Thoracoscopic sympathectomy for treatment of primary palmar hyperhidrosis: Single versus multiple levels division

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ABSTRACT

Background: Palmar hyperhidrosis is a disorder of excessive eccrine gland activity affecting the palms with an estimated prevalence of approximately 2.8%. Endoscopic thoracic sympathectomy (ETS) remains the definitive therapeutic intervention for refractory palmar hyperhidrosis, performed either through multi-level interruption of the sympathetic chain (T2–T5) or targeted single-level division at T3 or T4, the latter demonstrating a reduced incidence of postoperative complications.

Methods: This multicentric study employed a descriptive design with both prospective and retrospective components and was conducted between (June 2021) to (June 2023). A total of 45 patients with primary palmar hyperhidrosis underwent endoscopic thoracoscopic sympathectomy (ETS). Patients were followed for a mean duration of 6 months and were assessed for improvement in palmar sweating, postoperative pain, the occurrence of postoperative complications, and overall quality of life.

Results: All patients showed an improvement for their 1ry palmar hyperhidrosis, with a significant difference in favor of the single-level cut. Compensatory hyperhidrosis was recorded in all cases of group A (100%) and in 6 cases of group B (40%) and 1 case of group C (6.7%). 2 (13.3%) cases of group B and 6 (40%) cases in group C showed recurrence of 1ry palmar hyperhidrosis, but less severe than the original condition. Patients' satisfaction with improvement in quality of life was recorded starting from the first postoperative evaluation, but without a difference between the 3 groups.

Conclusion: Both techniques were effective for handling palmar hyperhidrosis with a high grade of patients' satisfaction. Single-level division carries more advantages in the form of less incidence of post-operative pain, short operative time, with fewer incidences of post-operative complications.

KEYWORDS: Palmar hyperhidrosis, Compensatory hyperhidrosis, Endoscopic thoracic sympathectomy (ETS), Sympathectomy.

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INTRODUCTION

Hyperhidrosis involves excessive sweating of the palms. In the United States, its prevalence increased from 2.8% in 2004 to 4.8% in more recent estimates. A Chinese epidemiological study reported a 2.08% prevalence of palmar hyperhidrosis. The condition can interfere with social life, school, and work, and may also contribute to significant psychological stress [1].

Hyperhidrosis is broadly divided into primary and secondary forms. Primary hyperhidrosis is a functional disorder in which sweat production is disproportionately high relative to the body's actual thermoregulatory needs. It affects an estimated 2–3% of individuals worldwide and shows no significant difference in prevalence between males and females. The condition often manifests early in life and is widely considered to have a hereditary basis [2].

The exact ways that main hyperhidrosis happens aren't known yet. People who have the disease do not have any problems with how their eccrine sweat glands are built or how they work, so it's clear that the disorder is not caused by those glands. Rather, primary hyperhidrosis is thought to be caused by a problem in the sympathetic part of the autonomic nerve system, where there is a huge imbalance between the stress and the sweat. Once started, the body quickly produces more sweat and continues to do so as if it were in a "short-circuited" state, unaffected by whether the original cause is still there. People often sweat a lot even when there isn't a clear reason for it [3].

Primary hyperhidrosis usually only affects the hands, but it can also affect the arms, feet, and face. People with primary hyperhidrosis usually start sweating way too much in the first decade of life, and it becomes more noticeable during the teenage years. It generally affects the quality of life. Stresses that are physical, mental, or emotional tend to make the symptoms worse. Another important thing to know about primary hyperhidrosis is that the person only sweats when they are awake [4].

Secondary hyperhidrosis is a symptom rather than a distinct disease, reflecting an underlying medical condition. It usually causes widespread sweating, with onset typically occurring in adulthood. Episodes can happen both while awake and asleep, and stress is generally less influential. Causes may include environmental heat, obesity, systemic illnesses such as hyperthyroidism and diabetes, menopausal changes, neuroendocrine tumors, blood cancers, neurological disorders, spinal cord injuries, and infections like tuberculosis. Certain medications, including antidepressants, can also induce secondary hyperhidrosis. Regardless of its origin, this type of hyperhidrosis is not suitable for surgical treatment, and management should focus on addressing the root cause [5].

