

## Evaluation of Efficiency of Endoscopic trans-thoracic Sympathectomy for Primary Palmar Hyperhidrosis

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### ABSTRACT

**Background:** Primary hyperhidrosis is a condition of unknown etiology characterized by excessive sweating, typically on the palms of the hands, on the soles of the feet, and in the arms. The sweating response is increased by emotional stimuli, temperature, or elevated anxiety level or even spontaneously with no apparent cause.

**Objective:** The aim of the study is to evaluate the safety, efficacy and early and late complications of bilateral simultaneous endoscopic thoracic sympathectomy in treatment of primary hyperhidrosis.

**Patients and methods:** Thirty patients with palmar hyperhidrosis grade 3 and 4 HDSS amenable for thoracoscopic sympathectomy were primarily managed. The study compromise 12 males and 18 females; the mean age at intervention was 20 (range 12-30) years. All were evaluated preoperatively with detailed history, full physical examination and the required investigations to confirm the diagnosis and to assess the fitness for surgery. Consent was then taken after discussing everything with the parents.

**Results:** Immediately after sympathectomy, all patients were completely free from palm sweating (100%), in relation to the side operated upon. Three patients out of the 27 patients (11%) with associated plantar hyperhidrosis showed improvement of their plantar sweating immediately after endoscopic trans-thoracic sympathectomy (ETS), but the sweating recurred during the follow up period.

**Conclusion:** in view of the low morbidity and zero mortality rate of this surgical technique, we recommend it as a method of treatment for palmar hyperhidrosis. Thoracic sympathectomy eliminates palmar hyperhidrosis with minimal recurrence.

**Keywords** Endoscopic trans-thoracic Sympathectomy, Primary Palmar Hyperhidrosis.

### INTRODUCTION

Primary hyperhidrosis is currently the most debilitating form of hyperhidrosis, Although hyperhidrosis is not a life – threatening condition, it can have a deeply detrimental effect on a patient's quality of life, resulting in dramatic impairment of daily activities, psychological and social interactions and occupational activities <sup>(1)</sup>.

With recent advances in video assisted thoracic surgery, upper thoracoscopic sympathectomy has emerged the 1<sup>st</sup> line of treatment for primary hyperhidrosis being less invasive technique with short hospital stay, the incidence and complication following treatment with video-assisted thoracoscopic (VATS) including Horner have been showed to decline. Most series revealed high degree of patient satisfaction due to complete ceseating sweating in the affected area <sup>(2)</sup>.

However many different procedure and surgical technique were described (simple resection of ganglion, transection, ablation with cautery or clipping sympathetic chain) without proving their advantages compared with each other's <sup>(3)</sup>.

Common conservative treatment have included antiperspirant anticholinergic which are effective only in mild cases more recently botillinum toxin for treatment also <sup>(4)</sup>.

Surgical treatment of hyperhidrosis should be reserved for cases of hyperhidrosis not responding to any other conservative treatment. Local procedure such as curettage or liposuction of adipose tissue can

be used to remove sweat glands from axilla. Although this treatment provides long term relief from excessive sweating and doesn't result in compensatory sweating often seen with sympathectomy, it does place patient at risk of complication such as wound infection and scarring <sup>(5)</sup>.

Surgical treatment based on prevention of the transmission of impulse from sympathetic ganglion to the eccrine sweat gland is considered more effective method. Many study has been conducted aiming to reduce the incidence and severity of compensatory symptoms by limiting the level and extent of sympathetic ganglia ablation with conflicting result <sup>(6)</sup>.

### AIM OF THE WORK

The aim of the study is to evaluate the safety, efficacy and early and late complications of bilateral simultaneous endoscopic thoracic sympathectomy in treatment of primary hyperhidrosis.

### PATIENTS AND METHODS

From November 2016 to May 2019, 30 patient presented with bilateral primary palmar hyperhidrosis (PPH) underwent 60 thoracoscopic sympathectomies (TS). 27 patients (90%) also had plantar hyperhidrosis, and 6 patients (20%) had axillary hyperhidrosis as well. Eighteen patients were females (60%), and twelve patients (40%) were males with their ages ranging from 12 to 30 years (the mean age was 20 years). **The study was approved by the Ethics Board of Al-Azhar University and**

## **an informed written consent was taken from each participant in the study.**

All the patients were considered in grades 4 of the HDSS in which their life style was markedly affected. Ninety percent of the patients were students in different educational stages and the other 10% were having professions which are depending markedly on hand work. None of the patients was complaining of any other co-morbidity. No previous thoracic surgery was done to any of the patients.

