NATIONAL INSTITUTE FOR HEALTH AND CARE EXCELLENCE

INTERVENTIONAL PROCEDURES PROGRAMME

Interventional procedure overview of endoscopic thoracic sympathectomy for primary hyperhidrosis of the upper limb

Hyperhidrosis is excessive sweating, especially of the palms and armpits. In endoscopic thoracic sympathectomy, keyhole surgery using an endoscope (a type of thin telescope) is done through a small incision in the armpit to remove nerve tissue near the spine that controls the affected sweat glands and so reduce sweating.

Introduction

The National Institute for Health and Care Excellence (NICE) has prepared this interventional procedure (IP) overview to help members of the Interventional Procedures Advisory Committee (IPAC) make recommendations about the safety and efficacy of an interventional procedure. It is based on a rapid review of the medical literature and specialist opinion. It should not be regarded as a definitive assessment of the procedure.

Date prepared

This overview was prepared in July 2013 and updated in December 2013.

Procedure name

- Endoscopic thoracic sympathectomy for primary hyperhidrosis of the upper limb
- Video-assisted thoracic sympathectomy (VATS) for primary hyperhidrosis.

Specialist societies

- Vascular Society of Great Britain and Ireland
- Society for Cardiothoracic Surgery in Great Britain and Ireland.

Description

Indications and current treatment

Primary hyperhidrosis is characterised by excessive, bilateral sweating, most commonly affecting the axillae, palms, feet and face. It typically begins during childhood or adolescence, but can occur at any age and runs a chronic course. In a few people, symptoms can spontaneously improve over time. Excessive sweating can have a profound effect on quality of life, interfering with daily activities, and causing anxiety and embarrassment.

First-line management of primary hyperhidrosis includes lifestyle measures, such as avoiding known triggers, avoiding tight clothing and using antiperspirants (including aluminium chloride hexahydrate). Iontophoresis involves immersing the sites of hyperhidrosis in warm water (or a wet contact pad may be applied) through which a weak electric current is passed. It is suitable for the hands, feet, and less easily, the axillae. Oral medications used to treat hyperhidrosis include anticholinergics and antimuscarinics, beta-blockers, antihypertensives and anxiolytics. Another treatment option is botulinum-toxin A, delivered by multiple intradermal injections to the affected areas. If the hyperhidrosis fails to respond to conservative treatment, surgical options include local sweat-gland excision by subcutaneous curettage or tumescent liposuction, and sympathectomy. Sympathectomy involves dividing appropriate parts of the sympathetic chain beside the vertebral column: this removes the sympathetic drive that promotes sweating.

What the procedure involves

Thoracic sympathectomy aims to relieve hyperhidrosis from the palms and axillae permanently by dividing appropriate parts of the sympathetic chain beside the vertebral column.

Endoscopic thoracic sympathectomy is usually done with the patient under general anaesthesia. Small incisions are made in the axilla and an endoscope is inserted. The lung is partially collapsed. The sympathetic chain is visualised and the chosen part of the chain is divided by electrocautery or endoscopic scissors, or surgical clips may be applied. The extent of division varies but usually involves the part of the sympathetic chain over the second or third ribs, or both. Gas is removed from the pleural space, allowing the lung to re-expand, and the wounds are closed. The procedure is then usually repeated on the other side.

Literature review

Rapid review of literature

The medical literature was searched to identify studies and reviews relevant to endoscopic thoracic sympathectomy for primary hyperhidrosis of the upper limb. Searches were conducted of the following databases, covering the

period from their commencement to 22October 2013: MEDLINE, PREMEDLINE, EMBASE, Cochrane Library and other databases. Trial registries and the Internet were also searched. No language restriction was applied to the searches (see appendix C for details of search strategy). Relevant published studies identified during consultation or resolution that are published after this date may also be considered for inclusion.

The following selection criteria (table 1) were applied to the abstracts identified by the literature search. Where selection criteria could not be determined from the abstracts the full paper was retrieved.

Table 1 Inclusion criteria for identification of relevant studies

Characteristic	Criteria
Publication type	Clinical studies were included. Emphasis was placed on identifying good quality studies. Abstracts were excluded where no clinical outcomes were reported, or where the paper was a review, editorial, or a laboratory or animal study. Conference abstracts were also excluded because of the difficulty of appraising study methodology, unless they reported specific adverse events that were not available in the published literature.
Patient	Patients with primary hyperhidrosis of the upper limb.
Intervention/test	Endoscopic thoracic sympathectomy.
Outcome	Articles were retrieved if the abstract contained information relevant to the safety and/or efficacy.
Language	Non-English-language articles were excluded unless they were thought to add substantively to the English-language evidence base.

List of studies included in the overview

This overview is based on 14,709 patients (including 14,171 patients with hyperhidrosis) from 1 non-randomised comparative study, 5 case series, 1 non-systematic review, and 7 case reports[1–14].

Other studies that were considered to be relevant to the procedure but were not included in the main extraction table (table 2) have been listed in appendix A.

Table 2 Summary of key efficacy and safety findings on endoscopic thoracic sympathectomy for primary hyperhidrosis of the upper limb

Abbreviations used: ETS, endoscopic thoracic sympathectomy; NS, not significant; QoL, quality of life; VATS, video-assisted thoracoscopic sympathectomy

Study details

Ambrogi V (2009)[1]

Non-randomised comparative study

Italy

Recruitment period: 2001–7

Study population: patients with severe palmar hyperhidrosis

n=154 (68 ETS versus 86 botulinum-toxin A injection)

Age: median 30 years (range 20–45)
Sex: 59% (91/154) female

Patient selection criteria: all patients had severe palmar hyperhidrosis since childhood and were 'socially, professionally, and psychologically handicapped'. 64% of patients had symptoms refractory to conservative treatments (antiperspirants, oral medication, or iontophoresis).

Technique: *ETS* – one-stage, two-port, T2 to T3 bilateral procedure under general or epidural anaesthesia. The sympathetic chain was divided by cautery at the T3 section and by endoscopic scissors at the T2 level. *Botulinum-toxin A injection* – after regional median and ulnar nerve block, botulinum-toxin A was injected intradermally at 28 sites in each palm in the same session.

Follow-up: 12 months

Key efficacy findings

Number of patients analysed: **154 (68 vs 86)**

Objective sweating assessment

Follow-up	ETS		Botulinum-toxin A		p value
	n	score	n	score	
Minor's iodine starch test					
Baseline (grey scale, 0–240)	68	32.4 ± 7	86	35.1 ± 8	0.061
6 months (% change)	68	+94	86	+63	0.036
12 months (% change)	59	+94	70	+30	0.011
Pad glove test					
Baseline (g/h)	68	1.36 ± 0.2	86	1.37 ± 0.3	0.313
6 months (% change)	68	-60	85	-34	0.013
12 months (% change)	59	-55	70	-29	<0.001

The intragroup differences from baseline were significant at all follow-up periods (p≤0.01)

Patient satisfaction (mean score, range 1–5 [very poor, poor, good, very good, excellent])

	n	ETS	n	Botulinum-toxin A	p value
24 hours	68	4.18	86	4.78	0.03
6 months	63	4.49	74	3.93	0.04

Key safety findings

Postoperative complications in ETS group:
- Persistent intercostal pain=2.9% (2/68)
- Slight pneumothorax=5.9% (4/68) (spontaneously resolved without the need for a chest tube)

Complications in botulinum-toxin A group:
- Persistent hand pain=2.3% (2/86)
- Grasp weakening=2.3% (2/86)

Compensatory sweating in at least 1 site (facial, axilla, lumbar or plantar):
- ETS=98%
- Botulinum-toxin A=90%

The mean % sweat increment from baseline at 12-month follow-up after ETS (estimated from graph):
- Axilla=20%
- Lumbar=20%
- Plantar=10%

In the botulinum-toxin A group, compensatory sweating was observed at 1-month follow-up but there was no increment at 12 months.

Compensatory sweating was significantly greater and long-lasting in the ETS group (the authors noted that the presence of compensatory sweating had a minor influence on quality of life compared with the effect of the reprise of palmar sweating).

Comments

Follow-up issues:
- One-year follow-up was complete for all patients but 28 patients did not fill in the questionnaire.

Study design issues:
- Prospective study, consecutive patients.
- All patients were given the choice between bilateral T2 to T3 ETS or botulinum-toxin A injection. Crossover from 1 group to another was authorised after a minimum period of 1 year from the beginning of the treatment (14 patients initially belonging to the Botulinum-toxin A group underwent ETS and were excluded from further evaluation; none of the ETS group underwent botulinum-toxin A injection).
- Objective sweating assessment was done by Minor's iodine starch test (scored on a modified grey scale from 0 [black] for maximum sweating to 240 [white] for minimum sweating, and a pad glove test. Subjective sweating changes were assessed by the Hyperhidrosis Quality of Life Questionnaire (scored from 20 to 100, higher scores indicate better quality of life) and the

Abbreviations used: ETS, endoscopic thoracic sympathectomy; NS, not significant; QoL, quality of life; VATS, video-assisted thoracoscopic sympathectomy

Study details	Key efficacy findings	Key safety findings	Comments
Conflict of interest/source of funding: study carried out within research fellowship programme awarded by the Tor Vergata University.	12 months | 58 | 4.52 | 68 | 3.12 | 0.001 **Subjective sweating assessment** Follow-up | n | ETS | n | Botulinum-toxin A | p value *Hyperhidrosis Quality of Life score* Baseline | 68 | 32.3 ± 10 | 86 | 34.9 ± 8 | 0.092 6 months (% change) | 63 | +121 | 74 | +85 | 0.007 12 months - % change | 58 | +80 | 68 | +5 | <0.001 *Dermatology Life Quality Index* Baseline | 68 | 27.8 ± 0.9 | 86 | 28.2 ± 0.8 | 0.072 6 months (% change) | 63 | +60 | 74 | +48 | 0.008 12 months (% change) | 58 | +50 | 68 | +17 | <0.001 The intragroup differences from baseline were significant at all follow-up periods (p≤0.05) Mean baseline values of SF-36 psychosocial domains were significantly lower than that of a same-age normal population. At 3 months, almost all domains of the SF-36 improved in both groups. In the botulinum group, there was progressive decline to near baseline levels at 12-month follow-up. In the ETS group, most of the domains remained significantly improved at 12-month follow-up.		Dermatology Life Quality Index (scored from 0 to 30, higher scores indicate better quality of life). **Study population issues**: • Demographic and clinical characteristics were similar between the 2 groups at baseline.

Abbreviations used: ETS, endoscopic thoracic sympathectomy; NS, not significant; QoL, quality of life; VATS, video-assisted thoracoscopic sympathectomy

<table>
<tr><th>Study details</th><th>Key efficacy findings</th><th>Key safety findings</th><th>Comments</th></tr>
<tr>
<td>Wolosker N (2012)[2]

Case series (prospective)

Brazil

Recruitment period: 2001–3

Study population: patients with primary hyperhidrosis (68% palmar hyperhidrosis, 30% axillary hyperhidrosis, and 2% facial hyperhidrosis).

n=453

Age: mean 25 years (range 11–57)
Sex: 66% (297/453) female

Patient selection criteria: no specific criteria listed.

Technique: bilateral ETS, the level of ganglion resection varied according to the type of hyperhidrosis (6% R2, 46% R2+R3, 6% R3, 29% R3+R4+R5, and 12% R4+R5).

Follow-up: 5 years

Conflict of interest/source of funding: none</td>
<td>Number of patients analysed: 453

Complete bilateral remission of the palmer, axillary or facial sweating at 5-year follow-up=97.3% (441/453)

Comparison between 30 days after surgery and 5 years after surgery with regard to QoL
<table>
<tr><td>30 days after surgery</td><td colspan="3">5 years after surgery</td><td></td></tr>
<tr><td></td><td>Better</td><td>Same</td><td>Worse</td><td>Total</td></tr>
<tr><td>Better</td><td>391</td><td>16</td><td>5</td><td>412 (90.9%)</td></tr>
<tr><td>Same</td><td>12</td><td>13</td><td>2</td><td>27 (6.0%)</td></tr>
<tr><td>Worse</td><td>6</td><td>2</td><td>6</td><td>14 (3.1%)</td></tr>
<tr><td>Total</td><td>409 (90.3%)</td><td>31 (6.8%)</td><td>13 (2.9%)</td><td>453 (100%)</td></tr>
</table>
All patients had poor or very poor QoL at baseline.

There was no statistically significant change in QoL from 30 days to 5 years after the procedure.

1.5% (7/453) of patients were dissatisfied with the results. These patients had severe compensatory hyperhidrosis and said that they regretted having undergone ETS.</td>
<td>There were no deaths or conversions to open surgery.

Complications
• Right-sided residual pneumothorax=0.4% (2/453) (during the immediate postoperative period, did not need pleural drainage)
• Slight/weak pleural adhesions=2.4% (11/453) (detached using an endoscopic scalpel)
• Sinus bradycardia=0.2% (1/453)
• Horner’s syndrome=0.2% (1/453) (‘transient’)
• Venous bleeding >300 ml in the right hemithorax=0.2% (1/453)
• Postoperative paraesthesia on the right upper limb=0.2% (1/453)
• Compensatory hyperhidrosis=91.8% (416/453) (20.3% [n=92] classified as mild, 38.4% [n=174] moderate and 33.1% [n=150] severe)</td>
<td>Follow-up issues:
• An additional 22 patients were excluded from the study because of incomplete answers on the QoL questionnaire.

Study design issues:
• Consecutive patients.
• QoL was assessed using a questionnaire specific for patients with hyperhidrosis. The total score ranged from 20 to 100 and was classified into 3 different categories (score >68 was considered to be worse than before surgery, 67–52 considered to be the same, and from 51 to 20 considered to be better than before surgery).</td>
</tr>
</table>

Abbreviations used: ETS, endoscopic thoracic sympathectomy; NS, not significant; QoL, quality of life; VATS, video-assisted thoracoscopic sympathectomy

Study details

Bischof G (2005)[3]

Case series

Austria

Recruitment period: 1965–2003

Study population: patients with essential hyperhidrosis (68% palmar, 12% axillary, and 20% combined)

n=406

Age: median 27 years
Sex: 44% (180/406) female

Patient selection criteria: no specific criteria listed.

Technique: Before 2001, the nerve was isolated at the second, third and fourth rib bed and the sympathetic trunk cut with a diathermy hook. From 2001 onwards, a clipping method at T4 was used. Videoendoscopy was introduced in 1991.

