INTRODUCTION

Hyperhidrosis (HH) is a clinical condition causing excessive sweating that exceeds the physiological needs of the person concerned. Generally, this condition occurs in the armpits, palms, soles of the feet or craniofacial, which can interfere with a person's quality of life. Epidemiologically, the incidence rate of palmar hyperhidrosis (PH) is 2.8% in the USA and 1.4% of them have severe axillary hyperhidrosis (AH). The mean age of affected patients is 40 years, the mean age at onset is 25 years, and prevalence peaks between 25 and 64 years of age, with the lowest prevalence in those aged 12 years or younger. Hyperhidrosis can be categorized as either primary or secondary. This distinction is important because treatment and management may significantly differ between the two groups. The etiology of primary hyperhidrosis remains unknown despite multiple literature reviews. Genetic factors are believed to play a role in excessive neural stimulation, although this is poorly understood. Secondary hyperhidrosis presents as a consequence secondary to another disorder, which means that hyperhidrosis is not the disease itself but only a clinical manifestation of another underlying process.

According to the recommendations of the Canadian Hyperhidrosis Advisory Committee, Hyperhidrosis Disease Severity Scale (HDSS) scores of 3 and 4 indicate severe hyperhidrosis where sweating is intolerable and greatly interferes with daily activities. The treatment of patients with severe hyperhidrosis is not straightforward. Conservative therapy with topical agents may be unsuccessful and lead to surgical referral. VATS offers high success rates and immediate and permanent symptom relief for PH and AH. With video equipment requiring only small incisions, VATS has become widely accepted as a safe method for treating HH with excellent results, low morbidity, rapid postoperative recovery, and minimal scars.

METHODS

Six cases of severe hyperhidrosis (five male – one female) between March 2022 – March 2023. The patient complained of excessive underarms, palms, and face sweating that interferes with daily activities. Chest X-ray examination and basic preoperative hematology were within normal limits in all cases. Before the procedure, the patient is informed of the possible complications and pain associated with the procedure.

RESULT

Four of the patients experienced improvement and were very satisfied with undergoing the VATS sympathectomy procedure, one patient was quite satisfied and the other was dissatisfied because the complaint of compensatory hyperhidrosis (CH) experienced was more disturbing to the patient's activities than before surgery. Complications found besides pain are subcutis emphysema, pleural effusion and bleeding. All patients experienced CH, which predominated in the chest and back areas.

CONCLUSION

Bilateral VATS sympathectomy in cases of severe hyperhidrosis is a minimally invasive procedure that can be recommended for the future. This action gives results, a good level of satisfaction and can improve patients' quality of life after surgery.
received informed consent regarding CH complications after surgery and agreed to undergo a VATS sympathectomy. All patients underwent bilateral T2 -T4 VATS Sympathectomy procedures with general anesthesia, one lung ventilation and an intubated double-lumen endotracheal tube. The patient is in a semi-Fowler’s position with the patient’s arms stretched out on the left and right and behind the left and right back, given a small pillow to facilitate surgery. A 3-4 cm incision was made on the ICS 3 mid-axilla line for the trocar and cautery entry and the ICS 4 inframammary fold for the camera port to enter. After the lungs have been deflated, the T2-T4 sympathetic nerve stellate ganglion is identified for a sympathectomy with diathermy and coagulation using cautery. Next, an evaluation of bleeding was carried out in the patient, and a chest tube was placed in ICS 3. The procedure was performed on both the right and left hemithorax. Furthermore, an assessment of the complications of VATS sympathectomy, the incidence of hyperhidrosis, length of stay in hospital, and assessment of patient satisfaction after 1 year of VATS sympathectomy was performed.