All patients underwent bilateral TS at the General and Vascular Surgery Units, Al- Azhar University Hospitals (Al-Zahraa Hospital). Before surgery, diagnosis was based on clinical feature. All data, including sex, age, medication, and complications, were obtained from clinical records. The mean follow-up period was 24 months, ranging from 1 to 2.5 years.

Clinical follow-up data were obtained by direct communication with the patients. All patients answered a questionnaire concerning changes in sweating and quality of life (scale: improved, unchanged) as well as compensatory and gustatory sweating (present or not, degree and distribution if present) and overall satisfaction with the results of the operation in addition to any other complications. Patient satisfaction was classified into four grades: very satisfied, satisfied, fair, and unsatisfied.

### **Inclusion criteria:**

Patients included in this study were those with PPH interfering with the quality of life, grade 3 or 4 HDSS with or without plantar and/or axillary hyperhidrosis.

### **Exclusion criteria:**

- 1- Age below 12 years.
- 2- Patients with respiratory or hemodynamic compromise.
- 3- Detection of lung anomalies on chest x-ray.
- 4- Failed previous thoracoscopy, where failure means significant complication related to the thoroscopic procedure.
- 5- Patients with suspected cause of secondary hyperhidrosis e.g. hyperthyroidism, T.B or malignancy.
- 6- Problems with skin circulation (e.g., lupus).
- 7- Situations known to degrade wound healing (e.g., steroid treatment, previous radiation therapy) may make the risk of surgery unacceptable.
- 8- Patients with only (or predominantly) axillary hyperhidrosis.
- 9- Hyperhidrosis of psychic origin.

### **Methods:**

All patients were subjected to the following:

**1- History taking:** Personal history, present history with search for possible causes of 2<sup>nd</sup> hyperhidrosis and manifestations of other system affection, past medical and surgical history.

**2- Full physical examination:** General and local examination.

### **3- Investigations:**

- Routine preoperative laboratory investigations including complete blood count, coagulation profile, liver and kidney functions.
- Plain chest and cervical x-ray postero-anterior (P.A.) and lateral view to rule out cervical rib and lung anomalies.
- Thyroid function panel, serum glucose levels, uric acid, and urine catecholamine level was done to rule out secondary hyperhidrosis that are potentially treated medically and if suspected, it was excluded.

**4- Consent:** Consent was taken from the patients and parents of children discussing with them the operative procedure and the possible intraoperative and postoperative complications, together with the need for postoperative ventilation and its possible hazards. Patients have to be thoroughly informed about success and complication rates as well as side effects of sympathetic surgery. An approval of the study was obtained from Al- Azhar University academic and ethical committee.

### **Surgical procedure:**

#### **Preparation of the patient:**

- 1- The axilla was scrubbed with disinfectant soap and clipped at the morning of the surgery.
- 2- Preoperative antibiotics e.g. 3<sup>rd</sup> generation cephalosporin (cefotaxime) were administered to the patient preoperative by an hour active against staphylococcus species.

#### **Operative technique:**

The procedures were performed with the patients under general anaesthesia with a double-lumen endotracheal tube. Throughout the procedure, the patients were ventilated with 100% inspired oxygen, and peripheral arterial oxygen saturation (SaO<sub>2</sub>) was monitored with a pulse oximeter to prevent hypoxemia.

