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# Outcome of Bilateral Video-Assisted Thoracoscopic Sympathectomy (BVATS) Thoracic Sympathectomy in Treatment of Hyperhydrosis

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## ABSTRACT

**Background:** Primary hyperhydrosis (PH) is a pathological condition that impacts the quality of life by inducing excessive, uncontrollable sweating in the palmar, axillary, and/or plantar regions.

**Objective:** We aimed to evaluate the effectiveness of undergoing B-VATS in the treatment of patients with hyperhidrosis. **Methods:** This prospective cohort trial was carried out on 60 patients who were subjected to B-VATS for primary palmar hyperhydrosis (HH). All patients were subjected for grading of palmar HH on the hyperhidrosis disease severity scale, full history taking, preoperative scores level of participants activity, associated axillary/plantar HH, and family history. **Results:** Regarding the outcome, the average hospital stay was 35.1 ± 6.84 days, the average follow-up period was 8.98 ± 1.74 months, the incidence of compensatory sweating (CS) was 17 (28.33%), the cure rate was 54 (90%) and no recurrence or mortality was detected. Concerning the patients' satisfaction, the majority of the studied patients were satisfied [35 (58.33%)], 5 patients (8.33%) were very satisfied, 5 patients (8.33%) were neutral, and 6 patients (10%) were very dissatisfied.

**Conclusions:** BVTS was an effective therapeutic method in treatment of hyperhidrosis had a higher cure rate, no recurrence or mortality with high patients' satisfaction. Early after VATS, CS was a significant health concern that impacted a considerable proportion of patients.

**Keywords:** Bilateral video-assisted thoracoscopic sympathectomy, Thoracic sympathectomy, Hyperhidrosis, Palmar hyperhydrosis, Compensatory sweating.

## INTRODUCTION

Primary hyperhidrosis (PH) is a pathological condition that impacts the quality of life by inducing excessive and uncontrollable sweating in the axillary, facial, palmar, and/or plantar areas [1]. Approximately 2.8% of the population is afflicted with PH, and a positive family history is present in 12.5% to 56.5% of the patients. [2]. Palmar hyperhidrosis (PmH) is the most significant form owing to the profound emotional, social, and occupational consequences it entails. Sympathectomy was the standard treatment for PH patients till 2010 [3]. Following that, oxybutynin chloride was administered as the initial treatment option [4]. Bilateral video-assisted thoracoscopic sympathectomy (B-VATS) is the gold standard and most frequently carried out procedure for the treatment of PmH. The observed favorable outcomes can be attributed, in part, to variables known to impact the sympathectomy efficacy individuals with hyperhidrosis, including body mass index, resection level, preoperative life quality, and the ganglia quantity that are resected [5]. In addition, VATS was discovered to be associated with significant elevations in heart rate variability, bronchomotor tone disturbances, and

sympathovagal imbalance. Although these modifications were described as subclinical, insufficient research has been conducted on their long-term effects on extremely active individuals [6]. As indicated by a prior randomized investigation, it is probable that these modifications were associated with the degree of denervation [7]. We aimed to evaluate the undergoing B-VATS effectiveness in the patient's treatment with hyperhidrosis.

## PATIENTS AND METHODS

This a prospective cohort study was carried out on 60 patients who underwent B-VATS for primary palmar HH. The study was conducted through the period from March 2022 to March 2023.

**Exclusion criteria:** Patients with previous thoracic surgery, effect on intimate relationship, inefficacy of medical treatment, repercussions on social life, repercussions on professional activity, VATS for recurrent HH severe and debilitating primary PmH, and patient motivation and determination.

All patients were subjected to full history taking including smoking, gender, age, body mass index (BMI), grade of palmar HH by the hyperhidrosis disease severity scale associated axillary/plantar HH, [8], activity level, family history, and preoperative hyperhidrosis quality of life questionnaire (HQLQ) scores [9].

**The surgical technique:** All patients experienced general anesthesia via double-lumen endotracheal tubes and the single-lung isolation technique. The participants were placed in a semi-sitting position while maintaining abducted arms. During the procedure, participants were positioned in a semi-prone position on both sides, with the ipsilateral arm abducted and in a mild anti-Trendelenburg position. During monitoring, electrocardiogram, saturation, and blood pressure were measured. Those patients who were undergoing general anesthesia were connected to a double-lumen endotracheal tube for one-lung ventilation. Two-minute incisions, each measuring around 1.0 cm in length, were created in every



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hemithorax. By means of an incision made in the fourth intercostal space along the anterior axillary line, access was gained to the pleural cavity. As a result, a 3- and 5-mm video optic was implemented. To insert an endoscopic scalpel, a second incision was performed in the middle axillary line of the second intercostal space.

