ELECTROPHYSIOLOGY IN THE ADULT BRACHIAL PLEXUS PATIENT: A SURGEON'S PERSPECTIVE

CHETAN PATEL
PLASTIC AND HAND RECONSTRUCTIVE SURGEON
SANDTON MEDICLINIC
It was said that Alexander the Great (365 BC) had a Brachial Paralysis after falling from a horse when a young man.
JOSEPH JUGHASVILLI

Stalin

Left OBPP
- **1827 Flaubert** –
  - Autopsies identified avulsion of nerve roots with “violent” reductions of shoulders
  - Widening of shoulder-neck angle
- **1899 Horsley confirmed with cadaver studies**
  - Dropped cadavers from ceiling onto head/shoulder
ON THE ROAD MEDIA
Transverse Ganglion Anatomy

- Dorsal Root Ganglion - *Sensory* Cell Body
- Ventral Horn - *Motor* Cell Body
Pre-ganglionic Injury: Avulsion
Post-ganglionic Injury: Stretch/Rupture
MECHANISMS OF INJURY

• Traction
• Stab/Gunshot
• 75% supraclav
• 25% infraclav
Forces

Low Energy

High Energy

Stretch

Possible

Recovery

Impossible

Transection

Avulsion
WHEN TO INTERVENE?

**CLASSIFICATION OF NERVE INJURIES**

<table>
<thead>
<tr>
<th>Degree of Injury</th>
<th>Recovery</th>
<th>Rate of Recovery</th>
<th>EMG / NCS (Fibrillations)</th>
<th>EMG / NCS (MUPS)</th>
<th>Surgical Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Neurapraxia</td>
<td>Complete</td>
<td>Up to 12 weeks</td>
<td>-</td>
<td>+</td>
<td>Normal</td>
</tr>
<tr>
<td>II Axonotmesis</td>
<td>Complete</td>
<td>1&quot; per month</td>
<td>+</td>
<td>+</td>
<td>+/-</td>
</tr>
<tr>
<td>III Partial</td>
<td>Partial</td>
<td>1&quot; per month</td>
<td>+</td>
<td>+</td>
<td>+/-</td>
</tr>
<tr>
<td>IV Neuroma</td>
<td>None</td>
<td>None</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>V Neurotmesis</td>
<td>None</td>
<td>None</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>VI Mixed Injury</td>
<td>Some fascicles</td>
<td>Depends on injury</td>
<td>-/+</td>
<td>-/+</td>
<td>+</td>
</tr>
</tbody>
</table>

*Note: EMG/NCS (Fibrillations) and EMG/NCS (MUPS) are neurological tests that help in diagnosing nerve injuries.*

*Note: Surgical Management indicates the need for surgical intervention based on the type of nerve injury.*
#1 DIAGNOSTIC TOOL

- YOUR BRAIN
- GREAT HISTORY & PHYSICAL EXAMINATION
BPI: WORKUP

• CLINICAL EXAM
• Xray
• CT Myelo/ MRI
• EMG/NCS
• Intraop Histo
• SSEP, NAP, Direct Nerve Stim
• Intraop Ultrasound

Pseudomeningocele
SENSORY NERVE CONDUCTION (SHOCKS)

- Normal in Root disease
- Abnormal in Plexus/nerve disease
EMG (STICKS)

0-2 weeks:
• Early after injury— not very informative
• To localize – EMG anytime.
• Acutely cannot tell nature of injury (Sunderland)

2-6 weeks:
• Fibrillation Potentials
• Reduced Recruitment

>6 weeks
• Incomplete collateral reinnervation – large complex motor units
• Reinnervation from scratch – short complex units
• Does not always indicate a functional recovery
FOLLOW UP EMG

• Recovery = More motor units recruited and less complex pattern
• Not much change in amplitude

• Muscle needs reinnervation by 9-12 months
• Decision about repair best by 3-6 months
• If no reinnervation in EMG then no recovery possible
MYTHS ABOUT INTRA-OP MONITORING

• No Value to it
• Palpation of neuroma – poor indicator of neural damage
• If Scarring bad – then injury probably post ganglionic at Scalenes
• No scar – preganglionic injury, wrong side, wrong patient, recovering
NAP

• Absence of NAP = Sunderland Grade 4
• NAP positive – 90% chance of recovery, before clinical or standard EMG
• Neurolysis with + NAP >> any other procedure
• Absent NAP – Poor recovery without any further reconstruction
WHY TREAT BPI’S?

• Surgical treatment of BPI decreased DASH by 25 points (P<0.0001)

• 70-80% Gr III-IV muscle recovery chance

• Patients with severe BPI will have disability

• “To those with nothing, even a little is a lot”
A 500 BED SPECIALTY CENTRE FOR TRAUMA, ORTHOPEDICS AND PLASTIC & RECONSTRUCTIVE SURGERY

10,000 SURGERIES (PLASTIC) ANNUALLY
500 BRACHIAL PLEXUS RELATED SURGERIES
TREATMENT OPTIONS:

• Neurolysis
• Nerve Graft
• Nerve Transfer
• Tendon Transfer
• Free Functioning Muscle Transfer
GRAFTS VS TRANSFERS

• Timing

• Sensory vs Motor Recovery

• Comparison of Functional Recovery
C5&6 PALSY
SA-SSN & TRICEPS BR TO AXILLARY N.
TRICEPS BR. TO ANTERIOR DIV. OF AXILLARY N. TRANSFER
CLINICAL CASES
Case 1
2. **Motor Conductions:**

<table>
<thead>
<tr>
<th>Nerve</th>
<th>Stimulation point</th>
<th>Latency (ms)</th>
<th>Amplitude (mV)</th>
<th>Conduction speed (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left Median</td>
<td>Wrist</td>
<td>3.4ms</td>
<td>6.9mV</td>
<td>-m/s</td>
</tr>
</tbody>
</table>

3. **Needle Examination:**

**Conclusions:**
The EMG/NCS in comparison with the previous examination of 30 January 2018 little or no change was seen from the Axillary nerve and may indicter sever upper rachial plexus injury. There was however signs of recent re-innervation from the middle and lower plexus. It may be of value to repeat the EMG/NCS in 3 months to evaluate possible re-innervation/denervation.

These findings must be correlated with the clinical and radiological findings.

<table>
<thead>
<tr>
<th>Left Deltoid</th>
<th>Increased</th>
<th>4+</th>
<th>-</th>
<th>No Activation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left Trapezius</td>
<td>Normal</td>
<td>-</td>
<td>-</td>
<td>Normal</td>
</tr>
</tbody>
</table>
CONCLUSION

• Electrodiagnostic testing is an adjunct to good clinical examination and anatomical understanding

• Standardisation of communication between treating surgeon and neurophysiologist

• Brachial plexus treatments have improved markedly

• Timing to surgery is the crux to success (3-6months)

• NAP most helpful intra-op test