Plexopathies

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**Brachial plexus birth trauma** → see [p. Ped9 >>](http://www.neurosurgeryresident.net/Ped.%20Pediatrics\Ped9.%20Perinatal%20Period.pdf#BRACHIAL_PLEXUS_INJURIES)

**Brachial plexus trauma** → see [p. PN7 >>](PN7.%20Trauma%20of%20Peripheral%20Nerves.pdf)

Etiology

* 1. ***trauma***
  2. ***neoplastic*** compression / infiltration (early prominent pain is characteristic!).
  3. ***radiation*** (painless and progressive weakness, usually bilateral but asymmetrical).
  4. ***immunologic attack*** (e.g. *brachial neuritis*, s. Parsonage-Turner syndrome).
  5. ***diabetes mellitus***.
  6. ***neurofibromatosis***.

Clinical Features

* *anatomy is complex* (difficult to recognize and localize) - different patterns of **motor** and **sensory** loss - depending on which portion of plexus is affected.
* best clue is motor & sensory deficit that involves more than one spinal or peripheral nerve.
* ***motor signs*** (weakness, tendon jerk loss, atrophy) are much more prominent than ***sensory changes*** (often patchy and incomplete).
* diffuse aching ***pain*** (sometimes quite severe) is often present!
* **plexus avulsion pain** is usually severe and immediate in onset: constant burning, crushing + intermittent shocklike pain.

Diagnosis

* **imaging**: N.B. high-resolution **MRI** is modality of choice!

1. ***empty enlarged nerve root sleeve***, often with contrast ***extravasation*** through rent in dura
2. ***pseudo-meningoceles*** (meninges pulled through intervertebral foramina) at levels of root avulsion.
3. ***failure to visualize avulsed*** ***intradural roots*** in cervical\* region when uninvolved rootlets are clearly visible.

\*roots usually seem intact in lumbosacral plexus avulsion injuries

1. look for ***neuroma*** at stumps of avulsed roots

* **EMG** is fundamental in localizing lesion (usually EMG is done 4 weeks after acute injury).
* *plexus stretch* injuries vs. *avulsion* injuries (avulsion injuries respond well to DREZ lesioning vs. stretch injuries).
* pure root injuries leave dorsal root ganglion intact - distal **nerve conduction velocities** are intact.
* **evoked potential** (after median nerve stimulation) shows delay at Erb's point.
* N9 dorsal root ganglion **evoked potential** is preserved in pure root avulsion.
* **CSF** may contain blood.

Treatment

* **acute transections** (lacerations with knife or glass) → rapid ***primary repair***.
* **closed stretch injuries** with severe axonal degeneration 3-5 months after injury → ***surgical*** ***exploration and repair***.
* **missile wounds** (usually leave nerve in continuity) - initial management is often ***conservative***.
* **avulsion of roots** - ***untreatable injury***; implantation of ventral roots into spinal cord may lead to recovery of motor function in animal and human studies.
* not improving **obstetrical palsy** → ***surgery*** at 3-9 months of age.

Pain management:

**plexus avulsion pain** → DREZ lesioning.

**distal stretch injuries** → spinal cord or deep brain stimulation.

Prognosis

* because of long regeneration distances, *intrinsic hand muscles* and *muscles below knee* reinnervate poorly after axon loss lesions.

Brachial Plexopathies

Trauma\* is most common cause! [other causes → see above >>](#Etiology)

\*stretching (motorcycle accidents, football injuries, breech delivery), penetrating

1. **Compressive injuries**
   * ***neoplastic*** plexopathies are characteristically painful; > 70% involve lower trunk and are due to axillary lymph node infiltration.
2. **Open injuries** most often affect ***infraclavicular*** plexus; often associated with injuries to major vessels and lung.
3. **Closed injuries**: birth trauma → see [p. Ped9 >>](http://www.neurosurgeryresident.net/Ped.%20Pediatrics\Ped9.%20Perinatal%20Period.pdf#BRACHIAL_PLEXUS_INJURIES)
4. ***supraclavicular*** - usually occur after high-speed motor vehicle accidents, often when rider is thrown from motorcycle, resulting in severe stretch injuries or avulsion of roots from cord.
   * Horner’s syndrome strongly suggests avulsion.
5. ***infraclavicular***- better prognosis (result of bony injuries in shoulder region; clavicular callus may compress plexus).

Clinical Syndromes

**Complete brachial plexus lesion** – **flail, anesthetic upper extremity** (except for medial strip along arm supplied by intercostobrachial branch of 2nd intercostal nerve).

**Duchenne-Erb palsy** (C5-6 roots or upper trunk lesion)

Causes:

1. most common cause – ***downward arm displacement***: fall from horse or motorcycle, obstetrics (*shoulder dystocia*).
2. ***direct pressure*** by carrying heavy objects (knapsack palsy), heavy backpacks; prolonged firing of shotguns; shoulder restraints in motor vehicles.
   * long necks, droopy shoulders, pendulous breasts may be contributing factors.
3. ***idiopathic*** ***brachial neuritis*** (s. Parsonage-Turner syndrome, neuralgic amyotrophy).
4. ***radiation-induced*** plexopathy.

Clinical features – mainly **shoulder & upper arm** muscles (deltoid, biceps, brachialis anticus, brachioradialis, pectoralis major, supraspinatus, infraspinatus, subscapularis, teres major) - “waiter’s tip” position:

* + upper arm hangs adducted (m. deltoideus – n. axillaris) and internally rotated (m. infraspinatus – n. suprascapularis).
  + can’t flex elbow; forearm is pronated (*m. biceps brachii – n. musculocutaneus*).
  + can’t reach with hand contralateral shoulder (*clavicular head of m. pectoralis major – n. pectoralis lat.*).
  + *sensory loss* is incomplete (hypesthesia on outer surface of shoulder, arm and forearm).

