Randomized controlled study thoracoscopic sympathotomy and thoracoscopic sympathectomy for primary palmar hyperhidrosis

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Background
One of the two halves of the autonomic nervous system, which controls the body's unconscious reactions to maintain proper function, is the sympathetic nervous system. The body's reaction to stress is controlled by the sympathetic nervous system ('fight or flight' response).
Aim
The aim of this study was to evaluate feasibility, merits and demerits of thoracoscopic sympathotomy in comparison to thoracoscopic sympathectomy while in the management of primary palmar hyperhidrosis to assess recurrence, operative time, safety and associated complications.
Subject and methods
This prospective randomised study was carried out on fifty patients diagnosed to have primary palmar hyperhidrosis, twenty five (25) patients was treated by using two ports thoracoscopic sympathotomy while the patient was in supine position and twenty five (25) patients by using three ports thoracoscopic sympathectomy while the patient was in lateral position. This study was carried out at the surgical department of Beni-Suef University hospital and Military hospitals from January 2021 with a follow up period for six months.
Results
None of the patients developed recurrence Hemothorax, pneumothorax or intra-operative bleeding. Only one patient (4%) developed compensatory hyperhidrosis at each group. Also, only one patient (4%) developed post-operative Horner's syndrome at each group. On the other hand, the percentage of patients developing dyspnea differed between the two groups as 12% (n=3) of patients in group B developed dyspnea which was higher than that of group A 4% (n=1). This difference was statistically insignificant as a Fisher's exact test was conducted between group A and group B for developing dyspnea. There was a statistically insignificant association between type of intervention and dyspnea.
Conclusion
A therapy for treating PH that improves the severity of sweating and patient satisfaction is thoracoscopic sympathotomy. Numerous advantages of this minimally invasive procedure include decreased postoperative discomfort, a shorter hospital stay, quicker healing and return to work, and fewer problems.It is possible to treat both sides at once to eliminate the need for a second treatment and readmission. In addition, it takes less time to perform and has less consequences than three ports thoracoscopic sympathectomy for treating primary palmar hyperhidrosis with a similar success rate.

Keywords:
lateral approach thoracoscopic sympathectomy, primary palmar hyperhidrosis, Randomized controlled trial (RCT), supine approach

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Introduction

One of the two halves of the autonomic nervous system, which controls the body's unconscious reactions to maintain proper function, is the sympathetic nervous system.

The body's reaction to stress is controlled by the sympathetic nervous system ('fight or flight' response). Sweating, blood pressure, and heart rate all rise as a result of sympathetic activity. By widening some blood arteries, such as those in the muscles required to assist the person fight or flee if faced with danger, and narrowing others, it controls

blood flow to various portions of the body. Additionally, sympathetic activity widens the bronchi to allow for greater oxygen absorption, widens the pupils to allow for greater light refraction, and delays the digestive process [1].

Primary hyperhidrosis is a disorder with no known cause that causes excessive sweating, usually in the armpits, on the soles of the feet, and on the palms of the hands. Increased emotional stimulation, temperature, high levels of anxiety, or even just plain old spontaneous perspiration, are all known to boost the sweating response. Young adults and teenagers make up the majority of patients [2].

Primary hyperhidrosis, which typically starts in childhood or adolescence, is an excessive response to sweating, a physiological process. Its pathogenesis is uncertain, but it is thought to be brought on by an overactive sympathetic nervous system at the level of the upper thoracic ganglia, which are located near the eccrine glands that produce excessive sweating [3]. While some medical procedures, including topical anaesthetics, iontophoresis, anticholinergic medications, and injections of botulinum toxin A, reduce symptoms Thoracic sympathectomy (TS) may offer a permanent remedy, but only momentarily [4].

Surgery for PH typically focuses on disconnecting the sympathetic thoracic ganglia T2, T3, or T4 because the condition is brought on by malfunctioning of the sympathetic nervous system. It is a successful method [5].