The patient was positioned in the semi setting position where the arms are abducted. The right side is done first because it is typically more technically demanding due to the proximity of the azygos vein and its tributaries. The optic port was introduced through the third intercostal space in the anterior axillary line using the open technique after transient disconnection of the endotracheal tube to allow deflation of the lung to avoid injury to any important structure. Using a blunt 5 mm thoracic port, access was gained to the thoracic cavity and the 5 mm 30 degrees lens was introduced for inspection after CO<sub>2</sub> insufflation into the thoracic cavity for a pressure of 5 to 10 mm Hg until a small space was made between the thoracic wall and the lung surface. The second 5 mm trocar was placed through the diathermy hook. After inspection of the

thoracic cavity and identification of the sympathetic chain, sympathetic chain was easily seen as it is a slightly raised, longitudinal structure running parallel to the spine and coursing over the rib heads the parietal pleura was opened overlying the sympathetic chain which runs perpendicular to the ribs heads, using special care to avoid the deep plains. Once the parietal pleura was opened, the sympathetic chain was exposed at T2 level.

The pad of fat overlying the 1<sup>st</sup> rib is the main landmark to detect the level of the sympathetic ganglia before opening the parietal pleura. The superior intercostal artery consistently runs lateral and parallel to the sympathetic chain at an average distance of 10 mm at the second rib, but, it may be obscure in children. The second rib always lies beneath the first intercostal muscle, so this muscle can offer the best method of identification of the second rib. The hook was used to elevate the chain to avoid bleeding from the bed on cauterization. Post T2 ganglion level was ablated in 15 patients and both T2 and T3 level were ablated in the other 15 patients using the diathermy hook with cauterization of the chain edges to prevent regeneration of fibres and recurrence of symptoms with meticulous cauterization of any detectable Kuntz fibers.

Hemostasis was achieved when necessary using bipolar cautery and major bleeding needed to be distinguished from minor bleeding or oozing. Slight bleeding or oozing was quite common during this procedure, hemostasis was achieved by simple tamponade with a small gauze pad.

Chylothorax is a very rare complication, although it has been described, so any abnormal chylous effusion should prompt the surgeon to look for an accessory thoracic duct and leakage is controlled with clips, also biological glue may be applied if needed.

The lung was allowed to re-expand completely under direct vision with deflation of the thoracic cavity using under water seal while expansion of the lung is going on. The thoracic wounds were closed without leaving a thoracic drain.

Upon completion of the right sympathectomy, the left sympathectomy was completed using the same described port sites on the left side of the chest, where the references were the thoracic aorta and left subclavian vein. The rest of the procedure was identical to that performed on the right side.

The entire procedure was complete in a time range of 25–50 minutes. After 4 hours of recovery, chest X-rays were taken to rule out a pneumothorax or hemothorax. Following this, patients were discharged 24 hours postoperatively.

As the procedure inflicted limited tissue damage, postoperative pain was typically mild to moderate and treated with oral pain medications (e.g., ibuprofen or paracetamol).

### Postoperative follow up:

#### Postoperative care:

- 1- At the end of the operation, the pupils of the patient were examined by a torch light for light reflex and possible Horner's syndrome.
- 2- Obtain a chest radiograph. A chest tube was not necessary unless a parenchymal air leak was noted.
- 3- The patient was typically able to leave the hospital on the day following surgery, occasionally on the same day of the procedure.
- 4- It was essential to inform the patients of what they may experience during the postoperative course such as anterior and posterior thoracic pain which was occasionally intermittently severe and last for the first 3 to 4 weeks, feeling of chest heaviness especially if a bilateral procedure was performed during the same operation and pain in both arms lasting for a few days.
- 5- All patients received postoperative antibiotics in the form of third generation cephalosporins for 7 days.
- 6- Postoperative pain was typically mild to moderate and treated with oral pain medications (e.g., ibuprofen or codeine-containing drugs). Patients were discharged within 24 hours, as the procedure inflicted limited tissue damage.
- 7- Stitches were removed for all patients 10 days to 2 weeks following surgery.



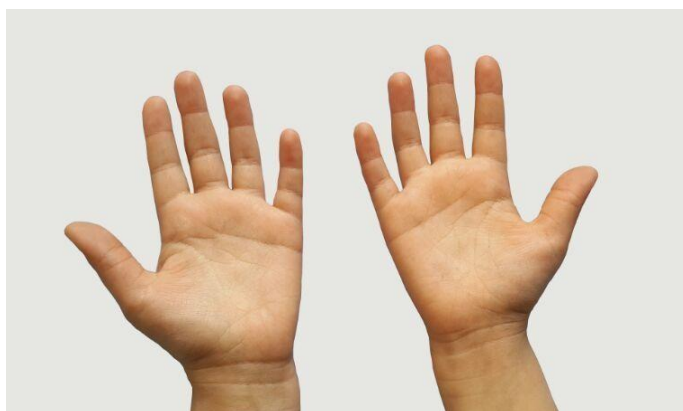
**Figure (1):** Preoperative



**Figure (2):** One month postoperatively.



**Figure (3):** Preoperative



**Figure (4):** One month postoperatively.

#### Statistical analysis:

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean. Qualitative data were expressed as frequency and percentage.