Endoscopic thoracic sympathectomy (ETS) is widely recognized as the treatment of choice for palmar hyperhidrosis, attributable to its high success rates, favorable safety profile, abbreviated operative time, and relatively rapid acquisition of surgical proficiency [6].

Historically, endoscopic thoracic sympathectomy (ETS) was commonly performed via T2–T5 division with resection of the intervening nerve segments. However, recent evidence favors a single-level division at either T3 or T4, as this approach achieves the desired therapeutic effect while minimizing procedure-related morbidity [7].

This study aimed to find out how effective and safe single-level and multiple-level endoscopic thoracic sympathectomy (ETS) are when used to treat primary palmar hyperhidrosis. The study focused on postoperative outcomes such as symptom resolution, operative complications, the severity and the incidence of compensatory sweating.

METHODS

A multicenter, descriptive, prospective, and retrospective model was carried out in one governmental and two private hospitals (Benha Teaching Hospital, Zenat Elhya, and Dar Elshefa Private Hospitals) during the period from June 2021 to June 2023.

The study included 45 patients (30 male &15 female). All with diagnosis of 1ry (hyperhidrosis). The patients were divided into 3 different groups depending on the level of the cut of the sympathetic chain:

- GROUP (A): division of the chain at T2 and T5 with excision of the nerve segment in between both ganglia. (15 patients).
- GROUP (B): division at T3 only. (15 patients).
- GROUP (C): division at T4 only. (15 patients).

Pre-operative diagnosis and selection

Our patients were clinically diagnosed depending on history taking and physical examination.

Inclusion criteria

- Patient diagnosed with 1ry hyperhidrosis.
- The patient has not been responding to medical treatment for at least the last 6 months before surgery.
- Mainly those with palmar hyperhidrosis, whether alone or mixed with any other subtype (axillary, plantar) hyperhidrosis.
- Parenteral acceptance for those underage.
- ASA I ASA II patients

Exclusion criteria

- Previous thoracic surgery may increase the difficulty of surgery because of adhesions.
- Any condition or disease that interferes with insufflation, such as poor cardiopulmonary reserve or cardiac arrhythmias.
- Recurrent cases post minimally invasive technique as radiofrequency (RF) or previous failed (ETS).

Operating room ergonomic

The laparoscopic set with the monitor was designed to be at the head of the patient, behind his elevated shoulder, in a lateral position. The operator stands in front of the patient while the camera man stands behind the back and scrub nurse in front of the surgeon at the patient lower limbs.

Anesthesia

All of the patients were given general sedation and were intubated. A double-lumen endotracheal tube was only used in 5 cases. The other 40 cases were handled with a standard single-lumen tube. The breathing settings were changed to keep a good level of oxygenation (SpO_2 > 94%) and ventilation ($ETCO_2$ 35–40 mmHg) and to lower the risk of barotrauma. For patients who were intubated with a single-lumen tube, a low total volume of about 4 mL/kg and a high breathing rate were used to make sure that there was enough ventilation. For those with a double-lumen tube, correct positioning and effective lung isolation were verified bronchoscopically, ensuring appropriate ventilation of the operative lung. During insertion of the first trocar, ventilation was briefly paused to minimize the risk of lung injury. Any hemodynamic disturbances or arrhythmias, such as bradycardia occurring during the procedure, were closely monitored and appropriately treated. At the end of surgery, reinflation of the previously collapsed lung before removing the trocars was achieved.

Patient Position

Lateral position with the targeted side up and the corresponding upper limb supported with an arm sling above the patient's head. A supporting belt at the patient's pelvis for the patient to be secured during surgery.