Prior to thoracoscopy, the majority of surgeons used an axillary or supraclavicular approach to perform thoracic sympathectomy. The axillary approach has the same morbidity and mortality as an open thoracotomy while the supraclavicular approach is well tolerated by patients but carries a significant risk of complications like Horner's syndrome, phrenic nerve injury, brachial plexus injury, chylous leak, pneumothorax, and bleeding. Thoracoscopic sympathectomy has gained popularity due to its low morbidity and mortality rates as well as its low level of intrusiveness [6]. The goal of this study was to compare the two ports thoracoscopic sympathectomy with the three ports thoracoscopic sympathectomy with the patient in the lateral position for the treatment of primary palmar hyperhidrosis in order to determine the feasibility, benefits, and drawbacks of each procedure.

Patient and methods

This prospective randomised study was carried out on fifty patients diagnosed to have primary palmar hyperhidrosis, twenty five (25) patients was treated by using two ports thoracoscopic sympathotomy while the patient was in supine position and twenty five (25) patients by using three ports thoracoscopic sympathectomy while the patient was in lateral position. This study was carried out at the surgical department of Beni-Suef University hospital and Military hospitals from January 2021 with a follow up period for six months.

The research protocol was accepted by the Institutional Human Ethical Committee of Beni Suef university hospital

Inclusion criteria

Patients with debilitating severe primary palmar hyperhidrosis that leads to occupational, educational or social problems.

Exclusion criteria

Mild cases responding to medical treatment, refusal of the patient or the parents to the thoracoscopic approach or refusing to be included in the study, previous open chest or heart surgery, patients with severe pulmonary disease **and** patients unfit for general anesthesia.

Patients were classified randomly into 2 groups by a research randomizer: **Group I (25 patients):** patients in this group will be subjected to thoracoscopic sympathotomy using two ports while the patient is in supine position. **Group II (25 patients):** patients in this group will be subjected to thoracoscopic sympathectomy using three ports while the patient is in lateral position.

Preoperative assessment

All patients will be subjected to:

Preoperative work up

Full history taking with considerable emphasis on: Age, sex, time of symptoms onset and time of presentation, residence, occupation and their special habits if present, side and onset of appearance, previous medications tried and medical history and past history of previous surgery in the chest.

Clinical examination including general examination and local examination: General Examination: Vital signs and chest examination. **Local examination**: Both

hands, axillae, and feet to detect the site and severity of hyperhidrosis, chest examination for chest deformities.

Preoperative investigations (laboratory. and imaging):

Laboratory studies: routine labs

Imaging studies: Chest X-ray to exclude lung or pleural pathology, ECG.

Surgical technique: Anesthesia: General anesthesia with double lumen endotracheal tube insertions to allow lung isolation and single lung ventilation (Fig. 1**).**

Positioning of the patient: Group I: Supine approach with two ports procedure: The patient lies in a supine position and abduction of both arms to allow both sides to be operated on simultaneously without the need to do repositioning. (Fig. 2**).**

Then both sides were sterilized by povidone-iodine solution then sterile towels were put (Fig. 3**).**

On the ipsilateral side of the procedure, we permitted lung deflation. Then, on the same side, two small incisions of roughly 5–10 mm each were made: one for the thoracoscope and one for the tools in the third intercostal gap on the anterior axillary line. (Fig. 4**).**

After insertion of ports. And insufflation of 10 mmHg co2 with a flow rate 5 mmHg per minute into the pleural space to accomplish partial collapse of the ipsilateral lung. The sympathetic chain is carefully located at the intersection of the second, third, and

Figure 1

Double lumen endotracheal tube insertion.

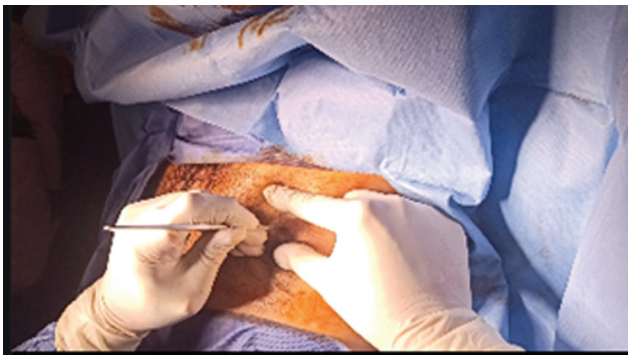
Figure 2

Positioning of the patient.