Once the sympathetic chain was noted, the ganglion was isolated in the following manner: from the medial costal pleura outwards, then inwards along the lateral costal pleura, and finally dissecting both the sympathetic chain and the ganglion in its entirety. The sympathetic chain was dissected at the costal arches. The sympathetic chain segment situated between the corresponding costal arches, including the target ganglion, was electrocauterized at the conclusion of this stage. All participants were maintained temporarily in apnea or low-flow ventilation throughout the sympathectomy. The residual pneumothorax was aspirated via nasogastric tube (no. 16) at the end of the operation, while pulmonary expansion was monitored via video optic. By means of intradermal sutures, the incisions were closed.

Anatomically, the right thoracic sympathetic chain and its more superior branches comprised a greater number of large-calibre veins, which rendered sympathectomy on that side marginally more laborious than on the left. This compelled the surgeon to perform the dissection with greater caution. Extubating patients in the operating room was typically a straightforward process. They were transferred to their rooms following anesthetic recovery following reawakening.

**Postoperative:** In the recovery room, a postoperative chest X-ray was conducted to confirm the absence of a significant hemothorax or pneumothorax. During the process of closing the incisional soft tissues, a temporary intra-operative paediatric chest tube was introduced into the chest. However, it was removed prior to the application of the skin closure suture.

The efficacy of sympathectomy was evaluated using scores from the hyperhidrosis quality of life questionnaire (HQLQ), and postoperative patient satisfaction with their palmar HH was assessed using a 5-point Likert scale (1 = extremely dissatisfied; 5 = extremely satisfied) [10].

A comprehensive examination was conducted on the incidence of compensatory sweating (CS), including its location, severity, and onset time. CS was defined as any reported increase in perspiration to a greater extent in any body part than before the procedure. At one week, one month, six months, and one year, patient-reported onset of CS information was reviewed in the medical records. CS was categorized as severe (disabling), absent, mild, moderate (embarrassing), or severe. Mortality and recurrence were additionally evaluated during the follow-up phase.

**Sample size calculation:** The sample size calculation was performed utilizing G. power 3.1.9.2 (Universität Kiel, Germany). The sample size was tabulated according to the CS incidence that was reported in 90 (46.4%) patients following treatment of PmH using VATS according to a previous study [11]. Based on the following considerations: 0.05 α error and 80% power of the study. Six cases were added to overcome dropout. Therefore, 60 patients were allocated.

**Ethical Approval: Before the study, informed written consent was obtained from each participants. The research was approved by the Institutional Ethical Committee of Benha University Hospitals (Approval code: RC 21-11-2022). The Helsinki Declaration was adhered through the research conduct.**

***Statistical analysis***

SPSS v 26 was utilized for the statistical analysis (IBM Inc., Armonk, NY, USA). The quantitative variables were expressed as the mean ± standard deviation (SD), and an unpaired Student's t-test was used to compare them between the two groups. The frequency and percentage (%) values of qualitative variables were utilized in the analysis, with the appropriate tests being the Chi-square test or Fisher's exact test. A two-tailed P value less than 0.05 was deemed to indicate statistical significance. A paired sample t-test is a statistical technique that is utilized to compare two groups' means in the case of two correlated samples. Multivariate logistic regression is also utilized to evaluate the relationship between a dependent variable and several independent variables.

## RESULTS

Regarding the baseline characteristics were obtained in table (1).

**Table (1):** Baseline characteristics and clinical data of of the total population

| | | **Total (n=60)** |
|---|---|---|
| **Age (years)** | | 28.4 ± 6.69 |
| **Sex** | **Male** | 21 (35%) |
| | **Female** | 39 (65%) |
| **Weight (Kg)** | | 77.7 ± 10.29 |
| **Height (m)** | | 1.6 ± 0.06 |
| **BMI (Kg/m$^2$)** | | 28.8 ± 4.46 |
| **Family history** | | 23 (38.33%) |
| **Smoking** | | 25 (41.67%) |
| **Level of activity** | **Low to moderate** | 47 (78.33%) |
| | **High** | 13 (21.67%) |
| **Main site** | **Palmar** | 50 (83.33%) |
| | **Axillary** | 8 (13.33%) |
| | **Plantar** | 1 (1.67%) |
| | **Cranial-facial** | 1 (1.67%) |

Data presented as frequency (%). Data presented as mean ± SD or frequency (%), BMI: body mass index

The average operative time was 28.4 ± 6.69 min.