Port position

We used the 3 ports technique for cases that belong to group A:

- 5mm port at the 3rd intercostal at the post-axillary line (for grasper).
- 5mm port at the 5th intercostal space in the ant. axillary line (for the camera).
- 5mm port at the 7th intercostal at post-axillary (for the hook).

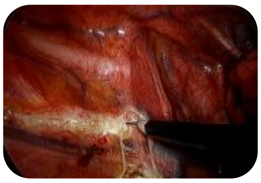
By gaining more skills and becoming more confident with the technique, we used the 2-ports technique for the remaining cases of group (B&C):

- 5mm port at the 5th intercostal space at the mid-axillary line (for the camera).
- 5mm port at the 3rd intercostal at post-axillary (for the hook).

Steps

After introducing 1st port with an advanced camera, we used to insufflate with CO2 to a pressure between 6 to 8mm HHG esp. in cases with a single lumen endotracheal tube, to create more chest housing and spacing for the working instruments. The sympathetic nerve is identified by being the only white cord-like structure that goes perpendicular to the ribs. In group A cases, it is important to find a yellowish lump of fat above the second rib because it shows where the satellite (cervicothoracic) ganglion is located. The sympathetic chain is covered by the mural pleura at the second, third, fourth, and fifth ribs, and these pleurae were hooked and cut apart with a standard 5 mm electric hook. The nerves between the second and fifth ribs were cut out too (this is for group A). While in the other two groups, only the mural pleurae at the level of division next to each other were hooked and cut apart with nerve separation next to the neck of the right rib (T3 or T4). In all of the groups, the Kuntz nerve and other missed nerve fibers are cut about 2 to 3 cm to the side along the surface of the rib cage. Any pleural fluid that is still there is removed with a suction device, and the lung is allowed to re-expand while it is being looked at closely. The French 16 closed suction drain was left in the patient's bed until a chest x-ray taken 12 hours

Figer (1): Identification of sympathetic nerve



Figer (2): Opening pleura adjacent to cut level

Figer (3): Division at T3

Figer (4): Lung inflation under visin with insertion of suction drain

after the surgery showed that the lungs were fully inflated and aerated.

Post-operative care

Patient was observed in the recovery room with special care for:

- Oxygen saturation reading at room air.

- Respiratory movement.
- Surgical emphysema.
- Pain score.

With complete recovery of the patient and O2 saturation more than 90 on room air, and no surgical emphysema, the patient can be shifted to the ward, starting regular oral feeding and analgesia for pain control.

Twelve hours later, a chest x-ray film was taken to confirm complete lung aeration without residual hemopneumothorax. The chest drain is then removed, and the patient is discharged home with medication for pain control and encouraged to mobilize and practice respiratory physiotherapy.

Follow up

Our protocol was to assess the patient in the clinic 1 week and 1 month after surgery, then a virtual telephone follow-up monthly for six months.

Ethical approval

For all prospective cases, informed consents were obtained before involving them in the study, while for retrospective cases; data were collected in a complete ethical manner from the patients' recording data system without declaring names or any personal details of enrolled patients. The Helsinki Declaration was followed.

Statistical analysis

IBM SPSS Statistics program, version 25 was used to look at the data statistically. Frequencies and ratios were used to show qualitative data, while means and standard deviations (SD) were used for numeric data. The chi-squared test (χ^2) was used on the categorical factors. Analysis of variance (ANOVA) was used to look at parametric quantitative factors. The P number had to be less than 0.05 to be statistically significant.

RESULTS

A total of 45 patients were involved in our study: 30 male (66.7%) and 15 females (33.3%). In Group A, the age of the patients ranged from 18 to 30 years, with a mean of (23.1± 3.2). They included 9 males (60%) and 6 females (40%). In Group B, the age of the patients ranged from 20 to 30 years, with a mean of (26.1±3.2). They included 11 males (73.3%) and 4 females (26.7%). In Group C, the age of the patients ranged from 21 to 33 years, with a mean of (26.5±2.9), 10 males (66.7%) and 5 females (33.3%). There was a positive family history in 4 patients (26.7%) in groups A and C and in 3 patients (20%) in group B. All the patients presented with palmar hyperhidrosis, while 40% of the patients were associated with axillary hyperhidrosis, and 26.7% were associated with plantar hyperhidrosis. A statistically significant difference among the three groups regarding the association of palmar hyperhidrosis with plantar hyperhidrosis (Table 1).