Figure 3

Sterilization and positioning of the patient.

Figure 4



Making small incisions.

Figure 5

Ports and thoracoscope insertion.

fourth costal heads after the thoracoscope has entered the thoracic cavity. The second rib is typically the upper-most posterior rib visible during thoracoscopy. (Fig. 5**).**

The sympathetic chain is cut using cautery with no excision of a segment (sympathotomy).

Follow up: Patients were followed up in the outpatient clinic after one week, one month, three months and six months after discharge.

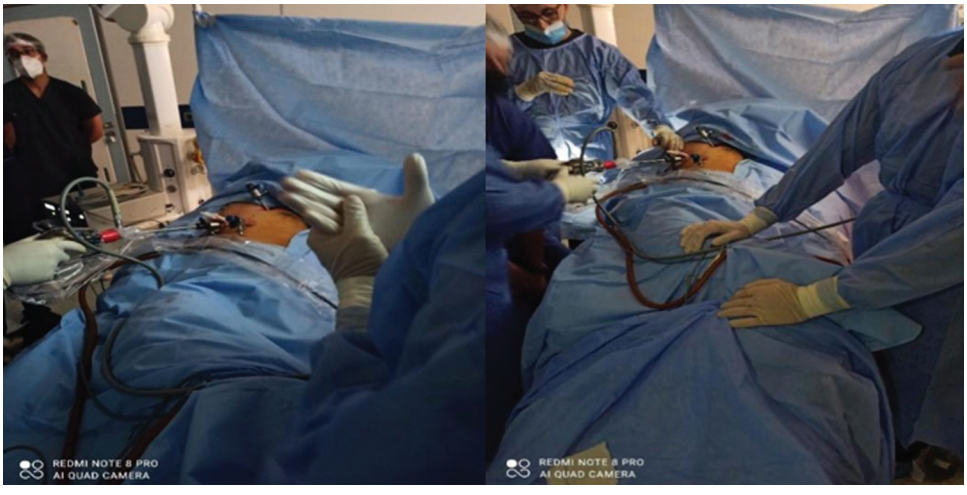
Patients were assessed for: Improvement of hyperhidrosis, failure or recurrence, CH, site, and severity, wound infection and chest x-ray film.

Group II: Lateral approach with three ports procedure: Insufflation of 10 mmHg CO_2 with a flow rate 5 mmHg/min into the pleural space to accomplish partial collapse of the ipsilateral lung were done. Then thoracoscope entered the thoracic cavity after that, the lung pleural surface was initially inspected to exclude lung injuries during needle or ports introduction. After this orientation to local anatomy was commenced by identification of the second rib and subclavian vessels followed by identification of the sympathetic chain. The sympathetic chain was precisely positioned where the second, third, and fourth costal heads crossed. During a thoracoscopy, the second rib is often the uppermost posterior rib that is visible. (View Fig. 6) Using cautery, a section of the sympathetic chain is severed (sympathectomy).

Results

This prospective randomized trial was conducted from January 2021 to June 2022; a total number of 50

Figure 6



Thoracoscope and instruments insertion.

patients with primary palmar hyperhidrosis, attending surgery clinic at Beni-Suef University and Military hospitals, agreed to participate in this study. Patients were classified randomly into 2 groups; Group I (25 patients) were subjected to thoracoscopic sympathotomy and Group II (25 patients) were subjected thoracoscopic sympathectomy. Their age ranged from 18 to 26 years with mean age 21.7±2.6 years. All the patients were followed up for 6 month post-operatively.

All of the studied patients were males 100% (n=50), without statistical difference between two groups. (Table 1**).**

The Patients' age in the two groups ranged from 18 to 26 years. The average age in Group A (n=25) was 21.5 ±2.6 and 21.8±2.7 in Group B (n=25). (Table 2).

