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Thoracoscopic T3-T4 versus T4 sympathectomy for primary axillary hyperhidrosis: A comparative study

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ABSTRACT

Background: Primary axillary hyperhidrosis could be managed with various video-assisted thoracoscopic sympathectomy procedures. We compared two levels of ganglion excision for managing primary axillary hyperhidrosis: T3-T4 and T4. *Methods:* A prospective study was conducted from March 2019 to January 2023. It enrolled seventy patients with axillary hyperhidrosis and randomly assigned them to two groups. Thirty-five patients were surgically treated with thermal ablation of T3-T4, while 35 patients were surgically treated with thermal ablation of T4 only. Both groups were followed up at one, six, and twelve months after surgery. The presence and severity of associated compensatory sweating (CS) were evaluated. Patient satisfaction was assessed using a questionnaire. *Results:* The mean age was 26.7±8.1 years in the T3-T4 group and 25.9±7.3 years in the T4 group. There were 19 (54.2%) males in T3-T4 group and 17 males (48.5%) in T4 group. Family history was positive in 25 patients (71.4%) in T3-T4 group and 23 patients (65.7%) in T4 group. No mortality, postoperative complications, or thoracotomy conversions were observed in both groups. The rate of immediate operative success was 100% in both groups. The T4 group showed a significant absence of CS after 1, 6, and 12 months after surgery ($p<0.001$). Moreover, there was no severe CS in T4 group after 12 months ($p=0.039$). There was a higher satisfaction rate in T4 group ($p=0.004$). *Conclusion:* Both treatments were effective in controlling primary axillary hyperhidrosis. The T4 group demonstrated less severe compensatory sweating and higher satisfaction rates.

Keywords: Hyperhidrosis, Sympathectomy, Video-assisted, Thoracoscopy.

1. INTRODUCTION

Primary hyperhidrosis (PH) is characterized by the presence of excessive sweating that is not related to thermoregulation. It significantly impacts patients' quality of life and personal/professional relations (Cameron, 2016; Wolosker et al., 2012). PH typically starts in infancy or adolescence and lasts for life if left

without treatment. The clinical manifestation is usually limited to the palms, the plantar aspect of the feet, and the axillae, which are symmetrical. It can frequently impact multiple body areas, including the face. Although the exact cause of PH is unknown, it is probably caused by stimulation of the sympathetic nervous system's regulatory center. PH affects around 2.8% of the population. Family history is positive in 12.5% to 56.5% of individuals. Both males and females are similarly affected (Cerfolio et al., 2011).

Surgical intervention has been recommended after the failure of trials of conservative treatment, and the optimal surgical procedure is sympathectomy (Cerfolio et al., 2011). VATS sympathectomy is the gold standard for treating hyperhidrosis definitively. It offers excellent surgical outcomes as it lowers sweating in the affected areas and significantly improves the quality of life. Among the factors that affect the surgical outcome of sympathectomy in hyperhidrosis patients are the resection level and the number of ganglia resected (Wolosker et al., 2022). The earliest studies that were conducted on surgically managed patients of axillary hyperhidrosis produced outcomes that were not as satisfactory as those obtained for the management of palmar hyperhidrosis.

Patient dissatisfaction after the sympathectomy procedure for axillary hyperhidrosis was due to the increased rate of compensatory sweating, which may be attributed to the level and extent of sympathetic chain excision (Gossot et al., 2000; Cameron, 2003). Based on the progression of surgical treatment of palmar hyperhidrosis, it has been shown that limited resection of thoracic ganglia at lower levels yields favorable outcomes in controlling palmer sweating, along with a reduction in the occurrence and severity of compensatory sweating. On this basis, axillary hyperhidrosis management has evolved along the same concept (Wolosker et al., 2022).

