Pilot Study of Fixed-Site High-Frequency Transcutaneous Electrical Nerve Stimulation in Fibromyalgia

Mauro Zappaterra1 MD, Frank McGillin2, and Shai N. Gozani2 MD, PhD
1Synovation Medical Group, Pasadena, CA, USA; 2NeuroMetrix Inc., Waltham, MA, USA

PURPOSE

Fibromyalgia is a condition of unknown etiology that is characterized by chronic widespread pain, poor sleep quality, fatigue, and neurological complaints. The disorder affects an estimated 10 million people in the U.S. and 3-6% of the world population. Common treatments include anticonvulsants, antidepressants and benzodiazepines. However, most patients do not obtain adequate pain relief and may suffer from dose limiting side effects. There is a need for non-pharmacological treatments with limited adverse effects.

Transcutaneous electrical nerve stimulation (TENS) is a non-invasive treatment for chronic pain that has no major side effects. Conventional TENS is delivered through surface electrodes to generate a strong, tissue afferents produces widespread pain relief by decreasing central nonpainful sensation. The resulting stimulation of large diameter, deep treatment for chronic pain that has no major side effects. Conventional non-pharmacological treatments with limited adverse effects.

Transcutaneous electrical nerve stimulation (TENS) is a non-invasive method of delivering low voltage, pulsating electrical impulses to the skin at pain sites. This stimulation is thought to alter pain perception by modulating pain-related neural activity. Fibromyalgia is a condition of widespread pain and fatigue that is often refractory to conventional treatments. In this study, we evaluated the efficacy of fixed-site high-frequency TENS (FS-TENS) in patients with fibromyalgia.

METHODS

This was a prospective, open-label, single-site, interventional study of FS-TENS in fibromyalgia. Consecutive patients presenting to a multispecialty pain clinic were considered. The inclusion criteria were age ≥ 18 and a diagnosis of fibromyalgia according to the 2010 American College of Rheumatology criteria. Exclusion criteria were a physical or psychological impediment to use of FS-TENS. Enrolled subjects provided informed consent and filled out a baseline Fibromyalgia Questionnaire (FQI). Subjects were given a FS-TENS device (Quell®, NeuroMetrix, Waltham, MA). The subjects were directed to self-administer therapy as much as possible for 30 days, including during sleep. Subjects returned to the study site for a 30-day follow-up at which time they filled out a follow-up FQI and indicated patient global impression of change (PGIC) on a 7-point scale (0 = "no change" to 7 = "a great deal better").

The primary outcome measure was the baseline to 30-day change in the FIQR. Statistical significance was assessed by the non-parametric Wilcoxon Signed-Rank test, with a one-sided hypothesis that FS-TENS improves FIQR over 30 days. FIQR responders were defined as ≥14% improvement. A PGIC was defined as ≥4 on the 7-point scale. Post-hoc analyses included evaluation of FIQR domains, the FIQR pain level (over past 7 days) item, the FS-TENS dose-response relationship and interactions between FS-TENS and concurrent prescription opioids.

RESULTS

A total of 12 subjects were enrolled and completed the study (see Table 1 for results). Subject age was 56±9 years (range 33-68), 100% were female and BMI was 27.7±5.7 kg/m². The median time since symptoms was 9.5 years and the median time since diagnosis was 6.5 years. Fibromyalgia severity was mild (1), moderate (0) and severe (11) according to the baseline FIQR.

The FIQR improved for 8 out of 12 subjects, with 5 (42%) classified as FIQR responders. The baseline FIQR was 69.0±15.9 and the 30-day FIQR was 58.2±24.7. The baseline to 30-day change approached statistical significance (p=0.068). A total of 7 (58%) subjects reported possible or definite improvement on PGIC. Fibromyalgia severity at 30-days was mild (3), moderate (3) and severe (6). Two subjects reported that FS-TENS aggravated their fibromyalgia symptoms. There were no serious adverse events.

Pain level decreased from 7.2±2.0 at baseline to 5.9±2.5 at 30-days which was a statistically significant change (p=0.007). 25% of subjects were responders at the 30% pain reduction level (moderate clinical improvement) and 30% of subjects were responders at the 15% pain reduction level (minimal clinically significant improvement). The relative change in FIQR was correlated (r=0.4, p<0.05) to the amount of FS-TENS therapy suggesting a dose-response association (Figure 1). Subjects not taking prescription opioids showed a trend towards greater improvement in FIQR, however the sample size was too small for statistical testing.

CONCLUSIONS

In this study, FS-TENS use for 30-days decreased the severity of fibromyalgia in about half of subjects as assessed by changes in FIQR and PGIC. The efficacy of FS-TENS was dose-dependent. Strengths of this study include use of validated FIQR and PGIC outcome instruments and objective assessment of therapy adherence. Limitations include a small sample size, non-compliance by several subjects, lack of a control group and a short study duration. The results of this study suggest that FS-TENS may be useful as a non-pharmacological treatment option for fibromyalgia and should be further evaluated.

