Review Article

NiVATS sympathectomy for hyperhidrosis: should I stay or should I go? A Narrative Review

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Abstract: Non-intubated video-assisted thoracoscopic surgery (NiVATS) has been shown to be a practicable and beneficial procedure for many thoracic operations. This review summarizes the current literature about NiVATS focusing on patients with hyperhidrosis. Seven studies about NiVATS and its efficacy and/or feasibility have been found and are discussed. There are only two randomized trials, while all other reports are case series. Four studies compare NiVATS with VATS. As seen for many other procedures as wedge resection, pleural biopsy and even anatomical resection, NiVATS sympathectomy for hyperhidrosis is a safe and feasible procedure to perform. Especially, due to the usual young, slim and otherwise healthy patients, this method is well suited to start a NiVATS program. Although NiVATS has a short learning curve, it challenges the whole team including surgeons and anesthesiologists, working on an awake patient. Nevertheless, evidence for clinical advantages of NiVATS compared to VATS is still scarce. The majority of thoracic surgery patients still gets a chest tube for a few days, which might outlast the positive effects of NiVATS, as for example lesser anestesiological trauma. However, there is evidence to show that NiVATS might be suitable in managing thoracoscopic sympathectomy as an outpatient operation, as these patients seem to have a faster general recovery postoperatively.

Keywords: Non-intubated; NiVATS; thoracic sympathectomy; hyperhidrosis; VATS

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Introduction

Non-intubated video-assisted thoracoscopic surgery (NiVATS) was first reported by Jacobaeus in 1922 (1). During the last 16 years, this procedure has become more popular and has been introduced in several centers worldwide (2-4). It has proved to be a feasible and safe technique for different thoracic surgery operations (5). In a randomized study, Liu *et al.* compared NiVATS procedures under epidural anesthesia with thoracic surgery operations under general anesthesia (VATS). For bullae resection, wedge resection and lobectomy, they showed a shorter postoperative fasting time, a shorter duration of antibiotic use and a shorter length of hospital stay (6). In addition, NiVATS combined with intravenous analgosedation, local infiltration anesthesia and intercostal nerve blocks was proven feasible as well (7) and to provide further benefits in reducing postoperative discomforts such as vomiting and nausea, sore throat and pain and reduces intubation and ventilation related lung injuries (8). An intrathoracic vagal block by infiltration near the vagal nerve inhibits the cough reflex during thoracoscopic manipulation of the lung (7).

The advantages of NiVATS such as lower risks, lower costs and outpatient management leads to more acceptance of a surgical treatment for non-life risk diseases like hyperhidrosis.

Table 1 Overview studies NiVATS sympathectomy for hyperhidrosis

Author	Year	Case numbers	Studydesign	NiVATS *vs.* VATS	Ref.
Stefano Elia *et al.*	2005	45	Case Series	Yes (15/30)	(9)
Ye Ning *et al.*	2015	32	Cases Series	No	(10)
Jian-Feng Chen *et al.*	2016	221	Randomized Controlled Trial	Yes (108/113)	(11)
Jian-Feng Chen *et al.*	2016	58	Case Series	No	(12)
Jian-Feng Chen *et al.*	2016	85	Cases Series	No	(13)
Jian-Feng Chen *et al.*	2016	168	Randomized Controlled Trial	Yes (85/83)	(14)
Claudio Caviezel *et al.*	2017	20	Case Series	Yes (10/10)	(15)

There are several studies demonstrated the feasibility, safety and effectiveness of NiVATS sympathectomy for hyperhidrosis (9-15). However, surgeons and anesthesiologists face new challenges during NiVATS, such as coughing, any movements by the awake patient, mediastinal shift and diaphragmatic displacement. This review aims to summarize the current literature about NiVATS for patients with hyperhidrosis. We present the following article in accordance with the Narrative Review reporting checklist (available at https://dx.doi.org/10.21037/vats-21-11).

