

Axillary Hyperhidrosis: T3/T4 *Versus* T4 Thoracic Sympathectomy in a Series of 276 Cases

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ABSTRACT

Background: Different techniques of video-assisted thoracic sympathectomy have been suggested to control the symptoms of axillary hyperhidrosis. We compared the results using two different levels of ganglion resection for treating axillary hyperhidrosis: T3/T4 *vs.* T4.

Materials and Methods: From a group of 1119 patients operated on between July 2000 and January 2005, 276 patients with axillary hyperhidrosis were studied. The mean age was 26 (range, 13–54 years) and 61.6% were female. Of these patients, 216 (78.3%) were treated with thermal ablation of T3/T4 and 60 (21.7%) with thermal ablation of T4 alone. The procedures were bilateral and simultaneous, using two 5.5-mm trocars and 30-degree optical systems, under general anesthesia in all cases.

Results: There was no mortality and no important postoperative complications or need to convert to thoracotomy in either group. The mean follow-up in the T4 group was 11 months (range, 2–23 months) and in the T3/T4 group mean follow-up was 24 months (range, 13–54 months). The immediate therapeutic success rate was 100% in both groups. There were recurrences in 7 (2.5%) patients, all from the T3/T4 group. The satisfaction rate was higher and more stable in the T4 group and compensatory sweating was lower in the T4 group.

Conclusion: Both techniques proved effective for controlling the axillary symptoms. Group T4 presented a higher satisfaction rate, lower recurrence rate, and lower severity of compensatory sweating.

INTRODUCTION

AXILLARY HYPERHIDROSIS is a distressing condition that is most prevalent in adolescents or young adults and which can create significant social and emotional problems. It is defined as excessive sweating of unknown etiology. There are many different treatments, including using deodorants or topical solutions, medical treatments,

and psychological therapies. Most of these are usually either unhelpful or temporary in their effect. Excision or suction-curettage of eccrine sweat glands and local injection of *Botulinum* toxin have been used, but these have drawbacks and should be offered only after careful consideration.

Video-assisted thoracic sympathectomy (VATS) for isolated axillary symptoms is the therapy of choice. It of-

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fers immediate and permanent symptom relief, with higher patient satisfaction rates.¹

The initial studies on surgically treated axillary hyperhidrosis cases gave results that were inferior to those for treatment of palmar hyperhidrosis. The high levels of compensatory sweating (compensatory hyperhidrosis), which may have been related to the level and extent of sympathetic chain resection, gave rise to patient dissatisfaction.^{2,3}

The evolution of palmar hyperhidrosis treatment indicates that limited resection of ganglia at lower levels gives good results in the correction of excessive sweating, together with decreased incidence and severity of compensatory hyperhidrosis. On the basis of this model, axillary hyperhidrosis treatment has developed along the same lines.

The present study compares the results from VATS carried out at two levels of denervation (T3/T4 and T4 alone), in a large case series of 276 consecutively operated patients. The follow-up monitored axillary hyperhidrosis, compensatory hyperhidrosis, and patient satisfaction.

MATERIALS AND METHODS

From July 2000 to January 2005, 276 consecutive patients with axillary hyperhidrosis underwent VATS. This was a retrospective, nonrandomized, and uncontrolled study. The patients underwent treatment following institutional protocol and in accordance with the ethical stan-

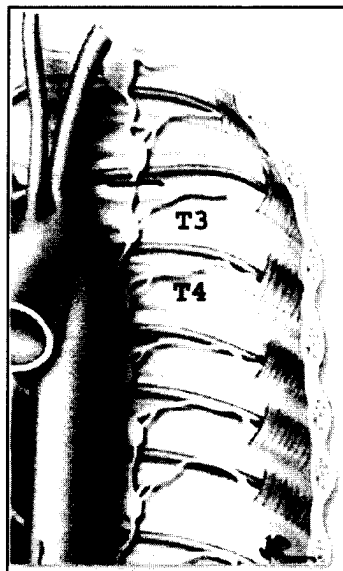


FIG. 1. Sympathectomy levels in the T3/T4 group.



