Cutaneous Field Stimulation in the Treatment of Severe Itch

Joanna Wallengren, MD, PhD; Frank Sundler, PhD

Objective: To evaluate the efficacy of cutaneous field stimulation of C fibers for the treatment of itchy skin and its effect on peripheral nerve fibers as shown in skin biopsy specimens.

Design: We conducted an open-label uncontrolled study of 19 patients with itching. Each patient applied a flexible plate containing electrodes to the itchy area for 20 minutes at a time once daily for 5 weeks to stimulate nerve fibers with a constant current (0.8 mA). Skin biopsy specimens were collected before treatment and at the end of treatment and were immunostained for calcitonin gene–related peptide and protein gene product 9.5.

Setting: University hospital in Lund, Sweden.

Patients: Sixteen patients with notalgia paresthetica or brachioradial pruritus and 3 with generalized itch.

Interventions: Cutaneous field stimulation and punch biopsies of the itchy skin.

Main Outcome Measures: Visual analog scale for assessment of itching and counting the immunoreactive nerve fibers in 3-mm biopsy specimens.

Results: Patients with localized itching experienced a reduction in mean values on the visual analog scale (from 78% before treatment to 42% by the end of the fifth week). The number of protein gene product 9.5–immunoreactive nerve fibers in the epidermis was reduced by 40% by the end of treatment compared with baseline values.

Conclusions: Cutaneous field stimulation is an effective alternative for the treatment of localized itching. The reduction in itching is accompanied by degeneration of the epidermal nerve fibers, as evidenced by the loss of protein gene product 9.5 immunoreactivity.

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PATIENTS AND METHODS

A total of 19 patients with severe pruritus were enrolled in the study. Sixteen had localized itching, and 3 others complained of generalized pruritus. Patients were advised to apply the CFS device (Figure 1) once daily 20 to 30 minutes at a time during the following 5 weeks and to evaluate their symptoms before the treatment and at home at the end of each week using a visual analog scale (VAS). Full-thickness skin biopsy specimens were obtained from the itchy skin of 10 patients before and at the end of the 5 weeks of treatment by means of a 3-mm punch. Details on the processing of biopsy specimens have been presented previously. The number of immunoreactive fibers in each section was counted using a Leica Aristoplan epifluorescence microscope (×16 objective) (Leica Lasertechnik GmbH, Heidelberg, Germany). The mean of the counts in the 3 sections was used to represent each specimen.