T2 resection was performed in 10 patients with craniofacial hyperhidrosis and palmar. T3 resection was engaged in 16 only palmar and only axillary

hyperhidrosis patients. T3–T4 resection was engaged in 34 palmar and axillary hyperhidrosis patients. The mean preoperative HQLQ score was 83.7 ± 6.19 that was significantly reduced postoperatively with a mean of 38.9 ± 8.37 (Table 2).

**Table (2):** Perioperative data of the total population

| | **Total (n=60)** |
|---|---|
| **Operative time (min)** | 28.4 ± 6.69 |
| **Preoperative HQLQ score** | 83.7 ± 6.19 |
| **Postoperative HQLQ score** | 38.9 ± 8.37 |

Data presented as mean ± SD, HQLQ: hyperhidrosis quality of life questionnaire.

Regarding the outcome, the average hospital stay was 35.1 ± 6.84 days, the mean follow-up period was 8.98 ± 1.74 months, the CS incidence was 17 (28.33%), the cure rate was 54 (90%) and no recurrence or mortality was detected. Concerning the patients' satisfaction, the majority of the studied patients were satisfied 35 (58.33%), 5 patients (8.33%) were very satisfied, 5 patients (8.33%) were neutral, and 6 patients (10%) were very dissatisfied (Table 3).

**Table (3):** Outcome and satisfaction of the total population

| | | **Total (n=60)** |
|---|---|---|
| **Hospital stay (days)** | | 35.1 ± 6.84 |
| **Follow-up period (months)** | | 8.98 ± 1.74 |
| **Incidence of CS** | | 17 (28.33%) |
| **Cure rate** | | 54 (90%) |
| **Recurrence** | | 0 (0%) |
| **Mortality** | | 0 (0%) |
| **Satisfaction** | **Very dissatisfied** | 6 (10%) |
| | **Dissatisfied** | 9 (15%) |
| | **Neutral** | 5 (8.33%) |
| | **Satisfied** | 35 (58.33%) |
| | **Very satisfied** | 5 (8.33%) |

Data presented as frequency (%). CS: compensatory sweating

When comparing between patients developed CS and those without, we found that age and BMI were statistically significant lower in non-CS group in comparison with CS group (P=0.038, 0.013). Numbers of patients with a positive family history and smokers were significantly elevated in CS group compared to non-CS group (P=0.001, <0.001), while there was insignificant difference between both groups regarding sex (Table 4).

**Table (4):** Baseline characteristics regarding the incidence of CS

| | | **CS group (n=17)** | **Non-CS group (n=43)** | **P value** |
|---|---|---|---|---|
| **Age (years)** | | 32.1 ± 9.97 | 27.6 ± 6.31 | **0.038*** |
| **Sex** | **Male** | 4 (23.53%) | 17 (39.53%) | 0.218 |
| | **Female** | 13 (76.47%) | 25 (58.14%) | |
| **BMI (Kg/m$^2$)** | | 31.03 ± 4.99 | 27.9 ± 3.96 | **0.013*** |
| **Family history** | | 15 (88.24%) | 8 (18.6%) | **0.001*** |
| **Smoking** | | 15 (88.24%) | 10 (23.26%) | **<0.001*** |

Data presented as mean ± SD or frequency (%), BMI: body mass index, CS: compensatory sweating, *: statistically significant as P value <0.05.

Both groups didn't differ significantly regarding the main site. In the CS group, the regions affected with CS was back in 6 patients (35.29%), abdomen in 4 patients (23.53%), chest in 2 (11.76%) patients, Back and abdomen in 2 (11.76%) patients, back and chest in 2 (11.76%) patients and chest and abdomen in 1 patients (5.88%) (Table 5).

**Table (5):** Clinical data regarding the incidence of CS

| | | **CS group (n=17)** | **Non-CS group (n=43)** | **P value** |
|---|---|---|---|---|
| **Main site** | **Palmar** | 16 (94.12%) | 34 (79.07%) | 0.619 |
| | **Axillary** | 1 (5.88%) | 6 (13.95%) | |
| | **Plantar** | 0 (0%) | 1 (2.33%) | |
| | **Cranial-facial** | 0 (0%) | 1 (2.33%) | |
| **Regions affected with CS** | **Back** | 6 (35.29%) | -- | --- |
| | **Abdomen** | 4 (23.53%) | -- | |
| | **Chest** | 2 (11.76%) | -- | |
| | **Back and abdomen** | 2 (11.76%) | -- | |
| | **Back and chest** | 2 (11.76%) | -- | |
| | **Chest and abdomen** | 1 (5.88%) | -- | |

Data presented as frequency (%), CS: compensatory sweating.