#### RESULTS

Patients demographics included 30 patients of whom 12 were males (40%) and 18 were females (60%). The mean age of the included patients (at time of surgery) was 20 years (range, 12-30).

Thirty patients with excessive PPH interfering with the quality of their lives underwent 60 video-assisted thoracoscopic sympathectomies in this study, 27 patients (90%) had associated plantar hyperhidrosis and 6 (20%) had associated axillary hyperhidrosis. Three of the patients had previous tonsillectomy.

Two of the patients had history of bronchial asthma. The others had no present history of other system affection. All patients had insignificant past medical history.

On examination, all patients were vitally stable, of average body built and had good overall activity. All patients showed no abnormalities in their preoperative laboratory investigations. Plain cervical spine x-ray showed no cervical rib in any of them.

After obtaining detailed consents and anaesthetic consultations, they were all scheduled for surgery.

The intensity of the preoperative palmar sweating was classified as severe (HDSS Grade 4) in all patients (100%). The patients felt mostly disturbed in daily life activity and working ability followed by interference of their hobbies.

Before ETS, none of the patients underwent botox injection but 12 patients (40%) tried local preparations. All patients underwent bilateral thoracoscopic sympathectomies except one patient underwent staged sympathectomy (6 months interval); this was because of anaesthetic difficulties. At the end of the procedure, the collapsed lung was allowed to re-expand, and no chest tube was left in any patient. The mean operative time was 35 (range, 25-50) minutes. Upon recovering consciousness in the surgical or recovery room, all patients observed that their hands were warm and dry.

Postoperatively, none of the patients complained from breathing difficulty and the postoperative chest x-ray showed no abnormalities in all patients. All patients were discharged on 2<sup>nd</sup> postoperative day on oral analgesics and antibiotics. There was minimal pain at the port sites, which resolved with analgesia. Follow-up was achieved via data collection on outpatient visits or by telephone. The mean follow-up period was 24 months (from 12 months to 30 months).

Immediately after sympathectomy, all patients were completely free from palm sweating (100%), in relation to the side operated upon. Three patients out of the 27 patients (11%) with associated plantar hyperhidrosis showed improvement of their plantar sweating immediately after ETS, but the sweating recurred during the follow up period.

The procedure was successfully accomplished thoracoscopically in all patients, and conversion to open thoracotomy to complete the procedure or to control massive operative bleeding was not required in any of the patients.

There was no intraoperative morbidity in the form of severe respiratory distress or massive bleeding leading to hemothorax with hemodynamic instability or air leak. There was no mortality in this study.

Early postoperatively, there was no pneumothorax, hemothorax, atelectasis or subcutaneous emphysema. Compensatory sweating was detected in 14 patients out of the 30 patients (47%) they were 4 patients out of the 15 patients (27%) in group 1 (only T2 sympathectomy), while it was noticed in 10 patients out of the 15 patients (67%) in group 2 (T2-3 sympathectomy). This phenomenon is also called reflex hyperhidrosis, and patients were always given information about it before surgery. It affected the back in 6 patients (43%), lower chest and abdomen in 5 patients (36%) and the leg in 3 patients (21%). This was seen in mild to moderate form and was tolerated by most of the patients. All patients

showed improvement of CS during the follow up period. The improvement was early in patients below 20 years old, which may indicate better tolerance to sympathectomy in children than in adults.

**Table (1):** Percentage of CS and its distribution in our series

CS	Number of patients	Percentage
Back	6	20%
Lower chest and Abdomen	5	17%
Legs	3	10%
<b>Total</b>	14	47%

Gustatory sweating (sweating in relation to eating) was encountered in one patient (3%) who was from Group 1. It was annoying to him and caused non satisfaction about the procedure. Pain at port site was encountered in 3 cases (10%) during the first month after intervention and improved during follow up period.