FIG. 2. Sympathectomy level in the T4 group.

dards of the Ethics Committee for Analysis of Research Projects on Human Experimentation. Among these patients, 86% had been previously treated locally without significant improvement. Their mean age was 26.08 ± 8.35 years (range, 13–54 years); 170 (61.6%) were female and 106 (38.4%) were male. Their mean body mass index (BMI) was 22.09 ± 3.0 (range, 17–31). Almost all the patients were healthy, with nothing notable in their history or on physical examination, but 9 (3.2%) had a previous history of respiratory diseases. The mean postoperative follow-up was 21.6 ± 10.2 months (range, 2–50 months).

The patients were divided into two groups according to the surgical technique used: T3/T4 when the sympathetic chain was resected with thermal ablation of the third (T3) and the fourth thoracic ganglion (T4) and T4 when only the T4 ganglion was thermally ablated (Figs. 1, 2). An electric scalpel was used in 52.8% and a harmonic scalpel in 48.2% of cases.

All patients underwent the procedure under general anesthesia with double lumen tube and alternate lung ventilation. The patients were placed in a supine position, slightly elevated at the shoulders with both arms abducted to 90 degrees. Two 5-mm incisions were made in each hemithorax: the first was a submammary incision for the 30-degree camera and the second was a midaxillary incision for the surgical instruments. No insufflation was used. After the sympathectomy, the lung was re-expanded under direct vision at the same time as the air was aspirated from the pleural space through a small 16 Fr catheter. No thoracic drain was necessary and a chest ra-

diograph was done postoperatively to evaluate lung expansion.

All the patients underwent at least two evaluations for the purpose of this study: 1 month after the surgery and at the final postoperative evaluation. Routine evaluations were conducted after 1 week, 1 month, 6 months, and thereafter every 6 months.

At the first study evaluation (after 1 month), an assessment was made regarding whether or not the axillary hyperhidrosis had disappeared. At the final clinical evaluation, the severity of compensatory hyperhidrosis, the satisfaction rate, and the recurrence of axillary hyperhidrosis were analyzed.

On each of these two occasions, the patients filled out a subjective rating scale, without any intervention or advice from the interviewer, based on their own estimates. The following parameters were studied: recurrent axillary hyperhidrosis, compensatory hyperhidrosis, and patient satisfaction.

Patients who did not notice any difference in the location or severity of their body sweating were considered to be unaffected by compensatory hyperhidrosis. Slight compensatory sweating was considered present when patients reported minor modifications in the location and severity of their sweating, such as shirt blotches, but without expressing significant concern about this. Moderate compensatory hyperhidrosis was considered present when patients reported embarrassing or occasionally disabling situations caused by sweating. Finally, severe compensatory hyperhidrosis was considered present when patients reported interference in their social and professional activities, such as the need for successive changes of clothing, caused by sweating at the same intensity as their previous axillary hyperhidrosis, but at other primary locations.

The patients' satisfaction with the final result of the procedure (including both the treatment and any complications) was subjectively evaluated using a four-point rating scale: 1, deficient; 2, regular; 3, very good; 4, excellent.

The statistical test used was the chi-square test. The significance level was set at $P < 0.05$.

RESULTS

Most of the patients (97.5%) had an uneventful postoperative course and were discharged on the following

day. Six (2.1%) were discharged after 48 hours and only one (0.4%) was discharged after 72 hours, because of air leaks and chest tube drainage.

The operative complications were: eight cases (2.9%) of minor pneumothorax, of which only five (1.8%) required chest tube drainage; three (1.1%) of pulmonary atelectasis; two (0.6%) of air leaks for 48 hours; one (0.4%) of intercostal pain at the trocar site; one (0.4%) of intercostal venous bleeding (<80 mL); and one (0.4%) of transient bradycardia that reverted immediately with drugs. There were no cases of chylothorax or Horner's syndrome. There was no mortality or conversion to open surgery.

The mean follow-up in the T4 group was 11.28 ± 7.32 months (range, 2–23 months) and in the T3/T4 group mean follow-up was 24.4 ± 12.47 months (range, 13–54 months).