2. METHODS

This prospective study was carried out from March 2019 to January 2023. It enrolled 70 patients aged 20-36 years with isolated primary axillary hyperhidrosis who were randomly assigned to receive VATS. After randomization, with 35 patients assigned to each group, all patients were informed about the risks and possibility of compensatory hyperhidrosis. Informed consent was discussed and obtained from all patients after approval from the ethical committee for human research. Inclusion criteria included participants who have primary axillary hyperhidrosis and have the intention to undergo surgery. Exclusion criteria included patients with minimal and mild symptoms, previous thoracic surgery, diseases that might increase surgical risk (e.g., cardiac, pulmonary, or pleural diseases and neoplasia), and a body mass index above 25 (De-Campos et al., 2005).

All patients underwent surgery using general anesthesia, selective intubation, and isolated lung ventilation. Two small 5mm incisions were done in each hemithorax, one at the 4th intercostal space on anterior axillary line and the other at the 3rd intercostal space on the mid-axillary line. After identifying each sympathetic chain on each side, patients randomized in T3-T4 group received thermal ablation and resection of T3-T4 ganglia. In contrast, patients randomized in T4 group received thermal ablation and resection of T4 ganglion only. Following the sympathectomy, the ipsilateral lung was re-expanded, and air was extracted from the pleural cavity using a tiny catheter (16 Fr).

The same procedure was performed on the other chain. There was no consistent usage of a chest drain. A chest x-ray was taken after the operation to evaluate lung expansion. Patients were observed for a year following the operation. All patients underwent systematic reexamination at 1, 6, and 12 months following the operation. Observers were not aware of the patient's operation while documenting results. The following were evaluated:

- Reporting the persistence of axillary hyperhidrosis by the patient, which the examiner validated.
- Reporting the development of compensatory hyperhidrosis, including location and severity, as indicated by the patient and verified by the examiner.

The severity of the compensatory sweating was categorized as mild, moderate, or severe. Patients with no noticeable changes in sweat location or intensity were not influenced by compensatory sweating. Mild compensatory sweating was defined as slight changes in location and intensity of sweating, such as noticeable sweating, without giving major worry about it. Patients with moderate compensatory sweating reported noticeable and embarrassing sweating and disabling situations due to sweating. Severe compensatory sweating was identified when patients experienced interference in their routine daily activities, which may require clothing change due to severe sweating at locations other than axillae. Severe compensatory sweating was classified as noticeable, embarrassing, and requiring at least one clothing change throughout the day.

Patients' Satisfaction with the procedure (including treatment and complications) was assessed 6 and 12 months after surgery using a multiple-choice questionnaire with four satisfaction levels: 1, dissatisfied; 2, fair; 3, very good; 4, excellent. We used this

questionnaire to characterize their overall satisfaction with the results of their operation. If a patient was 100% satisfied with the outcome of their surgery, they were rated as excellent. If they were 90% satisfied, they were rated as very good, and if they were 75% satisfied, they were rated as fair. They were rated as dissatisfied if they were less than 50% satisfied.

Statistical Analysis

For categorical variables, depending on the sample, the chi-square or Fisher's exact tests were used to verify associations between the type of surgery and possible results and complications. These statistical tests were used at each follow-up assessment to compare types of surgery with the variables of interest (axillary hyperhidrosis, incidence and severity of compensatory hyperhidrosis, and patient satisfaction). The significance level was set as $P < 0.05$.

3. RESULTS

This study evaluates VATS outcomes at two denervation levels (T3-T4 and T4 alone) in 70 patients with isolated primary axillary hyperhidrosis. Postoperative follow-up included assessment of axillary hyperhidrosis, compensatory sweating, and patient satisfaction. The mean age of patients in the T3-T4 group was 26.7±8.1 years, and 25.9±7.3 years in T4 group. Nineteen males (54.2%) and 16 females (45.7%) were in T3-T4 group. Meanwhile, 17 males (48.5%) and 18 females (51.4%) were in T4 group. The mean body mass index (BMI) of T3-T4 group was 21.5±2.51kg/m2 and 21.7±2.32 kg/m2 in T4 group. Family history of primary axillary hyperhidrosis was positive in 25 patients (71.4%) in T3-T4 group, while it was positive in 23 patients (65.7%) in T4 group.

