8)
- 1st intercostal nerve
- Upper subscapular nerve (C5, 6)
- Thoracodorsal (middle subscapular) nerve (C6, 7, 8)
- Lower subscapular nerve (C5, 6)
Anatomy

- musculocutaneous n.
- axillary n.
- radial n.
- median n.
- ulnar n.
- lateral pectoral n.
- posterior
- medial
- dorsal scapular n.
- suprascapular n.
- to subscapularis
  teres major
  latissimus dorsi
- medial pectoral n.
- medial cutaneous nerves to the arm and forearm
- long thoracic n.
Anatomy
Anatomy

Anatomy of Brachial Plexis
Meganism

-
Brachial plexus injuries

- Most common due to traction injury (motorcycle), knife wounds & gunshots
- Pattern of paralysis depends on level of injury (high or low)
- High lesion C5 & C6 paralyzes of the shoulder abductors and external rotators
- Arm internal rotated with sensation loss over C5,6
C5.6 Injury
Brachial plexus injury

- Lower lesion (not very common) C7,8,t1
- Loss of intrinsic hand muscle function & sensation over ulnar part of hand and forearm
- Clinically the patient have a simian hand
Brachial plexus injury

• Entire plexus injured – limb paralyzed and no sensation
• Combinations of the above occur
Etiology

• Infection
  – Combination of mechanisms

• Inflammatory - neuritis
  – Mononeuritis / polineuritis

• Metabolic : Vitamin deficiency

• Neoplastic: Neuroma
The ABC of treatment

• Treatment depends on the seriousness of the injury and the type of injury

• Repair continuity of the nerve (in case of neurotmesis)
  – Sometimes a primary repair can be done
  – In other cases a graft might be necessary (nerve, artificial)
  – Methods in micro surgery
The ABC of Treatment

• Keep mobility distal
  – Prevent contractures of joints
    • Static and dynamic splinting
  – Prevent atrophy of muscles while recovery takes place
  – Prevent overactivity of muscles if synergistic muscles are paralyzed

• Monitor progression of nerve growth
  – Tinel test
  – Recovery of function
The ABC of Treatment

• Sensory function has more time to recover
  – NB Protective sensation

• Height of injury influence prognosis due to fibrosis and motorendplate degeneration
  Can follow progress with EMG monitor

• 18 months after injury muscle transfers if necessary and possible
The ABC of Treatment

• For important motor function certain, less important muscles are transferred
  – Flexors which now gives extension of the wrist
  – Muscle transposition to give opposition of thumb
  – Strength of muscles is very important in transposition of muscles
  – Rehab after transposition is critical
Traction Injuries
Management

Pre-ganglionic avulsions
1 or 2 stage neurotization
Nerve interposition repair
Combination of pre- and post ganglionic
Post ganglionic

High velocity
Total brachial plexus deficit
Signs of proximal injuries

Early surgical exploration
- After a few days
As soon as patient is stable - associated injuries
Whole plexus exposed

Low velocity
Type title here

History
Clinical examination
X-rays
TARGET NERVES

- N.Suprascapularis
- N.Musculocutaneous
- N.Axillaris
- N.Radialis
- N.Medianus
NEUROTIZATION OPTIONS

- Intercostal nerves
- N.Accessorius
- N.Phrenicus
- Cervical plexus
- Contralateral C7 root
TRACTION INJURIES

- History
- Clinical examination
- X-rays
  - Low velocity
  - High velocity partial brachial plexus injury
Conservative treatment for 3 months

• Clinical examination monthly
• EMG at 4-6 weeks
• If available:
  » MEP
  » SNAP
  » Sweet test
  » SSEP
• Clinical recovery and/or proximal to distal migrating Tinel
• Continue with conservative treatment.
• Follow up EMG at 6 months
One/more miotome with no recovery
Tinel static

Exploration

Post ganglionic

Nerve discontinuation / Neuroma in situ

NAP & CMAP <50%  NAP & CMAP >50%

Neurotization  Nerve interposition repair  Neurolysis
Options depend on:

1. Total amount of avulsions
2. Localization
3. Surgeon’s choice
OPEN BRACHIAL PLEXUS INJURIES

• LACERATIONS

With complete motor and sensory deficit in any motor and dermatome is relatively an easy decision because the chance for recovery is actually non existant. With tear wounds allow time for demarcation of injured nerves – therefore delayed primary suture is indicated.
GUNSHOT WOUNDS

• MISSILE WOUNDS
  – Low velocity gun shot wounds 75% recovery
  – High velocity 65% recovery
  – Indication for early exploration - vascular damage
  – Delayed exploration ±30% (±80% neurolysis only)
MISSILE INJURIES

