

# Single-Port Video-Assisted Dorsal Sympathectomy (Uniportal)

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## ABSTRACT

**Background:** In the last 15 years, video-assisted thoracic surgery has been rapidly become a milestone in the thoracic surgical armamentarium. It is performed through a single port (uniportal) pursues the same objectives of the standard video-assisted thoracic surgery with even less invasiveness due to the involvement of only one intercostal space. Dorsal sympathectomy is indicated for a variety of sympathetic disorder, but it is most commonly performed for hyperhidrosis. Reflex sympathetic dystrophy, upper extremity ischemia, Raynaud's disease, debilitating facial blushing, and splanchnicectomy for pancreatic pain are less common indication.

**Objectives:** To study the benefits of single port video-assisted thoracic surgery over multiple ports in sympathetic and ischemic disorders.

**Methods:** Ten patients were operated upon at Ibn-Alnafees hospital from the 1<sup>st</sup> of January 2008 to 28<sup>th</sup> of February 2017 by single port dorsal sympathectomy, 5 males and 5 females with mean age of 35.5 ranges from 22-70 years. They suffered from primary focal hyperhidrosis and severe upper extremity ischemia, which were unsuitable for revascularization. Five of these patients had Raynaud's, two primary focal hyperhidrosis, one Buerger disease, one emboli, one causalgia, one male patient operated upon bilaterally at same session. They anaesthetized using one lung anaesthesia and under-went single-port videothoracoscopy. Sympathetic chain resection was limited to T2-T3 or T3-T4.

**Results:** In this study 10% of the patients bilateral sympathectomy done for them, unilateral right sided done for 40% and left sided for 50%. In 90% of patients there were no intraoperative or early postoperative complications. Ten per cent of the patients had pneumothorax postoperatively. Hospital stay ranged from 1-5 day.

**Conclusion:** Video-assisted thoracic surgery performed through a single port (unilateral) had excellent result in treating palmer hyperhidrosis with no recurrence "on short term follow-up", and good results for painful ulcerated upper limbs that not improved by medical therapy.

**Keywords:** Sympathectomy, Thoracoscopy, Ischemia, Hyperhidrosis.

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Thoracoscopic sympathectomy which is described for the first time in 1942 by Hauges<sup>(1)</sup> has been accepted as a procedure of choice for its better visualization of anatomic structures, favorable cosmetic results and less scar formation instead of conventional open surgical method<sup>(2,3)</sup>. Despite numerous reports of using thoracoscopic sympathectomy for hyperhidrosis, fewer studies have been conducted to evaluate this approach for upper extremity ischemia<sup>(2)</sup>. Several studies indicated good results of using thoracoscopic sympathectomy for patients with Buerger's disease<sup>(2)</sup>, Reynaud's syndrome<sup>(2,4)</sup> and inadvertent intra-arterial injections<sup>(2)</sup>.

Dorsal sympathectomy is indicated for a variety of sympathetic disorders, but it is most commonly performed for hyperhidrosis. Reflex sympathetic dystrophy, upper extremity ischemia, Reynaud's disease, debilitating facial blushing, prolong QT interval, refractory angina, pseudoangina and splanchnicectomy for pancreatic pain are less common indications. A more recent and emerging indication is in patients with catecholaminergic polymorphic ventricular tachycardia (CPVT), a disorder of abnormal myocardial calcium homeostasis<sup>(5)</sup>, characterized by life-threatening ventricular arrhythmias triggered during states of high sympathetic output. Patients with CPVT typically have structurally and functionally normal hearts and a normal baseline electrocardiogram,

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including a normal QTc measurement.

Many terms have been used in different studies to describe the procedure that is performed. Unfortunately, the terminology used in international papers is inconsistent and often leads to confusion. These terms are:

1- Ablation: procedures in which the chain is destroyed using electrocautery or laser without directed division.

2- Clipping: placing one clip above the ganglion; placing one clip each above and below the ganglion; placing a clip across the nerve over the middle of the rib; or placing clips above or below the ganglion<sup>(6)</sup>.

3- Sympathectomy: procedure in which the sympathetic chain is resected, ablated or divided.

4- Sympathicotomy: division of the sympathetic chain without removal of any section thereof. Unless otherwise specified, this excludes ablation techniques that are done without a directed division of the chain.