There were insignificant differences between both groups regarding the perioperative data (operative time, preoperative HQLQ score, postoperative HQLQ score, and hospital stay) (**Table 6).**

**Table (6):** Perioperative data regarding the incidence of CS

| | CS group (n=17) | Non-CS group (n=43) | P value |
|---|---|---|---|
| **Operative time (min)** | 27.8 ± 4.3 | 28.7 ± 7.45 | 0.660 |
| **Preoperative HQLQ score** | 85.4 ± 6.48 | 82.97 ± 6.01 | 0.172 |
| **Postoperative HQLQ score** | 39.6 ± 7.64 | 38.6 ± 8.71 | 0.674 |
| **Hospital stay (days)** | 35.9 ± 7.14 | 34.7 ± 6.78 | 0.566 |

Data presented as mean ± SD, CS: compensatory sweating, HQLQ: hyperhidrosis quality of life questionnaire.

Table (7) showed significantly better satisfaction in non-CS group compared to CS group as number of satisfied patients was significantly decreased in non-CS group compared to CS group (5.88 vs, 79.07, P<0.001).

**Table (7):** Satisfaction regarding the incidence of CS

| | CS group (n=17) | Non-CS group (n=43) | P value |
|---|---|---|---|
| **Very dissatisfied** | 4 (23.53%) | 2 (4.65%) | **< 0.001*** |
| **Dissatisfied** | 7 (41.18%) | 2 (4.65%) | |
| **Neutral** | 4 (23.53%) | 1 (2.33%) | |
| **Satisfied** | 1 (5.88%) | 34 (79.07%) | |
| **Very satisfied** | 0 (0%) | 5 (11.63%) | |

Data presented as mean ± SD, CS: compensatory sweating, *: statistically significant as P value <0.05

**Table (8)** showed that on multivariate logistic regression, age, BMI, family history, smoking and main site (Palmer) were significant risk factors for the incidence of CS, whereas sex was insignificant risk factor.

**Table (8):** Multivariate logistic regression of the risk factors of the CS

| | Coefficient | SE | P | Odds ratio | 95% CI |
|---|---|---|---|---|---|
| **Age (years)** | 0.132 | 0.056 | **0.019*** | 1.142 | 1.0223 to 1.2747 |
| **Sex** | 0.828 | 0.613 | 0.177 | 13.543 | 1.6375 to 112.0050 |
| **BMI (Kg/m$^2$)** | 0.143 | 0.064 | **0.026*** | 1.154 | 1.0177 to 1.3091 |
| **Family history** | 3.491 | 0.849 | **<0.001*** | 32.813 | 6.2178 to 173.1572 |
| **Smoking** | 3.208 | 0.838 | **<0.001*** | 24.725 | 4.7838 to 127.7871 |
| **Main site (Palmer)** | 2.155 | 0.812 | **0.008*** | 8.625 | 1.7545 to 42.4001 |

BMI: body mass index, SE: standard error, CI: confidence interval, *: statistically significant as P value <0.05.

## DISCUSSION

In present study, regarding the main site, the palmar region was the main site in the majority of the studied patients (50, 83.33%), at the axillary region was in 8 patients (13.33%), at the plantar region was in 1 patient (1.67%) and at the cranial-facial region was in 1 patient (1.67%) and was insignificantly different between those who developed CS and patients without.

With respect to the distribution of the main sites of hyperhidrosis, the study group exhibited a higher prevalence of PmH [12]. This condition is frequently accompanied by a significant decrease in quality of life, as it restricts the ability to perform manual activities. **Estevan *et al.*** [13] also identified these patient population characteristics in an epidemiological investigation that included information regarding surgical patients. Additionally, the axillary hyperhidrosis was identified as the second most frequent site, with cranial-facial and plantar hyperhidrosis following suit [14].

