Approach to suspected nerve injury

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Case report

- 55 years old woman – Latarjet procedure
- ASA- 1, 49 kg.
- NKDA
- Informed consent for RA
- ISB with catheter – uneventful throughout, rate – 4/4/60 according to her weight
- Open Latarjet operation - unremarkable
Case report

- up to 10% neurological complications (musculocutaneous, axillary, radial and truncal)
Case report

- POD 1 – VAS - 0- 4/10, The patient had unwitnessed syncope at very early morning.
- Wrist drop- noted with sensory loss at all fingers.
- The pump stopped at midday due to extended area of sensory deficit and new onset of loss of muscle power of the fingers, the wrist and the forearm up to the elbow.
Case report

- POD 2 – VAS- 2-5/10, pain only on movement of the shoulder
- Total sensory loss at the fingers, the wrist and the elbow with very difficult elbow flexion and impossible elbow extension
- Neurology consult – midday:
  We merken een volledige plegie en areflexie van de rechterarm. Er is ook een hypo-esthesie met proximo-distale gradiënt en bewaarde scherp stompdifferentiatie en positiezin.
  - Emergency ultrasound performed after the consultation
Case report

- DD:
  1. Haematoma
  2. Perioperative plexus trauma (compression / elongation)
  3. Related to RA and the catheter nerve injury
  4. Psychogenic
The ultrasound showed -- haematoma at the axillary fossa -- large collection of the anterior side of the right shoulder to the left axillary artery extending from the inferior surgical scar and below the m. Pectoralis major. The estimated size - CC 9 x LL 5 x AP 2,5 cm.

Emergency surgery at the early afternoon- wound exploration and evacuation of the haematoma
Case report
Case report
Case report

- POD- 2 postoperatively
- Recovered sensation at the hand and the wrist with good motor function of the 1, 2, and 3 fingers and diminished muscle power of the 4 and 5 fingers
- Still persistent sensory loss of the forearm with recovered flexion but impossible extension
Case report

- POD 8-
- EMG:
  - the signs of nerve(s) injury are present- but not clear which part of the brachial plexus is affected:
    - axillary nerve?
    - upper brachial plexus?
  - to be repeated in 4 weeks time
Case report

- POD-35
- Anaesthetic consult:
  - Long conversation with the patient and the spouse regarding the nerve injury
  - Total motor deficit in the area of the right ulnar nerve distribution.
  - Unable to do either elbow flexion or extension and shoulder abduction
  - Active follow-up and treatment option
Case report

- POD- 62
- MRI of the brachial plexus- appeared oedematous.
- EMG - brachial plexus injury.
- Neurology consult:
  - paralysis of the proximal arm (shoulder abduction, elbow flexion and extension) and paresis of 3 to 4/5 of the hand and the wrist.
  - sensory loss in the upperarm with areflexia.
  - partial recovery of the hand.
## Case report

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Nerve</th>
<th>Cord</th>
<th>Trunk</th>
<th>Predominant root(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abductor Pollicis Brevis</td>
<td>Median</td>
<td>Medial</td>
<td>Lower</td>
<td>T1 &gt; C8</td>
</tr>
<tr>
<td>Adductor Digit Minimi</td>
<td>Ulnar</td>
<td>Medial</td>
<td>Lower</td>
<td>C8 &gt; T1</td>
</tr>
<tr>
<td>First Dorsal Interosseous</td>
<td>Ulnar</td>
<td>Medial</td>
<td>Lower</td>
<td>C8T1</td>
</tr>
<tr>
<td>Extensor Indiceis</td>
<td>Radial</td>
<td>Posterior</td>
<td>Lower</td>
<td>C8T1</td>
</tr>
<tr>
<td>Extensor Digitorum Communis</td>
<td>Radial</td>
<td>Posterior</td>
<td>Middle</td>
<td>C7</td>
</tr>
<tr>
<td>Brachioradialis</td>
<td>Radial</td>
<td>Posterior</td>
<td>Upper</td>
<td>C6</td>
</tr>
<tr>
<td>Flexor Carpi Radialis</td>
<td>Median</td>
<td>Lateral/Medial*</td>
<td>Middle/Lower*</td>
<td>C7/8*</td>
</tr>
<tr>
<td>Biceps</td>
<td>Musculocutaneous</td>
<td>Lateral</td>
<td>Upper</td>
<td>C56</td>
</tr>
<tr>
<td>Deltoid</td>
<td>Axillary</td>
<td>Posterior</td>
<td>Upper</td>
<td>C56</td>
</tr>
<tr>
<td>Triceps</td>
<td>Radial</td>
<td>Posterior</td>
<td>Middle</td>
<td>C7</td>
</tr>
<tr>
<td>Latissimus dorsi</td>
<td>Thoracodorsal</td>
<td>Posterior</td>
<td>Middle</td>
<td>C7</td>
</tr>
<tr>
<td>Pectoralis Major</td>
<td>Lateral &amp; medial pectoral nerves</td>
<td>Lateral &amp; medial</td>
<td>Lower &amp; Upper</td>
<td>C6/7/8</td>
</tr>
<tr>
<td>Infraspinatus</td>
<td>Suprascapular</td>
<td>Lateral &amp; medial</td>
<td>Upper trunk</td>
<td>C56</td>
</tr>
<tr>
<td>Serratus Anterior</td>
<td>Long thoracic</td>
<td>Lower</td>
<td>C56</td>
<td></td>
</tr>
<tr>
<td>Trapezius</td>
<td>Spinal accessory</td>
<td></td>
<td></td>
<td>C34</td>
</tr>
</tbody>
</table>