Follow-up: median 16 years (range 6 months to 30 years)

Conflict of interest/source of funding: not reported

Key efficacy findings

Number of patients analysed: **406**

Long-term treatment success and satisfaction rates for conventional versus video-assisted ETS

	Conventional ETS	Video-assisted ETS	p value
Follow-up	16.7 years	1.8 years	
Dry limb	91.2% (n=239)	93.1% (n=67)	NS
Improved	6.9% (n=18)	4.2% (n=3)	NS
Wet limb	1.9% (n=5)	2.8% (n=2)	NS
Satisfied patients	66.8% (n=175)	80.6% (n=58)	NS
Partly satisfied	26.7% (n=70)	13.9% (n=10)	NS
Dissatisfied patients (regret operation)	6.5% (n=17)	5.6% (n=4)	NS

Treatment success and satisfaction rates for video-assisted ETS versus endoscopic sympathetic block at T4

	Video-assisted ETS T2-T4 n=91	Endoscopic sympathetic block at T4 n=53	p value
Follow-up	22.1 months	7.5 months	
Dry limb	87.9%	64.5%	NS
Improved	10%	35.5%	0.0002
Wet limb	2.1%	0%	NS
Satisfied patients	80.4%	100%	NS
Partly satisfied	14%	0%	NS
Dissatisfied patients (regret operation)	5.6%	0%	NS

Key safety findings

Complications:

- Conversion=0.2% (1/406)
- Pneumothorax that needed to be drained=1.1%
- Pleural effusion=1%
- Horner syndrome=2.2% (seen postoperatively after conventional ETS; this complication did not occur after introduction of videoendoscopy)

	Conventional ETS	Video-assisted ETS	p value
Compensatory sweating	67.7% (n=177)	55.6% (n=40)	0.06
Gustatory sweating	50.4% (n=132)	33.3% (n=24)	0.01
Rhinitis	9.9% (n=26)	1.8% (n=3)	NS

	Video-assisted ETS T2-T4 n=91	Endoscopic sympathetic block at T4 n=53	p value
Compensatory sweating	55.6%	8.5%	0.0002
Gustatory sweating	33.2%	2.1%	0.0019
Rhinitis	1.8%	1.8%	NS

The authors noted that compensatory sweating was the main reason for patients to regret having the procedure.

Comments

Follow-up issues:

- Complete follow-up information was available for 83% (337/406) of patients in the main cohort.
- Follow-up data were obtained from 79% of patients in the video-assisted ETS T2–T4 group and from 89% of patients in the endoscopic sympathetic block group, in the second cohort of patients.

Other issues:

- There appear to be discrepancies in the reported rates of complications – the rates presented here were taken from the main text of the paper.

Abbreviations used: ETS, endoscopic thoracic sympathectomy; NS, not significant; QoL, quality of life; VATS, video-assisted thoracoscopic sympathectomy

<table>
<tr><th>Study details</th><th>Key efficacy findings</th><th>Key safety findings</th><th>Comments</th></tr>
<tr>
<td>Lin T-S (2002)[4]

Case series

China

Recruitment period: 1993–2000

Study population: patients with palmar (n=1520) or axillary hyperhidrosis (n=480)

n=2000

Age: mean 23 years (range 9–60)
Sex: 61% (1212/2000) female

Patient selection criteria: not reported

Technique: uniportal, bilateral ETS. A T2 sympathectomy was done at the second and third rib beds with electrocautery, for patients with palmar hyperhidrosis and at the third, fourth and fifth rib bed for patients with axillary hyperhidrosis. The sympathetic trunk only was sectioned (no segment of the sympathetic nerve or ganglion was removed).

Follow-up: mean 51.7 months (range 6–89)

Conflict of interest/source of funding: not reported</td>
<td>Number of patients analysed: 2000

Technical success=99.6% (1992/2000; the procedure could not be done in 8 patients because of severe pleural adhesions)

Of the 1520 patients with palmar hyperhidrosis, 1398 (92%) patients also had plantar hyperhidrosis; 62% (942/1520) of patients with palmar hyperhidrosis had concurrent improvement of plantar sweating.

Recurrence rates after ETS
<table>
<tr><th>Follow-up period</th><th>Palmar hyperhidrosis (T2) n=1520</th><th>Axillary hyperhidrosis (T3/T4) n=480</th></tr>
<tr><td>1 year</td><td>0%</td><td>4.1%</td></tr>
<tr><td>2 years</td><td>0.2%</td><td>8.2%</td></tr>
<tr><td>3 years</td><td>0.5%</td><td>10.4%</td></tr>
<tr><td>4 years</td><td>0.7%</td><td>14.1%</td></tr>
<tr><td>5 years</td><td>1.3%</td><td>16.7%</td></tr>
</table>
</td>
<td>Surgical complications:
• Pneumothorax=0.5% (10/2000) (a tube thoracostomy was placed for 2–3 days)
• Segmental atelectasis=0.4% (7/2000)
• Haemothorax=0.1% (2/2000)
• Wound infection=0.1% (2/2000)

Compensatory sweating of the trunk and lower limbs=86% (1720/2000) (after T2 and T3/T4 ETS, compensatory sweating was classified as mild for 68% and 48% of patients; moderate for 8 and 35%; and severe for 2 and 5% of patients, respectively.

There were no cases of permanent or transient Horner’s syndrome.</td>
<td>Follow-up issues:
• No losses to follow-up were described.

Study design issues:
• Questionnaire survey.

Study population issues:
• No details were given about how recurrence was defined.</td>
</tr>
</table>

Abbreviations used: ETS, endoscopic thoracic sympathectomy; NS, not significant; QoL, quality of life; VATS, video-assisted thoracoscopic sympathectomy

Study details	Key efficacy findings	Key safety findings	Comments
Kao MC (1996)[5] **Case series** Taiwan Recruitment period: 1990–5 Study population: patients with palmar hyperhidrosis **n=9988** Age: range 5–71 years Sex: 51% (5088/9988) female Patient selection criteria: not reported. Technique: bilateral ETS of T2 and T3 or of T2 alone under general anaesthesia, using electrocautery, fibre optic laser evaporation or surgical resection. Most procedures were done with a video endoscopic system. **Follow-up: 3 years** Conflict of interest/source of funding: not reported	Number of patients analysed: **9988** ETS could not be done in <1% of patients because of severe pleural adhesions. 'Almost all' patients obtained satisfactory relief of palmar hyperhidrosis immediately after the procedure. About two-thirds of patients also had substantial alleviation of plantar hyperhidrosis. Recurrence rate: • 1-year=about 1% • 3 years= <3%	There was no surgical mortality. • Inadvertent traumatic bleeding needing chest tube drainage='about 0.1%' • 'obvious costal neuralgias were rarely encountered' • Significant pneumothorax or haemothorax needing chest tube drainage='about 0.3%' • Unilateral Horner's syndrome= <0.1% (most resolved gradually within a few months) • Compensatory hyperhidrosis= >50% (described as mild to moderate and decreased in severity with time)	**Follow-up issues**: • The paper reports a follow-up period of 3 years but does not state the mean follow-up or the number of patients followed up to 3 years. **Study design issues**: • No details are given about the methods used to carry out the patient survey.

Abbreviations used: ETS, endoscopic thoracic sympathectomy; NS, not significant; QoL, quality of life; VATS, video-assisted thoracoscopic sympathectomy

<table>
<tr><th>Study details</th><th>Key efficacy findings</th><th>Key safety findings</th><th>Comments</th></tr>
<tr>
<td>Smidfelt K (2011)[6]

Case series

Sweden

Recruitment period: 1989–98

Study population: patients with hyperhidrosis or facial blushing (47% [n=795] palmar hyperhidrosis, 6% [n=106] axillary hyperhidrosis, 3% [n=46] facial hyperhidrosis, 6% [n=105] a combination of more than 1 type of hyperhidrosis, 32% [n=536] facial blushing, and 7% [n=112] facial blushing combined with hyperhidrosis)

n=3015 (although data were only available for 1700)

Age: median 32 years (range 9–73)
Sex: 59% female

Patient selection criteria: not reported

Technique: single-incision ETS; the sympathetic chain was divided with electrocautery and the ganglia were not dissected. The nerve was divided over the second rib in 136 (8%), the second and third ribs in 748 (44%), the second to fourth ribs in 663 (39%) and the second to fifth ribs in 153 (9%) patients.

Follow-up: mean 14.6 years

Conflict of interest/source of funding: none</td>
<td>Number of patients analysed: 1700

Satisfactory and lasting effect of the procedure, or some increase in sweating or blushing over the years that patents did not consider a problem=85.1%

Poor or no effect from the procedure=6.9% (dominated by patients with axillary hyperhidrosis and facial blushing)

Problematic recurrence of sweating or blushing=8.1%

There were significant differences in the effect of the procedure according to indication (p<0.001), with the best effect achieved for palmar hyperhidrosis.

Overall satisfaction=80.0% (very satisfied, satisfied or semi-satisfied); 20.0% of patients were dissatisfied or regretted having the procedure.

Satisfaction rate by indication (proportion of patients very satisfied, satisfied or semi-satisfied):
• Palmar hyperhidrosis=86.6%
• Axillary hyperhidrosis=66.6%
• Facial hyperhidrosis=74%
• Facial blushing=73.5%, p<0.001

In multiple logistic regression analysis, women were more satisfied than men in both the palmar hyperhidrosis group (odds ratio 2.2, 95% CI 1.52 to 3.23) and the facial blushing group (odds ratio 2.9, 95% CI 2.03 to 4.06).

74.8% of patients stated that the procedure had improved their quality of life (82.1% of patients with palmar hyperhidrosis, 60.2% of patients with axillary hyperhidrosis, 72% of patients with facial hyperhidrosis and 68.6% of patients with facial blushing (p<0.001).</td>
<td>Postoperative compensatory sweating
<table>
<tr><th>Degree of compensatory sweating</th><th>Number of patients (n=1700)</th><th>% satisfied with the procedure</th></tr>
<tr><td>None</td><td>20% (n=340)</td><td>92.7</td></tr>
<tr><td>Insignificant</td><td>5.6% (n=95)</td><td>98</td></tr>
<tr><td>Troublesome</td><td>17.6% (n=299)</td><td>97.3</td></tr>
<tr><td>Annoying</td><td>24.1% (n=409)</td><td>91.4</td></tr>
<tr><td>Severe</td><td>21.6% (n=367)</td><td>68.9</td></tr>
<tr><td>Incapacitating/regret having the procedure</td><td>11.2% (n=190)</td><td>10.4</td></tr>
</table>

There was a significant difference in the prevalence of compensatory sweating between men and women (85.4% versus 76.2%, p<0.001).

Over time, 60% reported unchanged, 16.4% decreased and 23.6% increased compensatory sweating.

The main side-effects expressed in free-text comments were dry hands (3.7%), gustatory sweating (3.6%), cold hands (1.5%), low pulse rate (0.5%) and reduced stamina (0.4%).</td>
<td>Follow-up issues:
• A total of 3015 patients were treated by ETS during the study period; an address was available for 2639 patients, of which 387 letters were returned as undeliverable.
• The response rate was 56.4% of the total number of patients and 75.5% of those who presumably received the questionnaire.

Study design issues:
• Retrospective study.

Study population issues:
• The proportion of women was higher among the responders compared with non-responders (59.1% versus 46.3%, p<0.001) and the proportion of non-Scandinavians was smaller (3.5% versus 19.3%, p<0.001)</td>
</tr>
</table>

Abbreviations used: ETS, endoscopic thoracic sympathectomy; NS, not significant; QoL, quality of life; VATS, video-assisted thoracoscopic sympathectomy			
Study details	**Key efficacy findings**	**Key safety findings**	**Comments**
Ojimba TA (2004)[7] **Review** UK Recruitment period: not reported Study population: patients with complications after ETS **n=not reported** Age: not reported Sex: not reported Patient selection criteria: not reported Technique: not reported **Follow-up: not reported** Conflict of interest/source of funding: not reported	**Mortality, n=9** (5 due to haemorrhage, 3 due to problems related to anaesthetic technique and 1 unexplained cerebral event 'some hours' after ETS [the exact cause of death could not be established]) • In 2 patients, a trocar lacerated the subclavian artery causing massive intrathoracic bleeding. • In 1 patient, an intercostal vein was damaged; the patient died despite thoracotomy. • The cause of bleeding was not clear in 2 patients. • In 3 patients, double-lumen tubes were used for endobronchial single-lung ventilation and there was inadequate gas-exchange when the second lung was collapsed. This led to intraoperative hypoxia and subsequent death. In addition to these 3 deaths, 2 patients have suffered severe disabling cerebral ischaemia. **Operative complications** • Pneumothorax: temporary tube drainage is needed in 0.4–2.3% of patients • Surgical emphysema – up to 2.7% of patients • Segmental collapse – in 1 study, this occurred in 0.3% (4/1360) of patients • Pleural effusion – reported in 0–1% of patients • Intraoperative bleeding – in 1 study of 940 sympathectomies, there was 1 laceration of the subclavian artery (managed by immediate thoracotomy and suture) and 5.3% incidence of significant bleeding (300–600 ml) that could be controlled thoracoscopically. In another study of 7017 patients, incidence of intraoperative bleeding was 0.3% with 6 patients (0.08%) needing thoracotomy. False aneurysm of an intercostal artery has been reported in 1 patient; the patient collapsed due to rupture of the aneurysm 6 weeks after ETS and was treated by emergency thoracotomy. • chylothorax (3 cases were described; 1 patient needed postoperative tube drainage and parenteral nutrition for 6 days and in another patient the leak was recognised at surgery and the thoracic duct clipped) • wound haematomas and infection • Severe postoperative pain • Rebound sweating (temporary recurrence of sweating) can occur in 31% of patients. • Horner's syndrome • Intraoperative cardiac arrest • Brachial plexus injury **Long-term side effects** • Compensatory hyperhidrosis: severe in 1–2% of patients • Gustatory sweating: incidence varies from 1% to 51% • Horner's syndrome: 1 series reported permanent Horner's syndrome in 0.3% of patients. An early series reported an incidence of 3.5%, was attributed to thermal injury of the stellate ganglion because the chain was divided at a high level. • Rhinitis: reported with an incidence up to 10% • Phantom sweating • Cardiorespiratory symptoms		**Study design issues**: • Review (not systematic). • The purpose of the review is to focus on the drawbacks of ETS. • The 9 deaths have not been reported elsewhere (the authors note that they were anecdotal) – the other complications are reported from published literature. **Study population issues**: • The denominator for the 9 deaths is unknown.