Sympathectomy is not recommended for patients with diabetic neuropathy. Nor should it be performed in any of the vascular vasospastic syndromes until after conservative management, including cessation of tobacco products and institution of  $\beta$ -blockers, peripheral vasodilators, and calcium channel blockers, has been tried<sup>(7)</sup>.

## Methods

Thoracoscopic sympathectomy was initiated in Thoracic and Vascular Department of Ibn-Alnafees cardiovascular Hospital since 2006, but single port sympathectomy started 2 years later. This retrospective study using medical files of 10 patients operated on from 1<sup>st</sup> January 2008 to 28<sup>th</sup> February 2017 at Ibn Alnafees CVS hospital, 5 males and 5 females underwent the operation and 5 patients were carefully followed up in clinic. VATS that done with more than one port excluded from this study.

The indication for surgery was limb-threatening ischemia for this revascularization was not feasible, 5 patients had Raynaud, 1 Buerger's disease, 1 embolus, 1 causalgia and 2 patients had hyperhidrosis. One male patient operated bilaterally at same session. Preoperatively patients prepared well and investigated by complete blood picture, urea, serum creatinine and electrolytes, CXR, and pulmonary function test. Patients and families provided informed consent and the benefits and potential side effects of the operation were explained in detail.

**Surgical procedure:** The patient was placed in supine position, double lumen endobronchial tube anesthesia started and the chest elevated 45° and the arms were abducted 75-80° (semi fowler position) to facilitate exposure, this position allows gravity to assist in revealing the spine and the sympathetic chain and to help the lungs fall away from the apex.

A small roll was placed transversely behind the scapulae to slightly elevate the axilla from the operating table. After exclusion of the lung, a single, 1 cm-long incision was made for insertion of a 10-mm trocar into the pleural cavity at the third intercostal space in the midaxillary line. Along the side way of the port CO<sub>2</sub> insufflated at rate of 0.5-2 L/min for sustained intrathoracic pressure of 10 mmHg, a 45-degree endoscope inserted through this port, (Figure 1).

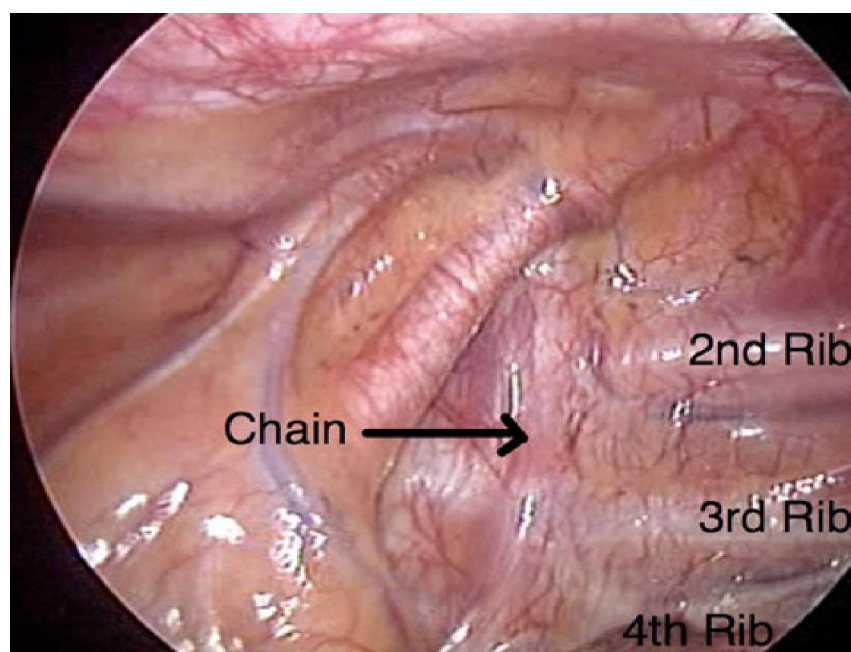
The dorsal sympathetic chain was identified running along the neck of the ribs close to the costovertebral junctions, (Figure 2). The ribs were carefully identified, regardless of the surgical technique, correct identification of the anatomic level is crucial. The second rib is generally the most proximal rib that can be seen in the thorax and can be reliably identified by a vertical, descending arterial branch that crosses the rib 1 cm lateral to the sympathetic chain<sup>(8)</sup>, this arterial branch originates from the subclavian artery and forms the second intercostal artery. The first intercostal space is

covered by a fat pad, and the first rib is generally not visible from within the thorax. Additional landmarks are the azygos vein, which lies at the level of the fifth interspace, and the aortic arch, which

reaches to the fourth interspace. Trocar pulled over scope externally and cautery inserted over the shaft scope, (Figure 3).