At the first evaluation, no axillary hyperhidrosis was reported in any case in either group.

At the final evaluation, there were no patients with recurrent axillary hyperhidrosis in the T4 group and 7 (2.5%) in the T3/T4 group. The recurrences were unilateral in 4 patients and bilateral in 3. Two of these patients underwent bilateral repeat sympathectomy, with therapeutic success and no complaints of severe compensatory hyperhidrosis.

Compensatory hyperhidrosis was observed in 196 (90.7%) patients in the T3/T4 group and 41 (68.3%) patients in the T4 group. The T4 patients had lower degrees of compensatory hyperhidrosis than the T3/T4 patients ($P < 0.001$). There was no severe compensatory hyperhidrosis in the T4 group (Table 1).

The patients in the T4 group had a higher satisfaction rate than those in the T3/T4 group ($P < 0.001$). There were no dissatisfied or regretful T4 patients (Table 2).

DISCUSSION

Axillary hyperhidrosis is a common condition. The psychosocial stress it causes places restrictions on the lives of individuals affected by this condition.

Several topical agents and iontophoresis methods have been used to achieve localized effects. The drawbacks of such treatments include short-lived effect, skin irritation, and the continuing need for daily application. Systemic agents such as anticholinergic drugs would appear to be

TABLE 1. SEVERITY OF COMPENSATORY SWEATING AFTER THORACIC SYMPATHECTOMY FOR AXILLARY HYPERHIDROSIS

	N	Absent	Slight	Moderate	Severe
T3/T4 ^a	216	20 (9.3%)	61 (28.2%)	85 (39.3%)	50 (23.2%)
T4	60	19 (31.7%)	37 (61.7%)	4 (6.6%)	0

^a $P < 0.001$.

TABLE 2. PATIENT SATISFACTION RATINGS AFTER THORACIC SYMPATHECTOMY FOR AXILLARY HYPERHIDROSIS

	N	Completely satisfied	Moderately satisfied	Dissatisfied	Regretted
T3/T4 ^a	216	141 (65.3%)	55 (25.5%)	11 (5.1%)	9 (4.1%)
T4 ^b	60	56 (93.7%)	4 (6.3%)	0	0

^aP = 0.528.

^bP < 0.001.

a logical choice, but high doses are needed, and this limits their usefulness because of a number of unpleasant side effects.⁶

Local surgical treatment, such as the excision of axillary tissue with or without the underlying subcutaneous tissue, is associated with surgical complications that include wound infection, slow healing, skin edge necrosis, hematoma, scarring (which may reduce shoulder mobility), and edema of the upper limbs.⁶ Moreover, the overall therapeutic success rate falls to only 40% after 6 months of follow-up.^{7,8}

Recently, local injection of *Botulinum* toxin A⁹ or B¹⁰ has demonstrated a promising effect in treating palmar and axillary hyperhidrosis, but successive local injections (every 6 months) may be necessary to obtain long-term results. The major drawbacks are the discomfort from multiple injections and antibody formation against the toxin that may reduce therapeutic effectiveness.¹¹

The efficiency of sympathectomy for treating palmar hyperhidrosis has been known for decades. The use of video equipment that only requires small incisions has led to VATS becoming widely accepted as a safe method for treating palmar hyperhidrosis, with low morbidity, rapid postoperative recovery, and imperceptible scars.

The initial results from VATS for the treatment of axillary hyperhidrosis were good in only 68–89% of cases.^{4,12} With technical improvements and resection from the second to the fourth ganglia, the results have become better and good results are now achieved in 94% of cases.¹⁴ In our series, we had initially successful results in all cases, both with resection of the T3 and T4 ganglia and with resection of the T4 ganglion alone.