Abbreviations used: ETS, endoscopic thoracic sympathectomy; NS, not significant; QoL, quality of life; VATS, video-assisted thoracoscopic sympathectomy			
Study details	**Key efficacy findings**	**Key safety findings**	**Comments**
Lin CC (1993)[8] **2 case reports** Taiwan Recruitment period: 1991 Study population: patients treated by ETS for palmar hyperhidrosis Ages: 16 and 21 years, Sex: 1 male. 1 female Technique: T2, 3 ETS Conflict of interest/source of funding: not reported.	**Intraoperative cardiac arrest** Case 1 (16-year-old male): just after the left T2,3 sympathetic trunk was transacted, cardiac arrest was confirmed. The operation was stopped immediately and cardiopulmonary resuscitation was done. Sinus rhythm returned after about 20 minutes. The patient was sent to the intensive care unit. He was discharged 5 days after the operation. No sequelae were found at follow-up. One year later, a right-sided ETS was done – no further intraoperative cardiac arrhythmia was noted. Case 2 (21-year-old female): Ventricular fibrillation was noted at the time the left T2,3 sympathetic trunk was transsected. Cardiac arrest soon followed. Sinus rhythm returned after 2–3 minutes of cardiopulmonary resuscitation and the operation was continued. The patient was discharged 2 days after the operation and ECG at follow-up was normal.		The authors note that more than 719 patients have been treated by ETS in the study centre.
Hirasuna RR (2007)[9] **Case report** USA Recruitment period: not reported Study population: patient treated by ETS for palmar hyperhidrosis Age: 32 years, Sex: female Technique: bilateral T2–T5 video assisted thoracoscopic sympathetic ganglion ablation. Conflict of interest/source of funding: not reported.	**Bronchospasm** The patient had a past medical history significant for remote mild exercise-induced asthma. After ETS, symptoms suggestive of bronchospasm occurred during emergence from general anaesthesia. The patient was treated with multiple doses of albuterol MDI and intravenous hydrocortisone. Symptoms of bronchospasm resumed during several attempts at emergence. A low-dose propofol infusion was started and bronchoscopy revealed erythema and mild oedema in the conducting airways. The patient was transferred to the intensive care unit on propofol sedation. The patient was extubated late on postoperative day 2 and discharged on day 5 without further complications.		

Abbreviations used: ETS, endoscopic thoracic sympathectomy; NS, not significant; QoL, quality of life; VATS, video-assisted thoracoscopic sympathectomy			
Study details	**Key efficacy findings**	**Key safety findings**	**Comments**
Chon S-H (2006)[10] **Case report** South Korea Recruitment period: not reported Study population: patient treated by ETS for axillary hyperhidrosis Age: 44 years, Sex: female Technique: bilateral ETS Conflict of interest/source of funding: not reported.	**Brachial Plexus Injury** Immediately after recovery from anaesthesia, the patient complained of numbness and weakness in her left arm, and physical examination showed a completely flail arm. On postoperative day 6, she had recovered almost all of her arm movement except for axillary nerve function. Complete recovery was noted after 8 weeks.		
Lie D (1999)[11] **Case report** Singapore Recruitment period: not reported Study population: patient treated by ETS for palmar, plantar, and axillary hyperhidrosis Age: 24 years, Sex: male Technique: bilateral ETS at T2 and T3 Conflict of interest/source of funding: not reported.	**Extensor pollicis longus paralysis** After ETS, the patient presented with weakness of his right thumb. There was no paraesthesia or numbness. Power of the fingers was normal. Specifically, there was total paralysis of the extensor pollicis longus of the right thumb. The patient was initially treated with an extensor dynamic splint. At 6-month follow-up, he was not keen for tendon transfer.		

Abbreviations used: ETS, endoscopic thoracic sympathectomy; NS, not significant; QoL, quality of life; VATS, video-assisted thoracoscopic sympathectomy			
Study details	**Key efficacy findings**	**Key safety findings**	**Comments**
Stenson K (2011)[12] **Case report** UK Recruitment period: 2005 Study population: patient treated by ETS for palmar and axillary hyperhidrosis Age: 24 years, Sex: female Technique: bilateral T3 ETS Conflict of interest/source of funding: none.	**Distal upper limb ischaemia** Three weeks after ETS, the patient complained of persistent chest pain, truncal compensatory sweating and an area of hypoaesthesia over the right scapula. All 3 symptoms settled spontaneously. Six months after the procedure, the patient presented with a cold, swollen, painful right hand associated with cyanosis and profound allodynia. Angiography suggested vasospasm of the radial and ulnar arteries. Pharmacological treatment offered no symptomatic improvement. Neuromodulation resulted in complete but transient pain relief. In the 5 years since ETS, the patient has continued to present with recurrent episodes of right distal upper limb ischaemia. The effectiveness of prostacyclin analogue infusions in offering symptomatic relief has diminished over time.		
Sihoe (2007)[13] **Case report** China Recruitment period: not reported Study population: patient treated by ETS for axillary hyperhidrosis Age: 28 years, Sex: male Technique: bilateral VATS, sympathetic trunks from lower border of the second rib to the fifth rib were excised. Conflict of interest/source of funding: none.	**Heatstroke** After ETS, the patient had anhidrosis in both axillae, both upper limbs, the upper chest, and head and neck. He had severe compensatory sweating over his abdomen and back. Four years after ETS, the patient presented with heat stroke and syncope after running a 10 km road race. The temperature on the day of the race was between 21° and 26°C with relative humidity between 75% and 95%. On arrival at hospital, the patient's body temperature was 41.8°C and his Glasgow coma score was E4V2M4. He was in shock with a systolic blood pressure of 55 mmHg. He developed multiple organ dysfunction syndrome, with severe renal and hepatic failure, grade II hepatic encephalopathy and disseminated intravascular coagulation. He responded well to aggressive supportive measures and was eventually discharged home after 1 month.		The authors note that a direct causal relationship between ETS and heat stroke and ETS cannot be verified.

Abbreviations used: ETS, endoscopic thoracic sympathectomy; NS, not significant; QoL, quality of life; VATS, video-assisted thoracoscopic sympathectomy			
Study details	**Key efficacy findings**	**Key safety findings**	**Comments**
Celik MR (2012)[14] **Case report** Recruitment period: not reported Study population: patient treated by ETS for palmar hyperhidrosis Age: 16 years, Sex: male Technique: bilateral ETS with monopolar electrocauterisation Conflict of interest/source of funding: none.	**Paraparesis** After recovering from anaesthesia, the patient had a dropped right foot. MRI showed oedema in the central spinal cord at the upper thoracic levels. The patient was treated with anti-inflammatory and anti-oedematous therapy and was discharged on the postoperative day 8. After 3 months, there was no abnormal finding on the MRI.		Conference abstract The authors suggest this complication was due to the use of monopolar electrocautery.

Efficacy

Symptom relief

A non-randomised comparative study of 154 patients with palmar hyperhidrosis treated by endoscopic thoracic sympathectomy (ETS) or botulinum-toxin A injection reported statistically significant improvements in both groups at 6- and 12-month follow-up, assessed objectively using an iodine starch test and pad glove test ($p<0.05$). The improvement was significantly higher in the ETS group than the botulinum-toxin A injection group (94% change versus 30% change on the iodine starch test respectively, $p=0.01$)[1].

A case series of 453 patients with palmar, axillary or facial sweating reported complete bilateral remission in 97% (441/453) of patients at 5-year follow-up[2].

A case series of 406 patients with palmar and/or axillary hyperhidrosis reported that 91% (n=239) of patients treated by conventional ETS had dry limbs at mean follow-up of 16.7 years; 93% (n=67) of patients treated by video-assisted ETS had dry limbs at a mean follow-up of 1.8 years[3].

A case series of 1700 patients reported that 85% of patients had a satisfactory and lasting effect of the procedure, or some increase in sweating or blushing that they did not consider a problem, at a mean follow-up of 14.6 years[6].

Patient satisfaction

The non-randomised comparative study of 154 patients with palmar hyperhidrosis treated by ETS or botulinum-toxin A injection reported a statistically significant higher mean satisfaction score for ETS at 12-month follow-up (4.52 versus 3.12 respectively [score range 1 to 5 with 1 being very poor and 5 being excellent], $p=0.001$)[1].

The case series of 1700 patients reported satisfaction rates of 87% of patients with palmar hyperhidrosis, 67% for patients with axillary hyperhidrosis and 74% for patients with facial hyperhidrosis ($p<0.001$). Overall, 75% of patients stated that the procedure had improved their quality of life[6].

Recurrence rates

A case series of 2000 patients reported recurrence rates of 1% for patients with palmar hyperhidrosis and 17% for patients with axillary hyperhidrosis at 5-year follow-up[4].

A case series of 9988 patients with palmar hyperhidrosis reported recurrence rates of about 1% at 1-year follow-up and less than 3% at 3-year follow-up[5].

Quality of life

The case series of 453 patients with palmar, axillary or facial hyperhidrosis reported that 91% (412/453) had better quality of life 30 days after ETS and 90% (409/453) had better quality of life 5 years after ETS. All patients had poor or very poor quality of life at baseline[2].

Safety

Death

The deaths of 9 patients after ETS were described in a review article (denominator unknown); 5 were due to major intrathoracic bleeding (described below), 3 were due to problems related to anaesthetic technique and 1 patient had an unexplained cerebral event 'some hours' after ETS[7].

Intrathoracic bleeding

Death due to intrathoracic bleeding was reported in 5 patients in the review article: in 2 patients, a trocar lacerated the subclavian artery and an intercostal vein was damaged in another patient, the details of the last 2 patients are not known[7]. Venous bleeding of more than 300 ml in the right hemithorax was reported in 1 patient in the case series of 453 patients[2]. Inadvertent traumatic bleeding needing chest tube drainage was reported in 'about 0.1%' of patients in the case series of 9988 patients[5].

Pneumothorax or chylothorax

Pneumothorax that needed to be drained was reported in 0.5% (10/2000) and 1% of patients in 2 case series of 2000 and 406 patients respectively[4,3]. Pneumothorax or haemothorax that needed to be drained was reported in 'about 0.3%' of patients in the case series of 9988 patients[5]. Chylothorax was reported in 3 patients included in the review article, 2 of which were described in more detail: 1 patient needed postoperative tube drainage and parenteral nutrition for 6 days and in 1 patient the leak was recognised at surgery and the thoracic duct was clipped[7].

Intraoperative cardiac arrest

Intraoperative cardiac arrest was reported in 2 case reports. Both patients recovered after cardiopulmonary resuscitation[8].

Sinus bradycardia

Sinus bradycardia was reported in 1 patient in the case series of 453 patients[2].

Segmental atelectasis

Segmental atelectasis was reported in 0.4% (7/2000) of patients in the case series of 2000 patients[4].

Horner's syndrome

Horner's syndrome was reported in less than 0.1%, 0.2% (1/453) and 2.2% in the 3 case series of 9988, 453, and 406 patients respectively[5,2,3]. There were no cases of Horner's syndrome reported in the case series of 2000 patients[4].

Compensatory hyperhidrosis

Compensatory hyperhidrosis was reported in 74% (1265/1700), 86% (1720/2000) and 92% (416/453) of patients in 3 case series[6,4,2]. In 2 of these studies, 33% (557/1700 and 150/453) of patients reported compensatory hyperhidrosis that was either 'severe' or 'incapacitating'. Of the 11% (190/1700) of patients in one of these case series who reported 'incapacitating' compensatory hyperhidrosis, 10% were satisfied with the procedure[6].

The case series of 453 patients reported that 2% (7/453) of patients were dissatisfied with the results at 5-year follow-up. These patients had severe compensatory hyperhidrosis and said that they regretted having undergone ETS[2].

The case series of 406 patients reported that 7% (n=17) of patients treated by conventional ETS were dissatisfied and regretted the operation at mean follow-up of 16.7 years[3].

Wound infection

Wound infection was reported in 0.1% (2/2000) of patients in the case series of 2000 patients[4].

Other

Other adverse events reported in case reports and in the review included surgical emphysema, pleural effusion, bronchospasm, severe postoperative pain, brachial plexus injury, extensor pollicis longus paralysis, distal upper limb ischaemia, paraparesis and heatstroke[7,9,10,12,13,14].

Validity and generalisability of the studies

- In the non-randomised comparative study of patients treated by ETS or botulinum-toxin A, patients were responsible for choosing which treatment they received[1].
- Only 1 study reports results from objective assessments[1].
- Few studies described patient selection in any detail.

- Most of the studies are retrospective case series and use data from patient questionnaires, so there may be some recall bias. In one of these studies, a response was obtained from only 56% of the total population of treated patients[6].
- Indications include palmar, axillary and facial hyperhidrosis. The efficacy may vary according to indication.
- A number of case reports of adverse events have been described – in most instances, the denominators for these cases are unknown.
- Different studies use different techniques – the procedure is done at different levels and different methods of dividing the sympathetic chain are described. The complication rates may differ according to the level of sympathectomy. A number of randomised controlled trials (RCTs) comparing different techniques are included in appendix A.

Existing assessments of this procedure

The Canadian Hyperhidrosis Advisory Committee published guidelines on the recognition, diagnosis and severity-based treatment of focal hyperhidrosis in 2007[15]. The recommendations stated: 'The Hyperhidrosis Disease Severity Scale (HDSS) provides a qualitative measure that allows tailoring of treatment. Mild axillary, palmar, and plantar hyperhidrosis (HDSS score of 2) should initially be treated with topical aluminium chloride (AC). If the patient fails to respond to AC therapy, botulinum toxin A (BTX-A; axillae, palms, soles) and iontophoresis (palms, soles) should be the second-line therapy. In severe cases of axillary, palmar, and plantar hyperhidrosis (HDSS score of 3 or 4), both BTX-A and topical AC are first-line therapy. Iontophoresis is also first-line therapy for palmar and plantar hyperhidrosis. Craniofacial hyperhidrosis should be treated with oral medications, BTX-A, or topical AC as first-line therapy. Local surgery (axillary) and endoscopic thoracic sympathectomy (palms and soles) should only be considered after failure of all other treatment options.'

A US expert consensus document from the Society of Thoracic Surgeons published in 2011 states that: 'Studies suggest that primary hyperhidrosis of the extremities, axillae or face is best treated by endoscopic thoracic sympathectomy (ETS). Interruption of the sympathetic chain can be achieved either by electrocautery or clipping. An international nomenclature should be adopted that refers to the rib levels (R) instead of the vertebral level at which the nerve is interrupted, and how the chain is interrupted, along with systematic pre and postoperative assessments of sweating pattern, intensity and quality-of-life. The recent body of literature suggests that the highest success rates occur when interruption is performed at the top of R3 or the top of R4 for palmar-only

hyperhidrosis. R4 may offer a lower incidence of compensatory hyperhidrosis but moister hands. For palmar and axillary, palmar, axillary and pedal and for axillary-only hyperhidrosis interruptions at R4 and R5 are recommended. The top of R3 is best for craniofacial hyperhidrosis.'[16]

A Multi-Specialty Working Group on the Recognition, Diagnosis and Treatment of Primary Focal Hyperhidrosis published a consensus statement in 2004[17]. For axillary hyperhidrosis, the recommendations stated: 'Failure to respond or intolerance to other treatments may be an indication for referral for a surgical procedure. Options include removal of the overactive sweat glands using subcutaneous curettage, tumescent liposuction, limited local incision with removal of the underlying apoeccrine glands, or endoscopic thoracic sympathectomy.

a) The patient should be seen by the surgeon and a dermatologist prior to surgery.

b) Patients must be well informed and willing to accept the surgical risks, such as compensatory hyperhidrosis.'