Table 1: Baseline Demographic and Clinical Characteristics of the studied groups

Variable	Group A (n=15)	Group B (n=15)	Group C (n=15)	Total (n=45)	Test of Sig.	P value
Age (years) Mean ± SD	23.1± 3.2	26.1±3.2	26.5±2.9	-----	5.38 **$**	0.528
Gender, n (%)						
Male	9 (60%)	11 (73.3%)	10 (66.7%)	30 (66.7%)	0.6 #	0.741
Female	6 (40%)	4 (26.7%)	5 (33.3%)	15 (33.3%)		
Positive family history, n (%)	4 (26.7%)	3 (20%)	4 (26.7%)	11 (24.4%)	0.24 #	0.887
Previous medical treatment, n (%)	3 (20%)	7 (46.7%)	11 (73.3%)	21 (46.7%)	8.75 #	**0.01***
Associated hyperhidrosis sites, n (%)						
Axillary	4 (26.7%)	1(6.7%)	1(6.7%)	6 (40%)	3.47 #	0.177
Planter	4 (26.7%)	0(0.0%)	0(0.0%)	4 (26.7%)	8.78 #	**0.01***

SD: Standard deviation, **$**: ANOVA test, #: Chi square test, *: Significant (*P* < 0.05).

Group A took about 45 minutes (±5 minutes) to complete the surgery, while Groups B and C took only 15 minutes (±3 minutes). All of the group A patients had intra-operative bradycardia, as did 3 patients in group B and 2 patients in group C. The differences between the groups were statistically significant. In group A, the bipolar diathermy stopped intraoperative bleeding from intercostal veins in 4 cases (26.7%), but no cases happened in Groups B or C. The groups' differences were statistically significant. None of the groups in our treatment had a conversion to open thoracotomy recorded. There was a statistically significant difference between the 3 groups (Table 2). The average amount of time spent in the hospital after surgery was 30.5±4 hours for group A and 9.8±3 hours for groups B and C.

Table 2: Operative Characteristics of the studied groups

Variable	Group A (n=15)	Group B (n=15)	Group C (n=15)	Total (n=45)	Test of Sig.	P value
Operative time (minutes)	45 ±5	15 ± 3	15 ± 3	----	314 $	**< 0.001****
Intraoperative bradycardia	15 (100%)	3 (20%)	2 (13.3%)	20 (44.4%)	28.3 #	**< 0.001****
Intraoperative bleeding	4 (26.7%)	0 (0.0%)	0 (0.0%)	4 (8.9%)	9.23 #	**0.01***
Conversion to open surgery	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	---	----
Hospital stay (hours) Mean ± SD	30.5±4	9.8±3	9.8±3	-----	152.8 **$**	**< 0.001****

SD: Standard deviation, $: ANOVA test, #: Chi square test, *: Significant (P < 0.05), **: Highly Significant (P < 0.001).
Short-term follow-up was applied for this study, depending on outpatient visits (OPD) and virtual appointments. Early in the post-operative period, pain was severe (7/10 pain scale) in patients belonging to group A, with less pain recorded for the other 2 groups (3/10 pain scale). All patients showed immediate post-surgical improvement with dry palms. Regarding the early postoperative complication, there was no bleeding or pneumothorax. In group A, intercostal neuralgia and surgical emphysema occurred in 4 cases and 2 cases, respectively (Table 3).

