

## CLINICAL SCIENCE

## ENDOSCOPIC LUMBAR SYMPATHECTOMY FOR WOMEN: EFFECT ON COMPENSATORY SWEAT

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Loureiro M de P, de Campos JRM, Kauffman P, Jatene FB, Weigmann S, Fontana A. Endoscopic lumbar sympathectomy for women: Effect on compensatory sweat. Clinics. 2008;63:189-96.

**INTRODUCTION:** Plantar hyperhidrosis is present in 50% of patients with hyperhidrosis. Thoracic sympathectomy is an important tool for the treatment of this condition, which is successful in about 60% of patients. For the remaining patients, lumbar sympathectomy is the procedure of choice. As new minimally invasive techniques have been developed, a significant demand for this type of access has led to its adaptation to the lumbar sympathectomy. The objective of this study was to evaluate the effectiveness of endoscopic retroperitoneal lumbar sympathectomy in controlling plantar hyperhidrosis and its effects on compensatory sweat.

**MATERIALS AND METHODS:** Thirty female patients with persistent plantar hyperhidrosis after thoracic sympathectomy were enrolled. They were randomly assigned to laparoscopic retroperitoneal lumbar sympathectomy (Group A) or no surgical intervention (Group B - control) groups. Quality-of-life modifications were assessed by specific questionnaires before and after surgery. In the same manner, direct sweat measurements were also performed pre- and post-intervention by evaluating trans-epidermal water loss. Despite the lack of intervention, the control group was evaluated at similar timepoints.

**RESULTS:** In Group A, no major complications occurred in the peri-operative period. During the immediate post-operative period, three patients (20%) experienced prolonged pain (more than ten days). Eight patients suffered from worsened compensatory sweating (53.3%). In Group A, after lumbar sympathectomy, the quality of life significantly improved ( $p < 0.05$ , intra-group comparison) beyond that of the control group ( $p < 0.05$ , inter-group comparison). Also, lumbar sympathectomy resulted in significantly lower values of foot sweat (pre- vs. post-operative periods,  $p < 0.05$ ; Group A vs. Group B,  $p < 0.05$ ). These patients also developed higher values of sweat measurements on specific points of their dorsal and abdominal regions after the procedure ( $p < 0.05$ ).

**CONCLUSIONS:** The endoscopic retroperitoneal lumbar sympathectomy diminishes plantar sweat and improves the quality of life of women with plantar hyperhidrosis. However, about half of the patients develop increased compensatory hyperhidrosis in other areas of the body.

**KEYWORDS:** Retroperitoneal space. Sympathectomy. Quality of life. Laparoscopy. Women.

## INTRODUCTION

The lumbar sympathectomy was first described by Julio Diez,<sup>1</sup> of Buenos Aires, Argentina, in 1924 and subsequently

by Royle<sup>2</sup> in Australia and Adson<sup>3</sup> in the United States. It was initially utilized for the treatment of ischemic and painful disorders of the lower limbs. This treatment, which was popular among vascular surgeons, remained unchanged for several decades. Its use slowly decreased after 1960, when arterial reconstruction techniques were introduced. It is still useful for some patients with vascular diseases; however, it is particularly useful in the treatment of plantar hyperhidrosis (PHH).<sup>4</sup>

Primary hyperhidrosis (HH) is the most frequent indication for sympathectomies, both lumbar and thoracic.<sup>4</sup> This disease affects about 1% of the population and is characterized by excessive sweating in specific regions of the body

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Received for publication on 01/10/07

Accepted for publication on 29/11/07

such as the hands, face, scalp, axilla and feet. The endoscopic thoracic sympathectomy (ETS) is indicated for the treatment of palmar, axillary and craniofacial hyperhidrosis. The results of plantar excessive perspiration, however, are less expressive (improved in up to 58% of cases).<sup>5</sup> Many patients with PHH who have undergone ETS still continue to experience excessive sweating of the feet after surgery.