For palmar hyperhidrosis, the recommendations included: 'Endoscopic thoracic sympathectomy is an option for selected patients who are unable to tolerate other therapies and for whom the burden of hyperhidrosis is severe.

a) Patients should be referred to a dermatologist and informed of the risk-benefits of various options before undergoing surgery.

b) Patients should be informed of the local results of endoscopic thoracic sympathectomy, including primary success rate, adverse event rate, and rate of compensatory hyperhidrosis.'

An ASERNIP-S report published in 2009 concluded: 'A lack of high quality randomised trial evidence on ETS means that it is difficult to make a judgement on the safety and effectiveness of this technique[18]. There is potentially a number of safety issues associated with this procedure. ASERNIP-S suggests that a full systematic review including all available comparative and case series information, together with clinical input, should be undertaken to provide an up-to-date and comprehensive assessment of the safety and effectiveness of ETS.'

The findings by the Swedish Council on Health Technology Assessment (SBU) Alert in 1999 show that 'poor evidence is available about ETS as regards side effects, risks, and short-term effects[19]. There is no scientific evidence demonstrating the long-term results of the method or its cost effectiveness in relation to other methods.

If the results from pilot studies are confirmed by current randomised studies, the method may prove to be a valuable alternative for patients in whom problems persist after traditional therapies have been unsuccessful. Until further notice, the

method should be used only in a controlled way within the framework of scientific studies. An assessment should be carried out addressing treatment benefits in relation to the risks for side effects, direct healthcare costs and socioeconomic effects.'

Related NICE guidance

Below is a list of NICE guidance related to this procedure. Appendix B gives details of the recommendations made in each piece of guidance listed.

Clinical guidelines

Social anxiety disorder: recognition, assessment and treatment. NICE clinical guideline 159 (2013). Available from http://guidance.nice.org.uk/CG159

Specialist advisers' opinions

Specialist advice was sought from consultants who have been nominated or ratified by their specialist society or royal college. The advice received is their individual opinion and does not represent the view of the society.

Mr F Smith (Vascular Society of Great Britain and Ireland), Mr J McGuigan, Mr P Rajesh (Society for Cardiothoracic Surgery in Great Britain and Ireland).

- Two specialist advisers perform the procedure regularly and one performs it intermittently.
- All the advisers consider the procedure to be established practice and no longer new.
- One adviser described standard practice as Botox injections for axillary hyperhidrosis, iontophoresis for palmar hyperhidrosis and topical astringents.
- One adviser noted 'Since surgery for hyperhidrosis is undertaken electively, usually on young fit people for a non-life threatening condition, the surgeon must have insight and awareness into potential deleterious outcomes of surgery. These should be carefully outlined to the patient when obtaining consent for surgery'.
- Theoretical adverse events include potential problems with access and locating the sympathetic chain; arterial bleeding; venous bleeding; arrhythmias and cardiac arrest on division of the sympathetic chain; cerebral oedema related to carbon dioxide (CO_2) insufflation; pulmonary embolus and pulmonary oedema; pneumothorax; subcutaneous emphysema; pleural

effusion; chylothorax; segmental collapse and atelectasis; brachial plexus injury; wound infections; Horner's syndrome; rhinitis; persistent bradycardia.

- Compensatory hyperhidrosis is the most common side effect of sympathetic chain surgery. The condition may be profoundly debilitating and in some patients worse than their original symptoms. Patients should be warned thoroughly about this potential outcome before surgery. Gustatory sweating may occur in some patients on eating hot or spicy food. The mechanism is not clear.
- Anecdotal adverse events include bleeding requiring open thoracotomy, air leaks requiring chest tube insertion, conversion to mini-thoracotomy because of lung adhesions, chest wall pain, transient truncal hyperhidrosis and wound infection.
- Adverse events reported in the literature include 9 deaths after the procedure: 5 from haemorrhage, 3 from anaesthetic problems with unrecognised hypoxia after double lumen tube anaesthesia for bilateral procedures, and 1from unexplained collapse hours post-procedure. Other adverse events reported in the literature include Horner's syndrome, transient truncal hyperhidrosis, and chest-wall paraesthesia.
- The key efficacy outcomes include reduction in hyperhidrosis and patient satisfaction, with reduction in the Hyperhidrosis Disease Severity Scale.
- Failures and recurrence may occur because of failure to identify the sympathetic chain at surgery, the presence of anomalous anatomy including the nerve of Kuntz, or incomplete disruption of the sympathetic chain or nerve regeneration.
- Training in video-assisted thoracic surgery is required.
- For severe palmar/plantar hyperhidrosis there is debate about the optimal extent of the procedure. This relates to the efficacy of treatment of symptoms balanced against reduction of the risks of side effects or complications of treatment, which include Horner's syndrome and compensatory hyperhidrosis.
- No clear difference has been shown between patient groups in terms of outcome concerning surgical division, thermo-coagulation, ultrasonic or laser

ablation, or clipping of the sympathetic chain. Some authors have, however, suggested that clipping the chain allows an opportunity for procedural reversal by clip removal, should the patient be severely affected by compensatory hyperhidrosis postoperatively. However, such procedures are difficult, must be undertaken in a limited timeframe, and offer no guarantee of reversal of deleterious effects.

- One adviser considers the potential impact of the procedure on the NHS to be major, in terms of numbers of patients eligible for treatment and use of resources; one adviser considers the potential impact to be moderate and one adviser considers the potential impact to be minor.

Patient commentators' opinions

NICE's Public Involvement Programme sent 65 questionnaires to 2 NHS trusts for distribution to patients who had the procedure (or their carers). NICE received 14 completed questionnaires.

The patient commentators' views on the procedure were consistent with the published evidence and the opinions of the specialist advisers. The problem of compensatory sweating was reported frequently. A minority of patients reported regret at having had the procedure.

Issues for consideration by IPAC

- The evidence includes different kinds of hyperhidrosis (palmar, axillary, plantar and facial).
- The main focus of the overview was to look for safety data – hence selection of studies to include large numbers of patients and long follow-up, rather than prioritising the RCTs (over the case series) that compare different levels of sympathectomy.

References

1. Ambrogi V, Campione E, Mineo D et al. (2009) Bilateral thoracoscopic T2 to T3 sympathectomy versus botulinum injection in palmar hyperhidrosis. Annals of Thoracic Surgery 88: 238–45

2. Wolosker N, de Campos JR, Kauffman P et al. (2012) Evaluation of quality of life over time among 453 patients with hyperhidrosis submitted to endoscopic thoracic sympathectomy. Journal of Vascular Surgery 55: 154–6

3. Bischof G, Zacherl J, Fugger R et al. (2005) Endoscopic transthoracic sympathectomy: Current indications and techniques. European Surgery – Acta Chirurgica Austriaca 37: 121–6

4. Lin TS, Kuo SJ, Chou MC. (2002) Uniportal endoscopic thoracic sympathectomy for treatment of palmar and axillary hyperhidrosis: analysis of 2000 cases. Neurosurgery 51: 84–7

5. Kao MC, Lin JY, Chen YL et al. (1996) Minimally invasive surgery: video endoscopic thoracic sympathectomy for palmar hyperhidrosis. Annals of the Academy of Medicine, Singapore 25: 673–8

6. Smidfelt K, Drott C (2011) Late results of endoscopic thoracic sympathectomy for hyperhidrosis and facial blushing. British Journal of Surgery 98: 1719–24

7. Ojimba TA, Cameron AEP (2004) Drawbacks of endoscopic thoracic sympathectomy. British Journal of Surgery 91: 264–9

8. Lin CC, Mo LR, Hwang MH (1994) Intraoperative cardiac arrest: a rare complication of T2,3-sympathicotomy for treatment of hyperhidrosis palmaris. Two case reports. European Journal of Surgery 160: 43-45

9. Hirasuna RR, Lujan E, Birmingham SD et al. (2007) Severe bronchospasm following bilateral T2-T5 sympathectomy. Internet Journal of Anesthesiology 12: DOI: 10.5580/101f

10. Chon SH, Suk Choi MS (2006) Brachial plexus injury with emphasis on axillary nerve paralysis after thoracoscopic sympathicotomy for axillary hyperhidrosis. Surgical Laparoscopy, Endoscopy & Percutaneous Techniques 16: 432–4

11. Lie D, Low CK, Yeo TT (1999) Extensor pollicis longus paralysis following thoracoscopic sympathectomy. Annals of the Academy of Medicine, Singapore 28: 282–3

12. Stenson K, Brownrigg JR, Mohamed M (2011) Occurrence and multiple recurrence of severe vasospasm of the upper extremity following thorascopic sympathectomy for hyperhidrosis. European Journal of Vascular & Endovascular Surgery 41: 264–6

13. Sihoe AD, Liu RW, Lee AK et al. (2007) Is previous thoracic sympathectomy a risk factor for exertional heat stroke? Annals of Thoracic Surgery 84: 1025–7

14. Celik MR, Ulutas H, Kuzucu A (2012) An unexpected complication of monopolar electrocauterization during thoracic sympathectomy. Interactive Cardiovascular and Thoracic Surgery. Conference: 20th European Conference on General Thoracic Surgery Essen Germany. Conference Start: 20120610 Conference End: 20120613.Conference Publication: 15 (S58)

15. 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

16. Cerfolio RJ, De Campos JRM, Bryant AS et al. (2011) The Society of Thoracic Surgeons expert consensus for the surgical treatment of hyperhidrosis. Annals of Thoracic Surgery 91: 1642–8

17. Hornberger J, Grimes K, Naumann M et al. (2004) Recognition, diagnosis, and treatment of primary focal hyperhidrosis. Journal of the American Academy of Dermatology 51: 274–86

18. Watt A, Cameron AL, Maddern GJ. Evidence essential: Endoscopic thoracic sympathectomy. ASERNIP-S report No. 71 Adelaide, South Australia: ASERNIP-S, August 2009

19. Hjalmarsson A. Endoscopic Transthoracic Sympathectomy (ETS). Alert 1999. Online, available from http://www.sbu.se/en/Published/Alert/Endoscopic-transthoracic-sympathectomy-ETS/ [accessed 12 September 2013] (translation of version 1 published on August 30, 1999. The latest version of this report is not available in English)

Appendix A: Additional papers on endoscopic thoracic sympathectomy for primary hyperhidrosis of the upper limb

The following table outlines the studies that are considered potentially relevant to the overview but were not included in the main data extraction table (table 2). It is by no means an exhaustive list of potentially relevant studies. Case series with fewer than 200 patients have not been included unless they report important or unique safety outcomes.

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
RCTs comparing different techniques for ETS			
Bolotin G, Lazarovici H, Uretzky G et al. (2000) The efficacy of intraoperative internal intercostal nerve block during video-assisted thoracic surgery on postoperative pain. Annals of Thoracic Surgery 70: 1872-1875	RCT (+/-internal nerve block) n=32	Thoracoscopic, internal intercostal nerve block with bupivacain 0.5% during VATS is safe and effectively reduced the immediate postoperative pain and analgesic requirements	Larger studies are included.
El-Dawlatly A, Al-Dohayan A, Almajed M et al. (2008) Pain relief following thoracoscopic sympathectomy for palmar hyperhidrosis: a prospective randomised double-blind study. Middle East Journal of Anesthesiology 19: 757-765	RCT (pain relief) n=40	Combination of interpleural bupivacaine and intramuscular ketoprofen provided superior analgesia when compared to each modality alone and was better than intramuscular pethidine injection. Further studies are needed on large sample size.	Small RCT focusing on pain relief.
El-Dawlatly AA, Al-Dohayan A, Samarkandi A et al. (2001) Right vs left side thoracoscopic sympathectomy: effects of CO2 insufflation on haemodynamics. Annales Chirurgiae et Gynaecologiae 90: 206-208	RCT (right vs left TS) n=20	Compared to left side TS, direct compression by CO_2 against the venae cava and right atrium and ventricle during right side TS caused reduction of the venous return and hence low cardiac output, cardiac index and stroke volume.	Small RCT focusing on effects of CO_2 insufflation.

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
RCTs comparing different techniques for ETS			
Fiorelli A, D'Aponte A, Canonico R et al. (2012) T2-T3 sympathectomy versus sympathicotomy for essential palmar hyperhidrosis: comparison of effects on cardio-respiratory function. European Journal of Cardio-Thoracic Surgery 42: 454-461	RCT (excision of 2 and T3 ganglia versus separation of the sympathetic chain) n=45	Sympathectomy may result in a disturbance of bronchomotor tone and cardiac function. Such changes remained at a sub-clinical level and seemed directly correlated with the extension of denervation	Small RCT focused on cardio-respiratory changes and their correlation with the extent of denervation.
Hashmonai M, Kopelman D, Schein M (1994) Thoracoscopic versus open supraclavicular upper dorsal sympathectomy: A prospective randomised trial. European Journal of Surgery, Acta Chirurgica, Supplement: 13-16	RCT (thoracoscopic versus open sympathectomy) n=24	2 significant differences were observed: longer anaesthesia and poorer patient satisfaction in the thoracoscopic group one week after surgery (probably because a higher proportion of cases developed prolonged postoperative chest pain). Both techniques similarly achieve dry hands. The open method is not longer or more difficult, is possibly associated with less morbidity, and gives a higher subjective satisfaction.	Small RCT
Inan K, Goksel OS, Ucak A et al. (2008) Thoracic endoscopic surgery for hyperhidrosis: Comparison of different techniques. Thoracic and Cardiovascular Surgeon 56: 210-213	RCT (resection vs transaction vs ablation vs clipping) n=80	The primary success rate for isolated palmar hyperhidrosis was 96%; for palmar and axillary hydrosis it was 96 % and for palmar and face/scalp hyperhidrosis it was 67%. No recurrence was observed. The overall success rate of the operation was 95% and the differences between the four groups were not statistically significant.	Small RCT comparing different techniques of ETS.
Ishy A, de Campos JR, Wolosker N et al. (2011) Objective evaluation of patients with palmar hyperhidrosis submitted to two levels of sympathectomy: T3 and T4. Interactive Cardiovascular & Thoracic Surgery 12: 545-548	RCT (third vs fourth thoracic ganglion) n=40 Follow-up=12 months	Both techniques were effective in the treatment of palmar hyperhidrosis, generating objective reduction of transepidermal water loss regardless of the ganglion operated. Sympathectomy G3 had a higher incidence of compensatory hyperhidrosis, yet the improvement in QoL was similar in both groups	Small RCT comparing different levels of sympathect-omy.
Katara AN, Domino JP, Cheah WK et al. (2007) Comparing T2 and T2-T3 ablation in thoracoscopic sympathectomy for palmar hyperhidrosis: a randomized control trial. Surgical Endoscopy 21: 1768-1771	RCT (T2 vs T2-T3) n=25 Follow-up=23 months	The findings show that T2 ablation in thoracoscopic sympathectomy for palmar hyperhidrosis is as effective as T2-T3 ablation in terms of symptomatic relief, recurrence, compensatory hyperhidrosis, and patient satisfaction	Small RCT comparing different levels of sympathect-omy.

