Prospective study of percutaneous radiofrequency sympathicolysis in severe hyperhidrosis and facial blushing: efficacy and safety findings

Carlos E. Garcia Franco a,*, Juan Perez-Cajaraville b, Francisco Guillen-Grima c, Agustin España b

a General Thoracic Surgery Department, Hospital Universitario Nuestra Señora de Candelaria, Tenerife, Spain
b Hyperhidrosis and Facial Blushing Unit, Clínica Universidad de Navarra, Navarra, Spain
c Department of Preventive Medicine, Clínica Universidad de Navarra, Navarra, Spain

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Abstract

Objective: Hyperhidrosis (Hh) and facial blushing (Fb) are conditions caused by hyperactivity of the sympathetic system; they affect around 2% of the population. Severe cases have been typically treated with thoracic sympathectomy through a minimally invasive approach. We sought to determine if severe Hh and/or Fb patients, who are reluctant to go through an operation with general anaesthesia, could benefit from receiving percutaneous radiofrequency ablation of the sympathetic chain. Methods: Prospectively collected data obtained from May 2007 to May 2010 were analysed to compare the treatment efficacy and effects on quality of life of the two procedures. Results: From a total of 58 patients enrolled in the study, 31 were treated with radiofrequency procedures, whereas 27 received surgical sympathectomy. Patients with Hh had better results with surgery than with radiofrequency sympathicolysis in terms of efficacy (p = 0.0001) and quality of life (p = 0.0002). However, there was still a significant improvement in quality of life in the group of patients treated with radiofrequency sympathicolysis (p = 0.004). Patients with Fb had good results with surgical procedures and poor outcomes with radiofrequency ablation, resulting in significant differences in treatment efficacy (p = 0.005) and in quality of life (p = 0.003). Fb patients treated with radiofrequency procedures had no improvement in quality of life after the intervention (p = 0.28). Conclusion: Our results support the view of surgical sympathectomy as the gold-standard treatment in severe cases of Hh and Fb. Radiofrequency sympathicolysis is useful as a second-treatment choice for Hh patients. Fb patients do not benefit from radiofrequency sympathicolysis.

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1. Introduction

Hyperhidrosis (Hh) and facial blushing (Fb) are two diseases caused by hyperactivity of the sympathetic system. The first is characterised by an excessive production of sweat in certain areas of the body: palms, face, armpits and/or soles. The second occurs when the face, and, sometimes, the neck and the upper part of the chest, turn red after common psychological stimuli. The aetiology of both diseases is unknown and, many times (in 70% of cases), they appear simultaneously [1]. These conditions normally affect patients between 15 and 40 years of age and may cause serious damage to their quality of life (QoL). Hh affects around 1—2% of the population, whereas Fb incidence could reach up to 1% [1,2].

Currently, the gold-standard treatment in severe cases of Hh or Fb is surgical resection of the sympathetic thoracic chain through video-assisted thoracoscopic surgery [3]. Either sympathectomy, sympathicolysis or clipping of the chain between T2 and T4 could be done with good results [4]. These procedures are regularly performed in surgical units with the patient under general anaesthesia. However, some patients fear surgical interventions due to general anaesthesia, possible complications (around 5%) and lack of satisfaction after surgery (10—15%) [1,4,5]. Apart from surgery, botulinum toxin injection is regularly applied for armpit- or palm sweating [6,7]. However, repetition of this treatment every 6—12 months is normally required to prevent recurrence. Psychiatric and psychological treatment is also used in severe cases of Fb, but with reduced benefit for patients [8,9].

Radiofrequency (Rf) percutaneous ablation of the sympathetic chain for treatment of Hh has been advocated by a few authors [10,11]. To our knowledge, there is no previous report of Rf use for treatment of Fb. The procedure consists in initial localisation of the sympathetic chain, either by
fluoroscopy or computed tomography (CT) techniques, followed by percutaneous application of damaging heat. The heat is produced by an electric generator and delivered through the tip of a catheter. T2–T3 is the area generally selected to treat Hh of palms, face, and armpits. RF is regularly used to treat pain disorders of the upper extremities and of the neck and the lower extremities by damaging the stellate ganglion (C7–T1) and the L1–L4 ganglia, respectively [12,13]. The procedure is safe, inexpensive and done under sedation with local anaesthesia in an outpatient setting. For these reasons, we explored whether the RF technique could also be useful to treat Fb and sole Hh.