The endoscopic retroperitoneal lumbar sympathectomy (ERLS) is efficient in the treatment of PHH isolated from or associated with other affected areas that persisted after ETS.<sup>6-7</sup> It is believed, however, that there could be a worsening of compensatory sweating (CS), when adding the effects of ETS to the lumbar regions of the same patient.<sup>8-10</sup> It is highly probable that suppression of one more segment of the sympathetic chain could actually increase CS. This is one of the principal doubts concerning lumbar sympathectomy but, despite this, has not been well-characterized in the literature.

The objective of this study was to evaluate whether endoscopic retroperitoneal lumbar sympathectomy is effective in controlling plantar hyperhidrosis and whether it increases the compensatory sweat generated after thoracic sympathectomy. To accomplish this, we utilized a quality-of-life questionnaire and evaluated for sudoresis by measuring transepidermic water loss.

## PATIENTS AND METHODS

The sample consisted of female patients who presented with PHH at the time of surgery and received ETS at our hospital. Because ETS can improve PHH, we exclusively selected those patients for whom this surgery had not yet caused the desired effect. ERLS was offered as a form of treatment. The volunteers were then evaluated for inclusion in the study.

Thirty-one females aged 17 to 44 years (mean = 23.3 years) were included. Before ETS, 14 of those patients presented with palmar and plantar HH, one with axillary and plantar, 15 with axillary, palmar, and plantar, and one with craniofacial and plantar.

Of the 31 patients initially selected, only one declined to participate. The remaining patients met the inclusion criteria and signed an informed consent after clarification of treatment characteristics, necessary evaluations, and participation in scientific research. In addition, all were given initial data regarding results from the lumbar sympathectomy in controlling PHH.

After the initial evaluation with the quality-of-life (QOL) questionnaire and sweat measurements, patients were randomized into two groups: Group A (test) and Group B (control). Each patient was asked to randomly select a piece

of paper from a bag in order to determine placement with a specific group (Figure 1).

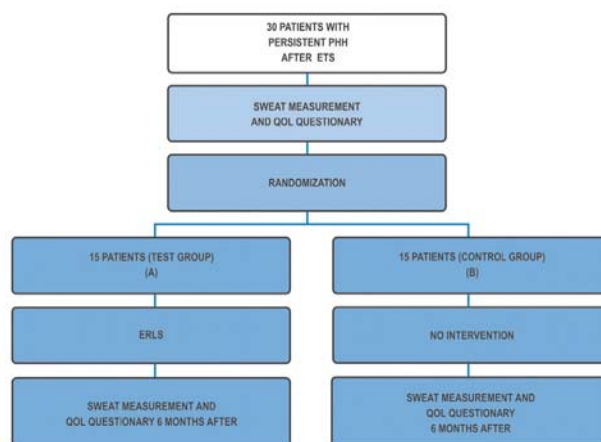


Figure 1 - Chart of activities

## Quality-of-life questionnaire.

The QOL questionnaire referred to the compromising effects of HH on the patients' daily routine, in social, professional, and emotional aspects and under specific circumstances.

The form was developed to evaluate the results of ETS<sup>5</sup>. It contained 21 questions divided into five categories, with five levels of responses. A score of 21 represented all responses at level 1, the rating of "excellent" by the patient. 105 represented all responses at level 5, or "poor". This rating system allows for the evaluation of quality of life before and after ETS and ERLS, as well as facilitates the understanding of the impact of PHH on the patients' routine.

## Sweat assessment

Sudorometry was accomplished at a specific laboratory, where patients remained for at least 30 minutes prior to measurement, allowing for thermal and psychological acclimatization.

The relative humidity of the air was maintained between 10% and 60%; the temperature was maintained between 20 °C and 25 °C. Neither thermal nor emotional or intellectual inducers of HH were utilized.