**CASE SERIES**

The demographic characteristics of the patient there is one woman in six cases. The average patient is of young, productive age. Most patients have complaints of PH, AH and Facial Hyperhidrosis (FH). Technical success was obtained in all cases. In evaluating postoperative complications (Table 1), all patients complained of pain in the operative wound with a visual analog scale of 3 and all patients had bilateral chest tube insertions. Three patients had emphysema subcutis post-VATS sympathectomy. One patient experienced postoperative bleeding and required exploration and evacuation of bleeding. One case with an infected wound requiring long wound care and one patient was reported to have pleural effusion. All patients underwent three to four days of postoperative care in the hospital. All patients were followed up through control in the polyclinic 1 month postoperatively and 5 months postoperatively by interviewing via cellular phone. CH occurred in all patients, which predominated in the chest and back area (Table 2) and changes in symptoms after six months of VATS sympathectomy (Table 3). One patient was dissatisfied with this procedure due to the CH he got, which interfered with his daily activities. One feels quite satisfied because the main symptoms are only partially gone. Moreover, the patients were satisfied with the VATS Sympathectomy procedure and did not interfere with their daily activities compared to before (Table 4).

**DISCUSSION**

Hyperhidrosis (HH) is a clinical condition causing excessive sweating that exceeds the physiological needs of the person concerned.1 Primary hyperhidrosis is a disease that significantly affects the population, particularly the younger population. The most affected areas are the hands, axillae, facial and feet. Hyperhidrosis has a profound negative impact on patients’ daily lives, including limitations in work, social interaction and leisure, as well as emotional and psychological distress.9,10 Genetic factors are believed to play a role in excessive neural stimulation. Although this is not well understood, the fundamental theory says that Eccrine sweat glands receive sympathetic innervation via cholinergic fibers that send impulses as a physiologic response to core body temperature control during physical or psychological stress. The thermoregulatory center of the hypothalamus mediates sympathetic innervation to the sweat glands. Cholinergic stimulation of muscarinic receptors induces sweating. It is believed that the negative feedback mechanism to the hypothalamus may be impaired, causing the body to sweat more than what is needed to cool the body. This pathologic reaction can be triggered by medications that increase the release of acetylcholine from the neuron or systemic medical disorders example, endocrine disease (hypoglycemia, hyperthyroidism), neurologic disorders, drug use (antidepressants, antiemetics), menopause, neoplastic disease (Hodgkin lymphoma, neoplastic disease (Hodgkin lymphoma,

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**Table 1. Complications After VATS Sympathectomy**

<table>
<thead>
<tr>
<th>Complications After VATS Sympathectomy</th>
<th>All Patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain</td>
<td></td>
</tr>
<tr>
<td>Subcutaneous Emphysema</td>
<td>3</td>
</tr>
<tr>
<td>Pleural Effusion</td>
<td>1</td>
</tr>
<tr>
<td>Bleeding After Surgery</td>
<td>1</td>
</tr>
<tr>
<td>Wound Infection</td>
<td>1</td>
</tr>
</tbody>
</table>

**Table 2. Compensatory Hyperhidrosis Location in Cases**

<table>
<thead>
<tr>
<th>No.</th>
<th>Abdomen</th>
<th>Chest</th>
<th>Back</th>
<th>Kepala</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
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<tr>
<td>3</td>
<td></td>
<td></td>
<td>*</td>
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<tr>
<td>4</td>
<td></td>
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<tr>
<td>5</td>
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<td>*</td>
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</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td>*</td>
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</tr>
</tbody>
</table>

**Table 3. Changes of Symptoms After 1 Year VATS Sympathectomy**

<table>
<thead>
<tr>
<th>Changes of Symptoms After Six Month VATS Sympathectomy</th>
<th>Relief of Symptoms</th>
<th>Partial Relief of Symptoms</th>
<th>Recurrent Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

**Table 4. Satisfaction Level After Undergoing Surgery**

<table>
<thead>
<tr>
<th>Satisfaction Level After Undergoing Surgery</th>
<th>Very Satisfied</th>
<th>Quite Satisfied</th>
<th>Dissatisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
The Hyperhidrosis Disease Severity Scale (HDSS) is a validated, single-question survey with four levels of sweat tolerability and impact on quality of life. A score of 3 or 4 indicates severe hyperhidrosis, whereas a score of 1 or 2 indicates mild or moderate primary hyperhidrosis (table 5). The treatment of patients with severe hyperhidrosis is not straightforward. In severe hyperhidrosis, conservative therapy with topical agents may be unsuccessful and may lead to surgical referral. Surgical therapy is effective and is based on interrupting the transmission of impulses from the sympathetic ganglia to the sweat glands. Thoracic sympathectomy has been used to treat various sympathetic disorders since it was first described in the 1940s. Surgical techniques for primary hyperhidrosis regarding the sympathetic nerve have developed continuously during the past decades. Techniques interrupting the sympathetic chain are well described and vary from sympathectomy, “sympathicotomy” or “sympathotomy,” sympathetic block to ramicotomy. The surgical term of “sympathectomy” presents the dissection of a specific part of the sympathetic trunk and ganglia.