The mean duration of symptoms was 4.31 ± 2.23 years in T3-T4 group, while it was 4.59 ± 2.67 years in T4 group. Patients with minimal and mild symptoms were excluded from this study. There were 20 patients (57.1%) with moderate symptoms (i.e., visible sweating that may limit daily activities) in T3-T4 group and 18 patients (51.4%) in T4 group. There were 15 patients (42.8%) with severe symptoms (i.e., visible sweating that may limit daily activities and necessitate at least one change of clothing) in T3-T4 group and 17 patients (48.5%) in T4 group (Table 1).

Table 1 Patients' characteristics and preoperative data

Total n=70	T3-T4 group (n=35)	T4 group (n=35)
Mean age ± SD, years	26.7±8.1	25.9±7.3
Male: Female	19 (54.2%) :16 (45.7%)	17 (48.5%):18 (51.4%)
Body mass index (BMI), kg/m2	21.5±2.51	21.7±2.32
Family history	25 (71.4%)	23(65.7%)
Duration of symptoms, years	4.31 ± 2.23	4.59 ± 2.67
Severity of symptoms:		
Moderate symptoms	20 (57.1%)	18 (51.4%)
Severe symptoms	15 (42.8%)	17 (48.5%)

Data are mean ± SD or n (%).

The mean duration of operation was 23.45 ± 1.72 minutes in T3-T4 group, while it was 22.89 ± 1.84 minutes in T4 group. The mean duration of hospital stays was 2.15 ± 0.56 days in T3-T4 group, while 2.23 ± 0.35 days in T4 group (Table 2). No mortality, postoperative complications, or thoracotomy conversions were observed in either group. The rate of immediate operative success was 100% in both groups. No recurrence was observed in both groups throughout the 12 months of postoperative follow-up.

Table 2 Perioperative data

Total n=70	T3-T4 group	T4 group	P value
Duration of operation, minutes	23.45 ± 1.72	22.89 ± 1.84	0.24
Duration of hospital stay, days	2.15 ± 0.56	2.23 ± 0.35	0.39

Data are mean ± SD.

There was a significant absence of compensatory sweating in T4 group after one month postoperatively (p= 0.001) (Table 3 and Figure 1). This statistical significance continued postoperatively after 6 and 12 months (p< 0.001) (Tables 4 and 5, Figures 2 and 3).

Table 3 Incidence and severity of compensatory sweating after 1 month

Total n=70	Absent	Mild	Moderate	Severe
T3-T4 group	4 (11.4%)	18 (51.4%)	6 (17.1%)	7 (20%)
T4 group	16 (45.7%)	15 (42.9%)	2 (5.7%)	2 (5.7%)
P value	0.001	0.473	0.130	0.075

Fisher's exact test was used instead if expected cell frequencies were less than 5. Data are n (%).