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
RCTs comparing different techniques for ETS			
Li X, Tu YR, Lin M et al. (2008) Endoscopic thoracic sympathectomy for palmar hyperhidrosis: a randomized control trial comparing T3 and T2-4 ablation. Annals of Thoracic Surgery 85: 1747-1751	RCT (T3 vs T2-4) n=232	The frequency of mild and moderate compensatory sweating was not significantly different between the two groups, but the incidence of severe compensatory sweating was significantly lower after T3 sympathectomy (3% versus 10%). As for satisfaction rate, group T3 was superior to group T2-4 (97% versus 90%). The rate of symptom resolution was 100%, and no recurrence was found in either group.	RCT comparing different levels of sympathect-omy.
Liu Y, Yang J, Liu J et al. (2009) Surgical treatment of primary palmar hyperhidrosis: a prospective randomized study comparing T3 and T4 sympathicotomy. European Journal of Cardio-Thoracic Surgery 35: 398-402	RCT (T3 vs T4) n=141 Follow-up=18 months	T3 and T4 sympathicotomies are both effective for the treatment of PH. T4 sympathicotomy, decreases the side effects but does not compromise the therapeutic effects, and should be the method of choice.	RCT comparing different levels of sympathect-omy.
Lieou FJ, Lee SC, Ho ST et al. (1996) Interpleural bupivacaine for pain relief after transthoracic endoscopic sympathectomy for primary hyperhidrosis. Acta Anaesthesiologica Sinica 34: 21-25	RCT (pain relief) n=60	Interpleural bupivacaine significantly decreased the intensity of postoperative pain and morphine consumption in patients undergoing ETS for palmar hyperhidrosis.	Small RCT focusing on pain relief.
Munia MA, Wolosker N, Kauffman P et al. (2007) A randomized trial of T3-T4 versus T4 sympathectomy for isolated axillary hyperhidrosis. Journal of Vascular Surgery 45: 130-133	RCT (T3-4 vs T4) n=62 Follow-up=6 months	All the patients were successfully treated. Compensatory hyperhidrosis=91% (T3-T4) vs 57% (T4) after 1 month. After 6 months, all the T3-T4 patients presented some degree of compensatory hyperhidrosis vs 13 T4 patients (43%). The severity of the compensatory hyperhidrosis was lower in the T4 patients ($p<0.01$). The quality of life was poor in both groups before the surgery, and was equally improved in both groups after 1 and 6 months of follow-up.	Small RCT comparing different levels of sympathect-omy.

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
RCTs comparing different techniques for ETS			
Munia MA, Wolosker N, Kaufmann P et al. (2008) Sustained benefit lasting one year from T4 instead of T3-T4 sympathectomy for isolated axillary hyperhidrosis. Clinics (Sao Paulo, Brazil) 63: 771-774	RCT (T3-4 vs T4) n=64 Follow-up=1 year	After one year, all T3-T4 patients experienced some degree of compensatory hyperhidrosis, compared to only 14 patients in the T4 group (42%). Compensatory hyperhidrosis was less severe in the T4 patients ($p<0.01$). Quality of life was poor before surgery, and it improved in both groups at six months and one year of follow-up ($p=0.002$). There were no cases of mortality, no significant postoperative complications, and no need for conversion to thoracotomy in either group	Small RCT comparing different levels of sympathect-omy
Yang J, Tan JJ, Ye GL et al. (2007) T3/T4 thoracic sympathictomy and compensatory sweating in treatment of palmar hyperhidrosis. Chinese Medical Journal 120: 1574-1577	RCT n=163 Follow-up=14 months	Palmar hyperhidrosis was cured in all patients. There was no recurrence of palmar hyperhidrosis. The difference of rates of mild CS in groups T(3) and T(4) was of no statistical significance. The rate of moderate CS was significantly lower in group T(4) than in group T(3). No severe CS occurred.	RCT comparing different levels of sympathect-omy.
Yazbek G, Wolosker N, de Campos JR et al. (2005) Palmar hyperhidrosis--which is the best level of denervation using video-assisted thoracoscopic sympathectomy: T2 or T3 ganglion? Journal of Vascular Surgery 42: 281-285	RCT n=60 Follow-up=6 months	Quality of life was very poor in both groups before surgery. One month after operation, quality of life was improved similarly in both groups. This improvement was maintained at 6 months in both groups.	Small RCT comparing different levels of sympathect-omy.
Yazbek G, Wolosker N, Kauffman P et al. (2009) Twenty months of evolution following sympathectomy on patients with palmar hyperhidrosis: sympathectomy at the T3 level is better than at the T2 level. Clinics (Sao Paulo, Brazil) 64: 743-749	RCT (R2 vs R3) n=60 Follow-up=20 months	Both techniques were effective for treating palmar hyperhidrosis. The most frequent complication was compensatory hyperhidrosis, which presented stable incidence and severity over the study period. Sympathectomy at the T3 level presented compensatory hyperhidrosis with less severity. Nevertheless, the improvement in quality of life was similar between the groups	Small RCT comparing different levels of sympathec-tomy.

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Non-randomised comparative studies			
Boley TM, Belangee KN, Markwell S et al. (2007) The effect of thoracoscopic sympathectomy on quality of life and symptom management of hyperhidrosis. Journal of the American College of Surgeons 204: 435-438	Non-randomised comparative study (ETS vs no ETS) n=48	ETS controls palmar hyperhidrosis, and, despite compensatory sweating, patients having the procedure are very satisfied. Patients who did not have surgery have decreased satisfaction, comfort, and QOL, and increased symptoms	Larger studies are included.
Chang YT, Li HP, Lee JY et al. (2007) Treatment of palmar hyperhidrosis: T(4) level compared with T(3) and T(2). Annals of Surgery 246: 330-336	Non-randomised comparative study n=234 Mean follow-up=47 months	Different from the current procedure of T(2) or T(3) sympathectomy for palmar hyperhidrosis, T(4) sympathectomy would be a better and more effective procedure with minimal long-term complications	Larger studies are included.
Chou SH, Kao EL, Lin CC et al. (2006) The importance of classification in sympathetic surgery and a proposed mechanism for compensatory hyperhidrosis: experience with 464 cases. Surgical Endoscopy 20: 1749-1753	Non-randomised comparative study n=464 Follow-up=17 to 35 months	The higher the level of sympathetic ganglion blockade, the higher is the regret rate. Therefore, for T2 and T3 ganglion, endoscopic thoracic sympathetic block by the clipping method is strongly recommended because of its reversibility	Larger studies are included.
Findikcioglu A, Kilic D, Hatipoglu A (2013) Is Clipping Superior to Cauterization in the Treatment of Palmar Hyperhidrosis? The Thoracic Cardiovascular Surgeon DOI: 10.1055/s-0033-1348920	Non-randomised comparative study (clipping vs cauterisation) n=60 FU=mean 33 months	Both clipping and cauterisation are highly effective for the treatment of palmar hyperhidrosis. The methods are comparable in terms of effectiveness and side effects despite the fact that the recurrence rate was higher in the cauterisation group. Potential reversibility of compensatory sweating was not observed.	Small non-randomised comparative study, comparing clipping with cauterisation.
Garcia Franco CE, Perez-Cajaraville J, Guillen-Grima F et al. (2011) Prospective study of percutaneous radiofrequency sympathicolysis in severe hyperhidrosis and facial blushing: efficacy and safety findings. European Journal of Cardio-Thoracic Surgery 40: e146-e151	Non-randomised comparative study (percutaneous RFA versus ETS) n=58	Results support the view that surgical sympathectomy is the gold-standard treatment in severe cases of hyperhidrosis and facial blushing. Radiofrequency sympathicolysis is useful as a second-treatment choice for patients with hyperhidrosis.	Small non-randomised study with mixed indications.

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Non-randomised comparative studies			
Gorur R, Yiyit N, Yildizhan A et al. (2011) Is T3 and T6 sympathetic clipping more effective in primary palmoplantar hyperhydrosis? Thoracic & Cardiovascular Surgeon 59: 357-359	Non-randomised comparative study (T3/4 clipping versus T3 and T6 clipping) n=60	The compensatory sweating (CS) rate was 60% in group A (T3/4) and 47% in group B (T3/6). CS was significantly less in group B compared to group A (p<=0.001). Patient satisfaction rate was 93% in group A and 97% in group B	Small non-randomised study comparing different levels of clipping.
Heidemann E, Licht PB (2013) A comparative study of thoracoscopic sympathicotomy versus local surgical treatment for axillary hyperhidrosis. Annals of Thoracic Surgery 95: 264-268	Non-randomised comparative study (thoracoscopic versus local surgical treatment) n=96 Follow-up=26 months	Local effect was significantly better after axillary surgery compared with sympathicotomy (p<0.001), but mild recurrent axillary symptoms were significantly more frequent after axillary surgery (51% versus 5%, p<0.001). Compensatory and gustatory sweating were significantly more frequent after sympathicotomy (84% versus 25%, p<0.001; and 54% versus 26%, p=0.01, respectively)	Small non-randomised study.
Hsu CP, Shia SE, Hsia JY et al. (2001) Experiences in thoracoscopic sympathectomy for axillary hyperhidrosis and osmidrosis: focusing on the extent of sympathectomy. Archives of Surgery 136: 1115-1117	Non-randomised comparative study (T3-4 vs T4 vs T4-5) n=171	T4-5 sympathectomies provide higher patient satisfaction rates in treating axillary hyperhidrosis and osmidrosis, with fewer sequelae	Non-randomised study comparing different levels of sympathect-omy.
Ibrahim M, Menna C, Andreetti C et al. (2013)Two-stage unilateral versus one-stage bilateral single-port sympathectomy for palmar and axillary hyperhidrosis. Interactive Cardiovascular and Thoracic Surgery 16: 834-838	Non-randomised comparative study (2-stage vs 1-stage) n=270 Follow-up=12.5 months	Both two-stage unilateral and one-stage bilateral single-port video-assisted thoracoscopic sympathectomies are effective, safe and minimally invasive procedures. Two-stage unilateral sympathectomy can be performed with a lower occurrence of compensatory sweating, improving permanently the quality of life in patients with palmar and axillary hyperhidrosis.	Non-randomised study comparing 2-stage unilateral with bilateral ETS.
Isla-Tejera B, Ruano J (2013). Economic Evaluation of Botulinum Toxin Versus Thoracic Sympathectomy for Palmar Hyperhidrosis: Data from a Real-World Scenario. Dermatology and Therapy 3: 63–72	Non-randomised comparative study (ETS vs botulinum toxin) n=228 (128 vs 100) Follow-up=mean 3.7 years	Effectiveness was greater for ETS when compared with botulinum toxin for the treatment of palmar hyperhidrosis (92% vs 68%, odds ratio 6.22 [95% CI 2.8 to 13.8]) Patient satisfaction=8.16 vs 6.66, p<0.001 (0 represented 'totally dissatisfied' and 10 'totally satisfied'	Data were only available for 66% of eligible patients.

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Non-randomised comparative studies			
Kim WO, Kil HK, Yoon KB et al. (2010) Influence of T3 or T4 sympathicotomy for palmar hyperhidrosis. American Journal of Surgery 199: 166-169	Non-randomised comparative study n=119	The rate of dryness and compensatory hyperhidrosis (CH) was significantly lower in the T4 sympathicotomy group than the T3 group (p< .01). Satisfaction rate, recurrence, and improvement of plantar sweating were of no statistical significance in either group.	Non-randomised study comparing different levels of sympathect-omy.
Licht PB, Jorgensen OD, Ladegaard L et al. (2005) Thoracoscopic sympathectomy for axillary hyperhidrosis: the influence of T4. Annals of Thoracic Surgery 80: 455-459	Non-randomised comparative study (T2-4 vs T2-3) n=100 Follow-up=31 months	Compensatory sweating occurred in 90% of patients and was so severe in 61% that they often had to change clothes during the day. There were no significant differences in occurrence or severity of compensatory sweating between the two extents of sympathectomy. Surgical outcome, however, was significantly better after T2-T4 sympathectomy.	Non-randomised study comparing different levels of sympathect-omy.
Mahdy T, Youssef T, Elmonem HA et al. (2008) T4 sympathectomy for palmar hyperhidrosis: looking for the right operation. Surgery 143: 784-789	Non-randomised comparative study (T2 vs T3 vs T4) n=60	Treatment success at follow-up was 90% for the ETS2, 95% for ETS3 patients, and 100% for the ETS4 patients. In the ETS2 and ETS3 groups, a higher rate of overdryness of limbs was observed (35% and 20%, respectively). The compensatory sweating was mild in the ETS4 group, whereas moderate-to-severe reflex sweating was more common in the ETS2 and ETS3 groups. About 40% of ETS2 groups and 25% of ETS3 group patients were unsatisfied with their operation. All patients of the ETS4 group were satisfied with the outcome.	Non-randomised study comparing different levels of sympathect-omy.
Mohebbi HA, Mehrvarz S, Manoochehry, S (2012) Thoracoscopic sympathicotomy vs sympathectomy in primary hyperhidrosis. Trauma Monthly 17: 291-295	Non randomised comparative study (sympathectomy vs sympathicotomy) n=60	There were no significant differences between the two groups in overall early and late satisfaction, gustatory sweating, pompholyx and post-operative pain. There was comparatively less early and late compensatory sweating (C.S.), and other adverse influences of C.S. in the sympathicotomy group.	Small non randomised study comparing different techniques.
Neumayer CH, Bischof G, Fugger R et al. (2001) Efficacy and safety of thoracoscopic sympathicotomy for hyperhidrosis of the upper limb. Results of 734 sympathicotomies. Annales Chirurgiae et Gynaecologiae 90: 195-199	Non-randomised comparative study (conventional ETS vs video-assisted) n=406 Median follow-up=16 years	In the conventional group (CTS) Horner's syndrome occurred in 2% and rhinitis in 10% of procedures. No patient of the VATS group experienced Horner's syndrome (p= 0.025), 3 patients developed rhinitis (p=0.11). At follow-up compensatory sweating was observed in 68% vs. 56% (p=0.051) and gustatory sweating in 50% and 33% (p = 0.01). There were 5 failures or recurrences (2%) in the CTS group and 2 in the VATS group at reevaluation. Overall 7% (CTS) and 6% (VATS) of patients regret the operation (p = 0.7)	A more recent study from the same centre is included.

