Management of Hyperhidrosis: Video assisted thoracoscopic sympathectomy

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Abstract

Background: Hyperhidrosis, also known as excessive sweating, is characterized by sweating more than is necessary for physiological thermoregulation18. Although it may arise as a result of psychological factors or a variety of medical conditions, the majority of cases are cryptogenic, or so-called primary, and there is no discernible medical condition underlying it. Video-assisted thoracic surgery is finding an ever-increasing role in the diagnosis and treatment of a wide range of thoracic disorders that previously required sternotomy or open thoracotomy. The potential advantages of video-assisted thoracic surgery include less postoperative pain, fewer operative complications, shortened hospital stay and reduced costs. The VATS approach was initially used for simple diagnostic and therapeutic procedures involving the pleura, lungs, and mediastinum. The thoracoscopic sympathectomy was first described in 1944 . Numerous reports of thoracoscopic sympathectomy were published with the advent of endoscopic surgery. Two fundamental approaches have been described: One involves electrocautery of the sympathetic chain and the other involves electroresection of the appropriate ganglia. Ablation of the ganglia with a CO2 laser has also been reported, but only a few large series have been published up to this point. In a 2018 study identifying the long-term impacts of VATS sympathectomy for PH, the procedure was shown to increase quality of life in 84% of patients, and leading to satisfaction in 97% of the respondents.It is important to note that there are many potential side effects of VATS sympathectomy such as pneumothorax, bradycardia, gustatory sweating, Horner's syndrome, rhinitis, and compensatory HH, .The specific side effects may be dependent on the rib level at which the procedure is performed, with procedures performed more superiorly generally causing more downstream effects.

Keywords: Video-Assisted Thoracoscopic Surgery (VATS)

Introduction

As opposed to a person who does not suffer from hyperhidrosis, the increased rate of sweating is not brought on by changes in temperature or other external factors.A specific type of the disease known as primary hyperhidrosis typically has a genetic component and primarily affects younger adults between the ages of 18 and 39.Living with hyperhidrosis comes with a lot of difficulties and affects many aspects of daily life.Patients with hyperhidrosis are affected in their social and occupational ways of life, as well as their psychological and profound wellbeing.This patients suffers from lower quality of life (QOL) as a result of these negative effects. Additionally, skin maceration can result from sweating's constant moisture.This makes skin conditions like athlete's foot and more serious ones like bacterial infections or pitted keratolysis more likely.Patients with hyperhidrosis, according to the findings of the study, have a nearly 30% higher risk of developing skin infections than healthy controls.**(1)**

Although hyperhidrosis can affect many parts of the body, up to 40% of hyperhidrotic patients show involvement of the palms, known as palmar hyperhidrosis (PH), which highlights a major source of patient burden.**(2)**

PH, particularly in moderate to serious cases, can possibly altogether affect patient nature of life. Increased palmar sweat can have both social and functional implications including social embarrassment and discomfort in school or the workplace. These side effects can be exacerbated by increased stress, nervousness, fear, and anxiety, which further increase sweat production.**(3)**

The sympathetic nervous system is comprised exclusively of efferent neurons. It divides into the left and right sympathetic chains. Each sympathetic chain extends from the skull base to the coccyx paravertebrally, carrying preganglionic fibers from the spinal cord that synapse in an adjacent ganglion, from which ascending and descending postganglionic fibers head toward viscera.**(4)**

Epidemiology

A recent large epidemiological survey of 150 000 households in the United States has revealed that focal hyperhidrosis is present in 2.8% of the general population. The condition affects both men and women equally, and its prevalence was found to be the highest among people aged 25–64 years. The average age of onset is 25 years but depends primarily on the body area affected. Palmar and axillary hyperhidrosis have the earliest average onset, at 13 and 19 years respectively. As many as 82% of patients with palmar hyperhidrosis have reported onset in childhood. Focal hyperhidrosis appears to have an onset in childhood; however, people may not seek medical help until early adulthood.Axilla is affected in 51% of patients, feet in 29%, palms in 25% and the face in 20%.4,6 No studies have documented the natural course of the disease with increasing age, but in our experience, the severity of sweating seems to decrease in patients older than 50 years. **(5)**

Management of hyperhidrosis

Surgical (sympathectomy)

- **Open sympathectomy**

Open sympathectomy for palmar HH was first proposed by Kotzareff in 1920.

Suraclavicular approch

Telford developed this strategy, which was later modified to include resection of the upper thoracic ganglia. During the same operation, both sides are approached. In several large series of upper dorsal sympathectomies performed using this method, excellent long-term results with dry hands in more than 90% of patients have been reported.

The Posterior Approach

This method, which was advocated by **Adson**, was further modified by **White et al. and Smithwick.** It makes it possible to resect the sympathetic ganglia as well as the intercostal nerves and their posterior roots and root ganglia. In one procedure, both unilateral and bilateral sympathectomy have been carried out.