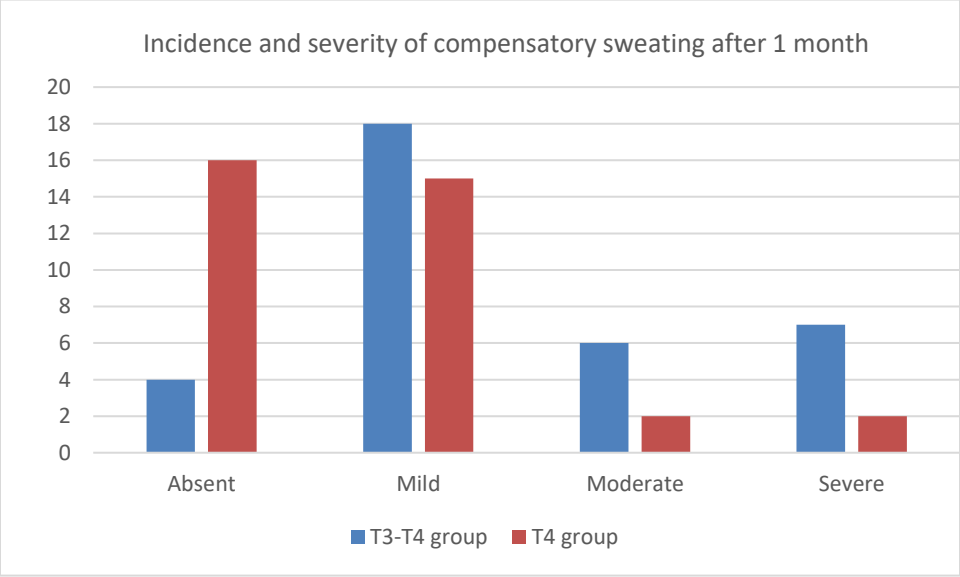

Figure 1 Incidence and severity of compensatory sweating after 1 month

Table 4 Incidence and severity of compensatory sweating after 6 months

Total n=70	Absent	Mild	Moderate	Severe
T3-T4 group	5 (14.3%)	22 (62.9%)	4 (11.4%)	4 (11.4%)
T4 group	19 (54.3%)	13 (37.1%)	1 (2.9%)	2 (5.7%)
P value	<0.001	0.028	0.178	0.377

Fisher's exact test was used instead if expected cell frequencies were less than 5. Data are n (%).

There was no statistical significance between both groups regarding mild compensatory sweating after 1 month postoperatively (Table 3). However, after 6 and 12 months, there was significant mild compensatory sweating in T3-T4 group (p=0.028 and 0.002, respectively) (Tables 4 and 5). Both groups had no statistical significance regarding moderate compensatory sweating postoperatively after 1, 6, and 12 months (Tables 3, 4, and 5). Neither group had any statistical significance regarding severe compensatory sweating postoperatively after 1 and 6 months (Tables 3 and 4). However, there was a statistical significance regarding severe compensatory sweating in T3-T4 group after 12 months postoperatively (p= 0.039) (Table 5). No severe compensatory sweating was noted in T4 group after 12 months postoperatively.

