UPDATES: PERIPHERAL NERVE STIMULATION

SRINIVAS CHIRAVURI MD
DIRECTOR ACUTE PAIN SERVICE
DIRECTOR NEUROMODULATION
brachial plexus clinic

UNIVERSITY OF MICHIGAN
ANN ARBOR
OUTLINE

Role of ultrasound in nerve localization

Current management of CRPS

Examples; ilioinguinal /iliohypogastric Ifcn, saphenous nerve, superficial peroneal and many more

Resection vs stimulation

Role of PNS
CRPS
CURRENT MANAGEMENT

CONSERVATIVE MANAGEMENT

MEDICATIONS PT /REHAB

BLOCKS/CATHETERS
LSB
LSB
LSB

SCS
CRPS
CURRENT MANAGEMENT

CONSERVATIVE MANAGEMENT

MEDICATIONS
PT / REHAB

LSB/CATHETERS

NERVE RESECTION ?

PNS?

DRG?

SCS
ILIOPINGUAL & IH NERVE BLOCK
II & IH NERVES
SAPHENOUS NERVE

Distribution of saphenous nerve in the thigh

Gracilis
Sartorius
Saphenous nerve
Probe

ANT
SN
G
S
VM
V
POS
SAPHENOUS NERVE
SUP PERONEAL NERVE
NERVE RESECTION

- Non reversible
- Neuroma formation
- Deafferentation/dysesthesias
- Numbness may be more bothersome
- Not a good option for mixed nerves or motor nerves
- Is an option for pure sensory nerves in scar entrapment
NERVE STIMULATION

- Reversible
- No procedure related neuroma
- No new deficits
- No deafferentation
- Is an option for mixed nerves ex; Axillary nerve stim for post stroke shoulder pain.
BENEFITS OF PNS

• Target specific Rx and not “blasting” CNS with SCS
• Long term observed analgesic response
• Need to use PNS becomes less over time
• Improvement in function
# PNS; MECHANISM OF ACTION

## GATE CONTROL THEORY

<table>
<thead>
<tr>
<th>Potential Activation/Mechanism for PNS for PSSP</th>
<th>Mechanism for PSSP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Activation</strong></td>
<td></td>
</tr>
<tr>
<td>Direct Response</td>
<td></td>
</tr>
<tr>
<td>$\alpha$ motor neurons (deltoids, teres minor)</td>
<td>Biomechanical Alignment</td>
</tr>
<tr>
<td>Type Ia, Ib, II sensory fibers (neuromodulated)*</td>
<td>Gate Theory</td>
</tr>
<tr>
<td>$\alpha\beta$ fibers*</td>
<td>Gate Theory and Desensitization</td>
</tr>
<tr>
<td>Indirect Response</td>
<td></td>
</tr>
<tr>
<td>Type Ia, Ib, II sensory (physiological)*</td>
<td>Desensitization through “normalized” input</td>
</tr>
</tbody>
</table>

[Figure showing nerve cells and muscle spindles related to the PNS mechanism.]
FDA-APPROVED PNS OPTIONS

Stimrouter

Sprint

Stimwave
Novel Use of Peripheral Nerve Stimulation in the Treatment of Pain/Shoulder Subluxation Resulting from Stroke Hemiplegia

University of Michigan

Rashad Albeiruti MD, Srinivas Chirarvuri MD, Ted Edward Claflin MD, Kate Wan-Chu Chang, MA, MS, Lynda Yang MD, PhD
Introduction

• Pain & shoulder subluxation from stroke hemiplegia is common (5-84% pain; 17-81% subluxation)

• Koyuncu et al. showed Functional Electrical Stimulation to supraspinatus and deltoid muscles improved subluxation

• Hypothesis: Axillary nerve stimulation can activate deltoid and teres minor muscles, reducing stroke-related subluxation & pain

• 2 hemiplegic patients with pain & subluxation underwent minimally invasive neuromodulation system implantation (StimRouter TM)

AXILLARY NERVE IN QUADRANGULAR SPACE
Sonoanatomy of the quadrangular space. Color, posterior circumflex artery (long axis); 1, deltoid muscle; 2, humerus (short axis).


Distal AN sonoanatomy. Arrow, the AN (short axis); red, posterior circumflex artery (short axis); 1, deltoid muscle; 2, teres minor muscle; 3, humerus.
Quadrangular space & Axillary Nerve

- Supraspinatus muscle
- Infraspinatus muscle
- Teres minor muscle
- Axillary nerve and posterior circumflex humeral artery
- Deltoid muscle (cut and reflected)
- Superior lateral brachial cutaneous nerve
- Long head
- Lateral head
- Tendon
- Triceps brachii muscle
- Brachioradialis muscle
## Methods & Results

<table>
<thead>
<tr>
<th></th>
<th>Patient 1</th>
<th></th>
<th>Patient 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Preop</td>
<td>Postop</td>
<td>Preop</td>
<td>Postop</td>
</tr>
<tr>
<td>Numeric Pain Scale</td>
<td>7/10</td>
<td>0/10</td>
<td>6/10</td>
<td>0/10</td>
</tr>
<tr>
<td>Subluxation (finger breadth)</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Shoulder AROM</td>
<td>0°</td>
<td>Sig improved</td>
<td>0°</td>
<td>Sig improved</td>
</tr>
<tr>
<td>Motor Strength</td>
<td>0/5</td>
<td>4/5</td>
<td>3/5</td>
<td>4/5</td>
</tr>
</tbody>
</table>
## Sig Improvement in AROM

<table>
<thead>
<tr>
<th>Shoulder AROM</th>
<th>Patient 1</th>
<th>Patient 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Abduction</td>
<td>45°</td>
<td>90°</td>
</tr>
<tr>
<td>-Flexion</td>
<td>45°</td>
<td>90°</td>
</tr>
<tr>
<td>-Extension</td>
<td>10°</td>
<td>10°</td>
</tr>
<tr>
<td>-External Rotation</td>
<td>10°</td>
<td>10°</td>
</tr>
<tr>
<td>-Internal Rotation</td>
<td>5°</td>
<td>5°</td>
</tr>
</tbody>
</table>
Conclusions

• Pain reduction and improved subluxation from neuromodulation facilitates and improves conventional post-stroke rehabilitation efficacy.

• While various studies have shown the value of Functional Electrical Stimulation (muscle & field stimulation), ours demonstrates the exciting potential for neuromodulation (axillary nerve stimulation).
QUESTIONS ???

• THANK YOU
Questions?