Table 1

<table>
<thead>
<tr>
<th>Subject</th>
<th>Age (y)</th>
<th>BMI (kg/m²)</th>
<th>Height (cm)</th>
<th>Weight (kg)</th>
<th>Therapy Session Count</th>
<th>FIQR Baseline</th>
<th>FIQR F/U</th>
<th>FIQR Change</th>
<th>PGIC</th>
<th>Baseline</th>
<th>F/U</th>
<th>FGI</th>
<th>TENS Device</th>
<th>Follow-up</th>
<th>Responder</th>
<th>Adverse Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>101</td>
<td>67 F</td>
<td>160</td>
<td>75.1</td>
<td>29.6</td>
<td>10</td>
<td>4</td>
<td>73.2</td>
<td>65.0</td>
<td>-8.2</td>
<td>51</td>
<td>155</td>
<td>54</td>
<td>75.0</td>
<td>23</td>
<td>No</td>
<td>3</td>
</tr>
<tr>
<td>104</td>
<td>53 F</td>
<td>165</td>
<td>113.4</td>
<td>41.7</td>
<td>15</td>
<td>15</td>
<td>61.8</td>
<td>74.7</td>
<td>-12.8</td>
<td>32</td>
<td>70.7</td>
<td>60</td>
<td>70.2</td>
<td>12</td>
<td>Yes</td>
<td>5</td>
</tr>
<tr>
<td>115</td>
<td>55 F</td>
<td>166</td>
<td>68.1</td>
<td>25.9</td>
<td>16</td>
<td>15</td>
<td>81.7</td>
<td>87.0</td>
<td>-5.9</td>
<td>17</td>
<td>56.4</td>
<td>15</td>
<td>70.1</td>
<td>11</td>
<td>No</td>
<td>3</td>
</tr>
<tr>
<td>106</td>
<td>53 F</td>
<td>165</td>
<td>75.0</td>
<td>28.5</td>
<td>8</td>
<td>83.2</td>
<td>56.3</td>
<td>-24.8</td>
<td>18.7</td>
<td>22.5</td>
<td>60</td>
<td>15</td>
<td>70.7</td>
<td>14</td>
<td>No</td>
<td>3</td>
</tr>
<tr>
<td>114</td>
<td>55 F</td>
<td>168</td>
<td>60.0</td>
<td>21.3</td>
<td>1</td>
<td>28.7</td>
<td>18.3</td>
<td>-9.9</td>
<td>27.2</td>
<td>36.9</td>
<td>32.5</td>
<td>15</td>
<td>70.7</td>
<td>11</td>
<td>No</td>
<td>6</td>
</tr>
<tr>
<td>108</td>
<td>53 F</td>
<td>170</td>
<td>75.9</td>
<td>26.2</td>
<td>51</td>
<td>50</td>
<td>84.0</td>
<td>22.0</td>
<td>-42.8</td>
<td>48.5</td>
<td>235</td>
<td>15</td>
<td>70.7</td>
<td>11</td>
<td>Yes</td>
<td>4</td>
</tr>
<tr>
<td>109</td>
<td>58 F</td>
<td>150</td>
<td>57.7</td>
<td>25.7</td>
<td>9</td>
<td>70.7</td>
<td>29.3</td>
<td>-47.1</td>
<td>41.5</td>
<td>35.3</td>
<td>30</td>
<td>15</td>
<td>70.7</td>
<td>11</td>
<td>No</td>
<td>5</td>
</tr>
<tr>
<td>113</td>
<td>52 F</td>
<td>176</td>
<td>65.2</td>
<td>20.7</td>
<td>8</td>
<td>75.7</td>
<td>72.5</td>
<td>-3.2</td>
<td>4.5</td>
<td>4.3</td>
<td>43</td>
<td>15</td>
<td>70.7</td>
<td>11</td>
<td>No</td>
<td>5</td>
</tr>
<tr>
<td>107</td>
<td>53 F</td>
<td>155</td>
<td>65.1</td>
<td>22.5</td>
<td>1</td>
<td>75.0</td>
<td>52.5</td>
<td>-22.5</td>
<td>27.5</td>
<td>30.0</td>
<td>222</td>
<td>15</td>
<td>70.7</td>
<td>11</td>
<td>Yes</td>
<td>5</td>
</tr>
<tr>
<td>103</td>
<td>53 F</td>
<td>165</td>
<td>75.0</td>
<td>28.4</td>
<td>85.2</td>
<td>56.3</td>
<td>-28.8</td>
<td>-33.9</td>
<td>171</td>
<td>92.5</td>
<td>17.5</td>
<td>15</td>
<td>70.7</td>
<td>11</td>
<td>Yes</td>
<td>5</td>
</tr>
<tr>
<td>110</td>
<td>53 F</td>
<td>163</td>
<td>72.7</td>
<td>29.5</td>
<td>15</td>
<td>61.8</td>
<td>81.7</td>
<td>-44.2</td>
<td>121</td>
<td>57.7</td>
<td>15</td>
<td>15</td>
<td>70.7</td>
<td>11</td>
<td>Yes</td>
<td>5</td>
</tr>
<tr>
<td>102</td>
<td>55 F</td>
<td>168</td>
<td>75.9</td>
<td>29.6</td>
<td>1</td>
<td>70.7</td>
<td>73.2</td>
<td>-3.2</td>
<td>4.3</td>
<td>4.3</td>
<td>41</td>
<td>15</td>
<td>70.7</td>
<td>11</td>
<td>No</td>
<td>5</td>
</tr>
<tr>
<td>111</td>
<td>53 F</td>
<td>163</td>
<td>72.7</td>
<td>27.5</td>
<td>12</td>
<td>58.6</td>
<td>56.3</td>
<td>-2.5</td>
<td>4.2</td>
<td>4.2</td>
<td>41</td>
<td>15</td>
<td>70.7</td>
<td>11</td>
<td>Yes</td>
<td>5</td>
</tr>
</tbody>
</table>

Figure 1

Poster #81, Presented at PAINWeek 2018, Sep 4-8, Las Vegas, NV, USA

Scan the code to download a copy of the poster

ID

Poster Categorization

Therapy Session Count

FGI

Responder

Adverse Events

PGIC

TENS Device

Follow-up

Responder

Adverse Events

PGIC

TENS Device

Follow-up

Responder

Adverse Events

PGIC

TENS Device

Follow-up

Responder

Adverse Events

PGIC