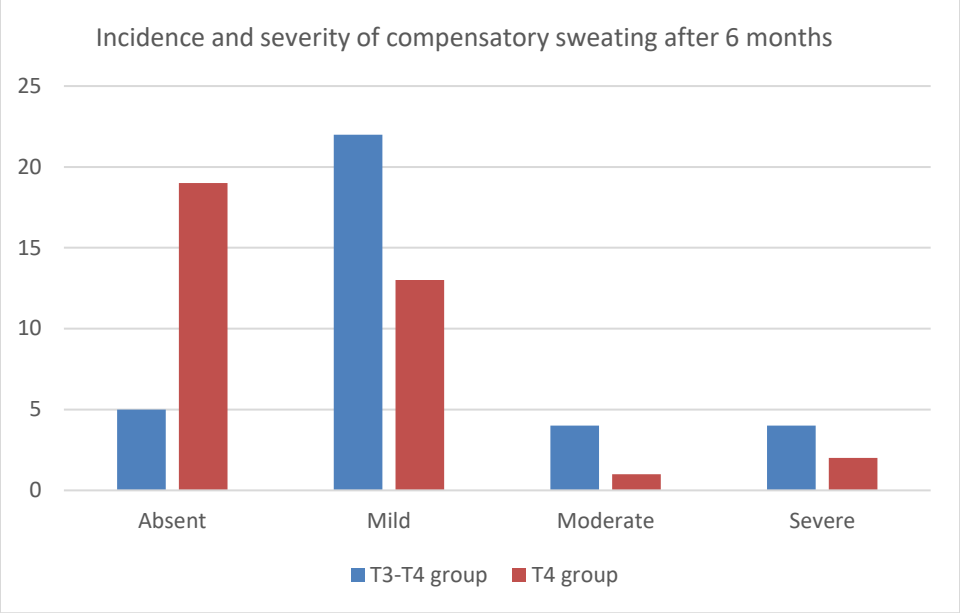

Figure 2 Incidence and severity of compensatory sweating after 6 months

Table 5 Incidence and severity of compensatory sweating after 12 months

Total n=70	Absent	Mild	Moderate	Severe
T3-T4 group	2 (5.7%)	25 (71.4%)	4 (11.4%)	4 (11.4%)
T4 group	22 (62.9%)	12 (34.3%)	1 (2.9%)	0 (0%)
P value	<0.001	0.002	0.178	0.039

Fisher's exact test was used instead if expected cell frequencies were less than 5. Data are n (%).

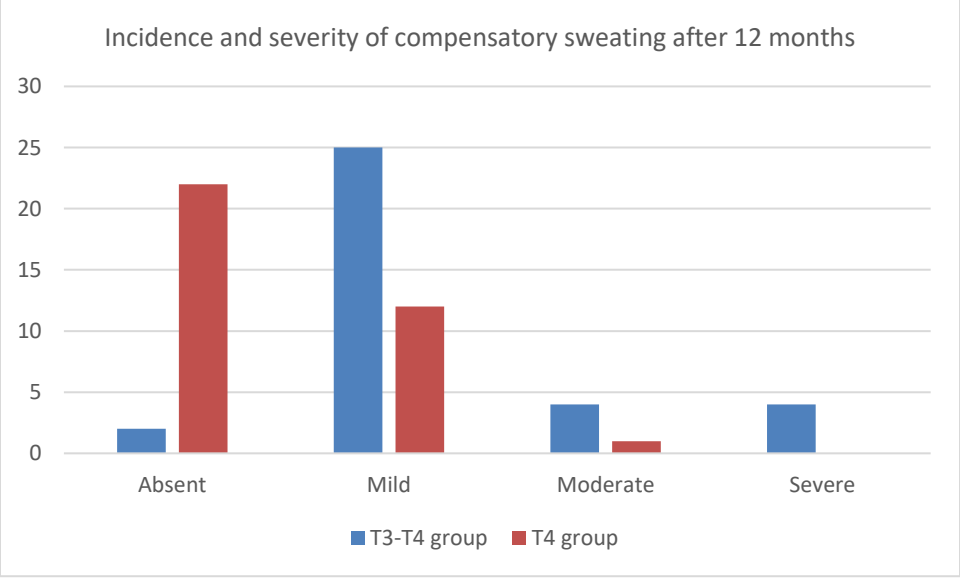

Figure 3 Incidence and severity of compensatory sweating after 12 months

The patients in T4 group have a higher satisfaction rate than those of T3-T4 group after 6 and 12 months of postoperative follow-up (p=0.004 and 0.004, respectively). Moreover, the dissatisfaction rate is higher in T3-T4 group than in T4 group after 6 and 12 months of postoperative follow-up (p=0.010 and 0.039, respectively) (Table 6). After six months of follow-up, six patients in T3-T4 group regretted

performing the operation and were not recommending the operation to others. However, the number of those patients decreased to 4 patients after 12 months of postoperative follow-up. No patient in T4 group regretted performing the operation and did not recommend it to others after 6 or 12 months of postoperative follow-up (Table 6).

