Palmar hyperhidrosis—which is the best level of denervation using video-assisted thoracoscopic sympathectomy: T2 or T3 ganglion?

Guilherme Yazbek, MD,[a*] Nelson Wolosker, MD, PhD,[b] José Ribas Milanez de Campos, MD, PhD,[c] Paulo Kauffman, MD, PhD,[b] Augusto Ishy, MD,[c] and **Pedro Puech-Leão, MD, PhD,[a]** *São Paulo, Brazil*

Purpose: **This study compares early results of video-assisted thoracoscopic sympathectomy (VTS) at the thoracic T2 versus T3 ganglion denervation levels for the treatment of palmar hyperhydrosis (PH).**
Methods: **Sixty patients with PH were prospectively randomized for VTS at the thoracic T2 or T3 ganglion denervation levels. The patients underwent postoperative evaluation on three occasions: before surgery, and 1 and 6 months after the operation. Endpoints included the absence of PH, the presence, location, and severity of compensatory hyperhydrosis (CH), and a quality-of-life assessment.**
Results: **Fifty-nine of 60 patients reported complete resolution of PH after surgery. One failure occurred in the T3 group. CH was observed in 26 patients (86.66%) in the T2 group and in 27 patients (90%) in the T3 group at 1 month. At 6 months, 30 of 30 patients in the T2 group and 29 of 30 in the T3 group experienced CH, although in the T3 group, CH was less severe at both 1 and 6 months ($P < .05$). Quality of life was very poor in both groups before surgery. One month after operation, quality of life was improved similarly in both groups. This improvement was maintained at 6 months in both groups.**
Conclusion: **PH is well treated by VTS at either the T2 or T3 levels. Denervation at the T3 level appears associated with less severe CH in the early postoperative period. Quality of life improved significantly in both groups. (J Vasc Surg 2005; 42:281-5.)**

Video-assisted thoracoscopic sympathectomy (VTS) is the treatment of choice for palmar hyperhidrosis (PH). This technique avoids manipulation of the stellate ganglion, thus minimizing the occurrence of Horner's syndrome.[1-3] However, VTS is associated with the development of compensatory hyperhidrosis (CH), with an incidence ranging from 30% to 90%.[4-8] The level of the ganglia resection that successfully treats PH while minimizing the incidence and severity of CH is unknown.[9-11]

This study compares the early results of VTS at two levels of denervation, thoracic ganglion T2 versus T3, in a prospective randomized manner. Patients were followed for PH, CH, and quality of life.

METHODS

From May 2003 to January 2004, 60 patients with PH underwent VTS. All consented to enter a prospective, randomized study designed according to the guidelines of the Ethics Committee for Analysis of Research Projects on Human Experimentation at the study institution. Patients were included in this study if they had not had thoracic operations and had no disease or associated condition, such as cardiac diseases, pulmonary infections, neoplasia, or inflammatory diseases affecting the lungs or pleurae, which might put the patient and the results of the procedure at risk. Patients with a body mass index >25 were excluded.

After randomization, 30 patients underwent VTS at the T2 ganglion level and 30 at the T3 level. All the patients were blinded to the level of sympathectomy. All the procedures were performed by the same surgical team, and standard surgical techniques were used throughout the study period.

All patients underwent surgery under general anesthesia and in a semi-seated position inclined at 60°. Two 5-mm mini-incisions were made. The first was at the fourth intercostal space on the anterior axillary line, into which a video camera was introduced. The second was at the fourth intercostal space on the medial axillary line, into which the electric or harmonic cautery was introduced.

The level of ganglion resection was selected at random. After identification of the sympathetic chain, the patients randomized for the T2 ganglion level underwent resection of the chain (sympathicotomy) on the body of the second and third ribs, followed by thermoablation of the segment isolated between them. The patients randomized for the T3 ganglion level underwent resection of the chain (sympathicotomy) on the body of the third and fourth ribs, followed by thermoablation of the segment isolated between them. During thermoablation, the adjacent ganglia were protected from any transmitted heat. The same procedure was performed on the contralateral chain.