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Non-randomised comparative studies			
Neves S, Uchoa PC, Wolosker N et al. (2012) Long-term comparison of video-assisted thoracic sympathectomy and clinical observation for the treatment of palmar hyperhidrosis in children younger than 14. Pediatric Dermatology 29: 575-579	Non-randomised comparative study (ETS vs observation) n=45 Follow-up=4 years	83% (25/30) of patients in the ETS group experienced great improvement in palmar hyperhidrosis, and 17% (5/30) experienced partial improvement; 80% (12/15) of children from the control group had some type of improvement, and 20% (3/15) had partial improvement. 13% of children in the control group and 77% in the VATS group had great improvement in QOL. For children with PH and poor QOL, VATS is better than no treatment. It produces better results with regard to sweating and greater improvement in QOL.	Small non-randomised study comparing ETS with clinical observation.
Reisfeld R (2006) Sympathectomy for hyperhidrosis: should we place the clamps at T2-T3 or T3-T4? Clinical Autonomic Research 16: 384-389	Non-randomised comparative study (T2-T3 vs T3-T4) n=1274	Overall satisfaction was higher in the T3-T4 group. Severe compensatory sweating was more common in the T2-T3 group. Around 2% of patients requested a reversal of their surgery.	Larger studies are included.
Reisfeld R, Nguyen R, Pnini A (2002) Endoscopic thoracic sympathectomy for hyperhidrosis: experience with both cauterization and clamping methods. Surgical Laparoscopy, Endoscopy & Percutaneous Techniques 12: 255-267	Non-randomised comparative study n=1312	Endoscopic thoracic sympathectomy with clamping appears to be at least as safe and effective as earlier cauterization techniques, with the potential advantage of reversibility in those patients unhappy with the outcome.	Larger studies are included.
Wolosker N, Yazbek G, Ishy A et al. (2008) Is sympathectomy at T4 level better than at T3 level for treating palmar hyperhidrosis? Journal of Laparoendoscopic & Advanced Surgical Techniques Part (1): 102-106	Non-randomised comparative study n=67 Follow-up=6 months	ETS at either the T3 or T4 level provides an effective treatment for palmar hyperhidrosis. ETS at the T4 level is associated with a less severe form of compensatory hyperhidrosis (CH). Despite the occurrence of CH, patients' quality of life is significantly improved following VTS at the T3 or T4 levels.	Small non-randomised study comparing different levels of sympathectomy.

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Non-randomised comparative studies			
Zacherl J, Imhof M, Huber E et al. (1999) Video assistance reduces complication rate of thoracoscopic sympathicotomy for hyperhidrosis. Annals of Thoracic Surgery 68: 1177-1181	Non-randomised comparative study n=369 Follow-up=16 years	Dry limbs were immediately achieved in 93% of the conventional ETS (CTS) group and 98% VATS group (p=0.98). In the CTS group, Horner's syndrome occurred after 2% of all operations and rhinitis in 8%. No patient in the VATS group showed any symptom of Homer's triad (p=0.03 versus CTS group) or rhinitis (p=0.02 versus CTS group). Compensatory sweating was observed in 67% in the CTS group versus 69% in the VATS group (p=0.73) and gustatory sweating, in 50% versus 28%, respectively (p=0.01).	Non-randomised study comparing conventional ETS with video-assisted ETS.
Case series			
Baumgartner FJ and Toh Y (2003) Severe hyperhidrosis: clinical features and current thoracoscopic surgical management. Annals of Thoracic Surgery 76: 1878-1883	Case series n=309	Sympathectomy at the level of the T2-T3 ganglia is curative for palmar hyperhidrosis (PH), and in 80% of instances will improve plantar hyperhidrosis when in combination with PH. Sympathectomy for axillary hyperhidrosis is not as effective as for PH. Compensatory hyperhidrosis is common, occurring in nearly half, but only rarely is extreme and problematic.	Larger case series are included.
Bell D, Jedynak J, Bell R (2013) Predictors of outcome following endoscopic thoracic sympathectomy. ANZ Journal of Surgery doi: 10.1111/ans.12098	n=210 (palmar, axillary, facial/scalp hyperhidrosis and facial blushing Follow up=not reported	Patient satisfaction following ETS is highest among younger patients and those undergoing the procedure for palmar hyperhidrosis. Dissatisfaction arises from failure to achieve the desired aim as well as the development of severe compensatory sweating, which is more common in older patients and those undergoing ETS for axillary and scalp/facial hyperhidrosis.	Larger case series are included in table 2.
Cameron A EP (1998) Complications of endoscopic sympathectomy. European Journal of Surgery 164: 33-35	Case series n=4	1 inappropriate ETS resulted in disabling hyperhidrosis; 1 laceration of the subclavian artery needed major surgery; 2 intraoperative cerebral damage.	A later review by the same author is included. Safety events are already described in table 2.

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Case series			
Chuang K-S, Liu J-C (2002) Long-term Assessment of Percutaneous Stereotactic Thermocoagulation of Upper Thoracic Ganglionectomy and Sympathectomy for Palmar and Craniofacial Hyperhidrosis in 1742 Cases. Neurosurgery 51: 963–70	Case series n=1742 Follow-up=2 to 59 months	Initial success rate=99.5% (3465/3484 sides). Recurrence rate=8% (268/3484 procedures). All patients in whom hyperhidrosis recurred were retreated successfully, resulting in a final success rate of 99.9%. Complications: pneumothorax (0.2%) and partial Horner's syndrome (0.2%). Decreased plantar sweating was noted during follow-up in 92% of patients.	Larger studies are included.
Chwajol M, Barrenechea IJ, Chakraborty S et al. (2009) Impact of compensatory hyperhidrosis on patient satisfaction after endoscopic thoracic sympathectomy. Neurosurgery 64: 511-518	Case series n=220	Some degree of compensatory hyperhidrosis (CH) developed in 94% of patients. Isolated T3 ganglionectomy led to a significantly lower incidence of severe CH, when compared with all other levels ($p<0.03$). 90% of patients were satisfied with the procedure. The development of severe CH significantly correlated with a lower satisfaction rate ($p=0.003$)	Larger studies are included.
Claes G, Drott C, Gothberg G (1993) Endoscopic electrocautery of the thoracic sympathetic chain. A minimally invasive way to treat palmar hyperhidrosis. Scandinavian Journal of Plastic & Reconstructive Surgery & Hand Surgery 27: 29-33	Case series n=450 Follow-up=196 days (median)	Complications: pneumothorax (n = 2), haemothorax (n = 1), and Horner's syndrome (n = 1). Five patients required reoperation (four because of primary failure to destroy the nerve and one for recurrent symptoms). At follow-up all patients but three, who are awaiting reoperation were satisfied with the result.	Studies with longer follow-up are included.
Cohen Z, Mares AJ (1997) Endoscopic procedures to the thoracic sympathetic chain in children. Pediatric Endosurgery and Innovative Techniques.1: 245-250	Case series >200	No conversions to open technique. Two patients required intercostal drainage for a residual pneumothorax. Over 98% of patients were satisfied with the results.	Larger studies are included.
Cohen Z, Levi I, Pinsk I et al. (1998) Thoracoscopic upper thoracic sympathectomy for primary palmar hyperhidrosis--the combined paediatric, adolescents and adult experience. European Journal of Surgery, Acta Chirurgica, Supplement (580) 5-8.	Case series n=223	Three patients with residual pneumothorax required intercostal drainage. 219 patients (98%) were completely satisfied, having immediate and permanent relief of palmar sweating. Four patients were dissatisfied.	Larger studies are included.

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Case series			
De Andrade Filho LO, Kuzniec S, Wolosker N et al. (2013) Technical difficulties and complications of sympathectomy in the treatment of hyperhidrosis: An analysis of 1731 cases. Annals of Vascular Surgery 27: 447-453	Case series n=1731	Complications: postoperative pain=97%, pneumothorax with chest drainage=4%, neurologic disorders involving the upper limbs=2%, Horner's syndrome=1%, significant bleeding=<1%, and 1 patient had extensive subcutaneous emphysema. Compensatory hyperhidrosis=88% (27% severe); gustatory sweating=19% 3% of patients expressed regret for undergoing surgery. No deaths occurred in this series.	Larger studies are included.
de Campos JR, Wolosker N, Yazbek G et al. (2010) Comparison of pain severity following video-assisted thoracoscopic sympathectomy: electric versus harmonic scalpels. Interactive Cardiovascular & Thoracic Surgery 10: 919-922	Case series n=1515	Only 152 patients did not present postoperative pain. There was no difference between harmonic and electric scalpel use in the levels of thoracic pain during the first 30 days after ETS.	Larger studies are included.
De Campos JRM, Kauffman P, Wolosker N et al. (2006) Axillary hyperhidrosis: T3/T4 versus T4 thoracic sympathectomy in a series of 276 cases. Journal of Laparoendoscopic and Advanced Surgical Techniques16: 598-603	Case series n=276 Follow-up=24 months (mean)	The immediate therapeutic success rate was 100% in both groups. There were recurrences in 7 (3%) patients, all from the T3/T4 group. The satisfaction rate was higher and more stable in the T4 group and compensatory sweating was lower in the T4 group.	Larger studies are included.
De Campos JRM, Wolosker N, Munia MAS et al. (2011) Is age group a predictive factor for satisfaction among patients undergoing sympathectomy to treat hyperhidrosis? Jornal Vascular Brasileiro10: 284-288	Case series n=1644 Follow-up=30 days	Patients with primary hyperhidrosis experience quality of life improvement after thoracic sympathectomy regardless of their age	Studies with longer follow-up are included.
De Campos JRM, Kauffman P et al. (2003) Quality of life, before and after thoracic sympathectomy: Report on 378 operated patients. Annals of Thoracic Surgery 76: 886-891	Case series n=378 Follow-up=12 months	The recurrence rates were 8% for palmar hyperhidrosis, 14% for pure axillary hyperhidrosis, 28% of which were reoperated successfully. Improvement of plantar hyperhidrosis was also registered in 58%. Horner's syndrome was reported in 1% with regression in half of them after 30 days. No mortality or serious complications were observed. 86% of patients noted improvement after the procedure.	Larger studies are included.

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Case series			
Drott C, Claes G (1996) Hyperhidrosis treated by thoracoscopic sympathicotomy. Cardiovascular Surgery 4: 788-790	Case series n=1163 Follow-up=31 months (median)	No mortality or life-threatening complications. <1% of patients needed intercostal drainage because of haemo- or pneumothorax. Horner's syndrome occurred in four cases. Primary failure occurred in < 2% of patients and < 2% developed recurrent symptoms. At the end of postoperative follow-up, 98% of the patients were satisfied.	Studies with longer follow-up are included.
Drott C, Gothberg G, Claes G (1995) Endoscopic transthoracic sympathectomy: an efficient and safe method for the treatment of hyperhidrosis. Journal of the American Academy of Dermatology 33: 78-81	Case series n=850 Follow-up=31 months (median)	No mortality or life-threatening complications. 1% of patients needed intercostal drainage because of haemothorax or pneumothorax. Treatment failure occurred in 2% of patients and symptoms recurred in 2% of patients. At the end of follow-up 98% of the patients reported satisfactory results	Studies with longer follow-up are included.
Fischel R, Cooper M, Kramer D (2003) Microinvasive resectional sympathectomy using the harmonic scalpel. A more effective procedure with fewer side effects for treating essential hyperhidrosis of the hands, face or axillae. Clinical Autonomic Research 13 Suppl-70	Case series n=486	100% relief of sweating was noted in all cases. For axillary sweating the addition of T4 resection resulted in complete relief of axillary hyperhidrosis symptoms. Overall compensatory sweating rate was approximately 18% with significant compensatory sweating occurring in less than 2% of patients.	Larger studies are included.
Fredman B, Zohar E, Shachor D et al. (2000) Video-assisted transthoracic sympathectomy in the treatment of primary hyperhidrosis: friend or foe? Surgical Laparoscopy, Endoscopy & Percutaneous Techniques 10: 226-229	Case series n=336 Follow-up= at least 6 months	Questionnaire survey (54% response rate) 97% ($p< 0.0001$) and 29% ($p<0.001$) of patients reported significant improvement in palmar hyperhidrosis and axillary sweating, respectively. Postsurgery, severe compensatory sweating was experienced in 90% of patients ($p<0.0001$). 11% of patients regretted having undergone the surgical procedure. 25% and 64% of patients were either satisfied or very satisfied with the outcome of the procedure.	Larger studies are included.

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Case series			
Gossot D, Galetta D, Pascal A et al. (2003) Long-term results of endoscopic thoracic sympathectomy for upper limb hyperhidrosis. Annals of Thoracic Surgery 75: 1075-1079	Case series n=125 Follow-up=4 years	Recurrence rate=9%: 7% for palmar hyperhidrosis and 65% for axillary hyperhidrosis. Compensatory sweating was observed in 86% of the patients. It was considered as minor by 61% of them, as embarrassing by 32%, and as disabling by 8%. Other reported side effects were: Horner's syndrome (2%); chronic rhinitis (2%); gustatory sweating (7%); and hand dryness in 42%. 65% of patients were fully satisfied, 29% were globally satisfied, and 6% regretted the operation.	Larger studies are included.
Gossot D, Kabiri H, Caliandro R et al. (2001) Early complications of thoracic endoscopic sympathectomy: a prospective study of 940 procedures. Annals of Thoracic Surgery 71: 1116-1119	Case series n=467 Follow-up=1 month	3 major complications: 1 tear of the right subclavian artery and 2 chylothoraces. Bleeding (300 to 600 ml) =5% (controlled thoracoscopically), pneumothorax=1% (4 needed chest drainage for <24 hours). One patient had a mild pleural effusion. Horner Syndrome=0.4% (disappeared within 3 months in 2 patients. The other 2 patients were lost to follow-up). One patient complained of rhinitis.	Larger studies are included.
Herbst F, Plas EG, Fugger R et al. (1994) Endoscopic thoracic sympathectomy for primary hyperhidrosis of the upper limbs. A critical analysis and long-term results of 480 operations. Annals of Surgery 220: 86-90	Case series n=323 Mean follow-up=14.6 years	No postoperative mortality and no major complications. 98% of patients were relieved, and 96% were satisfied initially. Permanent side effects included compensatory sweating in 67%, gustatory sweating in 51% and Horner's trias in 3%. Patient satisfaction declined over time, although only 2% recurred. This left only 67% satisfied, and 27% partially satisfied. Compensatory and gustatory sweating were the most frequently stated reasons for dissatisfaction. Individuals operated for axillary hyperhidrosis without palmar involvement were significantly less satisfied (33% and 46%, respectively)	Larger studies are included.
Kao MC, Chern SH, Cheng LC et al. (1994) Video thoracoscopic laser sympathectomy for palmar hyperhidrosis. Annals of the Academy of Medicine, Singapore 23: 38-42	Case series n=300	Compensatory hyperhidrosis occurred in about half of the cases. Two-thirds of the patients were followed up for more than 12 months and only 3 had recurrence. The technique is considered to be a minor and safe procedure and able to achieve a definite and long-lasting therapeutic effect. It causes minimal discomfort and scarring.	A larger study from the same centre is included in table 2.