Details of Patients Treated With Cutaneous Field Stimulation*

<table>
<thead>
<tr>
<th>Patient No./Sex/Age, y</th>
<th>Diagnosis</th>
<th>Duration and Symptoms</th>
<th>Location</th>
<th>Visual Analog Scale, %</th>
<th>Before Treatment</th>
<th>1 wk</th>
<th>2 wk</th>
<th>3 wk</th>
<th>4 wk</th>
<th>5 wk</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/M/33</td>
<td>Brachioradial pruritus</td>
<td>1 mo; 8-10 attacks/d of severe itch, mainly in the evening</td>
<td>Neck, shoulders, upper thorax</td>
<td>100</td>
<td>89</td>
<td>74</td>
<td>49†</td>
<td>58†</td>
<td>28†</td>
<td></td>
</tr>
<tr>
<td>2/F/47</td>
<td>Brachioradial pruritus</td>
<td>1 mo; severe itch in the morning, increasing during the day, 5-8 attacks/d</td>
<td>10 × 7-cm patch on left shoulder</td>
<td>63</td>
<td>32</td>
<td>8</td>
<td>8</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>3/F/29</td>
<td>Brachioradial pruritus</td>
<td>2-3 y; severe itch, mainly in the evening, wakes up at night</td>
<td>Upper arms and back</td>
<td>85</td>
<td>83</td>
<td>50</td>
<td>47</td>
<td>75</td>
<td>77</td>
<td></td>
</tr>
<tr>
<td>4/M/70</td>
<td>Brachioradial pruritus</td>
<td>7 y; itch in the evening, wakes up at night</td>
<td>Upper arms</td>
<td>80</td>
<td>50</td>
<td>71</td>
<td>58</td>
<td>60</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>5/F/28</td>
<td>Notalgia paresthetica</td>
<td>2 mo</td>
<td>Lower medial edge of left scapula</td>
<td>38</td>
<td>58</td>
<td>61</td>
<td>62</td>
<td>33</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>6/F/71</td>
<td>Mycosis fungoides</td>
<td>0.5 y</td>
<td>General pruritus, mainly on shoulders and hips</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>7/F/68</td>
<td>Notalgia paresthetica</td>
<td>6-7 y; initially attacks, later continuous pain, compression of Th III–Th V</td>
<td>8 × 8-cm excoriated patch at right scapula</td>
<td>93</td>
<td>93</td>
<td>79</td>
<td>70</td>
<td>33</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>8/F/53</td>
<td>Brachioradial pruritus</td>
<td>Recurrent itch for last 2.5 y, severe itch for last 0.5 y</td>
<td>Lower arms, mainly around elbow</td>
<td>89</td>
<td>72</td>
<td>58</td>
<td>64</td>
<td>59</td>
<td>NT</td>
<td></td>
</tr>
<tr>
<td>9/F/33</td>
<td>Neurodermatitis</td>
<td>3 y; severe itch and dermatitis</td>
<td>Upper part of both feet</td>
<td>100</td>
<td>41</td>
<td>19</td>
<td>10</td>
<td>8</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>10/F/65</td>
<td>Meralgia paresthetica</td>
<td>8 mo; severe dysesthesia, mostly at night</td>
<td>Inner part of both thighs</td>
<td>78</td>
<td>74</td>
<td>69</td>
<td>72</td>
<td>71</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>11/F/45</td>
<td>Brachioradial pruritus</td>
<td>27 y; recurrent severe itch, pigmented lichenification recently</td>
<td>Shoulders and upper arms</td>
<td>48</td>
<td>57</td>
<td>43</td>
<td>31</td>
<td>32</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>12/F/58</td>
<td>Notalgia paresthetica</td>
<td>Episode 6 y ago, recurrent itch for last 0.5 y</td>
<td>5 × 4-cm patch below medial aspect of right scapula</td>
<td>95</td>
<td>85</td>
<td>92</td>
<td>88</td>
<td>91</td>
<td>92</td>
<td></td>
</tr>
<tr>
<td>13/F/52</td>
<td>Notalgia paresthetica</td>
<td>7 y; recurrent itch</td>
<td>1.5 × 1.5-cm pigmented, lichenified patch on medial part of left scapula</td>
<td>61</td>
<td>48</td>
<td>38</td>
<td>20</td>
<td>18</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>14/F/44</td>
<td>Brachioradial pruritus</td>
<td>Episode last year, and for last 2 mo</td>
<td>Shoulders and upper arms</td>
<td>98</td>
<td>49</td>
<td>18</td>
<td>13</td>
<td>9</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>15/F/67</td>
<td>Brachioradial pruritus</td>
<td>2-3 mo last year, 2 mo in current year</td>
<td>Left arm, right shoulder</td>
<td>89</td>
<td>12</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>16/F/62</td>
<td>Notalgia paresthetica</td>
<td>7 y; brief improvement after topical capsaicin</td>
<td>Left scapula</td>
<td>70</td>
<td>66</td>
<td>55</td>
<td>43</td>
<td>34</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>17/F/61</td>
<td>Brachioradial pruritus</td>
<td>&gt;1 y</td>
<td>Both lower arms</td>
<td>88</td>
<td>74</td>
<td>64</td>
<td>65</td>
<td>58</td>
<td>58</td>
<td></td>
</tr>
</tbody>
</table>

*NT indicates no treatment.
†Patient 1 broke off cutaneous field stimulation treatment after 3 weeks and went on treating the itch with (0.025%) capsaicin cream.
recently, topical treatment with capsaicin was reported to in-
crease a loss of epidermal nerve fibers together with a re-
duction in pain. It appears that CFS is a viable treatment 
for localized itching. Generalized pruritus in mycosis fungo-
goides did not respond to CFS. This may be related to the 
widespread nature of itching and the difficulties in using 
CFS at many skin locations. Chronic lichenified patches 
of prurigo nodularis did not respond to CFS either. This 
may be a result of the epidermal layer being severely hy-
pertrophic in prurigo nodularis, making it difficult for the 
electrodes to reach to the dermoepidermal junction.

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COMMENT

In this open trial, localized itching responded to CFS treat-
ment, and pruritus was reduced by 49% at the end of the 
fifth week compared with baseline. In patients with back 
pain, Deyo et al found that scores for pain severity, pain 
frequency, and functional status improved an average of 
20% to 40% after the application of sham transcutaneous 
electrical nerve stimulation, despite the chronicity of pain 
(average duration, 4 years). Cutaneous field stimulation re-
duced the number of epidermal nerve fibers in all patients 
but 3, and this reduction was paralleled by relief of itch. 
This indicates that the treatment actually influences spe-
cific active components necessary for perceiving itch. Pro-
tein gene product 9.5 before (A) and after (B) cutaneous field stimulation treatment. 
Arrows indicate nerve fibers (original magnification ×200).

Figure 2. Localized itch in response to cutaneous field stimulation showing 
mean values on the visual analog scale (n=16). For statistical evaluation we 
used the t test for paired data. Asterisk indicates P=0.01; dagger, P=0.001.

Figure 3. Nerve fiber density in biopsy specimens from whole-skin samples 
and the epidermis (epidermal nerve fibers) before and after cutaneous field 
stimulation treatment (n=10). After treatment, the number of epidermal 
nerve fibers was reduced (t test for paired data).

Figure 4. Skin biopsy specimen (patient 13) immunostained for protein gene 
product 9.5 before (A) and after (B) cutaneous field stimulation treatment. 
Arrows indicate nerve fibers (original magnification ×200).