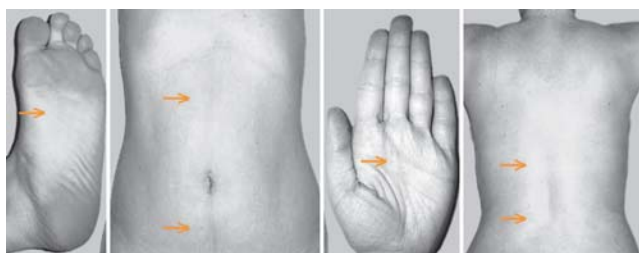
The equipment chosen to measure HH was the Vapometer®<sup>11</sup>. It is capable of measuring transepidermic water loss (TEWL). The evaporation rate is a measure of flow, calculated by the increase in relative humidity inside the measuring chamber of the equipment. After chamber contact with the skin being examined, the evaporation rate is measured and expressed in grams (g) per square meter (m<sup>2</sup>) per hour

(h). The rate varies from 0 to 300g/m<sup>2</sup>/h. The examiners who performed the measurements had been trained in the correct utilization of the equipment.

The skin regions were uncovered at least five minutes prior to measurement to facilitate natural evaporation. The measurement was taken in a standardized sequence: the plantar surface of the feet, supra and infra-umbilical regions, palmar surface of the hands, and the dorsal region superior and inferior to the projection of the umbilical scar (Figures 2 and 3).



**Figure 2** - Plantar sudorometry and transmission of data by wireless system



**Figure 3** - Localization of 8 points of measurement (right foot, left foot, abdomens; supra and infra-umbilical, right hand, left hand, dorsal; supra and infra)

## Surgery

All 15 bilateral ERLSs were performed by the same surgeon with the same technical sequence from October 2005 through November 2006.

Patients underwent general anesthesia with endotracheal intubation and were placed in a dorsal decubitus position, slightly lateralized with a cushion under the lumbar region. Retroperitoneal access was always obtained using an intra-peritoneal view as a guide to the retroperitoneal placement of the first trocar halfway between the iliac crest and the inferior costal facet of each side, at the median axillary line. Once the extraperitoneal space was established, the other trocars were placed equidistant to the first in a semi-lunar distribution.

The first landmark identified was the psoas major muscle. In a medial direction, the genitofemoral nerve was identified above the psoas tendon. The ureter was then located and

isolated in the direction of the peritoneum. Following this, the lumbar sympathetic trunk was identified medially to the muscle where it is covered by a capsule formed by the psoas muscle insertion at the lumbar spine (Figure 4).



**Figure 4** - Paravertebral lumbar sympathetic trunk (white arrow) under the vena cava (yellow arrow)

Once the capsule was open, the trunk and its ganglia were revealed. After correct identification, we proceeded with careful resection of the sympathetic ganglia, LG2 and LG3 (second and third lumbar ganglia). The length of the removed chain was standardized to 4 cm.

After release from the hospital, the patients were re-evaluated after one week, one month, and six months. During these consultations, they were interviewed and examined, in an attempt to identify their impression of the surgery, its results and the development of any side effects. Perspiration and evaluation of the quality of life were re-assessed six months after the lumbar sympathectomy.

## Statistical analysis

After verification of their normal distribution, the data were analyzed using the t-test for paired samples. The level of significance was established at 5% ( $p < 0.05$ ).

Statistical calculations were performed using the Statistical Package for Social Sciences program (SPSS, version 10.0).<sup>12</sup>

## RESULTS

### Operatory results

There were no conversions from the endoscopic to open access. In addition, there were no perioperative complications like lumbar vessel bleeding, lesions of the vena cava, or lesions of the ureter or genitofemoral nerve. Hospitalization varied from one to three days, with a mean of 2.3 days.

In the early post-operative period, some patients experienced progressively decreasing but prolonged pain for more than ten days (3 patients; 20%) or up to three months (1 patient). The mean time off of work was 13.5 days; this ranged from 5 to 22 days.