6 patients (20%) complained from excessive dryness of the hand after sympathectomy which required the use of hand creams daily. These patients were one from group 1 (1/15 about 7%) and five from group 2 (5/15 about 33%).

The immediate results were very good in all patients. Relapses or recurrence of symptoms occurred in two cases (7%), one from the only T2 sympathectomy group and one from the T2-3 group. The first one was re-operated and missed Kuntz nerve was found and cauterized and resulted in improvement of the symptoms. The other patient refused to redo the operation.

Three patients (10%) showed partial improvement with recurrence of mild bilateral palmar sweating which was well tolerated by the patient who shifted from grade 4 HDSS to grade 1 (all were from the only T2 sympathectomy group).

**Table (2):** Late complications of 30 patients underwent bilateral thoracoscopic sympathectomies

Complications	Nu	Percentage
No	12	4
Compensatory	14	4
Gustatory	1	3
Port site pain	3	1
Hand dryness	6	2
Mild relapse	3	1
Recurrence	2	7

**Table (3):** Degree of patient satisfaction in our study

	Number of patients	Percentage
<b>Very satisfied</b>	24	80%
<b>Satisfied</b>	3	10%

<b>Unsatisfied</b>	3	10%
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**Table (4):** The main differences between the two groups

	Group 1	Group 2 (T2-3)
<b>Recurrence</b>	1 (7%)	1 (7%)
<b>Partial recurrence</b>	3 (20%)	Zero
<b>CS</b>	4 (27%)	10 (67%)
<b>Gustatory sweating</b>	1(7%)	Zero
<b>Hand dryness</b>	1 (7%)	5 (33%)
<b>Port site pain</b>	1 (7%)	2 (13%)
<b>Mean operative</b>	23 mi.	39 min.

## DISCUSSION

**Turkyilmaz et al.** (7) reported that few or none of the fibers from T2 or T3 innervate the hands, whereas fibers from T4 to the skin of the palm definitely pass through T2 and T3. Fibers directed to the palm can be transected at T4 without interrupting the sympathetic tone to the human brain. Based on this, they have concluded that T3 and T4 sympathectomy is better than T2 sympathectomy in achieving dry hands with decreased incidence of side effects specially CS and avoiding of over dryness of the hands which refers to excessively dry hands that necessitate the use of hand cream daily.

**Kao et al.** (8) found that a certain amount of moisture in the palms makes hand movements easier, and he stated that the ideal result of surgery for PPH is to avoid excessive sweating or dryness, but maintain a slight level of moisture in the hand.

**Ueyama et al.** (9) emphasized that a dry hand is considered the expected positive outcome by surgeons, but not by patients. The incidence of excessive dryness ranges from 9% as reported by **Yoon et al.** (10) to 51% as reported by **Nicholson et al.** (11). In our study, 6 patients (20%) suffered from this complication.

Controversy exists regarding the necessary extent to which the sympathetic ganglia should be resected in patients with hyperhidrosis. Resection of the T -2 sympathetic ganglion results in sympathetic denervation of the lower trunk of the brachial plexus; some authors, however, have advocated more extensive denervation that includes the T3-4 ganglia and possibly the inferior aspect of the stellate ganglion in severe cases of axillary and palmar hyperhidrosis (12).

In our study the primary difference in patients undergoing thoracoscopic sympathectomy is the smaller surgical exposures that allow rapid recovery and return to full activity following a brief hospital stay; this alone suggests cost effectiveness. In our series we have done ablation at the level of T2 alone in half of our patients and both T2-3 in the other half.



Our mean operative time was about 35 (range 25 to 45) minutes, similar to report by **Steiner et al.** <sup>(13)</sup> and longer than some <sup>(14)</sup> because surgical ablation requires shorter time than that needed for resection. The mean operation times varied from 39–124 minutes as reported by **Baram** <sup>(15)</sup>. The duration of postoperative hospital stay in our study was 24 hours, similar to a report by **Steiner et al.** <sup>(16)</sup>.