Our goal was to assess the role of RF and surgical procedures in the clinical management of our Hh and Fb patients. We sought to determine if RF could benefit Hh and/or Fb patients who refuse to undergo an operation with general anaesthesia. We also compared the outcomes from these patients with those of patients surgically treated.

2. Patients and methods

We conducted a prospective, comparative, non-randomised study. Patients suffering from severe Hh or Fb were enrolled by the Departments of Dermatology and Thoracic Surgery (University of Navarra, Spain) after approval of the study by the Institutional Review Board. All patients were offered surgical sympathectomy as the treatment of choice. Treatment with RF was then offered to patients who refused surgery. Surgical treatment consisted in T2 or T2–T3 sympathectomy and was administered to Fb or Hh patients, respectively. RF was performed at the same levels, adding sympatholysis of the stellate ganglion (C7–T1) for Fb and treating sole sweating with L1–L4 ganglia damage.

Patients were treated and followed-up for at least 6 months. Data on clinical outcomes of interest were collected through patient surveys performed immediately before the procedure and during follow-up. Severity of cases before treatment was established through Hyperhidrosis Disease Severity Scale (HHDS) [14–16]. This simple scale was used in Hh patients and was adapted for Fb patients. The scale was composed by the following levels of severity: 0 (no sweating or Fb), 1 (mild embarrassment), 2 (moderate inconvenience), 3 (severe inconvenience) and 4 (extreme embarrassment).

The efficacy of treatment was determined based on the percentual values (0—100%) reported by the patient to indicate the level of dryness after the procedures. The technique was considered effective if the level of dryness after the procedure was at least 50%. In addition, patient satisfaction was measured with a four-grade scale: 0 (not satisfied), 1 (slightly satisfied), 2 (satisfied) and 3 (very satisfied).

QoL before and after the procedures was evaluated using the Dermatology Life Quality Index [17]. This test consists of 10 simple questions regarding patients’ daily life, intended to determine disease influence on various issues, such as clothes they can wear, social activities, sports, work/studies, sexual relations, relations with friends/family, and embarrassment, among other issues. Patients were requested to report their level of inconvenience (marked by the reviewer in percent units) caused by sweating or facial blushing over the previous week.

Patients were asked to comment on the occurrence and location of any compensatory sweating, defined as excessive sweating after the procedures in areas of the body that previously did not sweat. A scale was designed to measure the level of compensatory sweating: 0 (no sweating), 1 (mild sweating), 2 (moderate sweating) and 3 (severe sweating).

Efficacy and safety data were analysed according to disease and/or treatment modality (see the study groups defined in Section 3). Statistical analysis included the t-test, the Mann–Whitney U test and the Pearson test in the Statistical Package for Social Sciences (SPSS) 10.1 statistical software package (SPSS, Chicago, IL, USA). All p values <0.05 were considered statistically significant.

2.1. Percutaneous radiofrequency sympatholysis

While awake and under sedation (local anaesthesia), the patient is positioned prone on a fluoroscopically compatible operating table with a C-arm fluoroscope or CT scan in place and a small bolster beneath the chest to increase neck flexion. The C-arm is positioned in a 10–15° rostrocaudal angle, centred over the patient so that the tips of the spinal processes appear midway between the pedicles. Skin wheels are raised with lidocaine over the intercostal spaces corresponding to the target sympathetic ganglia. Localisation is fluoroscopically confirmed. After the skin is punctured with a 16-gauge needle, two 18-gauge radiofrequency TIC needle electrodes (Radionics, Burlington, MA, USA) are used. Lesions are most commonly made at both the second and the third thoracic sympathetic ganglia (T2 and T3) for palmar and facial Hh, at L1–L4 for soles or at C7–T1 for Fb. T2–T3 lesion is also performed in this last group of patients. For sympatholysis of the stellate ganglion (C7–T1), the procedure is done in the supine position and the neck is punctured anteriorly, following the same steps described above for other locations. Once satisfactory placement of the needles has been achieved, under posteroanterior and lateral fluoroscopic guidance or CT transversal slices (Fig. 1), electrical stimulation is performed at 2 Hz through electrodes with 10-mm bare tips. This tip is used to generate heat and damage the sympathetic chain. A temperature of 80° C around the chain is reached and maintained for 2–8 min. The rise in skin temperature (palms and soles), of at least 0.5–1 °C, confirms the neurolysis of the sympathetic chain. The needle is then withdrawn and the patient is nursed in the supine position for 2 h before discharge; the pulse, blood pressure and respiration are monitored. Light analgesia can be administered in the event of pain.