The Transpleural Axillary Approach.

This was formulated by **Schultze and Goetz**, and later depicted and published by **Atkins.** An extrapleural transaxillary approach with resection of the principal rib has additionally been described. Reciprocal sympathectomy by this methodology was generally proceeded as a staged procedure and the results revealed in a few series are like those of the other techniques.

The anterior Transthoracic Approach .

which, despite being initially proposed by **Goetz and Marr** and later supported by **Palumbo**, did not gain popularity**.**

Video assisted thoracoscopy

Introduction :

Video-assisted thoracic surgery is finding an ever-increasing role in the diagnosis and treatment of a wide range of thoracic disorders that previously required sternotomy or open thoracotomy. The potential advantages of video-assisted thoracic surgery include less postoperative pain, fewer operative complications, shortened hospital stay and reduced costs. **(6)**

Thoracoscopy was first performed in 1910 by Hans Christian Jacobaeus, Professor of Medicine. He used a modified cystoscope for lysis of pleural adhesions to obtain therapeutic pneumothorax in a patient with pulmonary tuberculosis **(6)**

With the arrival of drug treatment of tuberculosis and the end of the era of pneumothorax therapy, the use of thoracoscopy declined. However, its use was retained by respiratory physicians in several European centres as a diagnostic tool. Resurgence of interest in the field of thoracoscopy ensued after two international symposiums on thoracoscopy; Marseille in1980, then Berlin in 1987 **(5)**

Indications for (VATS)

The VATS approach was initially used for simple diagnostic and therapeutic procedures involving the pleura, lungs, and mediastinum. **(7)**

However, VATS operations continue to replace many procedures that formerly required thoracotomy . For example,pulmonary operations using VATS have evolved from simple wedge and segmental resections to complete lobectomy. In selected patients a VATS lobectomy is a reasonable treatment option to thoracotomy for both adults and children .VATS operations can be used for all structures in the chest, and are not limited to the lungs, pleura and mediastinum. The heart and great vessels, the esophagus and diaphragm, the spinal column and nerves can all be operated on using VATS . Each year has seen new, innovative applications of the technique. For example, intractable pain as a result of chronic pancreatitis can now be treated by inactivation of the major afferent pain nerves with the use of thoracoscopic splanchnicectomy . **(6)**

Surgical technique :

While the patient is in the lateral decubitus position, a small (2-3 cm) incision is made in the lateral chest wall . Although minor operations like thoracentesis and pleural biopsy can be carried out through a single incision, two or three additional incisions are typically made to accommodate the use of stapling devices and surgical instruments.mAfter selectively collapse of the lung on that side, a trocar is inserted into the chest cavity. The trocar is then used to insert the thoracoscope into the chest. At the determination of the strategy a chest tube is inserted and the lung is re-expanded.**(6)**

Video assisted thoracoscopic sympathectomy :

The thoracoscopic sympathectomy was first described in 1944 . Numerous reports of thoracoscopic sympathectomy were published with the advent of endoscopic surgery. Two fundamental approaches have been described: One involves electrocautery of the sympathetic chain and the other involves electroresection of the appropriate ganglia. Ablation of the ganglia with a CO2 laser has also been reported, but only a few large series have been published up to this point.**(8)**

Video assisted thoracoscopic sympathectomy (VATS), which has evolved from an open procedure to an endoscopic one and involves cutting or clipping sympathetic nerves, has been used to treat severe cases of hyperhidrosis. **(9)**

Referral for endoscopic thoracic sympathectomy may be indicated when less invasive therapies (topical antiperspirants, iontophoresis, BoNTA, or topical or oral anticholinergics) fail in sever hyperhidrosis patients . **(9)**

(VATS) thoracic sympathectomy is typically carried out using a three-port approach, which can be accomplished with a 5-mm thoracoscope and instruments or needlescopic instruments with a 3-mm diameter. VATS sympathectomy has developed into a two-port or even single-port (uniportal) procedure over time. The potential advantages of singleport techniques include less access trauma and improved cosmesis. The fact that the single-port technique requires fewer intercostal spaces for its surgical access than the conventional three-port VATS may be even more significant. This may reduce the likelihood of intercostal nerve injury and subsequent neuralgia.**(10)**