With respect to CS, we observed that six months after ERLS, seven (46.6%) patients did not report worsening. One patient reported slight improvement in CS development in the legs after ETS. The remaining (53.33%) patients, however, reported an increase in CS. This worsening, classified on a scale of 1 to 10, presented values that varied from 3 to 8 (mean= 5.87).

The aesthetic result, evaluated six months after surgery, was considered good in eight (53.3%) of the patients, considered average for five (33.3%) and considered poor for two (13.3%) patients.

Two patients (13.33%) reported sexual alterations: in one, an increase in libido; in the other, a slight decrease in vaginal lubrication, without interference in sex life.

In two patients (13.33%), there was a temporary recurrence of palmar sweating around the second month after surgery.

No patient expressed regret over having undergone the surgery.

### Quality of life

The QOL scores were expressed as minimum values, maximum values, means, and standard deviations. These are presented in Figure 5. We observed the best mean (lowest numerical value) in the test group (26.33) after ERLS. This was close to the minimum possible value of 21. Patients with persistent PHH who underwent ERLS presented values close to ideal in the QOL indices related to HH.

The mean scores of QOL after ERLS in the test groups presented a considerable decrease from 48.8 to 26.33. When comparing these scores, we observed a statistical difference between the pre- and post-ERLS periods (Figure 6). Patients with PHH who underwent ERLS commented on improvements in quality of life.

Six months after ERLS, the QOL scores in the test group were compared to control group results. A considerable difference between the groups (means of 26.33 and 47.6, respectively) was observed (Figure 7). After ERLS, patients in the test group presented with a greater improvement in QOL relative to the control group patients.

### Sweat measurement

We observed that values from the sweating assessment of the right and left feet in the test group before and after ERLS

	Minimum	Maximum	Average	Standard Deviation
Control Group Before ETS	70	105	93,07	8,87
Control Group After ETS	29	57	48,00	7,46
Control Group 6 months after first measure	29	57	47,60	7,84
Test Group Before ETS	73	103	94,67	8,95
Test Group After ETS	40	62	48,80	6,54
Test Group Before ERLS	55	87	73,08	9,67
Test Group After ERLS	21	34	26,33	4,20

Figure 5 - Quality of life scores.

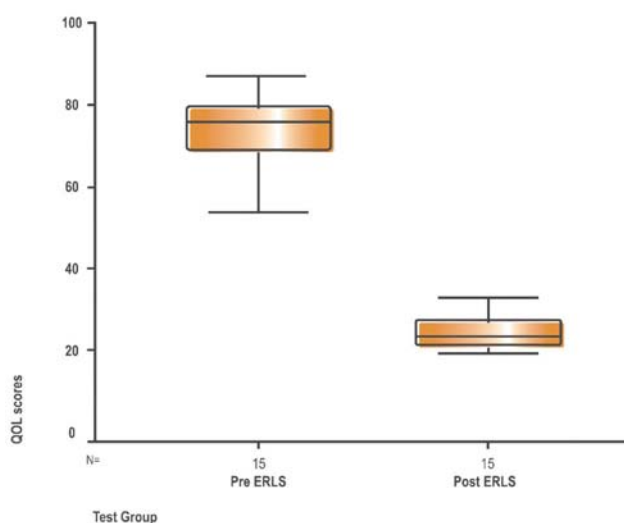


Figure 6 - Comparison between the QOL scores of the test group before and after intervention (ERLS). Test group in red (p<0.05)