Table 3: Early Postoperative Outcomes

Outcome	Group A (n=15)	Group B (n=15)	Group C (n=15)	Total (n=45)	Test of Sig.	P value
Immediate improvement in palmar sweating	15 (100%)	15 (100%)	15 (100%)	45 (100%)	----	----
Early complications						
Intercostal neuralgia	4 (26.7%)	0 (0.0%)	0 (0.0%)	4 (8.9%)	8.8 #	**0.01** *
Surgical emphysema	2 (13.3%)	0 (0.0%)	0 (0.0%)	2 (4.4%)	4.2 #	0.1

#: Chi square test, *: Significant (P < 0.05),

Group A exhibited no recurrence, whereas groups B and C showed recurrence rates of 13.3% and 40%, respectively, and this difference was statistically significant. The degree of improvement also varied significantly across groups, with group B achieving the highest improvement rate (*P* = 0.03**)**. Compensatory hyperhidrosis was recorded in all cases of group A and in 6 cases (40%) of group B and 1 case (6.7%) of group C, with a highly significant difference among the groups (*P* < 0.001). Patient satisfaction was significantly higher in groups B and C compared with group A (*P* = 0.02) (Table 4).

Table 4: Follow-up Outcomes at Mean 6 Months

Outcome	Group A (n=15)	Group B (n=15)	Group C (n=15)	Total (n=45)	Test of Sig.	P value
Recurrence rate	0 (0.0%)	2 (13.3%)	6 (40%)	8 (17.8%)	8.5 #	**0.01 ***
Degree of improvement (HDSS or patient global score)	8 (53.3%)	14 (93.3%)	12 (80%)	43 (75.6%)	6.7 #	**0.03 ***
Compensatory hyperhidrosis	15 (100%)	6 (40%)	1 (6.7%)	22 (48.9%)	26.9 #	< **0.001****
Satisfaction	8 (53.3%)	14 (93.3%)	13 (86.7%)	35 (77.8%)	8 #	**0.02 ***

$: ANOVA test, #: Chi square test, *: Significant (P < 0.05),**: Highly Significant (P < 0.001).

DISCUSSION

Hyperhidrosis is a disorder characterized by excessive sweating due to overactivity of the eccrine sweat glands. Emotional stimuli are frequently implicated as a triggering factor in this condition [8]. People most often show and use their hands, so palmar hyperhidrosis is the most common condition. So, how often hyperhidrosis happens in other parts of the body, like the armpits and feet, is usually not realized [9].

There are many different ways to treat primary palmar hyperhidrosis, including creams, injections, radiofrequency heat removal, and even surgery [10]. ETS has recently is now the most commonly chosen surgery to treat primary palmar hyperhidrosis [11]. The therapeutic aim in managing palmar hyperhidrosis is not the absolute elimination of palmar perspiration, but the optimization of functional outcomes and enhancement of patients' quality of life. In our study, 24.4% of patients had a positive family history. This is similar to the findings of Brown et al. [12], which raises the idea of genetic inheritance. In a group of patients in California with similar races, numbers as high as 65% have been seen [13]. But there is no proof that having a family history of hyperhidrosis or blushing should change how these conditions are investigated or treated.

A single-lumen endotracheal tube achieved a satisfactory partial lung compression that was similar to what a double-lumen tube would have done. The single-lumen tube had benefits like a faster surgery time, quicker mobilisation after surgery, a shorter total recovery, and less bodily stress. For this reason, a double-lumen tube didn't need to be used in every situation. A low amount of CO_2 mediastinal insufflation (8 mmHg), along with the effects of gravity, caused enough of a partial lung collapse that it was fully re-expanded while being directly observed at the end of the operation. There were no problems with the chest that were mentioned.

The expected operative time, or how long the surgery took, was 45 ± 5 minutes for group A and 15 ± 3 minutes for both group B and C. The operative time started when the port was inserted and ended when all of the surgical steps were finished. It was discovered that the difference was highly statistically significant. This is like what Aboollo et al. [14] reported. It's pretty normal for people to have bradycardia after thoracoscopic sympathectomy. Interrupting the thoracic chain in ETS might let uninhibited vagal impulses through reflex baroreceptor suppression. In our study, bradycardia occurred to all the patients in group A, three patients in group B, and two patients in group C. There was a statistically significant difference between the groups. The study by Chung et al. had similar findings [15].