• History
• Clinical examination
• X-rays
  – No vascular damage
    • Monthly exam
    • EMG at 4-6 weeks
      – Clinical recovery and Tinel advancing
OBSTETRICAL INJURIES

• Conservative first 3 months
• 3-4 months decision made exploration or not
• Exploration
  – neuromas excised and grafted
  – Avulsions neurotizations done
  – Postganglionic nerve grafts done
Brachial plexus injury
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Tendon Transfers
Brachial plexus injury

• REMEMBER
Etiology of injuries

- Laceration eg. Knife wounds fractures.
- Traction - in MVA’s, high velocity, low velocity
- Pressure - POP, crutches, “Sunday morning palsy”
- Gunshot wounds
Nervous ulnaris

- Usually injured at the wrist or elbow
- 2 Types: high & low
- Low lesion - hypotenar atrophy with a “klouhand” + poor abduction of fingers
- Loss of thumb adduction
Ulnaris

Abduktur digiti minimi

Poor abduction

Froment
Nervous ulnares

- High lesion - especially at elbow fractures
- Sometime ulnar neuritis (entrapment)
- F D Profundus ulnar ook uit dus minder klou van hand (ulnare paradox)
Nervous ulnaris
Nervous ulnaris questions

• What is the function of the intrinsic muscles of the hand?

• What is the functional position in which the intrinsic muscles of the hand holds the fingers and the MP joints?
Nervous Medianus

- Low lesion - wrist level
- Atrophy of tenare emmenensie
- Poor thumb abduction and opposition
- Specific sensation
- Carpal Tunnel Syndrome
Nervous Medianus

- High lesion
- The same but also paralyzes of the long flexors of the thumb, index and middle finger
- "Taxi call" when trying to make a fist
- Can’t “OK”
Nervous Medianus
Nervous Medianus
Nervous Medianus
Periphery nerve injury
The injury

- Walk with a “dropfoot” with atrophy of the calf muscle
Nervous Radialis

- Devided into three clinical groups:
  - Low lesion. Usually on the level of the elbow or wrist after fractures or dislocations
  - Cannot extend MP’s
Nervous Radialis

• Posterior interosseous nerve
  – Motor nerve of the posterior compartment of the forearm
  – Can be trapped where it moves between the two heads of the supinator muscle
Nervous Radialis

- High lesion - Usually after humerus fractures or lengthy tourniquet time
- Can’t extend wrist and have sensation lost
Nervous Radialis

- Very high lesion – Usually in the axilla after lengthy use of the old crutch
- The same as high lesion but paralyzes of the triceps as well
Nervous Ischiadicus

- After gunshot wounds and especially hip dislocations
- Supply motor function to every movement below the knee
Nervous Ischiadicus

- Sensation loss a major problem
- Complete dysfunction
Nervous Ischiadicus

• Therapist must always test Nervous ischiadicus when the patient have a lower limb injury, knee replacement

• NB!! Check regularly

• Also at upper limbs
Nervous peronealis

- Injured usually lateral of knee
- Two parts
- Total gives a “dropfoot” and loss of eversion and dorsal flexion
- Loss of sensation on the dorsal aspect of the foot and anterior and lateral of lower leg
Nervous peronealis

- Superficial branch
  - Loss of eversion but dorsal flexion is intact
  - Loss of sensation over outer part of foot and lower leg

- Deep branch
  - Poor dorsi flexion and loss of sensation in 1st web space
Treatment of periphery nerve injury
Rehab after transposition

• Immobilize for 3 – 6 weeks
• Start quickly with active exercises
• Move on to exercises against resistance
• It is critical to follow the rehab program extensively not to waste all the trouble of the operation
Tendon Injury

- Open injury
  - Wound
  - Loss of function
- Closed injury
  - Hematoom /swelling
  - Loss of function
Tendon Injury
Tendon Injury
Tendon Injury
Tendon Injury
Tendon Injury
Meganism of muscle injuries

- Open
- Closed
Treatment of muscle injuries

- Open
- Treat geass injuries
- Gesle
- Conservative
- RICE
REHABILITATION

• Continued physiotherapy and improvement
• At 2-3 years further reconstruction and tendon transfer to augment repair.
• History
• Clinical examination
• X-rays
  – Vascular damage
    • Vascular repair and explore nerves
Etiology

• Congenital
  – ERB C5 + C6
  – Proximal paralysis
  – Medial rotation
  – Adduction
  – Flexion of wrist
  – Waiters tip position
Etiology

- Congenital
  - Klumpke C8 + T1
  - Distal injury