The patients were had a clinical and quality-of-life assessment once before surgery and then at 1 month and 6 months after the operation. The primary investigator did all

From the Division of Vascular Surgery and Thoracic Surgery, Hospital das Clínicas, Faculty of Medicine, University of São Paulo.
Reprint requests: Guilherme Yazbek, MD, Department of Vascular Surgery, Rua Bom Pastor, 1263, São Paulo, SP 04203-051, Brazil (E-mail: guilhermeyazbek@yahoo.com)
0741-5214/$30.00

doi:10.1016/j.jvs.2005.03.041

Table I. Clinical characteristics of the patients with palmar hyperhidrosis

	T2	*T3*	*P**
Mean age ± SD	23.4 ± 5.3	23.2 ± 6.5	.5833
Men/women	24:6	17:13	.052

*Values were not significant

Table II. Degree of compensatory hyperhidrosis after surgery

	At 1-month follow-up		*At 6-month follow-up*	
	T2:T3	*P*	*T2:T3*	*P*
Nonsevere	16:27	.001	20:26	.033
Severe	10:0		10:3	

Table III. Point totals on quality-of -life questionnaire

Variable	*T2*	*T3*	*P**
Initial (before operation)			
Median (range)	92 (67-100)	87.5 (75-100)	.3052
1-month follow-up			
Median (range)	23 (20-47)	23 (20-42)	.8423
6-month follow-up			
Median (range)	24 (20-56)	24 (19-52)	.3905

*Obtained by Mann-Whitney *U* test

of the evaluations. The primary endpoints in the study were:

1. Presence or absence of palmar anhydrosis, as reported by the patient and confirmed by physical examination.
2. Presence or absence of CH, with evaluation of its location and severity, as reported by the patient and confirmed by physical examination. The severity of the CH mentioned spontaneously by the patients was graded as severe or nonsevere. The CH was considered to be severe if it was visible, embarrassing, and necessitated more than one change of clothes during the day.
3. The patient's degree of satisfaction was measured by the quality-of-life protocol described by Amir et al.[12] Patients completed the quality-of-life assessments without physician involvement. The patient's preoperative quality of life was classified in one of five different levels of satisfaction by summing the points obtained from this questionnaire. When the total >84, we considered that the preoperative quality of life was very poor; 69 to 84, poor; 52 to 68, good; 36 to 51, very good; and 20 to 35, excellent. The quality of life assessment was repeated at 1 and 6 months after operation, and the patients were similarly classified in one of five different levels of satisfaction according to their score: much worse when the total >84; little worse, 69 to 84; unchanged, 52 to 68; a little better, 36 to 51; and much better, 20 to 35.[12,13]

Statistical analysis. For categoric variables, the χ^2 or Fisher's exact frequencies test were used, depending on the sample, for verifying associations between the type of surgery and the possible results and complications. These statistical tests for comparing the types of surgery with the variables of interest (palmar anhydrosis, incidence and severity of CH, and quality of life) were performed in relation to each of the assessment periods. The association between patients' ages and degrees of satisfaction measured by the quality-of-life protocol and the level of ganglion resection (T2and T3) were performed using the Mann-Whitney *U* test. The significance level considered for all tests was 5%.

RESULTS

The mean ages and the sex distribution of the two groups selected by the randomization process were similar (Table I). During the immediate postoperative period, all the patients denied episodes of PH. One patient had transitory (1 month) right-side Horner's syndrome, likely attributable to heat transmission during the lysis of pulmonary adhesions. Pleural drainage was necessary in one patient in each group because of significant pleural adherence.

No PH was reported at the 1- and 6-month follow-up visits by any of the 30 patients who underwent sympathectomy at the T2 level. One patient in the T3 group had continued PH. This patient underwent repeat thermoablation at the same level (T3), with no reduction in the PH. This patient is receiving clinical treatment with anticholinergic drugs and experiencing a slight reduction in the PH.