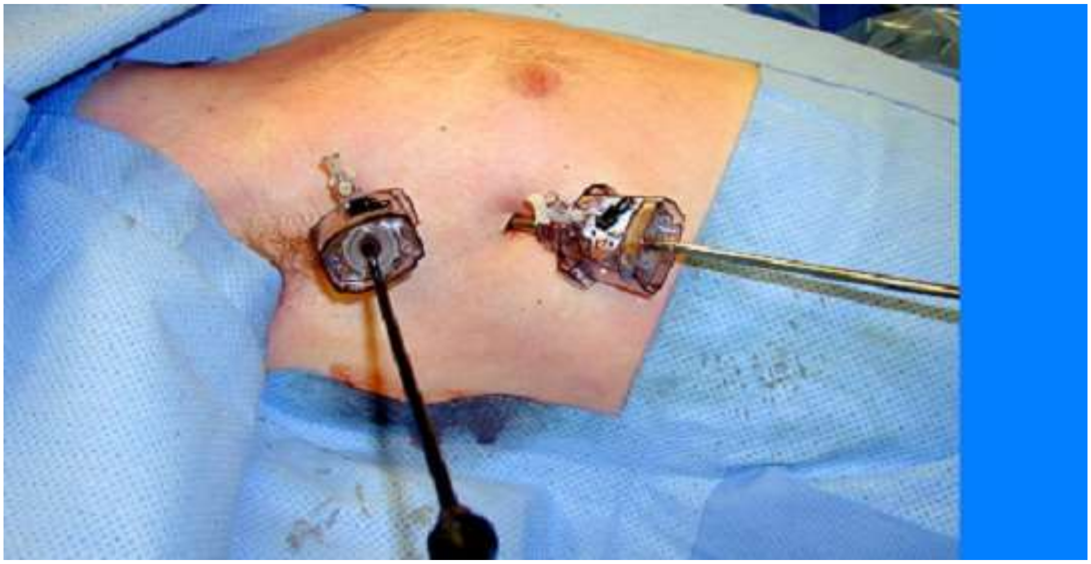
Ideal candidates are those with early age onset of HH who are generally healthy, do not sweat at night, have a body mass index below 28, and do not have bradycardia. Although the thoracic spinal nerve level is often used as a landmark in the literature, rib numbers were seen to be more accurate reference points due to patient mediastinal fat variations. For patients suffering solely from PH, the best outcomes are generally seen when it is performed superior to rib 3 or 4.**(3)**

In a 2018 study identifying the long-term impacts of VATS sympathectomy for PH, the procedure was shown to increase quality of life in 84% of patients, and leading to satisfaction in 97% of the respondents.It is important to note that there are many potential side effects of VATS sympathectomy such as pneumothorax, bradycardia, gustatory sweating, Horner’s syndrome, rhinitis, and compensatory HH, .The specific side effects may be dependent on the rib level at which the procedure is performed, with procedures performed more superiorly generally causing more downstream effects. **(9)**

Compensatory sweating (CS) seems to represent a reflex circuit mediated by an aberrant feedback mechanism at the level of the hypothalamus, which is inversely correlated with the height and

extent (total number of levels disrupted) of the sympathetic denervation.**(11)**

Although the best ganglion for resection in the treatment of PH is still debatable, metaanalysis suggests that limiting VATS sympathectomy at the T4 level alone can result in lower incidence and intensity of CS. **(11)**



video-assisted thoracic surgery (VATS) is known to be as effective as open surgery but to have significantly less morbidity . When compared to open surgery, the advantages of VATS include shorter hospital stays, less need for analgesics, and probably less post-operative respiratory impairment .However, up to 63% of VATS patients are said to experience chronic pain, which can last for several years after surgery . Although the pain is typically not severe or debilitating, it frequently resists conventional analgesic treatments. Local analgesia, intercostal nerve blockade, or early aggressive post-operative pain control are examples of such strategies .Other examples include modifying the surgical technique to lessen torquing at the wounds. **(12)**

bilateral single-port thoracoscopic sympathicotomy : **(13)**

The patient is positioned on the left side with the arm flexed over the head to expose the axilla. The patient was prepped and draped once more for a left-sided sympathicotomy after being moved to the right side for the right-sided sympathicotomy. We adopted the beach-chair or semi-fowler's position, which was developed in the 1980s for orthopedic shoulder arthroscopy procedures, to reduce operating time and ensure patient safety. With their heads secured in a headrest and sitting at a 45° angle above the horizontal plane, patients were provided with appropriate padding. The obtained angle aids in folding the collapsing lung in both the dorsal and caudal directions, facilitating a comprehensive view of the surgical field, and the bilateral axillary exposure achieved in this manner enables a one-stage bilateral procedure. This can be beneficial during a sympathicotomy of R5, in which the fifth rib is more easily reached thanks to the lung's downward fold.