In Group A, intraoperative bleeding from the intercostal veins was seen in 4 cases (26.7%), but Groups B and C did not have any bleeding. On the other hand, all of the groups had no blood after surgery. Our study had no conversions to open thoracotomy. This is similar to what Moya et al. [16] found, there was minor bleeding during the operation in 15% of cases, major problems in 0.4% that required change to thoracotomy, and hemothorax and atelectasis, both in 0.1%.

All patients in Group A were discharged on postoperative day two, while patients in the other groups were discharged on the same day as the procedure. These results are in agreement with those reported in previous studies [17].

The present study found a 100% rate of instant change. These results agree with earlier research (see references 17 and 18). Still, the higher success rate might have been due to the smaller number of patients and the specific surgery method used. This included cauterizing the upper edge of the second rib 3–5 cm lateral to the sympathetic chain. Many people suggest this maneuver to get rid of extra sympathetic fibers or the secondary nerve of Kuntz, if they are there. This has been linked to very high instant success rates in several studies [19, 20]. As for complications that happened early after surgery, 8.9% of patients had neuralgia, which is close to the 6.25% rate found in [17].

Using the (pain 10 scale) as pain severity index, all patients of group A showed severe pain 7 scale in the 1st 24 hrs., which was relieved by narcotics. Pain severity was less than 5 in the other 2 groups and relieved by paracetamol IV infusion, and 10 cases needed NSAIDs. Our results were nearly the same as previous research. Many factors in group (A), such as extended time of surgery with more dissection and division of KUNTZ nerves at different levels, and usage of large-sized chest tubes in early cases-might contribute to the severity of pain for patients in that group.

Recurrence rates in the present study were 0% in group A, 13.3% in group B, and 40% in group C, and this difference was statistically significant. These results complied with those reported by several studies [18, 21]. Several factors may explain the recurrence, including Kuntz fibers not divided, incomplete interruption of the chain, and collateral sympathetic reinnervation.

Compensatory hyperhidrosis was seen in all of group A, 6 cases (40%) of group B, and 1 case (6.7%) of group C. The differences between the groups were statistically very significant. This study's data is like that of earlier studies [9, 22]. But these findings are not the same as the findings from another study; a 2020 meta-analysis found that 84% of the R2-R5 patients and 57% of the R3 and R4 patients had CH [23].

A statistically significant variation in the degree of clinical improvement was observed among the study groups, with Group B exhibiting the greatest improvement magnitude. Choi et al. reported that a minimal degree of palmar moisture facilitates normal hand function. Accordingly, they proposed that the optimal surgical outcome in the management of palmar hyperhidrosis is the preservation of mild moisture, avoiding both excessive sweating and complete dryness of the hands [24].

Leaving the ganglion with only the transection of interganglionic fibers is the most accepted technique worldwide. That's why (R4) has the advantages of high success with less incidence of hand dryness and CS [25].

LIMITATIONS

There are certain limitations for this study, such as: retrospective design, with a small sample size, results may be biased as all cases were operated on by the same surgeons, and patient satisfaction is subjective, with no objectives for postoperative assessment.

CONCLUSION

Single-level R3 or R4 sympathectomy offers a clinically effective and safer alternative to higher-level (R2-R5 with segment resection) sympathectomy, achieving high symptom resolution with lower rates of debilitating compensatory hyperhidrosis. It represents the current gold standard for isolated palmar hyperhidrosis, aligning with both physiological principles and patient-reported outcomes. R4 is an optimal surgical treatment for isolated palmar hyperhidrosis, and R3 is preferred for (palmar+axillary) cases.

RECOMMENDATION

Current evidence with our results obtained from this study supports single-level sympathectomy as an optimal treatment of choice for 1ry palmar hyperhidrosis, but with the recommendation of ongoing comparative trials, with a large sample size and longer-term follow-up studies to validate this single-level approach.

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