OBJECTIVE

In Peripheral Nerve Field Stimulation (PNFS) and Occipital Nerve Stimulation (ONS), several system parameters can be varied to optimise the effect of stimulation in the management of chronic pain; one of which is the stimulation amplitude. Unlike the small threshold range of stimulation amplitudes often observed in Spinal Cord Stimulation (Threshold ratio of ~1.7-1.8), the threshold usage range and ratio in PNFS is thought to be much greater. This study investigates the threshold usage range and ratio of PNFS in a range of bipole, crosslead, and monopole configurations.

METHOD

To study the effect of cathode-anode interaction on amplitude threshold ranges and ratios, 21 patients with a permanently implanted PNFS or ONS systems in either their low back (n=13) or occipital regions (n=8) underwent a series of programming combinations to find perception and maximum discomfort thresholds. Combinations involved the cathode location being fixed, whilst the anode was either located on the IPG-can (monopole), other lead (crossleads), or on the same lead at differing distances (bipole) (Table 1). Pulse width was set at 500μs. Lead depths were determined using the pin-drop technique. Please see associated poster presented at INS London 2011 - Lee D. et al. The “pin-drop” technique: A novel method to measure the depth of implanted stimulation leads, for further details on this method. IRB approval was obtained.

RESULTS

Similar threshold ratios (Max discomfort mA/perception mA) were observed between the low back and ONS groups.

Table 1. Programming Combinations

<table>
<thead>
<tr>
<th>Electrode Configurations</th>
<th>Close Spaced Bipole 4mm</th>
<th>Close Spaced Bipole 8mm</th>
<th>Close Spaced Bipole 28mm</th>
<th>Wide Spaced Crossleads &gt;30mm</th>
<th>Wide Spaced Crossleads &gt;50mm</th>
<th>Monopole of the Cathode</th>
</tr>
</thead>
</table>

Average Perception Threshold at 500μs (mA)

<table>
<thead>
<tr>
<th>Implant Location</th>
<th>Average Perception Threshold at 500μs (mA)</th>
<th>95% CI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head (ONS) n=8</td>
<td>0.9 ± 0.3</td>
<td>0.8, 1.1</td>
<td>0.001</td>
</tr>
<tr>
<td>Low Back n=13</td>
<td>2.1 ± 0.3</td>
<td>2.0, 2.3</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Threshold Ratio at 500μs

<table>
<thead>
<tr>
<th>Implant Location</th>
<th>Threshold Ratio at 500μs</th>
<th>95% CI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head (ONS) n=8</td>
<td>0.7 ± 0.2</td>
<td>0.6, 0.9</td>
<td>0.01</td>
</tr>
<tr>
<td>Low Back n=13</td>
<td>1.5 ± 0.3</td>
<td>1.4, 1.6</td>
<td>0.005</td>
</tr>
</tbody>
</table>

SUMMARY

* Higher perception thresholds are observed in low back PNFS when compared with Head (ONS). This may be due to the shallower depth of the ONS electrodes (4-13mm) compared with the low back PNFS electrodes (4-20mm).

* In the low back pain group perception thresholds decreased with increasing bipole distance. Perception thresholds observed using a tight bipole (4mm) were almost twice as high as that of crosslead and monopole configurations.

* Lead configurations did not impact on perception thresholds in ONS

* Threshold ratios are not dependent on bipole spacing. This result is concordant with those found in Spinal Cord Stimulation.

* Threshold ratios in PNFS are higher than those traditionally observed in Spinal Cord Stimulation (SCS TR=1.4-1.8).

These preliminary findings demonstrate that in PNFS, the threshold ratio is higher than in typical SCS, suggesting that peripheral nerve fibres may have a slow recruitment as compared to dorsal column fibres.

REFERENCES


ACKNOWLEDGMENTS

We wish to acknowledge Boston Scientific Corporation for their financial support and technical assistance provided by their team members.

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Assessing Perception Threshold and Usage Ranges as a Function of Bipole Distance in Peripheral Nerve Field Stimulation and Occipital Nerve Stimulation

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