A double lumen endotracheal tube or a single lumen endotracheal tube with a unilateral blocker (EZ-blocker Inc., Delft, The Netherlands) was used to achieve single lung ventilation. A six- to seven-millimeter incision was made in the right anterior axillary line following bupivacaine local infiltration. A trocar with an inner diameter of 5 millimeters was inserted through the third intercostal space, just posterior to the major pectoral muscle, following lung deflation. When the collapse of the lung proved insufficient, CO_2 insufflation was initiated. The cautery hook and a 5 mm Karl Storz scope from Tuttlingen, Germany, were then used. The sympathetic chain that runs along the ribs' necks and the first and second ribs were identified. The piece of the thoughtful chain overlying the rib was cut across by diathermy on a high costal level, saving the thoughtful ganglia. For isolated palmar PHH, a R3 sympathicotomy was performed, and for axillary or combined palmar/axillary PHH, a R3-R5 sympathicotomy was performed. To transect accessory nerve fibers, the transection was always extended 2 cm laterally over the rib. The presence of the Kuntz's nerve was actively searched for, and when it was found, it was transected. The collapsed lung was examined for parenchymal damage at the conclusion of the surgery, and an 8-French thoracic drain was inserted through the same access port. Under direct vision, the collapsed lung was resufflated and recruited. Positive end expiratory pressure was applied when the thoracic drain was removed.

A completely positioned subcutaneous string stitch guaranteed impermeable cut fixing. The skin was shut with an intracutaneous stitch. On the left side, the same procedure was repeated.

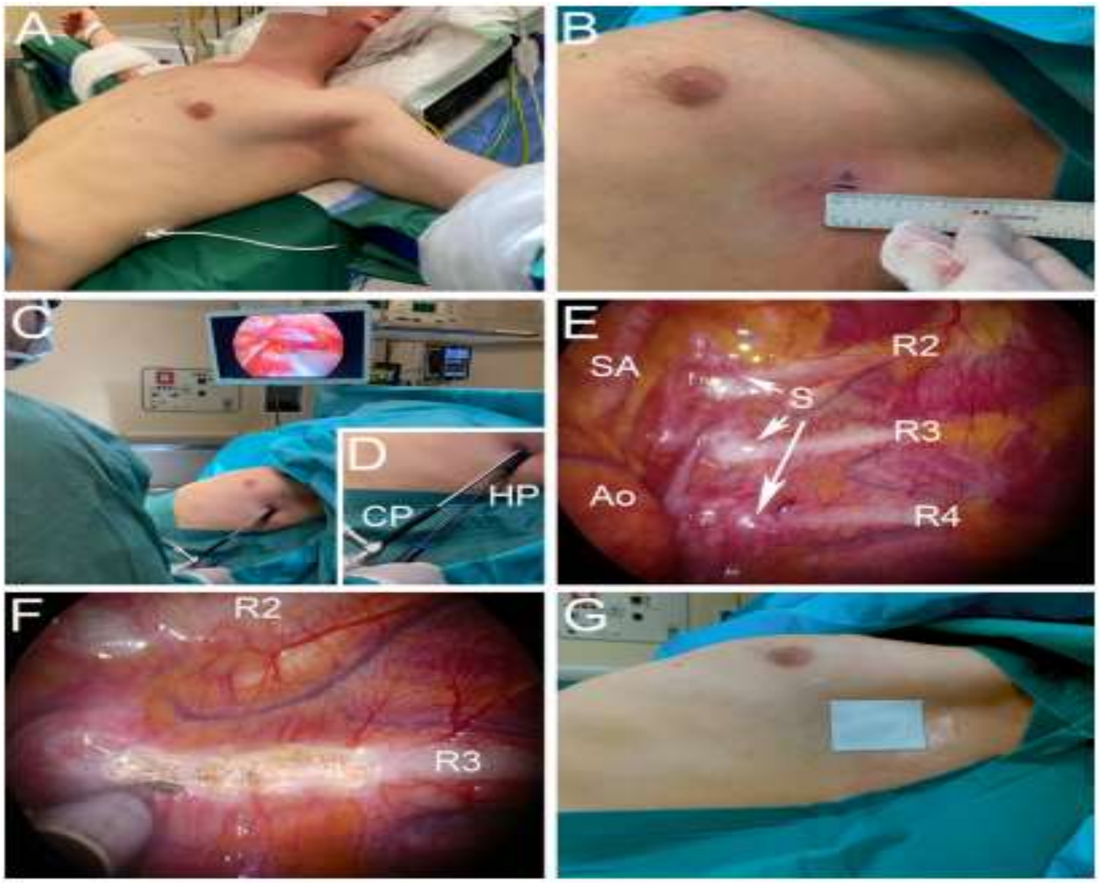
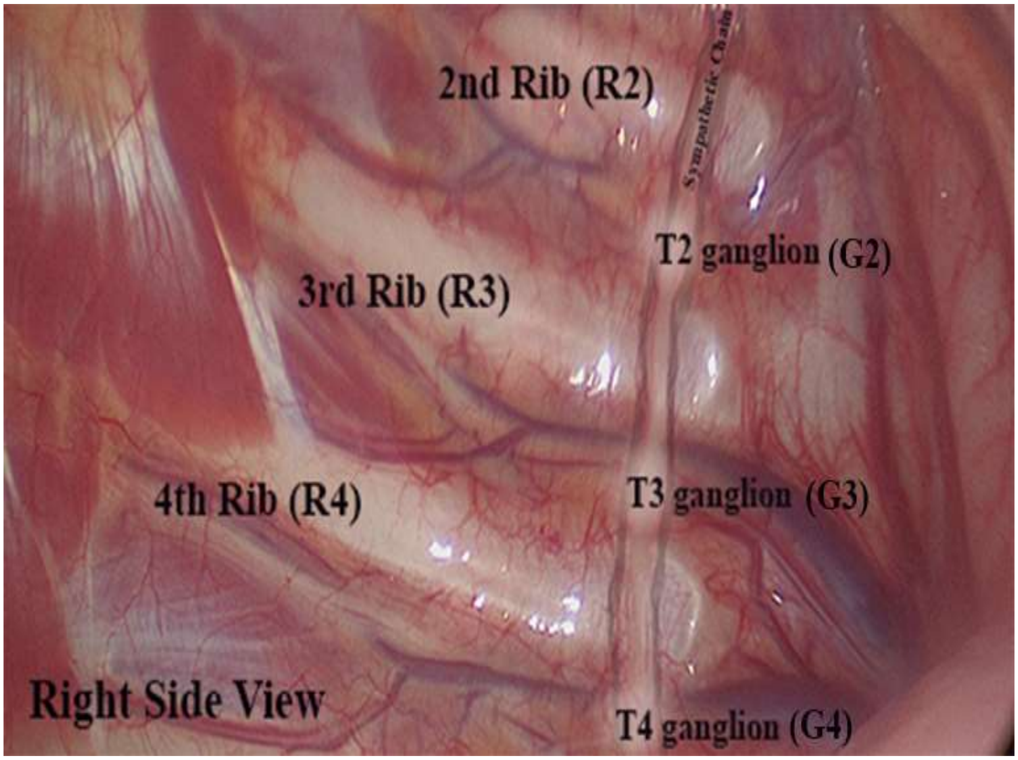