**Dejerine-Klumpke palsy** (C8-Th1 roots or lower trunk lesion)

Causes:

1. ***upward arm displacement***: obstetrics (*breech delivery*), shoulder dislocation.
2. ***metastatic*** plexopathy (axillary lymph nodes), infiltrating ***tumor*** from lung apex (Pancoast tumor).
3. true neurogenic ***thoracic outlet syndrome***, cervical rib, scalene syndrome.
4. coronary artery bypass surgery (associated with sternal retraction).

Clinical features – mainly **forearm & hand** muscles:

* + *n. ulnaris* + *n. medianus* (flexor carpi ulnaris, flexor digitorum, interossei, thenar and hypothenar) – can’t flex wrist, “claw hand”, “simian (flattened) hand”.
  + *n. pectoralis med.* – can’t adduct upper arm.
  + lesion to communicating branch to inferior cervical ganglion → *Horner's syndrome*.
  + *sensory* - hypesthesia on inner arm / forearm / hand.

**Middle Radicular Syndrome** (C7 root or middle trunk lesion) - paralysis of *n. radialis* muscles (except brachioradialis, which is spared entirely).

* + *sensory loss* is inconstant (hypesthesia over dorsal forearm surface and external part of dorsal hand surface).

**“Burners” / “stingers”** - symptoms following sudden shoulder depression in contact sports, usually football.

* + burning dysesthesias going down ipsilateral upper extremity (often into thumb) ± weakness of biceps and shoulder girdle muscles.
  + symptoms resolve within few minutes (occasional cases last for weeks).

**Root avulsions** more commonly involve C7-Th1 roots, whereas **extraforaminal ruptures** more commonly affect C5-6 roots.

Diagnosis

* + **plain cervical films** - fractured cervical trans­verse processes - presumptive evidence of nerve injury.
  + **cervical myelography** or **MRI** (2-4 weeks\* after injury) - ***traumatic pseudomeningoceles*** at site of avulsed nerve foots.

\*root avulsion is generally *not investigated radiologically* in acute stage

Treatment

* + flail or weak arm should be supported (immobilized across upper abdomen) against gravity to prevent additional damage!
  + injury by ***sharp object*** (knife, glass, needles) → early surgical intervention.
* **lost neural tissue** during initial exploration (for repair of other injuries) → early grafting (after allowing local edema to resolve).
  + ***blunt injuries*** → observation (duration depends on proximal or distal location of injury).
  + ***gun shot wounds*** → observation for up to 3 months (to help establish degree of neural injury); if serial examina­tions demonstrate 4-5° lesions → surgical intervention.
  + **root avulsions** (flail arm) → grafting of intercostal nerves to distal end of musculocutaneous nerve (gives useful elbow flexion when combined with distal limb prosthesis).

Neuralgic Amyotrophy (s. brachial plexitis, Parsonage-Turner syndrome, shoulder-girdle syndrome)

Similar disorder may affect lumbosacral plexus!

* + unknown cause (sporadic >> familial) - viral or immunologic inflammatory processes?
  + typically young men.
  + often preceded by some ***antecedent event*** (e.g. upper respiratory infection, hospitalization, vaccination, non-specific trauma, intravenous heroin, general anesthesia!!!).
  + may be **bilateral** and asymmetric.
  + upper trunk suffers most (actually, multiple proximal mononeuropathies):
* sudden onset of **severe pain** (usually about shoulder; often begins at night).
* soon followed by **weakness & wasting** of various forequarter muscles (esp. shoulder girdle); weakness is maximal within few days then regresses.
  + **nerve conduction studies** - ***axonal*** neuropathy (*demyelination* may play role in rare instances).
  + CSF is normal.
  + establish diagnosis - EMG
  + corticosteroids have no proven benefit.
  + clinical recovery takes 2 months ÷ 3 years (so don’t rush to operate!!!): good in 66%, fair in 20%, poor in 14%; if no improvement by 18-24 months, may recommend tendon transfer surgery.

Lumbosacral Plexopathies

Etiology

1. most frequently - ***penetrating*** injuries.

N.B. plexus is better protected in its *retroperi­toneal & pelvic location* - injury is not as common as brachial plexus injury!

1. hip ***surgery***, pelvic ***fractures***, pelvic ***hematomas*** in psoas muscle (e.g. due to anticoagulation).
2. ***labor & delivery*** (pressure by fetal head or forceps).
3. direct ***neoplastic*** infiltration.
4. ***radiation*** induced fibrosis (painless and progressive weakness, usually bilateral but asymmetrical)
5. ***idiopathic*** ***plexitis***.

Clinical Features

* most of motor output of **lumbar plexus** is in *femoral nerve*; of **sacral plexus** in *sciatic nerve* - it may be difficult to distinguish lumbosacral plexus lesions from lesions of their respective nerves.
* weakness of thigh adduction or sensory loss in inguinal region or over genitalia, are outside distribution of *femoral nerve*.
* weakness of thigh abduction & internal rotation and of hip extension, or sensory loss on posterior thigh are lacking in *sciatic nerve* palsy.

Bibliography for ch. “Peripheral Neuropathies” → follow this [link >>](http://www.neurosurgeryresident.net/PN.%20Peripheral%20Neuropathies\PN.%20Bibliography.pdf)

[Viktor’s Notes℠ for the Neurosurgery Resident](http://www.neurosurgeryresident.net/)

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