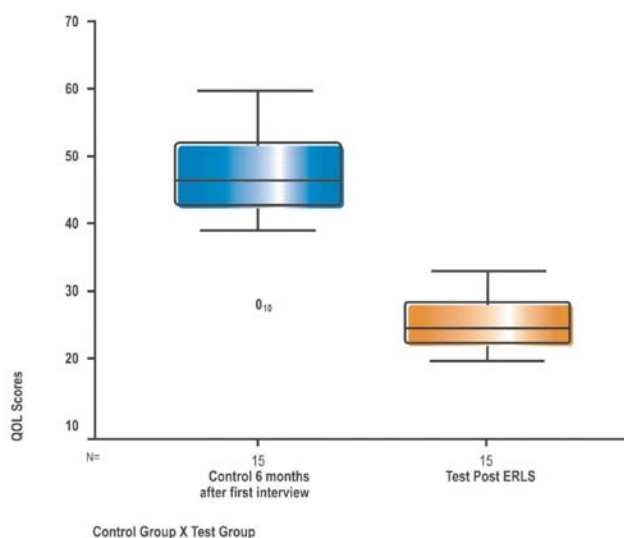
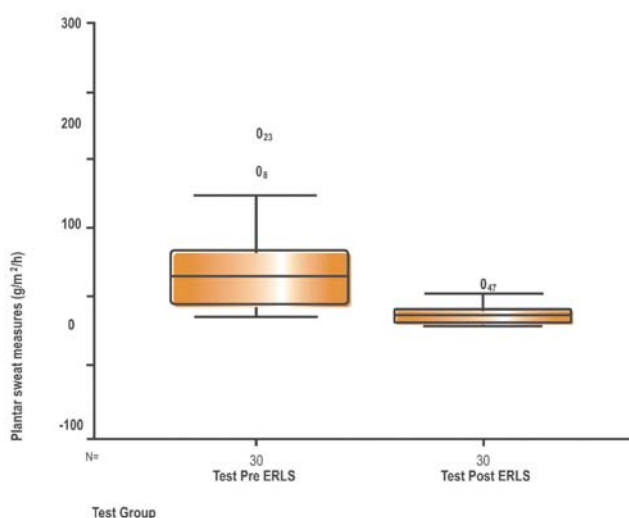


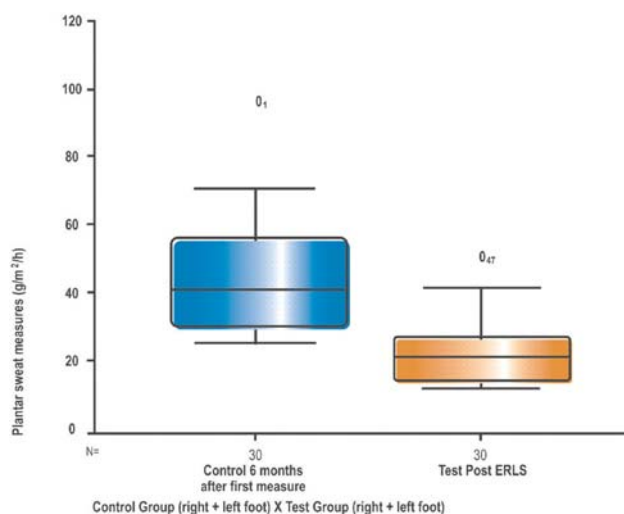
Figure 7 - Comparison between the QOL scores of the control group in the interview of 6 months and the test group after the VRLS. Control group in blue and test group in red (p< 0.05)

were different, with a decrease in the pre-operative mean from 64 to 22.6g/m<sup>2</sup>/h and a decrease in standard deviation from 42.42 to 8.88, which made the group much more homogenous. The comparison between the two measures demonstrates a reduction in sudoresis after surgery. The values were significantly different (Figure 8). Patients with PHH who underwent ERLS experienced less sweating.

To corroborate these results, the foot sweat assessment values for the test group after ERLS were compared to the corresponding results in the control group after six months. The means, 22.6 and 45.12 g/m<sup>2</sup>/h, respectively, were significantly different (p<0.05) (Figure 9). Patients who underwent ERLS experienced less sweating of the feet than did the control group.