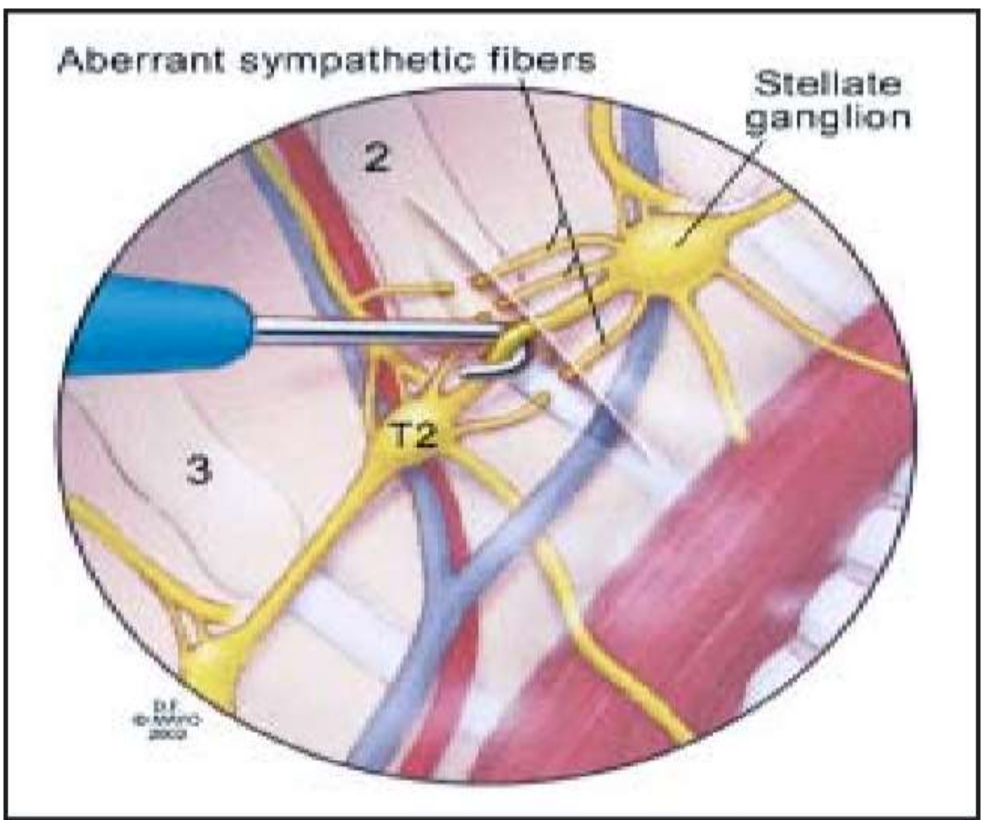
Figure 1. Surgical technique of single-port R3 sympathicotomy for palmar hyperhidrosis. (A) Patient positioned in the ‘beach chair’ or semi-Fowler position, seated at a 45o angle, with both arms spread out. (B) Marked incision just posterior to the axillary/mammary fold. (C) The camera and cautery hook are inserted through the same incision, over a camera port and hook port. (D) Close-up of the camera port (CP) and hook port (HP). (E) Thoracoscopic view of the left superior mediastinum. Identification of the subclavian artery (SA), aorta (Ao), sympathetic nerve (S) and the second (R2), third (R3) and fourth rib (R4). (F) Thoracoscopic view after R3 sympathicotomy. The sympathetic chain is transected on the mid-rib level, in an attempt to spare the ganglia. (G) Double plastic-coated sticker placed over the wound, preventing air re-entry