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Case series			
Karplus G, Kleiner O, Newman N et al. (2005) Twelve years of minimally invasive surgery in children and adolescents: A single center experience. Journal of Laparoendoscopic and Advanced Surgical Techniques – Part A.15: 419-423	Case series n=746 procedures (ETS)	All patients in this series were well at follow-up and there was no long-term morbidity.	Includes other laparoscopic procedures.
Kwong KF, Hobbs JL, Cooper LB et al. (2008) Stratified Analysis of Clinical Outcomes in Thoracoscopic Sympathicotomy for Hyperhidrosis. Annals of Thoracic Surgery 85: 390-394	Case series n=304 Follow-up=at least 6 months	Significant improvement in quality of life can result from surgery for hyperhidrosis. However, the incidence of postoperative compensatory sweating may be dependent on the level of sympathicotomy performed.	Larger studies are included.
Leao LE, de Oliveira R, Szulc R et al. (2003) Role of video-assisted thoracoscopic sympathectomy in the treatment of primary hyperhidrosis. Sao Paulo Medical Journal = Revista Paulista de Medicina 121: 191-197	Case series n=743	The surgery was regarded as efficient in all cases of palmar hyperhidrosis. In the craniofacial hyperhidrosis cases, partial recurrence of the symptoms occurred in 2 cases (3%). Partial recurrence or persistence of symptoms occurred in 20% of the patients with predominantly axillary symptomatology. The compensatory sweating was considered disagreeable or uncomfortable by about 30% of the patients, but it only reached the level of regretting the operation for 3% of them. This occurred more frequently in patients with axillary hyperhidrosis.	Larger studies are included.
Lee DY, Hong YJ, Shin HK (1999) Thoracoscopic sympathetic surgery for hyperhidrosis. Yonsei Medical Journal 40: 589-595	Case series n=1167	Recurrence=1% (14/1167) (treated successfully by reoperation with ETS) Long-term satisfaction rates: 98% for palmar hyperhidrosis, 92% for craniofacial hyperhidrosis and 89% for axillary hyperhidrosis.	Larger studies are included.

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Case series			
Lee LS, Ng SM, Lin CC (1994) Single-lumen endotracheal intubated anaesthesia for thoracoscopic sympathectomy--experience of 719 cases. European Journal of Surgery, Acta Chirurgica, Supplement: 27-31	Case series n=719 procedures	Single-lumen endotracheal intubated anaesthesia is safe and economic for thoracoscopic sympathicotomy	Larger studies are included.
Licht PB, Pilegaard HK (2006) Gustatory side effects after thoracoscopic sympathectomy. Annals of Thoracic Surgery 81: 1043-1047	Case series n=238 Follow-up=17 months	Overall, gustatory sweating occurred in 32% of patients, and the incidence was significantly associated with extent of sympathectomy (p=0.04).	Larger studies are included.
Lin CC, Mo LR, Lee LS et al. (1998) Thoracoscopic T2-sympathetic block by clipping--a better and reversible operation for treatment of hyperhidrosis palmaris: experience with 326 cases. European Journal of Surgery, Acta Chirurgica, Supplement (580) 13-16	Case series n=326 Follow-up=6 months to 1 year	Good results and few complications were noted during follow up. 2% (5/326) of patients had the operation reversed because of intolerable compensatory sweating.	Larger studies are included.
Lin T-S, Fang H-Y, Cheng C-Y et al. (1999) Transthoracic endoscopic sympathectomy for palmar and axillary hyperhidrosis (Analysis of 1600 cases). Formosan Journal of Surgery 32: 76-83	Case series n=1600 Follow-up=26 months	Compensatory sweating=88% Patient satisfaction=95% for palmar hyperhidrosis, 94% for axillary hyperhidrosis, and 67% for patients with axillary hyperhidrosis and osmidrosis. Ablation of T2 ganglion via ETS is a safe, and effective method in treating patients with palmar hyperhidrosis and a similar procedure on T2-3 ganglia is also practical for patients with AH without osmidrosis. But only ablation of T3 ganglion might be inadequate for patients with AH with osmidrosis.	Larger studies are included.
Lin T-S, Lai C-Y, Hou C-T et al. (2001) Endoscopic thoracic sympathetic block using clipping for palmar and axillary hyperhidrosis. Formosan Journal of Surgery 34: 192-197	Case series n=250 Follow-up=24 months	Improvement of palmar or axillary hyperhidrosis was obtained in all patients. 85% (212/250) of patients developed compensatory sweating. One patient with palmar hyperhidrosis received a reverse operation which included the removal of the endo clips. The patient had improvement of compensatory sweating 14 days after removal of the endo clips.	Larger studies are included.

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Case series			
Lin TS (1999) Transthoracic endoscopic sympathectomy for palmar and axillary hyperhidrosis in children and adolescents. Pediatric Surgery International 15: 475-478	Case series n=438 Follow-up=25 months	The result was highly satisfactory in 408 patients (93%), although 377 (86%) developed compensatory sweating. The recurrence rate of palmar hyperhidrosis was <1% in the 1st, 1% in the 2nd, and 2% in the 3rd year.	Larger studies are included.
Lin TS, Fang HY (1999) Transthoracic endoscopic sympathectomy in the treatment of palmar hyperhidrosis--with emphasis on perioperative management (1,360 case analyses). Surgical Neurology 52 (5) 453-457	Case series n=1360 Follow-up=28 months	1,292 patients (95%) had highly satisfactory results, although 1,140 patients (84%) developed compensatory sweating. The recurrence rates of PH were <1% in the first year, <1% in the second year, and 1% in the third year	Larger studies are included.
Lin TS (1999) Transthoracic endoscopic sympathectomy for palmar hyperhidrosis in children and adolescents: analysis of 350 cases. Journal of Laparoendoscopic & Advanced Surgical Techniques Part (4) 331-334	Case series n=350 Follow-up=25 months	The result was highly satisfactory in 95% (331/350) of patients although 301 patients (86%) developed compensatory sweating. The recurrence rates of palmar hyperhidrosis were <1% in the first year, 1% in the second year, and 2% in the third year.	Larger studies are included.
Lin TS, Wang NP, Huang LC (2001) Pitfalls and complication avoidance associated with transthoracic endoscopic sympathectomy for primary hyperhidrosis (analysis of 2200 cases). International Journal of Surgical Investigation 2 (5) 377-385	Case series n=2200	Successful sympathectomy were achieved up to 2178 patients (99%). Surgical complications included pneumothorax (10 patients, 0.5%), haemothorax (2 patients, 0.1%) segmental atelectasis (12 patients, 0.6%), mild wound infection (3 patients, 0.1%) and compensatory sweating (1936 patients, 88%).	A more recent study from the same author is included.
Miller DL, Bryant AS, Force S et al. (2009) Effect of sympathectomy level on the incidence of compensatory hyperhidrosis after sympathectomy for palmar hyperhidrosis. Journal of Thoracic & Cardiovascular Surgery 138: 581-585	Case series n=282	Compensatory hyperhidrosis continues to occur after sympathectomy for palmar hyperhidrosis; however, a significant reduction in incidence can be achieved by dividing the sympathetic chain at a single level (T2). Patients who are older and/or have increased body mass index should be warned of their increased risk of compensatory hyperhidrosis after sympathectomy.	Larger studies are included.

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Case series			
Moya J, Ramos R, Morera R et al. (2006) Thoracic sympathicolysis for primary hyperhidrosis: a review of 918 procedures. Surgical Endoscopy 20: 598-602	Case series n=458	The anhydrosis rate was 9%, with a hypohidrosis rate of 2% and a failure rate of 0.2%. The rate of major perioperative complications with conversion to thoracotomy was 0.4%. The overall rate of postoperative complications was 3.6%. The complications and rates observed were as follows: pneumothorax (2%), subcutaneous emphysema (1%), pleural bleeding (0.2%), haemothorax (0.1%), and atelectasis (0.1%). Compensatory hyperhidrosis was observed in 48% of the patients, but the sensation of compensatory hyperhidrosis was reported in 86% of the cases. Excessive dryness of the hands was reported in 0.4%, Horner's syndrome in 0.3%, and gustatory hyperhidrosis in 1% of the cases. The overall satisfaction rate was 89%	Larger studies are included.
Oncel M, Sunam GS, Erdem E et al. (2013) Bilateral thoracoscopic sympathectomy for primary hyperhydrosis: A review of 335 cases. Cardiovascular Journal of Africa 24: 137–40	Case series n=335 FU=mean 24 months	The initial cure rate was 95% and the initial satisfaction rate was 93%. There was no mortality in this study. The complication rate was 15.8% in 53 patients. Despite the appearance of postoperative complications, such as compensatory sweating, patient satisfaction with the procedure was high and their quality of life improved.	Larger case series are included in table 2.
Plas EG, Fugger R, Herbst F et al. (1995) Complications of endoscopic thoracic sympathectomy. Surgery 118: 493-495	Case series n=412	Asymptomatic pneumothorax=4%, cutaneous emphysema=2%, pleural effusion=1%, and segmental atelectasis in <1% of the procedures. One case of bleeding from an intercostal vessel occurred (0.1%). A permanent Homer's ptosis was seen in 2% of the patients.	Larger studies are included.
Prasad A, Ali M, Kaul S (2010) Endoscopic thoracic sympathectomy for primary palmar hyperidrosis. Surgical Endoscopy 24: 1952-1957	Case series n=322	All patients had immediate cessation of palmar hyperhidrosis. Compensatory hyperhidrosis=63%	Larger studies are included.
Ramos R, Moya J, Macia I et al. (2007) Anatomical redistribution of sweating after T2-T3 thoracoscopic sympathicolysis: a study of 210 patients. Surgical Endoscopy 21: 2030-2033	Case series n=210	Bilateral upper thoracic sympathicolysis is followed by redistribution of body perspiration, with a clear decrease in the zones regulated by mental or emotional stimuli, and an increase in the areas regulated by environmental stimuli.	Larger studies are included.

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Case series			
Reisfeld R, Nguyen R, Pnini A (2000) Endoscopic thoracic sympathectomy for treatment of essential hyperhidrosis syndrome: experience with 650 patients. Surgical Laparoscopy, Endoscopy & Percutaneous Techniques 10: 5-10	Case series n=650	Palmar and facial hyperhidrosis were resolved in 584 of 585 (>99%) and 62 of 65 (95%) patients, respectively. Compensatory sweating was observed in 83% of patients and was considered mild or moderate in approximately 67% of those patients	Larger studies are included.
Rex LO, Drott C, Claes G et al. (1998) The Boras experience of endoscopic thoracic sympathicotomy for palmar, axillary, facial hyperhidrosis and facial blushing. European Journal of Surgery, Acta Chirurgica, Supplement: 23-26	Case series n=1152 Follow-up=38 months	Overall effect rate and satisfaction rate were: 99% and 87% for palmar hyperhidrosis; 95% and 68% for axillary hyperhidrosis; 97% and 76% for facial hyperhidrosis; 96% and 85% for facial blushing.	Larger studies are included.
Rodriguez PM, Freixinet JL, Hussein M et al. (2008) Side effects, complications and outcome of thoracoscopic sympathectomy for palmar and axillary hyperhidrosis in 406 patients. European Journal of Cardio-Thoracic Surgery 34: 514-519	Case series n=406 Follow-up=1 year	Complication rate=6% (pneumothorax being the most frequent). The success rate after discharge, 6 and 12 months was respectively, 100%, 98% and 97% for palmo-axillary hyperhidrosis; 100%, 99% and 98% for isolated palmar hyperhidrosis and 100%, 86% and 71% for isolated axillary hyperhidrosis. Global recurrence was 4% (29% axillary hyperhidrosis group). Compensatory sweating (CS) appeared in 55% and was not related to the extension of the TS. Being female was a predisposing factor of CS ($p<0.004$). Excessive dryness appeared at 9% and was associated with extensive TS ($p<0.001$). Satisfaction decreased over time and was associated with recurrence. Quality of life was excellent at discharge, 6 and 12 month in 100%, 100% and 97%, respectively.	Larger studies are included.

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Case series			
Singh B, Moodley J, Allopi L et al. (2006) Horner syndrome after sympathectomy in the thoracoscopic era. Surgical Laparoscopy, Endoscopy and Percutaneous Techniques 16: 222-225	Case series n=567	In 1 patient (during the early part of the technical experience) a unilateral Horner syndrome was noted on the first postoperative day; this effect was noted to have resolved spontaneously within 6 months.	Larger studies are included.
Steiner Z, Kleiner O, Hershkovitz Y et al. (2007) Compensatory sweating after thoracoscopic sympathectomy: an acceptable trade-off. Journal of Pediatric Surgery 42: 1238-1242	Case series n=621 Follow-up=more than 24 months	Questionnaire response rate=43% 89% of patients reported complete symptomatic relief and 8% reported reasonable symptomatic relief. The long-term postoperative satisfaction was high (85%). 41% claimed that their quality of life decreased moderately or severely as a result of CS. 20% would not have undergone the operation in retrospect (31% in adults and 9% in children). The extent of the CS did not change with time in 70% of the patients. It exacerbated in 10% and it diminished in 20%, usually within the first 2 postoperative years.	Larger studies are included.
Steiner Z, Cohen Z, Kleiner O et al. (2008) Do children tolerate thoracoscopic sympathectomy better than adults? Pediatric Surgery International 24: 343-347	Case series n=325 Follow-up=more than 24 months	The rate of compensatory sweating and its severity is tolerated better by children, and their postoperative satisfaction is higher than that of adolescents and adults.	Larger studies are included.
Sugimura H, Spratt EH, Compeau CG et al. (2009) Thoracoscopic sympathetic clipping for hyperhidrosis: long-term results and reversibility. Journal of Thoracic & Cardiovascular Surgery 137: 1370-1376	Case series n=727 Follow-up=10 months	When compared with endoscopic thoracic sympathetic clipping at the T2 or T2+3 levels, endoscopic thoracic sympathetic clipping at the T3+4 level was associated with a higher satisfaction rate, a lower rate of severe compensatory sweating, and a trend toward fewer subsequent reversal procedures. Subjective reversibility of adverse effects after endoscopic thoracic sympathetic clipping was seen in approximately half of the patients who underwent endoscopic removal of surgical clips.	Larger studies are included.