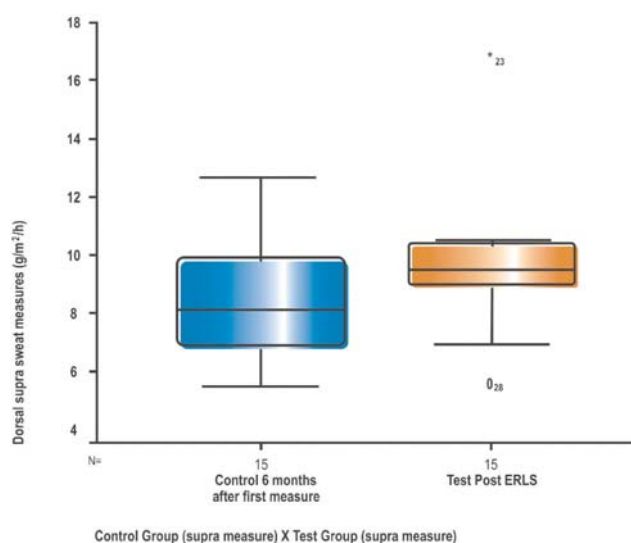


**Figure 8** - Comparison between the values of sweat assessment of the feet before and after the VRLS. The circles represent values atypical measures. Test group in red (p<0.05)



**Figure 9** - Comparison between the values of sweat assessment of the feet of the control group six months after VRLS. The circles represent atypical measures. Control group in blue and test group in red (p<0.05)

With respect to compensatory sweating, measurements of dorsal and abdominal sudoresis allowed for the identification of some changes. With respect to the measurements of dorsal sweating in the superior (supra) position, the values of the test group after ERLS were greater than the corresponding values of the control group. A significant difference was observed between the means. Compared to patients in the control group, patients who underwent ERLS presented with an increase in compensatory sweating in the superior dorsal position (Figure 10).



**Figure 10** - Comparison of values of assessment of dorsal supra sweating between the control groups six months after VRLS. The circles represent atypical value measurements. Control group in blue and test in red (p<0.05)

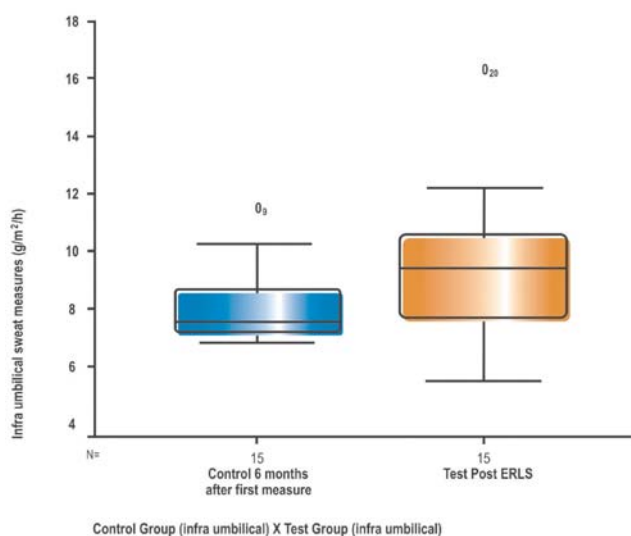
The same increase occurred for values of abdominal sweating in the infra-umbilical position. The test group had comparatively greater values than the control group. The difference between the means was also statistically significant. As compared to patients in the control group, patients who underwent ERLS presented with an increase in compensatory sweating in the infra-umbilical position (Figure 11).

**DISCUSSION**

The surgical endoscopic sympathectomy performed on the thorax is superior to any other treatment modality for HH.<sup>5,13,14-17</sup> ERLS appears to be a more adequate method of obtaining the anhidrotic effect of the feet, as it is minimally invasive and allows for visualization and precise identification of the sympathetic chain. Resection can be safely performed without the inconvenience of open surgery.