**Figure 1:** A 10-mm port passed at 3<sup>rd</sup> intercostal space at midaxillary line and a 45-degree endoscope passing through it.



**Figure 2:** Sympathetic chains in relation to ribs and supreme intercostal vein.



Figure 3: Cautery and scope in the same port.

Table 1: Levels for denervation in dorsal sympathectomy<sup>(10)</sup>.

### Recommended Level for Denervation in Dorsal Sympathectomy

palmar hyperhidrosis	R3 ± R4
Axillary hyperhidrosis	R3 + R4
Complex regional pain syndrome	R2 + R3
Vascular occlusive disease	R2 + R3
Raynaud's syndrome	R2 + R3
Long QT syndrome	R2 + R3
splanchnicectomy	R4 to R10

After identification of sympathetic trunk, T3-4 sympathectomy was performed for isolated palmar and palmar plus axillary hyperhidrosis. T2-3 sympathectomy was performed for facial sweating, causalgia, Raynaud and other ischemic problems, (Table 1). Ablation was extended laterally for 2 to 3 cm on the corresponding ribs to divide any accessory fibers, known as the Kuntz nerve, if present. Extreme caution was taken so as not to ablate the stellate ganglion, which was not usually seen endoscopically. A small chest tube was inserted from the port and the re inflation of the lung was controlled by the camera. The chest tube was connected to underwater drainage. The same procedure was done

sequentially to the other side. The subcutaneous tissue was approximated by polyglactin sutures. Both chest tubes were withdrawn during exertion of continuous positive pressure by the anesthesiologist and the skin was closed accordingly.

### Results

A total of 11 thoracoscopic procedures were done in 10 patients, 5 females and 5 males (22–70 years of age, median = 35.5). There was no conversion to open procedure and no mortality. One patient was operated on bilaterally. Sympathectomy achieved immediate complete dryness and hot limb, and all the patients were satisfied with the outcome of



the procedure (at 1<sup>st</sup> postoperative day) but after the 1<sup>st</sup> postoperative day 2 females with Raynaud complaining of pain (but lesser than preoperative pain) and they are unsatisfied. Chest tube removed at end of operations in 6 patients, and at evening of operating day in 3 patients and 1 patient it remained 9 days. Only 5 patients followed-up (range: 2 to 36 months) and the other 5 patients not seen after their discharge.

Postoperative complications such as ptosis, wound infection, or hemothorax were not observed in any patients. One patient had residual pneumothorax, which

required thoracic drainage. In this patient a persistent air leak, this was probably due to an intraoperative lung injury, and discharged after 4 days with Heimlich valve that removed 5 days later. In the other 9 patients the lung was completely expanded. These 9 patients were discharged uneventfully the next day. Patients with hyperhidrosis are magically improved with slight reflex sweating and no gustatory sweating. The median hospital stay was 1 day. The results are shown in table 2.

**Table 2: Patients demographics.**

	Age years	Sex	Disease	Site of sympath.	Level of sympath.	Complications	Discharge (days)	Follow up	Results
1	34	Male	Hyperhidrosis	Right	R3+r4	Nil	1	NF	S
2	70	Male	Finger ulcer	Right	R3	Nil	1	36 m	S
3	24	Female	Raynaud	Left	R2+r3	Nil	1	2 m	S
4	33	Female	Raynaud	Left	R2+r3	Nil	2	NF	U
5	40	Female	Causalgia	Left	R2+r3	Nil	1	6 m	U
6	49	Female	Raynaud	Left	R2+r3	Nil	1	NF	S
7	35	Male	Tao	Right	R2+r3	Pnx.	4	8 m	S
8	24	Female	Raynaud	Left	R2+r3	Nil	1	NF	S
9	24	Female	Raynaud	Right	R2+r3	Nil	2	NF	S
10	22	Male	Hyperhidrosis	Bilateral	R3+r4	Nil	1	4 m	S

Abbreviations: TAO: thromboangitis obliterans, PNX: pneumothorax, R: rib, m: month, S: satisfied, U: unsatisfied, NF: not followed.