In terms of results, we observed that the average length of hospitalization was 35.1 ± 6.84 days, the mean duration of follow-up was 8.98 ± 1.74 months, the cure rate was 54 (90%) cases, and there were no instances of recurrence or mortality reported. The findings indicate that a significant proportion of the patients under investigation expressed satisfaction: 35 (58.3%) were satisfied, 5 (8.33%) were extremely satisfied, 5 (8.33%) were neutral, and 6 (10%) were extremely dissatisfied. In **Öncel *et al.*** [15] study, who conducted the most extensive retrospective B-VATS analysis for PH achieved the following results: 95% initial cure rate and 93% initial satisfaction rate. Neither mortality nor recurrence were documented during the follow-up phase. **Wolosker *et al.*** [5] observed that in excess of 90% of the patients, there was an improvement in quality of life during the postoperative period, and that in more than 90% of this sample, the level of satisfaction was rated as excellent or good. Furthermore, significant clinical improvement (exceeding 90%) was observed when the hands or axilla served as the primary site of hyperhidrosis. The patients' anticipations prior to and following the procedure are reflected in these results, indicating that VATS is a therapeutic approach that can significantly improve the lives of PH patients who seek treatment.

Our results revealed that 17 individuals (28.33%) had CS. The most prevalent and incapacitating complication of video-assisted thoracoscopic sympathectomy continues to be CS, which is thought to arise from a thermoregulatory mechanism [16]. CS is characterized by profuse perspiration in anatomical regions other than the sympathectomy site. The most frequent sites affected include the thorax, back, abdomen, and inguinal area [17]. This circumstance is susceptible to change and is typically challenging to assess. There is significant variation in the reported frequencies, giving rise to conflicting perspectives regarding the severity and predisposition of the condition. In addition to population heterogeneity, variables including geographic location, working environment, and climatic conditions (temperature and humidity) can influence the incidence of CS [15].

The trial examined by **Dumont** [18] showed that severity ranged from 1% to 30%, while the mild form fluctuates between 15% and 90%. Serious CS is more likely to occur, according to other trials, the higher the sympathectomy is performed (T2), the more extensive the resection (T2–T5) [18, 19].

**Öncel *et al.*** [15] showed that CS was in 34 (10.14%) cases the most frequent complication.

In **Alkosha *et al.*** [11] study, CS was documented by 46.4% of the patients who underwent follow-up. The considerable incidence of CS exposes a statistical proportion of patients who treated to health risks, which amplifies patient discontent and obscures the VATS success [20, 21].

We identified age, BMI, family history, smoking, and the main site (Palmer) as significant risk factors associated with the development of CS. Additionally, **Alkosha *et al.*** [11] documented that three factors, namely BMI, laterality of VATS, and association of plantar HH, demonstrated a significant predictive capacity for CS. At a threshold of 28.5, BMI was a positive predictor of the development of CS. Two prior studies documented an association which is significant between BMI and CS subsequent to VATS. Nevertheless, BMI was utilized as a categorical variable in both studies, which classified patients into distinct groups based on their BMI [21, 22]. **de Campos *et al.*** [23] categorized patients into three groups (BMI <20, 20-25, and >25), the researchers discovered in their multivariate analysis correlated significantly with the severity of CS. In a similar vein, **Kara *et al.*** [21] classified patients into two groups (22 and >22) based on their BMI, however their multivariate analysis did not yield a statistically significant association, despite the initial univariate analysis indicating that it was correlated significantly.

**Limitations:** Relatively small sample size, there was no matching or randomization in the study. However, we attempted to account for confounding variables by including all independent variables correlated with the outcome in a multivariable logistic regression analysis.

## CONCLUSION

B-VATS was an efficacious therapeutic approach for the management of hyperhidrosis, as evidenced by its high patient satisfaction and absence of recurrence or mortality. Early after VATS, CS was a significant health risk that impacts a patient's significant proportion.


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- **Conflict of Interest:** Nil