Methods

We performed a literature search on PubMed with the terms 'nonintubated + sympathectomy + hyperhidrosis' and 'awake + sympathectomy + hyperhidrosis'. Only original articles were included. Case series with less than 10 patients were excluded. One article was excluded because it was only available in Spanish (16). Therefore, seven articles were included in our review (*Table 1*).

NiVATS for sympathectomy

Patient selection

In all studies, healthy patients with primary hyperhidrosis were included. Caviezel *et al.* performed one NiVATS in a patient with facial blushing (15).

Anesthesia

Elia *et al.* performed the NiVATS procedure without any sedation or intravenous analgetic medication (9). In all other studies dexmedetomidine or propofol in combination with sufentanil, remifentanyl or fentanyl was administered intravenously with boluses or by target-controlled infusion, as required for patient comfort.

Oxygen was administered continuously through a standard nasal cannula or a face mask with a rate of 2–5 L/min. Chen *et al.* performed one study using a laryngeal mask in some cases (12).

Surgery and local anesthesia

Patients were placed in a semi-prone position for each side/procedure and mild anti-Trendelenburg inclination (9) or in a prone position with both arms abducted (15).

Elia *et al.* performed a two port thoracoscopy while the other authors all describe an uniportal thoracoscopy.

For local anesthesia, when described, mepivacaine, lidocaine and/or ropivacaine were used for the skin and intercostal space. Before cutting the sympathic chain, lidocaine was applied to both sides in the subpleural space through an endoscopic syringe. The cutting of the sympathic chain was performed using scissors or electrocautery hook. Additionally, Caviezel *et al.* performed a vagal block with lidocaine to inhibit the cough reflex during thoracoscopy.

The number and level of insertion of the 5 mm ports varied between centers. Caviezel *et al.* used a wound protector (*Figure 1*). Therefore, the entry point was chosen between the 3th and 4th intercostal space in the mid-axillary line or anterior of it. In contrast, Chen *et al.* performed a transareolar access.

For re-expansion of the lung, most authors used a temporary chest tube, which was connected to a suction device under thoracoscopic visualization. Some authors describe manually ventilation with continuous positive pressure by the anesthesiologist to prevent a pneumothorax—provided a laryngeal mask *in situ*. Once the procedure was completed, the chest tubes were removed. After a surveillance of 1 to 2 hours, the patients could be transferred to the ward. Most of them were dismissed from

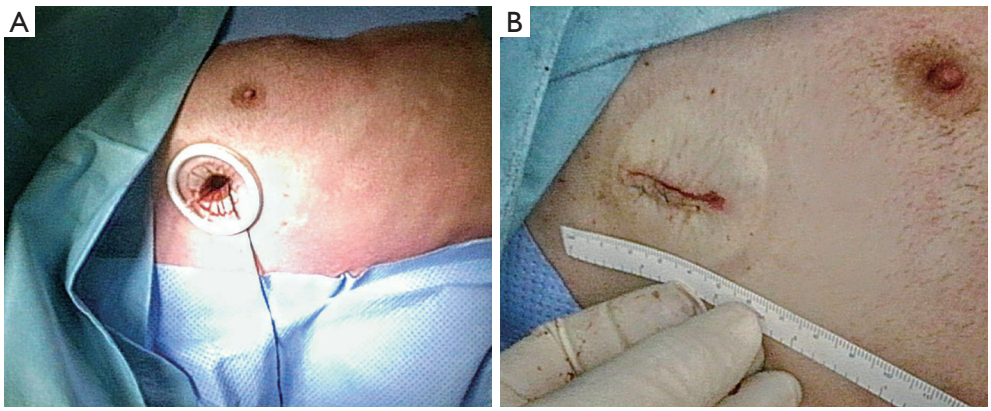

Figure 1 Wound protector used by Caviezel *et al.* (A), wound closure after procedure (B).