<u>Needlescopic VATS : (17)</u>

Needlescopic VATS (n-VATS) is a recent approach to enhance VATS results . In this method, very fine instruments of 2 or 3 mm are used in place of the ports and instruments of conventional VATS (c-VATS) that are 10 mm in size. It is argued that because the wounds are so small, there is less tissue trauma, less wound torquing, and even better cosmesis than with conventional VATS. The current generation of video technology has relatively poor image quality, and using such fine cameras and instruments requires less tactile feedback and dexterity than with this method . As a result, n-VATS is currently primarily used for less complicated thoracic procedures, such as thoracodorsal sympathectomy for palmar and axillary hyperhidrosis.

Although it has been suggested that n-VATS may lessen pain after surgery compared to c-VATS , only a few studies have specifically documented pain after n-VATS for sympathectomy. There are no studies comparing n-VATS to c-VATS to see if it can lower the incidence of paresthesia.





Robotic sympathectomy :

Robotic-assisted thoracoscopic surgery (RATS) has been accepted as a valid alternative to VATS, carrying the advantages of three-dimensional high-definition visualisation and improved maneuverability.

The overall success rates are the same as sympathectomy. Robotic sympathectomy is promising as it has similar outcomes and decreases the incidence of compensatory sweating. Studies have shown that perioperative times are longer due to more time needed to set up the robot. However, precision, magnification, dexterity, and viewing are significantly enhanced via robotics, which are major advantages along with shorter learning curves. However, one hindrance proved to be the cost of the procedure, which needs to be examined to make it more accessible to multiple centers .**(14)**

There was no major difference regarding the majority of safety criteria in both the human-assisted and robotic-assisted sympathectomy; however, incorrect camera movements were less common in the robotic-assisted sympathectomy .Studies examined the use of robotics in video-assisted thoracic sympathectomy (VATS) by comparing a robotic versus a human-held camera . The study showed that the robotic approach used four incisions instead of two, the patient needed to be rotated 180 degrees under general anesthesia, longer operative time, and higher cost but there was an improved three-dimensional view . The costs of robot-specific one-time material were estimated in another study to be 500 euros per case . **(15)**

The use of a robotic arm lengthens surgery, according to a study by Kondraske et al. The study showed that while other studies find that it shortens surgery by six times, it is dependent on the surgeon's learning curve . The shifting of robotic instruments from left to right during procedures was presumably another element that prolonged the duration . Despite the fact that using robotic equipment for routine surgical procedures does not offer significant advantages, doing so improves the learning curve by giving the surgical team more experience and expertise Overall, although having faster learning curves and being as safe as human-holding during a VATS sympathectomy, robotic camera handling lengthened the surgical procedure .**(14)**

Nerve graft reconstruction should be made available to patients with severe complications or side effects from sympathectomy for hyperhidrosis who have used up all available options for treatment as a chance for them to be able to reverse these negative symptoms and experience measurable improvements in their quality of life . Sympathetic nerve regeneration has been proven in experimental models and clinically, according to a group study by Connery . A platform for carrying out this nerve reconstruction with a minimally invasive method is provided by the Da Vinci robotic nerve graft reconstruction. It enables typical nerve graft regeneration and offers excellent imaging, dissection, and neurolysis using microsurgical instruments at high magnification . The outcomes showed that the Da Vinci robot's tremor filtration and high-magnification camera made it possible to manipulate a 2 mm wide nerve graft and 10-0 monofilament suture. This demonstrates its efficacy in enhancing magnification and lowering tremor. **(16)**

Complications of Video assisted thoracoscopic sympathectomy

Immediate Complications

Intraoperative Air Fistula and Pneumothorax

Pneumothorax is the most common complication occurring in up to 25% of cases. Fortunately, less than 6% of cases require chest drainage. In our series, we had to drain in 3.5% of cases. There are two types of pneumothorax resulting from sympathectomy: residual pneumothorax due to failure of complete exsufflation of pleural cavity air and pneumothorax due to pulmonary injury (by insertion of the trocar or laceration caused by the hook or pleuropulmonary adhesions section) or rupture of subpleural blebs or emphysematous blisters during positive pressure ventilation. .**(14)**