2.2. Standard surgical sympatholysis

Under general anaesthesia and double-lumen intubation to deflate the ipsilateral lung, a 2-cm axillary port was performed and a 5-mm videothoracoscope was introduced inside the chest. Once the sympathetic chain was identified at the level of crossing of the second and/or the third rib, it was transected and extended laterally 2 cm to cut any accessory nerve fibres (nerve of Kuntz). All procedures were
completed by reinflation of the lung. The surgical wound was then closed. All cases were performed bilaterally. In most cases (93%), patients were discharged 24 h after the procedure.

3. Results

A total of 58 patients suffering from severe Hh \( (n = 40 - \text{Hh group}) \) or Fb \( (n = 18 - \text{Fb group}) \) were enrolled during a 3-year period (from May 2007 to May 2010). Surgical sympathectomy was offered to all patients and 27 underwent the recommended procedure (8 patients with Fb and 19 with Hh — surgery group). A total of 31 refused to have surgical treatment (10 patients with Fb and 21 with Hh) for personal reasons, normally including extreme concern with general anaesthesia and/or possible complications. These patients accepted treatment with Rf (Rf group).

The outcomes for Rf and surgery groups are shown in Tables 1 and 2, respectively. Median follow-up was 14 months for patients treated surgically and 12 months for patients treated with Rf. Mean age was similar in both groups: 35.1 years in the Rf group and 31.0 years in the surgical group. Gender distribution was well balanced across study groups with 51.6\% \( (n = 16) \) and 55.6\% \( (n = 15) \) of males in the Rf and surgery groups, respectively.

The HHDS scale showed that all patients were severely affected by Hh or Fb: score 3.1 for Fb patients treated with Rf; 3.3 for Hh patients treated with Rf; 3.6 for surgical Hh patients; and 4 for surgical Fb patients. The average number of Rf treatments per patient was 1.5 for Fb (range: 1—3) and 2.1 for Hh (range: 1—5). All surgical procedures were performed only once.

QoL score before treatment in the Hh group was 30.3\% for patients treated with Rf and 29.8\% for those treated surgically (Table 3). QoL post-treatment was 19.8\% and 5.7\%, respectively. In the Fb group, QoL pre-treatment was 36.8\% for patients scheduled for surgery and 22.4\% for patients who elected Rf treatment (Table 4). Post-treatment scores were 11.9\% and 20.0\%, respectively. In Hh patients, satisfaction levels after the procedures were 2.42 for those treated surgically and 0.95 for those treated with Rf (Table 3). For Fb patients, satisfaction levels were 2.25 and 0.60, respectively (Table 4).