Table 2 Differences in postoperative outcomes between NiVATS *vs.* VATS

Outcome	Elia *et al.* (9)	Chen *et al.* (11)	Chen *et al.* (14)	Caviezel *et al.* (15)
Rise hand temperature	No	No	No	–
QOL	No	–	–	No
Satisfaction	Higher in NiVATS (P<0.03)	No	No	No
Compensatory Sweating long-term	No	No	No	No
Long-term resolution	No	No	No	–
Recurrence	No	No	No	–
Pneumothorax	–	No	No	No
Residual pain	–	Higher in VATS (P<0.01)	Higher in VATS (P<0.01)	–
Recovery time	–	Faster in NiVATS (P<0.01)	Faster in NiVATS (P<0.01)	–

the hospital on the same day or on the first postoperative day, once the postoperative chest X-ray showed no relevant pneumothorax.

Data collections

The collected data in all studies were as follows; 'In operating room time', recovery time, palmar temperature rise, resolution of palmar hyperhidrosis, complications after surgery (pneumothorax, compensatory sweating, Horner syndrome, recurrence, bleeding), hospital stay and costs.

Results

The overall conclusion of the studies was that, that NiVATS is equal safe as VATS. The findings showed that there were no disadvantages compared to VATS. The patients who underwent NiVATS, suffered no residual pain and experienced a faster recovery after surgery (*Table 2*).

There was no mortality or the need to convert to an open procedure in both groups. The studies showed an equal operating time but a shorter in-operating-room time, a shorter length of stay and lower costs for NiVATS (especially in relation to anesthesia and hospitalization) (*Table 3*).

After thoracoscopic sympathectomy, patients had an increased quality of life (QOL), regardless of the surgical technique or type of anesthesia. In most articles, the follow up of patients was between operation and up to 12-month postoperatively. However, the main differentiation was that satisfaction of the NiVATS-group was significantly higher 24 hours postoperatively (9). Regarding the long-term follow-up, there was no difference in quality of life, resolution of symptoms or compensatory sweating. No patient showed a recurrence of symptoms.

Table 3 Outcomes

Outcome		Elia *et al.* (9)	Ning *et al.* (10)	Chen *et al.* (11)	Chen *et al.* (12)	Chen *et al.* (13)	Chen *et al.* (14)	Caviezel *et al.* (15)
Mortality		No	No	No	No	No	No	No
Conversion to open surgery		No	No	No	No	No	No	No
In operation room time (min)	N	63.55±10.58 [47–85]	–	–	–	–	–	117.5 [90–150]
	V	86.05±5.75 [77–96]	–	–	–	–	–	125 [110–240]
	P	<0.01	–	–	–	–	–	0.247
Operating time (min)	N	–	25–40 min	28.1±6.8	33.6±8.3 [26–68]	13.5	28.0±7.6	64.5 [48–95]
	V	–	–	26.5±5.5	–	–	26.9±6.3	47.5 [35–85]
	P	–	–	>0.05	–	–	>0.05	0.04
Hospital stays	N	Same day	1 POD (100%)	–	1 POD (96.6%)	1 POD (96.5%)	1 POD (97.6%)	Same day (90%)
	V	1.38±0.6 days	–	–	–	–	–	Same day (30%)
	P	<0.05	–	–	–	–	–	0.008
Recovery time (min)	N	–	–	5.5±1.7	4.6±0.9	4.5±0.8	5.6±1.7	–
	V	–	–	11.5±2.3	5.1±0.8	–	11.4±2.3	–
	P	–	–	<0.01	–	–	<0.01	–
Mean postoperative pain score	N	No pain	No pain	1.1±0.8	–	2.03±0.85	1.1±0.9	–
	V	–	–	3.2±0.8	–	–	3.2±0.9	–
	P	–	–	<0.01	–	–	<0.01	–
Cost operation room time (€)	N	953.25±158.7	Lower	–	–	–	–	–
	V	1,290.75±86.25	Higher	–	–	–	–	–
	P	<0.01	–	–	–	–	–	–
Cost hospital stay (€)	N	310	Lower	–	–	–	–	–
	V	427.8±1.86	Higher	–	–	–	–	–
	P	<0.05	–	–	–	–	–	–
Cost Anesthesia	N	–	–	385.60±38.72	–	–	368.79±38.36	–
	V	–	–	661.88±29.33	–	–	660.81±29.30	–
	P	–	–	<0.01	–	–	<0.01	–
All patient related costs	N	–	–	–	–	–	–	3,043.97±312.29
	V	–	–	–	–	–	–	4,146.52±192.19
	P	–	–	–	–	–	–	0.048
Follow-up (months)		7.16±2.97	30	–	12	12	–	Yes, duration unclear