*Flexor Carpi Radialis was found to be spared in some patients with operatively confirmed C67 pre-ganglionic root avulsions but intact C8 fibres*
Case report

Treatment option(s):

ONLY ACTIVE PHYSIOTHERAPY

Prognosis:

POOR
Incidence

- Meta analysis- 32 studies 1995-2005 including > 1 million of encounters (1)
- Neuropathy
  - Spinal: 0.04% (4/10,000)
  - Epidural: 0.02%
  - Interscalene: 3%
  - Axillary: 1.5%
  - Femoral: 0.34% (3/1,000)
Incidence

Permanent nerve injury
- Spinal: 0% to 0.04% (4/10,000)
- Epidural: 0% to 0.07%
- Peripheral block: 1 case among 16 studies
<table>
<thead>
<tr>
<th>Investigator</th>
<th>Approach</th>
<th>Number</th>
<th>Incidence</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auroy (2)</td>
<td>Mixed</td>
<td>21,278</td>
<td>0.004%</td>
<td>Anaesthetic report</td>
</tr>
<tr>
<td>Schroeder (3)</td>
<td>Mixed</td>
<td>330</td>
<td>0.6%</td>
<td>Retrospective Chart Review</td>
</tr>
<tr>
<td>Horlocker (4)</td>
<td>Axillary</td>
<td>1,614</td>
<td>0.4%</td>
<td>Retrospective Chart Review</td>
</tr>
<tr>
<td>Stan (5)</td>
<td>Axillary</td>
<td>996</td>
<td>0.7%</td>
<td>Surgeon Referral</td>
</tr>
<tr>
<td>Fanelli (6)</td>
<td>Mixed</td>
<td>1,821</td>
<td>1.3%</td>
<td>Surgeon Referral</td>
</tr>
<tr>
<td>Urban (7)</td>
<td>Mixed</td>
<td>508</td>
<td>14%</td>
<td>Direct Follow-up</td>
</tr>
<tr>
<td>Borgeat (8)</td>
<td>ISB</td>
<td>521</td>
<td>14%</td>
<td>Direct Follow-up</td>
</tr>
<tr>
<td>Hartung (9)</td>
<td>Axillary</td>
<td>178</td>
<td>11%</td>
<td>Direct Follow-up</td>
</tr>
</tbody>
</table>
Incidence – UZ Leuven 2013-2014

- 2118 blocks
- 5 cases reported with suspected nerve injury
- Only 1 proved to be related to RA
- Lack of follow up protocol
Structure of a nerve – note that all nerves contain both myelinated and unmyelinated sensory and motor fibers (axons)
## Classification of nerve injuries

<table>
<thead>
<tr>
<th>Seddon</th>
<th>Sunderland</th>
<th>Structural and functional processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neurapraxia</td>
<td>1</td>
<td>Myelin damage, conduction slowing, and blocking</td>
</tr>
<tr>
<td>Axonotmesis</td>
<td>2</td>
<td>Loss of axonal continuity, endoneurium intact, no conduction</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Loss of axonal and endoneurial continuity, perineurium intact, no conduction</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Loss of axonal, endoneurial, and perineurial continuity; epineurium intact; no conduction</td>
</tr>
<tr>
<td>Neurotmesis</td>
<td>5</td>
<td>Entire nerve trunk separated; no conduction</td>
</tr>
</tbody>
</table>
Mechanism of nerve injury

- Direct trauma caused by the needle
- Local anaesthetic neurotoxicity
- Ischemic injury secondary to pressure and volume of local anaesthetic or added vasoconstrictors.
- Hematoma or vascular injury
- Intra-operative factors including surgical trauma and positioning
- Tourniquet injury
- Postoperative factors including swelling and positioning
Short versus long bevel needle
The frequency of injury is greater with long bevel needles,
The duration and severity of the injury is greater with short bevel needles.\(^{(10)}\)
Less severe when the bevel orientation is kept parallel to nerve fibers.\(^{(10)}\)
Local anaesthetic neurotoxicity

- Direct neurotoxicity of local anaesthetics is related to exposure to excessive concentrations or doses.
- Among the available local anaesthetics, ropivacaine seems to have the least potential for neurotoxicity.
- The concept of drug volume should be favored over the concept of drug concentration.
Intra-neural injection of local anesthetics may cause increased pressure within nerves and may compromise neural blood flow. \(^{(13)}\)

- Nerve stimulation versus paraesthesia
Basic steps

- Detailed patient history
- Physical exam
- Detailed case history
  - Anaesthesia procedure
  - Perioperative events
- Referral
- Investigations
- Follow-up
PRACTICAL APPROACH TO MANAGEMENT OF A PATIENT WITH NEUROLOGIC DEFICIT AFTER PERIPHERAL NERVE BLOCK

1. Speak to patient directly about onset, quality, duration of symptoms
   - Ongoing emergent process?
     - Evaluate for:
       - restrictive casts
       - compartment syndrome
       - retroperitoneal hematoma
   - Surgical cause?
     - Evaluate for:
       - nerve transection
       - excessive traction
       - long tourniquet time
       - sutures/screws/clips on nerve

2. Seek immediate neurologic and/or neurosurgical consultation
   - YES
     - Anatomical distribution?
       - Difficult to localize or multifocal
       - In the distribution of peripheral nerve(s) blocked
       - In common areas of entrapment (e.g. ulnar, peroneal)
         - Solely sensory changes?
           - YES
             - Reassure patient (95% resolution in 4–6 weeks, 99% by 1 year)
             - Instruct patient to call back if symptoms progress or do not resolve.
           - NO
             - Consider neurologic conduction studies.