The video-assisted thoracoscopic sympathectomy (VATS) is considered the most effective treatment for PH for presenting long-lasting functional results, being considered the best therapeutic option. Several surgical approaches have been used to perform the sympathectomy, among which we highlight the posterior thoracic, anterior cervical or supraclavicular and axillary pathways. However, due to the high morbidity and mortality rate, these accesses were abandoned after the emergence of VATS.

The surgical approach to thoracoscopy involves creating a small (2 ± 3 cm) incision in the lateral chest wall with the patient in the lateral decubitus position, supine or semi-fowlers. General endotracheal anesthesia (GETA) with One lung Ventilation (OLV) is an option for VATS because it protects the nondiseased contra-lateral lung from contamination. “Lung separation,” on the other hand, refers to cases with no risk of contamination to the dependent lung and is performed primarily to improve surgical exposure such as for VATS. The inability to completely deflate the nondependent lung during VATS leads to poor surgical exposure, which can jeopardize the procedure’s success, potentially requiring conversion to an open technique.

The choice of the appropriate level primarily depends on the location of the primary symptoms, although it may also depend on the cause. Controversy exists about which levels and how many levels of sympathectomy ensure the highest success rate and carry the lowest incidence of CH. For facial sweating or blushing, the T2 level is isolated by dividing over or resecting between the T2 and T3 ribs. Some authors just make one cut over the middle or top of the T2 rib without attempting to isolate the nerve further below. For patients with hand sweating, the T2 and 3 levels are isolated by division or resection, or T3 alone is isolated; for axillary sweating, T3 and 4 are isolated. Recent series have emphasized the importance of including the T4 level in patients with axillary sweating.

Course, the occurrence of CH in postoperative sympathectomy is difficult to avoid. Several Authors report compensatory sweating is greater with T2–T4 resection than with T2 or T3 only or T2–T3 resection. Tan and associates compared T2 only versus T2–T4. He also reported 0% compensatory sweating in the T2 group. Van’t Riet et al. reported 0% compensatory sweating with only T3 resection compared to other studies that CH occurred in 72% of patients. Daniel L et al., in a case study of 282 hyperhidrosis patients after a follow-up of 1 to 42 months (median 26 months), found CH in 58 patients (21%), 23 in the T2 group and 35 in the T2 to T4 group. In both groups, the most common areas of CH were the upper back and abdomen. According to Chen et al. in the meta-analysis, T2 level thoracic sympathectomy is good in resolution of PH. Still, it has a high risk of occurrence of a CH compared to T3 or T4, giving good results. For patients with PH, a T2–T3 sympathectomy is highly effective (success rate of 99–100%) and shows a low incidence of severe CH of 1.3–12%. Lower level sympathectomy (T3 and/or T4) may decrease the incidence and severity of CH but may be less effective than T2–T3 sympathectomy. The treatment of AH by sympathectomy remains controversial. T4–T5 sympathectomy is successful in 86% with a CH incidence of 29%. Wolosker N et al. compared T3 and T4 sympathectomy in PH and plantar hyperhidrosis (PLH) cases and assessed PLH after undergoing sympathectomy. The results showed good improvement, but in the first year period, there was a deterioration in both groups. It can also be concluded that the VATS sympathectomy approach should not be used if only PLH symptoms are present.

Shoenfeld and colleagues investigated total sweat volume and found that, despite a reduction in hand sweating, the total volume of sweat did not change, suggesting that the total volume in hands is equivalent to the CH in other parts of the body that are more sensitive to thermal changes than before surgery. The mechanism of CH may be more complex than simple compensation for thermoregulation. Chou and colleagues suggested the concept of an altered feedback mechanism. They proposed that changes in sweating patterns are not compensatory but are reflex responses to positive and negative feedback mechanisms activated in the hypothalamus.