The efficacy of treatments, as measured by patient-reported percent of dryness after the procedure, was 93.7\% for surgical patients and 30.7\% for Rf patients in the Hh group (Table 3). In the Fb group, efficacy values by treatment type were 72.5\% and 15.0\% in surgery and Rf groups, respectively (Table 4). Compensatory sweating scores in the Hh group were 1.10 for patients treated surgically and 0.14 for patients treated with Rf (Table 3). In the Fb group, scores were 1.50 for those treated surgically and 0.00 for those who underwent Rf treatment (Table 4). Of a total of 17 patients with palmar Hh treated with Rf technique, seven (41\%) responded significantly to treatment, reducing their sweating by at least 50\%. Due to sole Hh, 10 patients were treated with the L1—L4 Rf technique, six of whom responded to this treatment given. Of a total of 3 facial Hh patients treated with the Rf technique, 2 responded to treatment (Table 5). In the whole group of patients treated with Rf for Hh, there were 2 with
Table 3. Patient characteristics and clinical outcomes of hyperhidrosis patients (Hh group).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Age (years)</th>
<th>Efficacy* (%)</th>
<th>Satisfaction*</th>
<th>QoL pre-procedure* (%)</th>
<th>QoL post-procedure* (%)</th>
<th>Compensatory sweat*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rf (n = 21)</td>
<td>Mean [SD]</td>
<td>35.1 [9.9]</td>
<td>30.7 [33.9]</td>
<td>0.95 [0.97]</td>
<td>30.3 [17.8]</td>
<td>19.8 [13.1]</td>
</tr>
<tr>
<td>Surgery (n = 19)</td>
<td>Mean [SD]</td>
<td>30.2 [10.3]</td>
<td>93.7 [13.4]</td>
<td>2.42 [1.01]</td>
<td>29.8 [16.7]</td>
<td>5.7 [9.3]</td>
</tr>
<tr>
<td>All (n = 40)</td>
<td>Mean [SD]</td>
<td>32.8 [10.3]</td>
<td>60.6 [41]</td>
<td>2.25 [1.16]</td>
<td>30.1 [17.1]</td>
<td>13.1 [13.4]</td>
</tr>
</tbody>
</table>

Abbreviations: QoL, quality of life; Rf, radiofrequency; SD, standard deviation. The asterisk (*) indicates statistically significant differences when comparing Rf and surgery.

Table 4. Patient characteristics and clinical outcomes of facial blushing patients (Fb group).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Age (years)</th>
<th>Efficacy* (%)</th>
<th>Satisfaction*</th>
<th>QoL pre-procedure* (%)</th>
<th>QoL post-procedure* (%)</th>
<th>Compensatory sweat*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rf (n = 10)</td>
<td>Mean [SD]</td>
<td>35.1 [11.7]</td>
<td>15.0 [27.9]</td>
<td>0.60 [1.26]</td>
<td>22.4 [10.1]</td>
<td>20.0 [12.3]</td>
</tr>
<tr>
<td>Surgery (n = 8)</td>
<td>Mean [SD]</td>
<td>32.9 [10.2]</td>
<td>72.5 [40.7]</td>
<td>2.25 [1.16]</td>
<td>36.8 [10.9]</td>
<td>11.9 [14.9]</td>
</tr>
<tr>
<td>Total (n = 18)</td>
<td>Mean [SD]</td>
<td>34.1 [10.8]</td>
<td>40.6 [44.3]</td>
<td>1.30 [1.45]</td>
<td>28.7 [12.5]</td>
<td>16.4 [13.8]</td>
</tr>
</tbody>
</table>

Abbreviations: QoL, quality of life; Rf, radiofrequency; SD, standard deviation. The asterisk (*) indicates statistically significant differences when comparing Rf and surgery.

Table 5. Different types of Hh location treated with Rf.

<table>
<thead>
<tr>
<th>Hyperhidrosis</th>
<th>Responders</th>
<th>Non-responders</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hands</td>
<td>7</td>
<td>10</td>
<td>17</td>
</tr>
<tr>
<td>Soles</td>
<td>6</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Facial</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
<td>15</td>
<td>30</td>
</tr>
</tbody>
</table>

Abbreviations: Rf, radiofrequency; Hh, hyperhidrosis.

In our patient cohort, Rf has shown to be useful in the treatment of Hh that Rf could be a valid option for treating this common form of hyperhidrosis, but more patients should be treated and followed-up to confirm our results.

4. Discussion

Endoscopic surgical techniques for Hh and Fb provide direct visualisation of the sympathetic trunk and ganglion, enabling surgeons to perform electrocautery, block, and lysis on these structures more precisely [4,5]. Some patients, however, are afraid of undergoing surgery due to fear of general anaesthesia, wounds, complications, etc. This is the main reason underlying the development of percutaneous techniques. In 1920, White was the first to use alcohol percutaneously [18] to block the upper ganglia of patients with Hh. However, subsequent studies raised concerns regarding alcohol use [19–21]. In the 1980s, Wilkinson [11] and Chuang and Liu [10] pioneered the application of Rf procedures in treatment of Hh. More recently, the administration of botulinum toxin type A (botox) was reported as an effective treatment for Hh patients [6], a finding that has greatly impacted current clinical practice. Phenol, botulinum toxin injections and Rf procedures are relatively non-invasive when compared with other techniques (such as endoscopic procedures).