Table 6 Patient satisfaction after 6 and 12 months of follow-up using a visual analog scale

Patient Satisfaction	After 6 months of follow-up			After 12 months of follow-up		
	T3-4 group	T4 group	P value	T3-4 group	T4 group	P value
Excellent	11 (31.4%)	23 (65.7%)	0.004	13 (37.1%)	25 (71.4%)	0.004
Very good	7 (20%)	7 ((20%)	0.617	10 (28.6%)	7 (20%)	0.289
Fair	11 (31.4%)	5 (14.3%)	0.077	8 (22.9%)	3 (8.6%)	0.094
Dissatisfied	6 (17.1%)	0 (0%)	0.010	4 (11.4%)	0 (0%)	0.039

4. DISCUSSION

Axillary hyperhidrosis is a benign condition that significantly affects the patient's quality of life (De-Campos et al., 2016). Symptoms may start in childhood and worsen during adolescence. There is no consensus on the best surgical treatment for patients with isolated axillary hyperhidrosis (Nawrocki and Cha, 2019). Medical therapies have inconsistent results and often provide unsatisfactory outcomes (De-Campos et al., 2016). When topical and less invasive treatments, including local surgery, fail, surgical intervention may be necessary (Cerfolio et al., 2011). Video-assisted thoracoscopic sympathectomy is a viable option with minimal complications and positive outcomes. Sympathectomy has a success rate of 68% to 100% for managing primary facial, palmar, and axillary hyperhidrosis, with high immediate satisfaction rates (Cerfolio et al., 2011; Nawrocki and Cha, 2019).

The first documented sympathectomy was performed in 1889. In 1940, Kux carried out the first VATS sympathectomy (Krasna, 2011). Sympathectomy is now the gold standard treatment for primary hyperhidrosis. Several approaches for interrupting the sympathetic chain have been outlined, but no clear superiority exists among them (Cerfolio et al., 2011). Despite numerous published researches, the level of sympathetic trunk section remains a topic of interest and debate. Our study found that T3-T4 and T4 sympathectomy were very effective in all cases after 1, 6, and 12 months of postoperative follow-up. We achieved a high success rate by carefully selecting patients who would benefit from surgical treatment and only accepting them after a thorough explanation of the risks and potential for compensatory hyperhidrosis, as well as their expressed intention to undergo surgery.

This approach ensured that only patients who were most suitable for the procedure and its subsequent effects were admitted for treatment. This study reported no deaths and no significant early postoperative complications. Standardized surgical techniques and the young age groups of patients with no comorbidities have contributed to this outcome. Compensatory sweating is a common complication of thoracic sympathectomy, affecting 80% of palmar hyperhidrosis and 100% of axillary hyperhidrosis (Cerfolio et al., 2011). According to De-Campos et al., (2016), compensatory sweating is the leading cause of post-surgical dissatisfaction. Although it does not regress over time, it can negatively impact the quality of life if it interferes with the patients' daily activities. This study found that compensatory sweating appeared in different body areas, specifically in the abdomen, back, feet, and gluteal region, consistent with medical literature.

Patients who have been informed about the possible development of this condition are typically able to tolerate it without experiencing social or occupational difficulties. Before surgery, all patients must be warned about the potential development of compensatory sweating, which is irreversible. Many studies indicated that higher levels of VATS ganglion resection increase the risk of developing severe compensatory sweating. Moreover, resecting multiple ganglion levels in the same surgery increases the likelihood of developing severe compensatory sweating (Salim and Ali, 2018; Ribas et al., 2006; Yazbek et al., 2005; Felisberto et al., 2016). This was the key to the good results observed in the T4 group, in which only the T4 ganglion was resected. T4 ganglion resection requires sympatheticotomy from upper border of the 4th rib to lower border of the 5th rib, followed by thermoablation of the chain.

After six months, patient satisfaction was higher in this group compared to the T3-T4 group. At a 12-month follow-up, T4 group showed even higher satisfaction levels. The prevalence of recurrent axillary hyperhidrosis in previous case series varies from 15% Gossot et al., (2000) to 65% (Gossot et al., 2003; Claes, 2003). Our study found no recurrence in either group throughout the follow-up. The lack of recurrence is liely related to the absence of technical failure among the operated patients (Yazbek et al., 2005). Horner's

syndrome is now a rare complication after VATS surgery. This condition is now limited to indirect damage to the stellate ganglia induced by heat diffusion or severe traction of the sympathetic chain. We avoided Horner's syndrome by focusing primarily on the T3 and T4 ganglia.