The residual cavity can be avoided by placing a thin tubular drain through the trocar into the pleural cavity. The drain is aspirated at the same time as the anesthesiologist manually inflates the lungs. Another alternative would be to dip the distal end of this drain into a water seal. At the end of the pulmonary insufflations or when the bubbling of air in the water seal stops this drain is removed. Sometimes on the chest X-ray we notice a small residual pneumothorax, which is not functionally translated and after a few days is reabsorbed without sequelae.**(14)**

Pneumothorax resulting from lung injury is most often identified when there is continuous bubbling when inflating the lung at the end of surgery and is treated with maintenance of thoracic drainage. Occasionally, if there is persistent air fistula, there may be a need for pleurodesis. **(16)**

Subcutaneous Emphysema

Subcutaneous emphysema occurs by air entering the pleural cavity through the intercostal opening created by the trocar. Usually, it is only noticed in the chest radiography, with or without pneumothorax but without any clinical repercussion. The use of 5 mm rather than 10 mm trocars minimizes the problem. We commonly perceive the radiographic presence of small subcutaneous emphysema in our patients without physiological repercussions. **(16)**

Atelectasis

Atelectasis is very rare, and usually improves with analgesia and respiratory physiotherapy. It is due to problems with intubation and exaggerated secretion in the postoperative period as a result of inadequate preparation and/or respiratory infection. **(16)**

Pleural Effusion

Pleural effusion is usually small, with no clinical significance and no need for treatment. Its incidence is as high as 1% of cases. Some authors believe that the incidence may be higher if the patient is discharged early. We have not observed this complication in our patients.**(14)**

Hemothorax

Arterial bleeds are rare and usually occur due to subclavian or intercostal artery laceration by the hook. Arterial bleeds may require open surgical correction if massive bleeding occurs. Venous bleeds occur more frequently and can occur as a result of trocar insertion or dissection of the sympathetic chain leading to intercostal vein injury. Normally, bleeding is controlled by the endoscopy route by cauterization, tamponade, or clipping of the vein. Bleeds of 300–600 mL of blood occur in up to 5.3% of cases. In our practice, the incidence of bleeding is only 0.7% of cases (intercostal vein lesion), all controlled with clipping or cauterization. **(16)**

Chylothorax

Chylothorax is extremely unusual, and can occur on the right or left side. Treatment requires thoracic drainage and a low fat diet. Occasionally there is a need for clipping of the thoracic duct or pleurodesis. We have had no complications of this nature. **(16)**

Hematomas and Incisional Infections

As in any surgical procedure, hematomas and incisional infections may occur, but there are no data in the literature. This is probably because it is a minimally invasive surgery, with small incisions and very short surgical time.**(14)**

Severe Pain

Thoracic sympathectomy usually causes moderate pain (in the retrosternal and upper dorsal region) that lasts for approximately 2–4 weeks, requiring only simple analgesics and anti-inflammatory drugs. However, between 0.6% and 2% of patients report severe pain , especially intercostal or ulnar neuralgia lasting up to 6 months. The use of minor trocars, anesthetic infiltration prior to trocar introduction, and the use of the single trocar technique may minimize the problem. In our series, 2.6% of patients experienced severe pain lasting more than 15 days. .**(14)**

Intraoperative Cardiac Arrest

Cardiac arrest and/or ventricular fibrillation may occur as a result of exaggerated sympathetic stimulation of the left star ganglion. Transient bradycardias or those requiring atropine are also reported. **(16)**

Brachial Plexus Injury

Brachial plexus injury is rare and can occur due to distension as a result of poor patient positioning or direct injury. Using the thoracoscopic approach, direct injury is extremely rare, but was more common when a supraclavicular approach was used. In this case, there may be a failure to identify the sympathetic chain in relation to the costal arcs. **(16)**

Excessive abduction of the upper limb during patient placement may lead to paresthesia, paresis, or temporary paralysis of the upper limb. It may occur in up to 4.6% of patients. Upper extremity paresthesia occurred in 2% of our patients. .**(14)**

Brain Complications

Cerebral edema can occur due to insufflation of CO_2; pulmonary thromboembolism have been rarely described. .**(14)**

Late Complications

Compensatory Hyperhidrosis

Compensatory hyperhidrosis is by far the most common and labor-intensive complication. It was first recognized in 1933 by Ross: “Some of our patients said that sweat has been considerably higher in areas not affected by the operation. At first, we were inclined to consider this only as an observation error, with the usual amount of sweat considered excessive when contrasted with the completely denervated area. However, the observation has been so commonly made, and it has been possible to observe the increase in sweat so often that the possibility of compensatory sweating cannot be excluded”. **(16)**

Compensatory sweating may be defined as sweat production in areas that showed no abnormal sweating preoperatively and to a higher degree than required for heat-setting. **(16)**