The first point to be considered in explaining these good results is the extreme care taken to correctly resect the ganglia. We agree with Hsu et al., who stated that the key factor for preventing failed or recurrent cases is a procedure that is accurate, adequate, and performed by a specialized team.²³

Another problem found in various case series was the degree of symptom recurrence. Gossot et al. found a recurrence rate of 65% for axillary hyperhidrosis,¹⁵ a result that was at variance from the 15% reported by Claes.¹⁴ In our series, the incidence of recurrence was 2.5% in the T3/T4 and zero in the T4 group. This difference may have been a result of the longer follow-up

in the T3/T4 group. Moreover, the technique of thermally ablating T4 alone has only recently been introduced. In any event, we consider that these results are excellent; they exceeded our initial expectations.

The most frequent sites for compensatory hyperhidrosis are the abdomen, back, legs, and gluteal region. It only becomes bothersome or inconvenient when the symptoms are severe. In most cases, it is tolerable and does not reach the point of social embarrassment or occupational disability. Patients should always be warned of this possible complication prior to surgery because of the irreversibility of these sequelae.

Resection of the T4 ganglion appears to be the key to these good results. The importance of T4 sympathectomy in treating axillary hyperhidrosis was emphasized by Masters and Rennie in 1992.⁴ Lin and Wu emphasized that, for a complete operation at the T4 level, the clip or resection or thermal ablation must include all the ganglia between the upper borders of the fourth and fifth ribs, because sympathetic procedures are considered complete only when the upper and lower ends of the ganglia have been blocked or destroyed.¹⁷ In addition to performing sympathectomy, we always carry out thermal ablation of the chain between these points to ensure that the sympathectomy is complete.

In a study on 200 patients, Hsu et al. observed that only T4 sympathectomy provided higher patient satisfaction rates in axillary hyperhidrosis treatment, with fewer sequelae.²⁴

With the advent of VATS, Horner's syndrome has become a rare complication. Its occurrence is now limited to indirect injury to stellate ganglia, caused by heat diffusion or excessive traction of the sympathetic chain. Since we only manipulated the T3 and T4 ganglia, we did not have this type of complication. It is important to take care when manipulating the upper border of the fifth rib, because the thoracic duct crosses behind the aorta to the left posterior side of the mediastinum and ascends on the left hemithorax. The duct is vulnerable in this area. Fortunately, we have not had such a case, but the risk increases following extensive dissection consequent to findings of pleural adhesions.

Compensatory hyperhidrosis is the most common complication related to VATS. It was present in 90.7% of our group T3/T4 patients and in 68.3% of group T4 patients.

In 2004, Licht and Pilegaard reported on their results in patients who underwent operations at the T2, T3, and T4 levels for all types of hyperhidrosis.¹⁸ They found that 89% of the patients had compensatory hyperhidrosis, which was severe in 35%. The severity of the compensatory hyperhidrosis was greater when the resection of the thoracic chain was more extensive. In our series, the T3/T4 patients (with two ganglia resected) had a greater incidence of compensatory hyperhidrosis.

Licht and Pilegaard published a second study in 2005, on 100 consecutive patients who underwent VATS for axillary hyperhidrosis at the T2/T3 levels or at the T2, T3, and T4 levels.¹⁹ Compensatory hyperhidrosis occurred in 90% of these patients and was disabling in its severity in 53%. There was no statistical difference between the compensatory hyperhidrosis in these two groups, but the clinical results were better when the T4 ganglion was resected.

Neumayer et al. also achieved good results and the reduction of compensatory hyperhidrosis to 8.5% by blocking only the T4 level to treat axillary hyperhidrosis.²¹

Despite the continuing presence of compensatory hyperhidrosis, an improvement in the quality of life has been found in all series of VATS performed for treating hyperhidrosis.

The patient satisfaction rate was greater and there was less compensatory hyperhidrosis in our T4 group compared to the T4/T5 group. Long-term follow-up for these two groups may show whether these results will be maintained over the course of time. Even in the T3/T4 group, re-intervention was only required in two cases. In the event of any later recurrence of symptoms in patients in the T4 group, it would be possible to reoperate and assess the need to extend the sympathectomy to the T3 ganglion.

With the results obtained, we conclude that both techniques are effective for the treatment of axillary hyperhidrosis. Ablation of the T4 ganglion alone is preferable, because this presents less compensatory hyperhidrosis and a greater degree of patient satisfaction.

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