All operations were successfully performed 100% completion rate. Operation time was assessed. The median operation time was 27.5 min (range, 10–45 min) for all subjects. The operation time differed among the two groups as in group A the median operation time was 15 min (range, 10–20 min) lower than group B in which the median operation time was 40 min (range, 35–45 min). (Table 3**).**

A Mann-Whitney U test was run to determine if the differences in operation time between group A and group B was statistically significant. Distributions of the operation time for the two groups were similar, as assessed by visual inspection of the population pyramid histogram figure 23. Operation time was statistically significantly higher in group B (Median = 40) than in group A (Median = 15), U=625, z=6.101, $P<0.001$, The post operative hospital stay period ranged from less than one day to two days only in all patients of both groups. The majority of patients only spent less than one day in hospital post-operatively 92% (n=46) and only 8% of all patients spent from one to two days in the hospital post-operatively 8% (n=4). 75% (n=3) of all the four patient that spent more than one day were in group B whereas there was only one patient from group A that spent more than one day and accounting for the remaining 25% (n=1). (Table 4**).**

The percentage of patients developing complications in group A 12% (n=3) was lower than the percentage of patients developing complications in group B 20% (n=5) (Table 5**).** However, the difference was statistically insignificant as a Fisher's Exact test was conducted between group A and group B for state of developing complications and there was a statistically insignificant association between type of intervention and developing complications, P=.702.

None of the patients developed Hemothorax, pneumothorax or intra-operative bleeding. Only one patient (4%) developed compensatory hyperhidrosis at each group. Also, only one patient (4%) developed post-operative Horner's syndrome at each group. On the other hand, the percentage of patients developing dyspnea differed between the two groups as 12% (n=3) of patients in group B developed dyspnea which was higher than that of group A 4% (n=1) figure 27. This difference was statistically insignificant as a Fisher's exact test was conducted between group A and group B for developing dyspnea. There was a statistically insignificant association between type of intervention and dyspnea, P=0.609 (Table 6).

All of the patients developing dyspnea (n=4) had hospital stay period from one to two days unlike all patients without dyspnea (n=46) who had hospital stay

Table 1 Gender distribution

Variable	Number (50 patient) (%)
Sex	
Male	50 (100.0)
Female	0 (00.0)

Table 2 Age by intervention group

Variable	Group A (25)	Group B (25)	Total (50)
Age (years)			
Mean	21.5	21.8	21.7
Standard deviation	2.6	2.7	2.6
Min	18	18	18
Max	26	26	26
Range	8	8	8

Table 3 Operation time by type of intervention

Variable	Group A (25)	Group B (25)	Total (50)
Operation time (minutes)			
Median	15	40	27.5
Interquartile range (IQR)	4	3	25
Min	10	35	10
Max	20	45	45
Range	10	10	35

Table 4 Distribution of hospital stay among groups of patients

	Group A (25)	Group B (25)	Total (50)
Percent of patient with hospital stay Less than 1 day	96% (24)	88% (22)	92% (46)
Percent of patients with hospital stay from 1 to 2 days	4% (1)	12% (3)	8% (4)

Table 5 Developing complications among groups of patients

Variable (50)	Group A (25)	Group B (25)	Total
Developing complications			
Yes	12% (3)	20% (5)	16% (8)
No	88% (22)	80% (20)	84% (42)

Table 6 Distribution of types of complications among the groups of patients

Complication type	Group A (25)	Group B (25)	Total patients (50)
Dyspnea	4% (1)	12% (3)	8% (4)
Compensatory hyperhidrosis	4% (1)	4% (1)	4% (2)
Post-operative Horner's syndrome	4% (1)	4% (1)	4% (2)
Hemothorax	0% (0)	0% (0)	0% (0)
Pneumothorax	0% (0)	0% (0)	0% (0)
Intra-operative bleeding	0% (0)	0% (0)	0% (0)
Total uncomplicated	88% (22)	80% (20)	84% (42)
Total complicated	12% (3)	20% (5)	16% (8)

period of only less than one day table 11. This difference was statistically significant as a Fisher's Exact test was conducted between dyspnea as a complication for hospital stay category periods in all patients. There was a statistically significant association between category of hospital stay and dyspnea, $P<0.001$ Table 7.