Compensatory sweating occurred in 92% (n = 1115) of our patients (quantified in the thirtieth postoperative period); in the literature, its prevalence ranges from 86% to 100%.**(14)**

The most affected sites are the dorsum, abdomen, thighs, and popliteal fossa. The incidence of compensatory sweating is the main reason for regret in patients who have undergone sympathectomy (in our sample 2.5% regretted surgery). Of these, 2.2% had the same quality of life as before surgery, 0.6% a little worse, and 0.9% a lot worse. **(16)**

There is a consensus in the literature that compensatory hyperhidrosis depends on the level or the extent of sympathectomy. The mechanism for compensatory hyperhidrosis to occur depends on thermoregulatory mechanisms after sympathetic denervation and/or neuro-mediated reflexes that rely on positive and negative feedback mechanisms from the hypothalamus. .**(14)**

In thermoregulation after high thoracic sympathectomy, there is loss of upper-limb sweat gland function, leading to greater activation of residual sweat glands in the trunk, leading to compensatory hyperhidrosis. **(16)**

The regulating center of the sweat is in the hypothalamus. Sympathetic efferent discharges must be controlled by negative or positive feedback mechanisms from sympathetic afferent pathways. The T2 sympathectomy would block the negative feedback of the afferent stimuli to the hypothalamus, since it would cut off practically all the afferent pathways, and favor the appearance of compensatory hyperhidrosis in the periphery, due to the continuous release of efferent stimuli by the hypothalamus. Sympathectomy below this level would cut off a number of afferent pathways, avoiding a feedback block and decreasing compensatory hyperhidrosis. .**(14)**

Selective sympathectomy (ramicotomy) was used in an attempt to avoid compensatory hyperhidrosis. In this type of procedure, the communicating branches are sectioned, preserving the sympathetic chain. However, due to the high relapse rate, the procedure was abandoned. **(16)**

Clamping (clipping) of the sympathetic chain has also been used. In this situation, if the patient develops compensatory hyperhidrosis, there is the possibility of reversing the surgery by removing the clips. However, while some authors report reversion of symptoms within 2 months, others have not been successful. **(16)**

The treatment of compensatory hyperhidrosis is multidisciplinary. It often involves psychologists, psychiatrists, neurologists, dermatologists, endocrinologists, dietitians, physical education teachers, and thoracic surgeons. Non-medication measures may be fundamental: weight loss, non-thermogenic diet, physical exercise, climate change, use of dry-fit clothing; drug measures (application of topical, intradermal, or oral medications); and surgical treatments (lumbar sympathectomy and re-innervation of the sympathetic chain). .**(14)**

Gustatory Sweating

Gustatory sweating is the occurrence of craniofacial sweating when eating spicy or acidic foods. The pathophysiology of this complication is uncertain, but it is thought that the sympathectomy causes parasympathetic stimulus on the salivary glands (innervation of the salivary glands would not be totally parasympathetic). **(16)**

The incidence varies greatly in studies (0–38%), and treatment involves oral anticholinergics, injectable botulinum toxin applications, or topical applications of anticholinergics. In our patients, there was a 19.3% incidence. . .**(14)**

Horner Syndrome

Horner syndrome (palpebral ptosis, pupillary myosis, enophthalmia, and anhidrosis) was considered previously as the marker of sympathectomy success, but today it is considered a serious complication. Temporary palpebral ptosis can occur in up to 1% of cases, usually resolving in weeks or a few months. Not using the electrocautery near the star ganglion is a way to avoid this complication. **(16)**

Rhinitis

The effect of sympathectomy on the subject with rhinitis is controversial. Some authors describe the onset of rhinitis with an incidence of up to 10%, while others recommend sympathectomy for the treatment of chronic rhinitis. The effect of sympathectomy on bronchial reactivity (asthma) is also unclear. In our patients, the incidence of rhinitis was 5.6%.**(14)**

Ghost Sweat

Ghost sweat is a phenomenon that is little mentioned in the literature. The patient has the sensation that he will sweat, but the sweating does not occur; this situation occurs soon after the sympathectomy, is triggered by the same stimuli that would cause localized hyperhidrosis, and lasts for a few seconds. Over time this symptoms tends to improve. **(16)**

Bradycardia

The sympathetic ganglia T2 and T3 are involved in cardiac sympathetic innervation. Sympathectomy at these levels has a β-blocking activity. This leads to a decrease in the heart rate and diastolic pressure is decreased on the dynamometer. Patients who are athletes should be warned about this effect of sympathectomy. In our series, 0.2% of patients had these complications. .**(14)**

Rare Complications

Cold intolerance, chronic pain, loss of libido, photophobia, lethargy, weight gain … these and other odd symptoms are rarely described, and many are not reported in the medical literature but instead found in depositions placed on the internet by dissatisfied patients with effects they attribue to the sympathectomy. **(16)**

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