CH was observed in 26 patients (86.66%) in the T2 group and 27 patients (90%) in the T3 group at the 1-month follow-up. At the 6-month follow-up, all patients in the T2 group had some degree of CH, and all but one patient in the T3 group (96.6%) had CH as well. The patients in the T3 group had a lower degree of severity of CH at both the 1-month and 6-month follow-ups ($P <$ .05). The degree of CH in the two groups is presented in Table II.

No differences in the preferential location for CH were observed between the two groups: the abdomen, back region, or both, were affected. There was also no difference in the situations that triggered CH for both groups. CH occurred preferentially in situations of excessive heat, physical exercise, or both. A small number of patients mentioned that the symptom appeared in relation to stress.

The patients' degrees of satisfaction measured by the quality-of-life protocol are presented in Table III.

Before surgery, the quality of life was very poor in both groups (median, >84). One month after the operation, the quality of life was much improved in both groups, without significant difference between them (P = .8423). This improvement was sustained at the 6-month follow-up (P = .3905).

DISCUSSION

PH can be defined as a somatic disorder characterized by excessive perspiration in the palmar region. It is caused by hyperfunctioning of the sudoriparous glands, which are frequently triggered by emotion. Sympathectomy is indicated in cases of essential (emotional) hyperhidrosis that does not present any relationship with the need for thermoregulation.

Clinically, PH seems to be more severe during the period of hormonal and sexual maturation (ie, adolescence), although it may exist from the time of infancy.[14,15] PH is usually bilateral and symmetrical. PH has greater importance than hyperhidrosis in other localities, such as axillary and craniofacial hyperhidrosis, because of the resulting problems of social, professional, and affective nature. PH may cause a condition of social phobia in some individuals.

When we perform the T2 technique, we are probably resecting the second sympathetic ganglion in most cases, as defended by Ramsaroop et al,[16] who studied 22 adult cadavers and demonstrated that the second thoracic ganglion was consistently located in the second intercostal space. Also, Chung el al[17] observed that in 27 adult cadavers, the second thoracic sympathetic ganglion was most commonly located (50%) in the second intercostal space.

A positive response of PH to sympathectomy has been long known. In our sample, therapeutic failure only occurred in one case in the T3 group. PH was not reduced in this patient, despite a second surgical intervention. This suggests a small number of patients may have a neurologic bypass via T2 ganglion fibers or postganglionic fibers in T2 that could maintain the PH in patients who undergo VTS at the T3 ganglion level.

With the advent of VTS, Horner's syndrome has become a rare complication. Its occurrence is limited to cases of indirect injury to the stellate ganglion caused by heat diffusion or excessive traction of the sympathetic chain.[15] We believe that resecting ganglia that are more distant from T1 should reduce the incidence of this complication further. In our study, only one case of Horner's syndrome occurred, caused by transmission of heat in a patient in the T3 group who presented with a lot of pleural adherences.[1,13]

The postoperative appearance of perspiration in regions of the body where it had not been previously observed is called CH.[18,19] Its physiopathology is unknown, but it is suspected that this phenomenon is caused by a temperature-regulating compensatory mechanism in the body.[11] It occurs most frequently in the back region and abdomen.[4]

CH is the most common complication reported with VTS[10,19,20-22]and was so in our study. When severe, CH can significantly affect quality of life.[13] In the present study, this complication occurred in 100% of the patients in the T2 group and 96.6% of the T3 group. The severe form was present in 33.3% of the patients in the T2 group and in 10% of the T3 group.

We believe that this high incidence is because Brazil is a tropical country, and the weather is most frequently hot, which naturally generates more sweating. This can be considered to be a normal physical response to high ambient temperatures. Nonetheless, postoperative CH can occur irrespective of how hot the environment is.