## Discussion

Dorsal sympathectomy is one of the options for treating patients with axillary or palmar hyperhidrosis. It is also considered as an appropriate procedure for management of cases suffering from peripheral vascular disease such as Raynaud syndrome<sup>(9,11)</sup>. Because the blood-vessel tonus is balanced between both autonomous nervous systems, once the sympathetic chain is severed, there is a release in tonus, causing peripheral vasodilatation and, as a consequence, an increase in circulation<sup>(12)</sup>. Moreover, dorsal sympathectomy may result in better pain management, ulcer healing, and prevention of ischemic upper extremities

amputation<sup>(2)</sup>. It is specifically indicated for patients involved with ischemia due to peripheral vascular lesions for which revascularization is not feasible<sup>(13)</sup>. Currently, thoracoscopic sympathectomy is performed in place of conventional open surgical method<sup>(3,9,14,15)</sup>. Since due to postoperative pain, 20% of the patients who had experienced dorsal sympathectomy through thoracotomy are not willing to undergo the operation of the opposite side<sup>(16)</sup>. Frequent studies indicated favorable results from thoracoscopic sympathectomy for management of upper extremity hyperhidrosis<sup>(1,3,9,14,15,17)</sup>.

Patient's satisfaction is variable in the present study, 2 female patients with

Raynaud's are unsatisfied in spite of their improvement at 1<sup>st</sup> day, while all patients with hyperhidrosis improved significantly. Some investigators considered it as an effective management<sup>(2)</sup> whereas others doubted its efficacy<sup>(18)</sup>, and still some believed that it should be re-evaluated<sup>(19)</sup>. Regarding to ischemia in the present study, because of poor follow up, and small group of patients and 2 patients unsatisfied, the outcomes of thoracoscopic sympathectomy are not as satisfactory as hyperhidrosis, its favorable results demand re-evaluation of its efficacy in this subset of patients. Nevertheless, some studies concluded that sympathectomy, because of its temporary effects, does not effectively contribute to prognosis of Raynaud's syndrome<sup>(18)</sup>. For hyperhidrosis, thoracoscopic dorsal sympathectomy is the

method of choice in case of severe palmar hyperhidrosis when conservative treatment measures failed (aluminum hydroxide, iontophoresis is appropriate if the patient can tolerate the side effects of tingling and electrical shocks, beta blockers and cholinergic). Short-term results reported cure rates of more than 98% for palmar hyperhidrosis<sup>(19,20,21,22)</sup>. Recurrence rates are acceptable (about 5%) even in long-term follow-up investigations of more than 10 years<sup>(20,21)</sup>. Analysis of the outcome of sympathetic surgery is difficult, as most of the studies report personal series with different surgical methods and different levels of ablation<sup>(19)</sup>. Moreover, the number of prospective randomized studies is limited<sup>(23)</sup>, and long-term follow-up studies<sup>(21,24,25)</sup> are rare<sup>(26-28)</sup>. The International Society for Sympathetic Surgery defines "long term" by a follow-up period of at least 5 years.

The transaxillary single-port approach provided excellent visualization of the sympathetic chain up to the first rib. In earlier reports of endoscopic transaxillary access several smaller ports were usually required, which could lead to greater patient discomfort and pain<sup>(11,29)</sup>. In our series, clinical assessment 4 months after

surgery revealed uneventful wound healing and excellent functional and cosmetic results in all patients. There were no neuralgic sequelae, and none of the patients complained of pain. As there was no need for a chest tube in most patients (6), and removed few hours later in other (3 patients), recovery was rapid, and the patients were ambulatory already a few hours after surgery.

Complications occurred in 9% of cases, a rate comparable to that in other reports<sup>(9,20)</sup>. However, no conversion to open surgery was required in our series. The development of residual pneumothorax is a well-known complication of endoscopic thoracic operations and is not specific to this procedure<sup>(20,30)</sup>. The risk of Horner's syndrome was reduced with our method compared to open sympathectomy through the transaxillary or supraclavicular approach<sup>(30)</sup> due to excellent view of the ganglion and the adequate magnification which allowed for precise ablation. Therefore, proper identification of the first rib is mandatory<sup>(9)</sup>.

In conclusion, our results suggest that single-port thoracoscopic sympathectomy for the treatment of hyperhidrosis or ischemic upper limbs offers excellent, cosmetic and functional results and avoids the chest wall sequelae sometimes seen after two- or three-port techniques and this simple port technique is safe, reliable, and quick way, and associated with low morbidity and a short hospital stay.

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