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Case series			
Sung SW, Kim YT, Kim JH (2000) Ultra-thin needle thoracoscopic surgery for hyperhidrosis with excellent cosmetic effects. European Journal of Cardio-Thoracic Surgery 17: 691-696	Case series n=417	There were no cases of bleeding or reoperation or hospital mortality. A large endoscope was required to eliminate the pleural adhesion in fourteen cases (8%). Thoracotomy conversion was needed in 2 patients because of pleural adhesions. Minor complications occurred in 17 patients (4%) (closed thoracostomy=10, peripheral nerve injury=3, pulmonary parenchymal injury=2, Horner's syndrome=2 and atrial fibrillation=1). Recurrence=1% (5/417)	Larger studies are included.
Ueyama T, Matsumoto Y, Abe Y et al. (2001) Endoscopic thoracic sympathicotomy in Japan. Annales Chirurgiae et Gynaecologiae 90: 200-202	Case series n=6776 Follow-up=not reported	There have been no deaths related to ETS. Intraoperative bleeding was reported in 28 cases (0.3%) and an open chest procedure to stop bleeding was required in 6 cases (0.08%). Short term Horner's syndrome after the operation was found in a few cases, however, permanent symptoms were recognized in only 18 (0.3%). The most common postoperative complaint was compensatory sweating.	The paper presents only limited outcomes.
Wait SD, Killory BD, Lekovic GP et al (2010) Thoracoscopic sympathectomy for hyperhidrosis: analysis of 642 procedures with special attention to Horner's syndrome and compensatory hyperhidrosis. Neurosurgery 67: 652-656	Case series n=322 Follow-up=8 months	Thoracoscopic sympathectomy is effective and safe treatment for severe palmar, axillary, and craniofacial HH. Ablating the T5 ganglion tends to increase the severity of compensatory sweating. Sympathectomy led to a higher incidence of ipsilateral Horner's syndrome compared with sympathotomy.	Larger studies are included.
Wolosker N, Yazbek G, de Campos JR et al. (2010) Quality of life before surgery is a predictive factor for satisfaction among patients undergoing sympathectomy to treat hyperhidrosis. Journal of Vascular Surgery 51: 1190-1194	Case series n=1167 Follow-up=30 days	The patients with very poor QOL had much better results in terms of improvement in QOL than did those with poor QOL ($p<.05$). The same result was observed for both the palmar and axillary hyperhidrosis subgroups ($p< .05$).	Studies with longer follow-up are included.

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Case series			
Zacherl J, Huber ER, Imhof M et al. (1998) Long-term results of 630 thoracoscopic sympathicotomies for primary hyperhidrosis: the Vienna experience. European Journal of Surgery, Acta Chirurgica, Supplement (580) 43-46	Case series n=352 Follow-up=16years	68% of patients were fully satisfied, 26% were partially satisfied and would again agree to the operation. In 93% the procedure cured hyperhidrosis permanently. Compensatory and gustatory sweating was observed in 67% and 47% of cases, respectively. Overall success was significantly ($p<0.001$) lower in the group with axillary hyperhidrosis. Main complications: drainage for pneumothorax 1%, Horner's syndrome in 4%, subcutaneous emphysema 2%	Larger studies are included.
Case reports			
Chi L-J, Hsu J-L, Tsai M-D et al. (2003) Position-related brachial plexopathy after thoracoscopic sympathectomy: A case report. Acta Neurologica Taiwanica12: 85-88	Case report n=1	**Position-related brachial plexopathy** Patient made a good recovery within 2 months.	Case report – safety event is already described in table 2
Harris RJD, Benveniste G, Pfitzner J (2002) Cardiovascular collapse caused by carbon dioxide insufflation during one-lung anaesthesia for thoracoscopic dorsal sympathectomy. Anaesthesia and Intensive Care 30: 86-89	Case report n=1	**Bradycardia** During one-lung anaesthesia the insufflation of carbon dioxide into the non-ventilated hemithorax for approximately 60 seconds, using a pressure-limited gas inflow, was accompanied by profound bradycardia and hypotension that resolved promptly with the release of the gas.	Case report – safety outcome already described in table 2.
Lai CL, Chen WJ, Liu YB et al. (2001) Bradycardia and permanent pacing after bilateral thoracoscopic T2-sympathectomy for primary hyperhidrosis. Pacing & Clinical Electrophysiology 24: t-5	Case report n=1	**Bradycardia and permanent pacing** Marked sinus bradycardia with a mean heart rate of 49 beats/min occurred after the procedure and persisted for > 2 years. Normal sinus node function was found by an invasive electrophysiological study and unopposed vagotonia after sympathectomy was diagnosed. A permanent pacemaker was implanted.	Case report – safety outcome is already described in table 2.
Lee PH, Hsieh LF, Hong CZ. (2003) Unilateral brachial plexus injury as a complication of thoracoscopic sympathectomy for hyperhidrosis: a case report. Archives of Physical Medicine & Rehabilitation 84: 1395-1398	Case report n=1	**Brachial plexus injury** A 26-year-old man developed weakness and numbness of the right arm after ETS for hyperhidrosis. Electromyographic study revealed evidence of denervation in the upper trunk of the right brachial plexus. There was almost complete recovery 3 months later.	Case report – safety outcome is already described in table 2.

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Case reports			
Lowe EG, Allmendinger PD, Lowe R. (2005) Cold sensitivity as a new side effect after sympathicotomy for hyperhidrosis. Annals of Thoracic Surgery 80: 2356-2358	Case report n=1	**Cold sensitivity** A young man who underwent ETS for hyperhidrosis developed cold sensitivity in his sympathicotomised right hand and arm. When exposed to cold, the right hand and forearm become numb and the skin temperature drops to uncomfortable levels, while the left extremity remains comfortably warm.	Case report.
Niinai H, Kawamoto M, Yuge O (2004) Severe pompholyx following endoscopic thoracic sympathectomy for palmar hyperhidrosis. Interactive Cardiovascular and Thoracic Surgery 3: 593-595	Case report n=2	**Severe pompholyx** 2 patients suffered from severe palmar pompholyx-like eczema following ETS. One was successfully treated with topical and oral steroids, however, the other had a wavelike continuation of eczema disturbing her daily activities.	Case report
O'Connor K, Molin F, Poirier P et al. (2009) Cardiac arrest as a major complication of bilateral cervico-dorsal sympathectomy. Interactive Cardiovascular & Thoracic Surgery 8: 238-239	Case report n=1	**Cardiac arrest** A patient had a 43 second asystolic cardiac arrest the night following a second contralateral thoracoscopic T(2)-T(3) sympathectomy for severe axillary and truncal hyperhidrosis.	Case report – safety outcome is already described in table 2.
Pang WW, Chang DP, Lin CH et al. (1998) Negative pressure pulmonary oedema induced by direct suctioning of endotracheal tube adapter. Canadian Journal of Anaesthesia 45: 785-788	Case report n=1	**Pulmonary oedema** Negative pressure pulmonary oedema was induced by direct suctioning of the endotracheal tube adapter during thoracic sympathetic ganglionectomy without recognized upper airway obstruction.	Case report – safety outcome is already described in table 2.
Westphal FL, de Campos JR, Ribas J et al. (2009) Skin depigmentation: could it be a complication caused by thoracic sympathectomy? Annals of Thoracic Surgery 88: e42-e43	Case reports n=2	**Skin depigmentation** Approximately 8 months after ETS, 2 patients noticed depigmentation of the region corresponding to the blockage of sympathetic stimulus. This fact could be explained by the possible effect of the nervous system on the melanocytes of human skin. Thus, patients with primary hyperhidrosis, who are candidates for thoracic sympathectomy and have brown skin, must be made aware of this possible complication	Case reports.

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Reviews			
Deng B, Tan QY, Jiang YG et al. (2011) Optimization of sympathectomy to treat palmar hyperhidrosis: the systematic review and meta-analysis of studies published during the past decade. Surgical Endoscopy 25: 1893-1901	Review and meta-analysis n=2878	Meta-analysis suggests that efficacy rates are similar for multiple and single ganglia sympathectomy (100 vs. 96%). However, single-ganglia sympathectomy can render a lower risk of total compensatory hyperhidrosis compared with multiple-ganglia block.	Review focused on comparison of different techniques for ETS.
Hashmonai M, Assalia A, Kopelman D (2001) Thoracoscopic sympathectomy for palmar hyperhidrosis. Ablate or resect? Surgical Endoscopy 15: 435-441	Review n=33 studies	Immediate success rate for resection= 100% versus 95% for ablation (p=0.00001). Palmar sweating recurred in 0% of patients treated via resection and 4% treated with ablation. Ptosis was noted in <1% of cases after ablation and in 2% after resection (p=0.017)	Medline search. Review focusing on different techniques.
Henteleff, HJ, Kalavrouziotis D (2008) Evidence-based review of the surgical management of hyperhidrosis. Thoracic Surgery Clinics 18 (2) 209-216	Review 146 studies	A cumulative experience in over 6000 patients suggests that ETS is a safe, reproducible, and effective procedure, and most patients are satisfied with the results of the surgery.	No meta-analysis.
Malmivaara A, Kuukasjarvi P, Autti-Ramo I et al. (2007) Effectiveness and safety of endoscopic thoracic sympathectomy for excessive sweating and facial blushing: a systematic review. International Journal of Technology Assessment in Health Care 23: 54-62	Systematic review n=15 studies	The evidence of the effectiveness of ETS is weak due to a lack of randomised trials. The intervention leads to severe immediate complications in some of the patients, and to persistent side-effects for many of the patients.	No meta-analysis.

Appendix B: Related NICE guidance for endoscopic thoracic sympathectomy for primary hyperhidrosis of the upper limb

Guidance	Recommendations
Clinical guidelines	**Social anxiety disorder: recognition, assessment and treatment. NICE clinical guideline 159 (2013)** **1.6 Interventions that are not recommended to treat social anxiety disorder** 1.6.1 Do not routinely offer pharmacological interventions to treat social anxiety disorder in children and young people. 1.6.2 Do not routinely offer anticonvulsants, tricyclic antidepressants, benzodiazepines or antipsychotic medication to treat social anxiety disorder in adults. 1.6.3 Do not routinely offer mindfulness-based interventions or supportive therapy to treat social anxiety disorder. 1.6.4 Do not offer St John's wort or other over-the-counter medications and preparations for anxiety to treat social anxiety disorder. Explain the potential interactions with other prescribed and over-the-counter medications and the lack of evidence to support their safe use. 1.6.5 Do not offer botulinum toxin to treat hyperhidrosis (excessive sweating) in people with social anxiety disorder. This is because there is no good-quality evidence showing benefit from botulinum toxin in the treatment of social anxiety disorder and it may be harmful. 1.6.6 Do not offer endoscopic thoracic sympathectomy to treat hyperhidrosis or facial blushing in people with social anxiety disorder. This is because there is no good-quality evidence showing benefit from endoscopic thoracic sympathectomy in the treatment of social anxiety disorder and it may be harmful.

Appendix C: Literature search for endoscopic thoracic sympathectomy for primary hyperhidrosis of the upper limb

Databases	Date searched	Version/files
Cochrane Database of Systematic Reviews – CDSR (Cochrane Library)	22.10.2013	Issue 10 of 12, October 2013
Database of Abstracts of Reviews of Effects – DARE (Cochrane Library)	22.10.2013	Issue 3 of 4, Jul 2013
HTA database (Cochrane Library)	22.10.2013	Issue 3 of 4, Jul 2013
Cochrane Central Database of Controlled Trials – CENTRAL (Cochrane Library)	22.10.2013	Issue 9 of 12, Sept 2013
MEDLINE (Ovid)	22.10.2013	1946 to October Week 1 2013 *(Medline hasn't been updated due to US Government shutdown)*
MEDLINE In-Process (Ovid)	22.10.2013	October 21, 2013
EMBASE (Ovid)	22.10.2013	1974 to 2013 October 42
CINAHL (NLH Search 2.0)	22.10.2013	n/a
PubMed	22.10.2013	n/a
JournalTOCS	22.10.2013	n/a

Trial sources searched on: 25/06/2013

- Current Controlled Trials *meta*Register of Controlled Trials – *m*RCT
- Clinicaltrials.gov
- National Institute for Health Research Clinical Research Network Coordinating Centre (NIHR CRN CC) Portfolio Database

Websites searched

- National Institute for Health and Clinical Excellence (NICE)
- Food and Drug Administration (FDA) – MAUDE database
- French Health Authority (FHA)
- Australian Safety and Efficacy Register of New Interventional Procedures – Surgical (ASERNIP – S)
- Australia and New Zealand Horizon Scanning Network (ANZHSN)
- Conference search
- Evidence Updates (NHS Evidence)
- General internet search

The following search strategy was used to identify papers in MEDLINE. A similar strategy was used to identify papers in other databases.

1	Hyperhidrosis/

2	Sweating/
3	((increas* or excess* or primary* or focal* or local*) adj3 (hyperhidrosis* or sweat* or perspir*)).tw.
4	or/1-3
5	Sympathectomy/
6	sympathectom*.tw.
7	(sympathetic adj3 denervat*).tw.
8	Ganglionectomy/
9	ganglionectom*.tw.
10	(gangli* adj3 (remov* or excis*)).tw.
11	or/5-10
12	Endoscopy/
13	Endoscopes/
14	Surgical Procedures, Minimally Invasive/
15	Video-Assisted Surgery/
16	Surgery, Computer-Assisted/
17	(endoscop* or scope*).tw.
18	ETS.tw.
19	Thoracic Surgical Procedures/
20	Thoracic Surgery, Video-Assisted/
21	Thoracoscopy/
22	(thoracic adj3 surg*).tw.
23	thoracoscop*.tw.
24	VATS.tw.
25	or/12-24
26	4 and 11 and 25
27	animals/ not humans/
28	26 not 27

29	limit 28 to english language