To the best of our knowledge, no study has assessed these therapeutic options in the clinical management of Fb. Although there is data in the literature that report high effectiveness of percutaneous techniques for Hh [10,11,22–24], they have not become popular treatments. This is likely a reflection of the discouraging results observed in daily practices such as ours, particularly during clinical implementation of the technique.

In this study, we established that the average effectiveness of the Rf technique for Hh was 30.7%. For palmar Hh patients, there were 41% (7/17) responders, who had at least a 50% of sweating reduction. Although we treated a small number of Fb patients with Rf, it is interesting to note that the procedure was rarely effective. We would not recommend this technique for Fb, but more patients should be treated and followed-up to confirm our results.
of Hh. Some authors have reported series of cases treated with a laparoscopic approach of the lumbar sympathetic chain with excellent results [25]. However, this treatment has not yet become widely adopted. Our results for treatment of facial sweating with RF were similar to those for palms or soles. However, with only three reported cases, we cannot draw conclusions on this area.

Dissatisfaction due to persistent sweating (47.6% of patients) or Fb (90.0% of patients) was the major complaint after RF procedures. In surgical patients, failure of the technique occurred in one case (5.2%) in Hh patients and in two cases (25%) in Fb ones. The difference in failure rates between both techniques could be due to several reasons: (1) RF is performed without a direct view of the sympathetic chain, using bone references next to it; the exact location of the sympathetic chain and/or accessory fibres, such as the Kuntz nerve, cannot be visualised and so they could be missed; (2) the lesion originating on the sympathetic chain is much smaller using a RF catheter than surgical electrocautery, due to the different diameter of these instruments and (3) the technique is not performed below T3 for hand sweating, and missing T4 could be another reason for reduced effectiveness. The Horner syndrome could have been an issue in patients with facial blushing, as the technique was applied on the stellate ganglion. For this reason, we reduce to 2 min the period of exposure of this area to RF, whereas, for the other stations, the exposure ranged from 6 to 8 min. As a consequence, no Horner syndrome occurred in our series.

Erectile dysfunction has also been described as a complication for lumbar sympathectomy [25] and we guess it could also be a side effect of lumbar RF sympatholysis. In our series, only three men underwent this procedure, and none of them suffered this problem; the rest of our patients (seven) were women. It is clear that a larger number of males should undergo this technique to determine whether this procedure avoids this complication or not.

Immediate back pain was another common reason for dissatisfaction after RF procedures (70.9% of patients). Numbness extending to the axillary area was also reported by some patients, but, in all of these cases, the pain disappeared 1 week after treatment. Severe neuropathic pain occurred in just one case after surgery (3.7%), although it had great impact on the QoL of this patient.

Compensatory sweating was practically absent in patients treated with RF and mild to moderate in most patients who underwent surgery (89%), only one case presented severe compensatory sweating. Nevertheless, both patients who had a complete remission of their Hh after RF procedures experienced a mild form of compensatory sweating. These observations could be explained by the development of compensatory sweating due to complete ablation of both chains, similar to what happens in surgically treated patients.

After comparing RF techniques with surgical procedures, we could conclude that results were clearly better in the latter group.

In this prospective cohort study, we have reported preliminary results from treatment of severe Hh and Fb in patients enrolled at a single institution. The study has two major weaknesses: (1) it consists of a small series of cases with (2) a short median follow-up period of only 1 year. A larger study with longer follow-up period will be necessary to fully support the data herein reported. Despite its shortcomings, our study enabled comparison of the two most significant treatment options available for Hh and Fb patients. Importantly, we have assessed the role of RF in clinical management of Fb and sole sweating.

5. Conclusion

Our results support the current view of surgical sympathectomy as the gold-standard treatment in severe cases of Hh and Fb. Radiofrequency sympatholysis can be useful to Hh patients as a second-choice treatment for palmar Hh and as a feasible treatment for excessive sole and facial sweating. Fb patients do not benefit from receiving radiofrequency sympatholysis.

References