Planter sweating was improved temporarily immediately after TS in 3 patients (11%) and worsened again during the follow up period. This result is near to that mentioned by Tobias in 2001 who had 5.7% of their patients showed complete plantar dryness immediately after TS but they said that the percentage after a year has been reduced to 3.1% <sup>(17)</sup>.

This was against the results from **Brandt et al.** <sup>(18)</sup>; in which 64% of the patients with plantar hyperhidrosis were cured after T2 sympathectomy. **Doolabh et al.** <sup>(19)</sup> reported improvement in plantar sweating in one third of their patients. This large initial improvement has no convincing anatomical or physiological explanation. It could possibly be explained in terms of stress reduction caused by the patients' postoperative palmar anhidrosis, which may have resulted in improvement of the patients' emotional state. This new situation may break the negative feedback that might have been leading to plantar sweating.

Most complications resulting from thoracoscopic sympathectomy are minor and self limiting. Our perioperative complications concerning mortality and conversion to open thoracotomy was zero, which is similar to some authors who reported conversion and mortality to be less than 1% (**Modaber et al.** <sup>(2)</sup> which occur in patients mostly due to associated cardiac condition or in cases performed bilateral sympathectomy at same session due to pulmonary insufficiency as a result of lung collapse.

None of the intraoperative complications occurred in our study. Reported rate of early complications by other authors was 3-10%; most common are Horner syndrome, recurrence, hemorrhage, and pneumothorax. **Formento et al.** <sup>(20)</sup> said that a small insignificant pneumothorax can be expected in 75% of patients, which gets absorbed spontaneously usually within 24 hours

None of our patients developed transient ptosis and none of them developed permanent lesions. However; 3-10% transient and the 0.28% permanent forms were reported by **Hatzipantelis et al.** <sup>(21)</sup>.

Postoperative Horner's syndrome (HS) is rare but is found in many series. It can be total or partial (without miosis). It is caused by a direct or indirect damage to T1, i.e. current diffusion or excessive traction on the nerve during dissection. Postoperative rhinitis is another symptom associated with a T1 lesion <sup>(22)</sup>.

Most authors agreed that the endoscopic approach reduces the rate of HS because of better

visualization. **Rothenberg** <sup>(23)</sup> found a significant difference between the open approach (4.6%) and the endoscopic approach (2.2%). As the magnification of the telescope allows for a much better view of the sympathetic chain and ganglion, one may wonder why HS is still observed. The cause may be the following: 1-Diffusion of monopolar HF current to the stellate ganglion. 2-Excessive traction on the nerve during dissection, temporarily stretching it. 3-Inadequate localization of the second rib <sup>(24)</sup>.

Intercostal neuralgia results from the injury of the intercostal nerves that can occur during port placement or when direct pressure is applied to the nerves during the procedure. Intercostal neuralgia did not occur in any of the patients in this series, which may be due to several factors. Our current use of a 5-mm- diameter endoscope and 5-mm working instrument may reduce the incidence of intercostal neuralgia. **Chen** and colleagues cited a lower incidence of intercostal neuralgia as the major difference between open supraclavicular and endoscopic sympathectomy procedures; however these differences may only reflect the use of flexible ports and smaller instruments <sup>(25)</sup>.

In our study postoperative pain measurement was beyond the scope of this study. The majority of our patients tolerated postoperative pain conservatively with simple oral non-steroidal analgesics and no nerve therapy was required. The symptomatology subsided completely at a maximum of one month.

In our study the percentage of complications, concerning infection at incision site, residual pneumothorax, and hypertrophic scar formation in our study was 0%. We believe that, once the technique has been mastered and refined, both the complication rate and morbidity should be quite low.

Compensatory sweating (CS) was evaluated by contacting patients for a minimum follow-up evaluation of 12 months. The patients were contacted by telephone, and a specific asking during another consultation. CS is, without a doubt, one of the most troublesome postoperative side effects for all patients. Perhaps this is why numerous surgeons have begun to search for the ideal technique to significantly reduce the percentage of cases developing CS. **Cai et al.** <sup>(26)</sup> showed that CS was nonexistent after limiting thoracoscopic sympathectomy to the third ganglion.