**Measurement methods**

When one attempts to measure sympathectomy results, it



**Figure 11** - Comparison of sweat assessment values in the abdominal infra-umbilical region between control groups six months the first measure and test group 6 months after ERLS. Control group in blue and test group in red ( $p < 0.05$ )

is fundamental to use direct sweating assessment methods. A measure of transepidermic water loss (TEWL) was utilized in this study. This measurement has been used to test new products in the cosmetic industry and has been recently tested for sweat assessment.<sup>11,18,19</sup> This measure of evaporation flow from the skin can be perfectly interpreted as the sudation rate.<sup>8,11</sup>

This method was practical and capable of identifying differences in the sudation rate provoked by ERLS in this study. However, other studies are necessary to investigate the limitations of the TEWL measurement for the evaluation of sympathectomy results.

### Endoscopic Surgery

Endoscopic surgery enabled our patients to return home quickly and resume normal activities rapidly. Less surgical stress and more-controlled tissue lesions enabled the patient to move about and also reduced complications. The concept of endoscopic surgery incorporated for thoracic sympathectomy brings about a great technical advance. A surgery that was at one time performed using large incisions, causing intense discomfort and high morbidity, has become minimally invasive. The innovation of minimal invasiveness has rapidly been adapted to surgical manipulation of the sympathetic chain due to its simplicity, rapidity, efficacy and less-aggressive nature. Similarly, the choice of a surgical method for controlling PHH should be endoscopic. ERLS comparisons with open surgery demonstrated its clear aesthetic superiority as well as overall functional recovery.<sup>21,22</sup>

### Resection level and pre-operative localization

In this study, we performed a LG2 and LG3 sympathectomy, following the principle that LG2 is situated along the lumbar spine, below the inferior renal pole, which should be our superior limit of dissection. Once the ganglion was located, its resection followed, as well as resection of the next ganglion immediately inferior to it. The anatomic location of the kidneys was confirmed by the pre-operative ultrasonography in all patients. Lumbar sympathectomy is predominantly a pre-ganglion surgery when LG4 is left intact because that's where the majority of the synapses of pre- and post-ganglion fibers occur.<sup>9</sup> We decided to remove only LG2 and LG3. This delimits the sympathetic denervation to the territory below the knee line.

### Discussion of results

Fifteen patients in each of the groups does not seem to be a large group, but compared to the ERLS series described in the literature,<sup>22,24-27</sup> this can be considered expressive.

Despite the minimal cuts, the aesthetic outcome was only considered good for 53% of patients. This fact demonstrates a high degree of aesthetic exigency in this population, making conventional surgery for PHH almost unacceptable for these young patients. Hyperhidrosis interferes with patient self-esteem and vanity, which obliges surgeons to search for the best possible cosmetic results in this type of treatment.

### Compensatory sweating

In the present study, CS characterization was performed by directed questions, analyses of QOL and sweating assessment. When patients were asked for their impression about CS at six months after the operation, the results were similar to those of our previous study.<sup>28</sup> Of the 15 patients, 53% reported worsening of CS, mainly on hotter days or when performing physical activities. The mean BMI (body mass index) of the operated group was low (21.7 kg/m<sup>2</sup>); the group consisted of thin patients. It is known that the greater the BMI the worse is CS development.<sup>5</sup> The only participant with a BMI greater than 25 kg/m<sup>2</sup> was the patient who presented with the worst CS. Considering only the subjective impression of patients, we observe that there is an increase in CS after ERLS; this could be related to BMI.

### Quality of Life

Analyzing the means and standard deviations of the QOL scores in the test group, we observed a considerable drop in QOL values after ERLS. The mean decreased from 73.08

points to 26.33 (best possible score: 21). This reflects the effectiveness of ERLS in the control of PHH and the inconvenience that the disease generated in these patients.