Another reason for the high incidence of CH is the conservative definition of CH adopted for this trial. At present, there is no consensus for the classification of CH. Because of this, we have created a comprehensive method in which we considered CH to be present if perspiration occurred in locations of the body where it had not existed before the surgical procedure, even if such sweating was only observed under specific conditions such as intense heat or physical exercise. Other methods for quantifying the severity of CH take into consideration situations of daily life that could indirectly indicate the quantity of sweat.[20]

We graded the 60 in our study into two groups of severity. Patients were considered to have severe CH if they inquired about additional therapy or if sweat soaked their clothes to the point of being visible and embarrassing and, because of such severity, needed to change their clothes more than once during the day. Those who presented with CH in situations of heat, exercise, or stress that could be visible or embarrassing, but without the need for more than one change of clothes or treatment, were graded as having nonsevere CH.

It has been suggested that CH has a correlation with the extent of the resection and also the level of the resection.[23,24] In the present series, one ganglion (T2 or T3)was resected in each of the two groups. Because the extent of the resection was the same, our results suggest the level of the neuroablation may be the most important factor. Others have reported similar results.

In 2001, Lin and Telaranta[25] reported that CH was less prevalent in patients who underwent T3 and T4 ganglion resection than in patients with T2 ganglion ablation. They theorized that the higher the interruption or resection in the sympathetic chain was performed, the more afferent fibers responsible for inhibiting sudoresis would be damaged, thereby causing a considerable increase in the quantity and severity of CH.[25]

Leseche et al[10] used different levels of sympathectomy in patients with PH and observed a therapeutic success rate of 97% and CH in 71% of the cases. Their study compared several levels of sympathectomy but did not evaluate the levels T2 and T3 separately.

Riet et al[11] retrospectively analyzed sympathectomy of the T3 ganglion in just 14 patients, reporting therapeutic success in all cases and an absence of CH after the operation. Hsu et al,[6] in a retrospective study, observed CH in 70% of the patients who underwent sympathectomy at the T3 and T4 ganglion levels, in 29% at the T4 ganglion level, and in 29% at T4-T5 ganglion.

Yoon et al[26] used sympathicotomy at the level of the third rib in 24 patients with PH. This achieved resolution of the PH in all patients, with low incidence of CH (1 patient).

In another study among patients with PH, Yoon et al[27] used sympathicotomy at the levels of the second and third ribs in one group compared with simple sympathicotomy at the level of the third rib (T3). They obtained therapeutic success in all patients and reduced incidence of CH in the T3 group (45.8% vs. 16.73%).[27]

The data obtained in our study, contrary to some of the above-mentioned studies, show similar incidence of CH in the T2 and T3 groups (100% and 96.77%). With regard to the severity of the CH, our results are similar to those in which CH is more severe after the higher resections than after the lower resections (33% vs 10%; $P = .033$).

In our environment, excessive sweating may be considered to be unaesthetic, may cause distress in social situations, and may become dangerous and incapacitating. Such traits usually begin during infancy and may worsen during adulthood. The quality of life of patients with PH can be severely affected.

Several studies have reported an improvement in quality of life after sympathectomy, despite postoperative pain and the presence of CH in most patients.[28] These elements were outweighed by the improvement in patients' palmar symptoms, social roles, mental and physical functioning, and overall quality of life.[29]

In our study, the scores from the quality of life questionnaire before the operation confirmed that the quality of life of patients with PH was very poor, with no statistical difference between the groups (median, 92 for T2 and 87.5 for T3). Quality of life was notably improved after the operation, as shown by the reduction in the questionnaire scores from 92 to 24 in the T2 group and from 87.5 to 24 for T3. Despite the difference in the severity of CH between the groups, there was no difference in patients' satisfaction after the procedure. This was shown in the notable improvement in quality of life for both groups, both at the 1-month (median, 23) and 6-month (median, 24) follow-ups. Perhaps if we had not had a therapeutic failure in the T3 group, the quality of life might have been greater than for the T2 group.

CONCLUSION

VTS at the T2 or T3 ganglion effectively treats for PH. CH is a likely complication of the procedure. Despite the occurrence of CH, patients' quality of life is significantly improved after VTS at T2 or T3. VTS at the T3 level appears to be associated with a less severe form of CH, even though the improvement in quality of life was similar for the two groups. For this reason, it is presently our preferred treatment for PH.

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Submitted Jan 7, 2005; accepted Mar 30, 2005.