Compensatory and gustatory sweating appear to be more permanent post-sympathectomy complications in most papers that have been published over the past 30 years. The reported frequencies of CS vary considerably. While most papers describe this side effect in 30% to 70% of patients, some investigators claim that they did not encounter CS after sympathectomy and others see it in almost all patients <sup>(27)</sup>.

**Wilson et al.** <sup>(28)</sup> have distinguished between varying degrees of CS after thoracic sympathectomy. Their frequency of embarrassing or disabling CS varies between 1.2% and 90% of patients. Most often severity is defined as sweating or severe sweating, but one study provided an objective measure as the need to change clothes more than twice a day.

Our results demonstrate that CS is a very common side effect, occurring in 47% of patients and it is more common with increased manipulation on the sympathetic chain (more in the T2-3 sympathectomy than in only T2 sympathectomy). Apparently, the majority of our patients accepted compensatory sweating as a side effect and did not change their opinion about the operation, because their answer to the question on the results of the operation was excellent or satisfactory.

The reported incidence of CS after thoracic sympathectomy varies widely. This variability could reflect that patient populations are heterogeneous or have undergone different surgical procedures, but it is likely to be a consequence of different definitions of CS. While some authors count only cases in which massive over perspiration occurs, others consider even a slight increase in perspiration as CS <sup>(29)</sup>.

**Arca and Holcomb** <sup>(30)</sup> considered CS to be a complication if the patient complained or when further treatment was required. In addition, **Zhang et al.** <sup>(31)</sup> dealt with perception of increased CS because quantitation was not done. Whether there is an increased level of CS or merely an increase in the subjective discomfort has yet to be determined; for example, someone with severe palmar sweating cured by sympathectomy would most likely tolerate a great amount of new back sweating postoperatively, whereas someone with mild axillary sweating and the same amount of new back sweating postoperatively would not be satisfied with the result. Finally, CS may vary with the intensity of questioning and the thoroughness of follow-up and may be affected by geographic location, working environment, humidity, temperature, and season <sup>(32)</sup>.

In our study nevertheless, 47% of our patients suffered from CS even though we live in a temperate geographical zone, and they all showed improvement with time on follow up.

**Wozniak and Steiner** <sup>(33)</sup> reported gradual decrease of the intensity of CS with a long follow up period. **Steiner and colleagues** <sup>(16)</sup> have concluded that the tolerability of CS in children younger than 14 years old was excellent and the overall satisfaction about sympathectomy was very high and better than in adults and they recommended undergoing sympathectomy as early as possible, the result which agrees with our results.

This study demonstrates that gustatory and compensatory sweating are common side effects after thoracoscopic sympathectomy, and we believe it is crucial to inform patients thoroughly before surgery.

Our outcome concerning long-term follow up of patients with PPH was 93% relief of symptoms (complete and near complete), while 7% had recurrence which is very near to the results of **Gutierrez and Simon** <sup>(34)</sup> who reported long term success rate more than 90%.

In a recent study involving 44 patients with hyperhidrosis, the postsympathectomy success rate was reported to be 93% which is equal to our series <sup>(35)</sup>.

## CONCLUSION

Endoscopic sympathectomy is a safe and effective treatment for severe palmar hyperhidrosis. There is a significant incidence of compensatory sweating after sympathectomy and this is sufficiently troublesome in some patients for them to regret surgery. The best level for sympathectomy and the technique used to interrupt the sympathetic chain remain the subject of debate. There is growing evidence that limited sympathectomy (T2 or T3 level) is effective for palmar hyperhidrosis with a lower incidence of complication.

We concluded that thoracoscopy has become adopted widely by general and vascular surgeons and is currently considered to be the optimum technique for management of hyperhidrosis in general and vascular patients.

In conclusion, in view of the low morbidity and zero mortality rate of this surgical technique, we recommend it as a method of treatment for palmar hyperhidrosis. Thoracic sympathectomy eliminates palmar hyperhidrosis with minimal recurrence (7 % in our series). Although the percentage of compensatory sweating is high (in some cases it tends to decrease spontaneously), it produces a high rate of patient satisfaction.

We recommend that surgeons receive formal training in these procedures, with didactic and laboratory training, followed by work with a senior experienced surgeon who performs these procedures on a regular basis.

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