Table 7 Hospital stay period by the state of developing dyspnea

	Developing dyspnea	
Variable	No (46)	Yes (4)
Hospital stay		
One day	100% (46)	0% (0)
Two days	0% (0)	100% (4)

Discussion

Primary hyperhidrosis (PH) is a condition that has no known aetiology and is defined by excessive sweating that occurs more often in the palms, axillae, and feet than is necessary for physiologic thermoregulation. It happens in response to psychological, thermal, and emotional stress. Up to 2.8% of the general population may be afflicted by the condition, which typically manifests in early infancy or adolescence. In addition to causing social and psychological issues, PH lowers patients' quality of life.

Treatment is necessary since the illness causes dread, anxiety, and aversion to social situations. Although there are several therapeutic options, endoscopic thoracic sympathectomy (ETS) is still the most effective approach for treating hyperhidrosis [7].

In this study, 50 patients with primary palmar hyperhidrosis were divided into two groups at random. Group I (25 patients) underwent thoracoscopic sympathotomy, which involves using two ports while the patient is laying flat, and Group II (25 patients) underwent thoracoscopic sympathectomy (using three ports while the patient is in lateral position).

In **Bakoush *et al.*** [8], study the age of the patients ranges from 14 –29 years with mean age ±SD 22±4.7 and the range is between 14-29 with median 21. And in **Sezen *et al.*** [7], study, the patients' mean age was 22.8 ±5.7 (range 18–43) years. Also the mean age of **Ho *et al.*** [9], study was 27±10.1 years, with the youngest being 18 years old and the oldest being 60 years old. The mean age was 21.79±5.79 years in **Gurhan *et al.*** [10], However, the median age was 30.31±8.35 years in **Kuhajda *et al.*** [11], Also in this study patients age ranged from 18 to 26 years with mean age 21.7 ±2.6 years. The Patients' age in the two groups ranged from 18 to 26 years. The average age in Group A (n=25) was 21.5±2.6 and 21.8±2.7 in Group B (n=25). Most studies have evaluated very young populations, typically in their second and third decades of life, because hyperhidrosis patients typically appear with the disease at an early stage in their lives.

Like most studies, Jeganathan *et al.* [12], and Mari *et al.* [13], described the same position. Katara *et al.* [14] study demonstrated that the supine position with a reverse Trendelenburg position gives adequate visualisation of the first three sympathetic ganglia and effectively reduces the operative time without increasing the risk of complications. But in their research, Roshdy and El Alfy [15] used both positions (the lateral and the supine). Additionally, both postures are employed in this study (the supine and the lateral). Operation time was evaluated in this investigation. For all subjects, the average operation time was 27.5 min (with a range of 10–45 min). The median operation time in group A was 15 min (with a

range of 10 to 20 min), which was shorter than the median surgery time in group B, which was 40 min (range, 35-45 min). Because the patient had to be repositioned to do the surgery bilaterally while in a lateral position with the ipsilateral arm abducted, operation time in group B was statistically substantially longer than in group A. This activity was time-consuming and extended the duration of the operation. In comparison, the mean operating time in Bakoush *et al.* [8] trial was 76.2 min (range: 55–125 min). The amount of time was calculated starting with the skin incision and ending with the dressing being applied to the wound. This included time consumed in changing patient's position, in management of double lumen endotracheal tube by anesthesia team and in sterilization and draping of the other side. The mean operating time for each side separately was 24.6 min±10.8 min (range: 16–50 min). It worth noting that in the first 20 cases the average operating time was 88 min and the average operating time for each side was 30.6 min While in the last 20 cases the average operating time decreased to 62.4 min and the average operating time for each side decreased to 19.8 min which reflects the increase in surgical experience of the surgical team.