When manipulating the upper border of the fifth rib, caution should be taken to avoid injury of the thoracic duct. At the same time, it passes behind the aorta to the left posterior side of the mediastinum and ascends on the left hemithorax. The thoracic duct is vulnerable in this location. Extensive dissection due to pleural adhesions increases the risk of thoracic duct injury, although this has not happened in our study (Cheng et al., 1994). Surgical treatment is effective regardless of the age of the patients, even for patients who have failed previous medical therapies (Leiderman et al., 2018). We only operated on individuals with a BMI below 25 kg/m2, as those with a higher BMI (i.e., above 25 kg/m2) have a higher risk of developing severe compensatory sweating after surgery (De-Campos et al., 2005).

All patients enrolled in this study had a low or very low quality of life due to the presence of moderate or even severe preoperative symptoms. They were warned about the potential of surgical failure and compensatory sweating before surgery. Most patients reported higher degrees of satisfaction after surgery and improvement in their quality of life. Additionally, treating axillary hyperhidrosis resulted in a significant (100%) clinical improvement (no axillary over-sweating anymore). So, VATS can significantly improve the patient's quality of life with primary axillary hyperhidrosis, as evidenced by their pre- and post-procedural expectations.

5. CONCLUSIONS

The obtained results revealed that both T3-T4 and T4 thoracoscopic sympathectomy are effective for managing primary axillary hyperhidrosis. Ablation of the T4 ganglion reduces compensatory sweating and improves patient satisfaction.

List of abbreviations

Abbreviations	
PH	Primary hyperhidrosis
CS	Compensatory sweating
VATS	Video-assisted thoracoscopic sympathectomy
BMI	Body mass index

Acknowledgment

We thank the participants who contributed to the study.

Author Contributions

All authors contributed equally to the study.

Ethical approval

The study was approved by the Medical Ethics Committee of the Faculty of Medicine, Zagazig University (IRB#:6587-2021).

Informed consent

Written & Oral informed consent was obtained from all individual participants included in the study.

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Conflict of interest

The authors declare that there is no conflict of interests.

Data and materials availability

All data sets collected during this study are available upon reasonable request from the corresponding author.