These results are confirmed in the comparison between post-ERLS scores of the test and control groups six months after the first interview. The mean scores were 26.3 and 47.6, respectively, with a significant advantage for the test group. The improvement of plantar sweating supplanted even the occasional inconvenience caused by the development or worsening of CS. For these patients, CS is not as important as PHH, even if it might be considered more visible than foot sweat. The ability to use an open shoe, to dance, and to be free of foot infection should not be underestimated for a woman, especially in a hot climate.

### Sweat Measurement

With the aim of objectively proving ERLS effectiveness with respect to the control of foot sweating, two comparisons were made. In the test group, the amounts of foot sweating were compared before and after ERLS. The observed values demonstrate that patients presented with significantly lower measures of plantar sudoresis after the procedure. A second comparison examined plantar sudoresis of the test group after ERLS versus the equivalent measures of the control group. In this case, we also observed measurements of plantar sudoresis of the test group to be significantly lower than those of the control group. Therefore, this confirms that the patients who underwent ERLS experienced less sweating of the feet; this alteration is directly assessed by the TEWL measurement, as previously observed in other studies (Pedevilla et al, 7th International Society of Sympathetic Surgery; 2007).

Prior to the present study, some evidence suggested that surgery did indeed, provide control in PHH. At that point, the evidence for sudoresis control was limited to the degree of patient satisfaction after ERLS, as well as the clinical observation of dry feet skin. Currently, we have more objective criteria for this evaluation at our disposal. Combining these analyses with improvements in quality of life and results reported by the patients, we can confirm the efficiency of the ERLS in PHH treatment.

The development or worsening of CS was reported by 8 (53.3%) of our patients. Several comparisons were made with the intent to confirm this observation. The values for sweating in the abdominal and dorsal regions were compared between the test and control groups and between the pre- and post-ERLS period, grouping the supra- and infra-umbilical measurements, as well as measuring them separately.

Comparing sweat from the supra-umbilical region of the test group to the corresponding values of the control group,

and consecutively for the infra-umbilical, superior dorsal, and inferior dorsal regions, we were able to obtain some significant information. There was a statistical difference between the superior dorsal and infra-umbilical regions. Patients of the test group presented with more sweating in these regions relative to the control group. These data, in association with those obtained in the post-ERLS interview, led to the observation that this surgery can provoke an increase in CS, for patients who have undergone prior ETS. Furthermore, these data corroborate previous studies.<sup>9,10</sup>

### Future Perspectives

The TEWL utilized in this study demonstrates a practical, reliable, and easily reproducible method of measuring sudoresis. It should be adopted as the method of choice for objective measurement of sweating in future studies. On the other hand, QOL questionnaires also demonstrate their importance in the analysis of diseases such as HH. The improvement of quality of life is a target parameter in the quality of treatment. New models of questionnaires should be developed and validated for each region affected by HH.

Randomized studies can serve to improve the quality of future studies. Similar methodology can be utilized in the evaluation of other sympathectomy results.

ERLS was determined to be safe, rapid and efficient in the control of PHH. Its complications are acceptable and well-tolerated by patients. We believe that this technique should become the treatment of choice for primary or persistent PHH after ETS, due to the tremendous benefit to patients. Its development also depends upon strict participation on the part of the patients, to whom falls the burden of observing and reporting all possible and long-term side effects.

Finally, data generated by ETS should be incorporated logically into the ERLS. Specifically, future studies should investigate the use or non-use of electrocautery, resection or clipping of the sympathetic chain, and definition of the level of the sympathectomy according to the desired anhidrotic effects.

### CONCLUSIONS

The endoscopic retroperitoneal sympathectomy in women is a safe surgery with very few and very tolerable side effects. It decreases plantar sudoresis and improves the quality of life of patients with plantar hyperhidrosis.

On the other hand, this surgery also promotes an increase in compensatory sweating in the dorsal and abdominal regions of patients, who previously underwent thoracic endoscopic sympathectomy.

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