We realize that all choices of action will cause a complication. Approximately 9% of VATS patients experience some complications. These include hemorrhage, subcutaneous emphysema, empyema, recurrent pneumothorax, pulmonary edema and pneumonia. It should be noted that the pneumothorax that
occurs after sympathectomy is a residual pneumothorax caused by the failure to fully expel air or gas from the thoracic cavity at the end of the sympathectomy but the installation of a chest tube after surgery and with positive pressure facilities for a few seconds can overcome this situation. Wound infection is rare, with few cases reported. Lin TS and colleagues reported three cases of minor wound infections (0.14%) and Zacherl and colleagues reported one case (0.1%)\textsuperscript{23}. Postoperative pain is a frequent complaint and is manifested acutely for some hours when taking deep breaths, particularly at the end of inhalation. This symptomology can be treated with analgesics and antiinflammatories that should be administered throughout the first postoperative week for the comfort of those patients.\textsuperscript{24} Hemorrhax and bleeding after surgery. Some investigators report cases of hemorrhax without details: Chang and colleagues, one case (0.4%); Rex and colleagues, four cases (0.3%); Reisfeld and colleagues, six cases (0.9%); and Schmidt and colleagues, one case (0.5%). Doolabh and colleagues reported on three patients (1.6%) who developed bleeding complications, with one patient requiring thoracoscopic re-exploration and the other patient requiring chest tube drainage.\textsuperscript{23,25}

In this modern era, this minimally invasive procedure is very important and benefits patients. This view is supported by Weatherford et al. in their review of the experience of thoracoscopy vs. thoracotomy at a community hospital. Weatherford compared length of stay, morbidity, mortality, operative time, length of time to extubation length of intensive care unit stay, number of days of pleural drainage and found improvements in these categories with thoracoscopy.\textsuperscript{8,17} Walid S et al.\textsuperscript{26} Reported postoperative hospital stay (POHS) ranged between 4 and 48 hours. The majority of patients remain in the hospital for around 4–6 hours postoperatively and then are discharged home. Only seven patients stayed for 48 hours as they had intra-operative bleeding due to injury of the superior intercostal vein clipped and the intercostal drain left in place for two days. Dumont et al.\textsuperscript{19} The length of hospital stay was 1.5 days (36 hours) for 106 patients (87.6%), 2.5 days for 12 patients, 4 days for 2 patients, and 5 days for 1 patient. The mean interval between discharge and return to work was 12 days.

Looking at our cases when they were contacted again, many patients were satisfied with the VATS T2-T4 sympathectomy procedure rather than dissatisfied. Looking at our cases when they were contacted again, many patients were satisfied with the VATS T2-T4 sympathectomy procedure rather than dissatisfied. As reported in an RCT conducted by Lin M et al., 96.10% of cases were satisfied with VATS in T2-T4 segments, while Li et al. reported that 89.60% of cases were satisfied. Very different from some of the data that underwent VATS Sympathectomy T2/T3 only or T2-T3, on average, had a 100% satisfaction rate.\textsuperscript{27} Other data were reported regarding satisfaction after two years of operation, which were divided into 3 groups, namely, very satisfied with a significant quality of life and without complaints 86.7%, 9.4% satisfied with postoperative quality of life improvement but with minor complaints and 3.9% dissatisfied with the same or worse quality of life after surgery.\textsuperscript{4}

**CONCLUSION**

Bilateral VATS sympathectomy in cases of severe hyperhidrosis is a minimally invasive procedure that can be recommended for the future. This action gives results, a good level of satisfaction and can improve patients’ quality of life after surgery. Of course, the selection of the target level for ganglion sympathectomy plays an important role in the occurrence of CH in patients. With good education for patients, it can be one of the benchmarks for patient satisfaction in receiving postoperative results. Of course, the sample from this study is still not representative of the existing population level, but can provide a bit of an overview of the results of the choice of VATS sympathectomy surgery in cases of severe hyperhidrosis.

**CONFLICT OF INTEREST**

All authors declared that there is no conflict of interest regarding this article.

**AUTHOR CONTRIBUTION**

All authors contributed equally in the writing of this article.

**ETHICS APPROVAL**

The informed consent for this case series had been obtained from each patient. Permission was also obtained from the Department of Thoracic and Cardiovascular Surgery.

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**REFERENCES**


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