The mean hospital stay was 1.136±0.6days in **Ibrahim M and Mennab C** [16], was 1.63±0.73days in **Elmallah *et al.*** [17], was 1.8±1.0 days in **Sezen *et al.*** [7], and the average length of hospital stay was 1.3 days in **Stefaniak and Ćwigoń** [18], Most of the studies published recently in literature recorded an average length of hospital stay around 24 h. As in this study, the post operative hospital stay period ranged from less than one day to two days only in all patients of both groups. The majority of patients only spent less than one day in hospital post-operatively 92% (n=46) and only 8% of all patients spent from one to two days in the hospital post-operatively 8% (n=4). 75% (n=3) of all the four patient that spent more than one day were in group B whereas there was only one patient from group A that spent more than one day and accounting for the remaining 25% (n=1).

In this study all operations were successfully performed with 16% (n=8) overall complications rate. The percentage of patients developing complications in group A 12% (n=3) was lower than the percentage of patients developing complications in group B 20% (n=5).None of the patients developed hemothorax, pneumothorax or intra-operative bleeding. Like in the study of **Ho *et al.*** [9], there were no pneumothorax and haemothorax and in **Atkinson *et al.*** [19], study experienced no pneumothorax among their patients and reported 1.2% hemothorax. In the other hand, **Elmallah *et al.*** [17], study there was four patients with residual pneumothorax requiring chest drainage from the port entry (6.7%).

Only one patient (4%) from each group in this study experienced compensatory hyperhidrosis. In contrast, problems were noted in Elmallah *et al.* [17] investigation in 10 patients (16.7%), including compensatory hyperhidrosis (13.3%), which typically affects the back, torso, and thighs. According to a different study, 4 patients (7.1%) showed increased sweating in other areas of the body, or compensatory sweating. These areas included the trunk, belly, and thighs. Despite the fact that in the Sezen *et al.* [7], study CH was noted in 62 patients (37.6%), 50 individuals developed CH after the first postsurgical month, and 12 patients did so during the first three weeks following surgery. Additionally, in this trial, only one patient (4% of all patients) at each group experienced post-operative transient Horner's syndrome. Since the technique has improved, surgical teams have gained more expertise, and video equipment that allows for sufficient viewing of the sympathetic chain is now used, Horner's syndrome has become an uncommon consequence. It only occurs in instances where the stellate ganglion has been indirectly damaged by heat diffusion or severe chain traction. The Horner's sign was caused by heat transmission during this surgery, but by the time Yazbek *et al.* [5] studied it, one patient (out of 60) experienced transitory right-side Horner's syndrome primarily caused by heat transmission with adhesiolysis.In this study the percentage of patients developing dyspnea differed between the two groups as 12% (n=3) of patients in group B developed dyspnea which was higher than that of group A 4% (n=1). All of the patients developing dyspnea (n=4) had hospital stay period from one to two days unlike all patients without dyspnea (n=46) who had hospital stay period of only less than one day.

In this study all operations were successfully performed 100% completion rate and in **Elmallah *et al.*** [17], Thoracoscopic sympathectomy trial success rates were 100% improvement in quality of life, as measured by completely dry hands and patient satisfaction. Unlike Chang *et al.* [20] study, which revealed that 32.5% of their patients did develop subcutaneous emphysema, there was no surgical emphysema recorded in this investigation. **Moya *et al.*** [2], found surgical emphysema in about 1% of patients [21].

Conclusion

Thoracoscopic sympathotomy is a PH therapy method that reduces sweating severity while also improving

patient satisfaction. Numerous advantages of this minimally invasive procedure include decreased postoperative discomfort, a shorter hospital stay, quicker healing and return to work, and fewer problems. It is possible to treat both sides at once to eliminate the need for a second treatment and readmission. When treating primary palmar hyperhidrosis, two ports thoracoscopic sympathotomy while the patient is supine has a shorter operating time and fewer problems than three ports thoracoscopic sympathectomy while the patient is in lateral position. Both procedures have the same success rate.

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Conflicts of interest

There are no conflicts of interest.

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