Table 4 Indications and Contraindications for NiVATS by Hung *et al.*

Indications	Contraindications
• Patients with significant risks for an intubated general anesthesia • Simple and easy-to-perform procedures • Major pulmonary resections (requiring experienced surgical team consisting of both surgeons and anesthesiologists)	• Hemodynamically unstable patients • Expected difficult airway management • Obesity (body mass index >30) • Expected dense and extensive pleural adhesions (previous ipsilateral chest surgery, pulmonary infection etc.) • Inexperienced and poorly cooperative surgical team • Large and central pulmonary lesions (>6 cm) for pulmonary resections • Thoracic spinal deformity and coagulopathy when thoracic epidural catheterization considered

Discussion

VATS sympathectomy is a worldwide accepted and evidence-based treatment for primary hyperhidrosis (17). The thoracoscopy is usually performed as uni- or biportal, depending on surgeons' preference. Mostly, resection or diversion is limited to the levels T3 or T4.

In a recent meta-analysis, comparing NiVATS with VATS in 1,684 cases, Zhang *et al.* described a significantly lower complication rate in NiVATS (5). Studies comparing NiVATS and VATS in sympathectomy showed no differences regarding efficiency and operative morbidity (9,11,14,15).

In terms of anesthesia and intubation time, ventilation associated complications (sore throat, nausea, vomiting), postoperative complications (pneumonia, air leak, pain), hospital stay and perioperative mortality rate, NiVATS with regional or local anesthesia has been shown to be equally safe compared with VATS procedures. In addition, there are usually lower costs due to shorter length of hospital stay, lesser equipment required such as double lumen intubation tube etc. (5,9-15). The more rapid patient recovery after NiVATS may also allow an outpatient management. However, this seems to be relevant in case of sympathectomy (15), but can be questioned in cases, where a postoperative chest tube might outlast the immediate faster recovery from anesthesia. Nevertheless, surgeons and anesthesiologists might have an increased level of stress while operating on an awake or at least non-intubated patient.

In addition, some authors showed significant less inflammatory cytokines (tumor necrosis factor alpha and C-reactive protein) (6), lymphocyte activity (18) and reduced endocrine response (19) after NiVATS as after VATS. This might explain the fewer postoperative respiratory complications, shorter postoperative fasting time, shorter duration of antibiotic use and shorter hospital stay generally in NiVATS patients.

Another issue to consider is that before performing NiVATS, it is essential to raise the patient's awareness of possible intraoperative discomfort. They should understand that they may experience some shortness of breath, cough reflex, pain and the surgeon's manipulations. They need to be able to cooperate well. Therefore, the patient has to be carefully selected, as shown in *Table 4*.

Indications and Contraindications for NiVATS as described by Hung *et al.* (20). The words highlighted in bold are well applicable to sympathectomy (*Table 4*).

Thoracoscopic sympathectomy is a simple and easy to perform procedure, although there are different techniques (number of ports, access, extent of resection, technique of resection). It is therefore appropriate to start a NiVATS program, providing a fast learning curve regarding the technique (15). Provided, that the team has extensive experience in VATS, surgeons and anesthesiologists can focus on local anaesthesia and the intrathoracic situation under spontaneous ventilation.

Most of the reviewed studies are retrospective and performed in different high volume centers. Current investigations of large databases and multinational studies comparing NiVATS and VATS for different indications show further promising results (21).

Caviezel *et al.* showed that the learning curve in a well prepared team is fast without any complications compared to VATS.

Especially in times of increasingly emerging ERAS programs in thoracic surgery (22), NiVATS might help to manage thoracoscopic sympathectomy as an outpatient procedure. Additionally, thoracoscopic sympathectomy might be an ideal immersion for NiVATS.

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Footnote

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