## REFERENCES


1. **Remington C, Ruth J, Hebert A (2021)**: Primary hyperhidrosis in children: A review of therapeutics. Pediatric Dermatology, 38:561-7.
2. **Hasimoto E, Cataneo D, Reis T, Cataneo A (2018)**: Hyperhidrosis: prevalence and impact on quality of life. The Brazilian Journal of Pulmonology, 44:292-8.
3. **Chudry H (2022)**: The treatment of palmar hyperhidrosis - a systematic review. International Journal of Dermatology, 61:1303-10.
4. **Attallah H, El-Gilany A, Youssef Y, Abdelshaheed M, Sharaf E (2022)**: Efficacy, safety and quality of life of oxybutynin versus aluminum chloride hexahydrate in treating primary palmar hyperhidrosis. Indian Journal Dermatology, 67:222-7.
5. **Wolosker N, de Campos J, Kauffman P *et al.* (2022)**: Cohort study on 20 years' experience of bilateral video-assisted thoracic sympathectomy (VATS) for treatment of hyperhidrosis in 2431 patients. Sao Paulo Medical Journal, 140:284-9.
6. **Alkosha M, Abuelnasr T, Mohammed M (2022)**: Efficacy and outcome prediction of unilateral video-assisted thoracoscopic sympathectomy in primary palmar hyperhidrosis: A comparative study with bilateral sympathectomy. World Neurosurgery, 161:308-18.
7. **Fiorelli A, Messina G, Chiodini P *et al.* (2017)**: Cardiac autonomic changes after thoracic sympathectomy: A prospective, randomized study. The Annals of Thoracic Surgery, 103:216-24.
8. **Solish N, Bertucci V, Dansereau A *et al.* (2007)**: A comprehensive approach to the recognition, diagnosis, and severity-based treatment of focal hyperhidrosis: recommendations of the Canadian Hyperhidrosis Advisory Committee. Dermatologic Surgery, 33:908-23.
9. **Hajjar W, Al-Nassar S, Al-Sharif H *et al.* (2019)**: The quality of life and satisfaction rate of patients with upper limb hyperhidrosis before and after bilateral endoscopic thoracic sympathectomy. Saudi Journal of Anaesthesia, 13:16-22.
10. **Chyung S, Roberts K, Swanson I, Hankinson A (2017)**: Evidence-based survey design: The use of a midpoint on the Likert scale. Performance Improvement, 56:15-23.
11. **Alkosha H, Mohammed M, Abuelnasr T, Amen M (2023)**: Predictors of compensatory sweating following video-assisted thoracoscopic sympathectomy in primary palmar hyperhidrosis. World Neurosurg, 5:34-9.
12. **Teivelis M, Wolosker N, Krutman M *et al.* (2014)**: Treatment of uncommon sites of focal primary hyperhidrosis: experience with pharmacological therapy using oxybutynin. Clinics, 69:608-14.
13. **Estevan F, Wolosker M, Wolosker N, Puech-Leão P (2017)**: Epidemiologic analysis of prevalence of the hyperhidrosis. Anais Brasileiros de Dermatologia, 92:630-4.
14. **Wolosker N, Teivelis M, Krutman M *et al.* (2014)**: Long-term results of the use of oxybutynin for the treatment of axillary hyperhidrosis. Annals of Vascular Surgery, 28:1106-12.
15. **Oncel M, Sadi Sunam G, Erdem E *et al.* (2013)**: Bilateral thoracoscopic sympathectomy for primary hyperhydrosis: a review of 335 cases. Cardiovascular Journal of Africa, 24:137-40.
16. **Loizzi D, Mongiello D, Bevilacqua M *et al.* (2023)**: Surgical management of compensatory sweating: A systematic review. Frontiers in Surgery, 10:116-22.
17. **Lee J, Jeong J, Suh J *et al.* (2021)**: Thoracoscopic sympathetic block to predict compensatory hyperhidrosis in primary hyperhidrosis. Journal of Thoracic Disease, 13:3509-17.
18. **Dumont P (2008)**: Side effects and complications of surgery for hyperhidrosis. Thoracic Surgery Clinics, 18:193-207.
19. **Rodríguez P, Freixinet J, Hussein M *et al.* (2008)**: Side effects, complications and outcome of thoracoscopic sympathectomy for palmar and axillary hyperhidrosis in 406 patients. the European Journal of Cardiovascular Surgery, 34:514-9.
20. **Moon D, Kang D, Kim D, Kang M, Lee S (2018)**: Early results of new endoscopic thoracic sympathectomy for craniofacial hyperhidrosis. Journal of Thoracic Disease, 10:3627-31.
21. **Kara M, Kose S, Cayirci C, Koksal A (2019)**: Can we predict the compensatory hyperhidrosis following a thoracic sympathectomy? Indian Journal of Thoracic and Cardiovascular Surgery, 35:190-5.
22. **Moon D, Kang D, Lee H *et al.* (2020)**: To avoid compensatory hyperhidrosis after sympathetic surgery for craniofacial hyperhidrosis. Journal of Thoracic Disease, 12:2529-35.
23. **de Campos J, Wolosker N, Takeda F *et al.* (2005)**: The body mass index and level of resection: predictive factors for compensatory sweating after sympathectomy. Clinical Autonomic Research, 15:116-20.