REFERENCES

1. Cameron AE. Selecting the Right Patient for Surgical Treatment of Hyperhidrosis. Thorac Surg Clin 2016; 26(4):403-6. doi: 10.1016/j.thorsurg.2016.06.004
2. Cameron AE. Specific complications and mortality of endoscopic thoracic sympathectomy. Clin Auton Res 2003; 13 (Suppl 1):I31-5. doi: 10.1007/s10286-003-1110-6
3. Cerfolio RJ, De-Campos JR, Bryant AS, Connery CP, Miller DL, DeCamp MM, McKenna RJ, Krasna MJ. The Society of Thoracic Surgeons expert consensus for the surgical treatment of hyperhidrosis. Ann Thorac Surg 2011; 91(5):1642-8. doi: 10.1016/j.athoracsur.2011.01.105
4. Cheng WC, Chang CN, Lin TK. Chylothorax after endoscopic sympathectomy: case report. Neurosurg 1994; 35:330–332. doi: 10.1227/00006123-199408000-0002
5. Claes G. Indications for Endoscopic Thoracic Sympathectomy. Clin Auton Res 2003; 13(suppl1):l16-l19. doi: 10.1007/s10286-003-1106-2
6. De-Campos JR, Da-Fonseca HV, Wolosker N. Quality of life changes following surgery for hyperhidrosis. Thorac Surg Clin 2016; 26(4):435–443. doi: 10.1016/j.thorsurg.2016.06.008
7. De-Campos JR, Wolosker N, Takeda FR, Kauffman P, Kuzniec S, Jatene FB, De-Oliveira SA. The body mass index and level of resection: predictive factors for compensatory sweating after sympathectomy. Clin Auton Res 2005; 15(2):116-20. doi: 10.1007/s10286-005-0259-6
8. Felisberto JG, Rubira CJ, Berumudes JP, Bueno-DA-Silveira-Júnior S. Comparison between high and low levels thoracic sympathectomy for the treatment of palmar and axillary primary hyperhidrosis: systematic review and meta-analysis. Rev Col Bras Cir 2016; 43(6):486-492. Portuguese, English. doi: 10.1590/0100-69912016006009
9. Gossot D, Debrosse D, Grunenwald D. Endoscopic Thoracic Sympathectomy for Isolated Axillary Hyperhidrosis. Ann Dermatol Venereol 2000; 127(12):1065-7.
10. Gossot D, Galetta D, Pascal A, Debrosse D, Caliandro R, Girard P, Stern JB, Grunenwald D. Long-term Results of Endoscopic Thoracic Sympathectomy for Upper Limb Hyperhidrosis. Ann Thorac Surg 2003; 75:1075-9.
11. Krasna MJ. The role of surgical treatment of hyperhidrosis. Mayo Clin Proc 2011; 86(8):717-8. doi: 10.4065/mcp.2011.0401
12. Leiderman DBD, Milanez-de-Campos JR, Kauffman P, Tedde ML, Yazbek G, Teivelis MP, Wolosker N. The relation between age and outcomes of thoracic sympathectomy for hyperhidrosis: The older the better. J Thorac Cardiovasc Surg 2018; 156(4):1748-56. doi: 10.1016/j.jtcvs.2018.05.084
13. Nawrocki S, Cha J. The etiology, diagnosis, and management of hyperhidrosis: a comprehensive review: etiology and clinical work-up. J Am Acad Dermatol 2019; 81(3):657–666. doi: 10.1016/j.jaad.2018.12.071
14. Ribas MDCJ, Kauffman P, Wolosker N, Munia MA, De-Campos-Werebe E, Andrade-Filho LO, Kuzniec S, Biscegli Jatene F, Krasna M. Axillary hyperhidrosis: T3/T4 versus T4 thoracic sympathectomy in a series of 276 cases. J Laparoendosc Adv Surg Tech A 2006; 16(6):598-603. doi: 10.1089/lap.2006.16.598.
15. Salim EF, Ali GA. Impact of Thoracoscopic T2 Sympathectomy on Patients with Primary Palmar and Axillary Hyperhidrosis. Ann Thorac Surg 2018; 106(4):1032-1037. doi: 10.1016/j.athoracsur.2018.05.023
16. Wolosker N, De-Campos JR, Kauffman P, De-Oliveira LA, Munia MA, Jatene FB. Evaluation of quality of life over time among 453 patients with hyperhidrosis submitted to endoscopic thoracic sympathectomy. J Vasc Surg 2012; 55(1):154-6. doi: 10.1016/j.jvs.2011.07.097
17. Wolosker N, De-Campos JRM, Kauffman P, Da-Silva MFA, Faustino CB, Tedde ML, Puech-Leão P, Pêgo Fernandes PM. Cohort study on 20 years experience of bilateral video-assisted thoracic sympathectomy (VATS) for treatment of hyperhidrosis in 2431 patients. Sao Paulo Med J 2022; 140(2):284-289. doi: 10.1590/1516-3180.2021.0078.R1.23072021
18. Yazbek G, Wolosker N, Milanez-de-Campos JR, Kauffman P, Ishy A, Puech-Leão P. Palmar hyperhidrosis—which is the best level of denervation using video-assisted thoracoscopic sympathectomy: T2 or T3 ganglion? J Vasc Surg 2005; 42(2):281-5. doi: 10.1016/j.jvs.2005.03.041