

Effectiveness and safety of endoscopic thoracic sympathectomy for excessive sweating and facial blushing: A systematic review

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Objectives: Despite controversies, endoscopic thoracic sympathectomy (ETS) has been used as a treatment for excessive sweating of hands and face and for facial blushing. This study aims to evaluate the effectiveness of ETS for the current indications in a systematic review.

Methods: Controlled clinical trials and cohort studies with more than 100 patients were included. Abstracts were searched from MEDLINE and CCTR from 1966 to June 2004. Two reviewers extracted the data and assessed study quality. Data on effectiveness and safety were synthesized qualitatively.

Results: We did not find any controlled clinical trials. Fifteen prospective studies were included. The internal and external quality of these studies were poor overall. Follow-up was commonly less than 2 years, during which time excessive sweating and facial blushing seemed to decrease among most patients. Immediate complications related to thoracoscopy occurred in up to 10 percent of patients. Compensatory sweating below breast level was reported in up to 90 percent of the patients. Other common side effects included dryness of face and hands, gustatory sweating, and neuralgic pain. Several other less common side effects were reported.

Conclusions: The evidence of the effectiveness of ETS is weak due to a lack of randomized trials. The intervention leads to severe immediate complications in some of the patients, and to persistent side-effects for many of the patients.

Keywords: Hyperhidrosis, Blushing, Sympathectomy, Effectiveness, Safety

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Table 1. Quality of the Studies on Endoscopic Thoracic Sympathectomy

Study (author, year)	1. Selection of population described	2. Inclusion and exclusion criteria	3. Prognostic factors described	4. Study size	5. Follow up > 2 years	6. Dropouts < 20%	7. Description of dropouts	8. Outcome measures congruent with aims	9. Data presentation congruent with aims	10. Confounders adjusted in the analysis	Total
Gossot et al., 2003	0	0	0	1	1	0	0	1	1	0	4
Leséche et al., 2003	1	0	0	1	1	1	1	1	1	1	8
Reisfeld et al., 2002	0	0	0	1	0	?	0	1	1	0	3
Gossot et al., 2001	1	1	0	0	0	1	1	1	1	0	6
Neumayer et al., 2001	0	0	0	1	0	?	0	1	1	0	3
Reisfeld et al., 2000	?	0	0	0	0	0	0	1	1	0	2
Drott et al., 1998	1	0	1	0	0	1	1	1	1	0	6
Kopelman et al., 1998	0	0	0	1	0	1	1	1	1	0	5
Lin et al., 1998	0	0	0	1	0	?	0	1	0	0	2
Gossot et al., 1997	?	0	0	0	0	1	0	1	1	0	3
Drott and Claes, 1996	0	0	0	1	1	?	0	1	1	0	4
Noppen et al., 1996	1	0	0	0	0	1	1	1	1	0	5
Kao et al., 1994	?	0	0	1	0	0	0	1	0	0	2
Shachor et al., 1994	?	0	0	0	0	0	0	0	0	0	0
Chao et al., 1993	0	0	0	0	0	?	0	0	0	0	0

Note. Presented is the criteria list for the assessment of the quality of studies of prognostic studies after endoscopic sympathectomy (modified from Borghouts AJ, Koes BW, Bouter LM. The clinical course and prognostic factors of nonspecific neck pain: a systematic review. *Pain.* 1998;77:1-13). Maximum 10 points. Study population: 1. Selection of study population described; 2. Description of inclusion and exclusion criteria provided; 3. Description of potential prognostic factors (age, sex, sweating, psychological symptom: at least four relevant prognostic factors presented); 4. Study size (200 patient-years for every reported group). Follow-up: 5. Follow-up 24 months; 6. Dropouts/loss to follow-up <20 percent; 7. Information provided for loss to follow-up/dropouts (or there was no dropouts/loss to follow-up = less than 5 percent); 8. Outcome measures used concords with the aim of the intervention in methods. Data presentation and analysis: 9. Presentation of outcome measures in frequency or percentage concords with the aim of the intervention in results; 10. Appropriate analysis techniques described.

Table 2. Successfulness of Reporting the Aims, Patient Selection, Inclusion and Exclusion Criteria, and Symptoms of Patients in the Studies on Endoscopic Thoracic Sympathectomy

Study (author, year)	Aims of the study	Patient selection	Inclusion criteria	Exclusion criteria	Degree of sweating or blushing	Degree of disability due to symptoms	Psychiatric symptoms at baseline	Problems in social behavior at work or leisure time at baseline	Comorbidity (e.g., psychiatric)	Previous treatments
Gossot et al., 2003, Ranska	1	0	0	0	0	1	0	1	0	1
Leséche et al., 2003, Ranska	1	0	0	0	0	0	0	0	0	1
Reisfeld et al., 2002, USA	1	1	0	0	0	1	0	0	0	1
Gossot et al., 2001, Ranska	1	0	0	0	0	0	0	0	0	0
Neumayer et al., 2001, Itävalta	1	0	0	0	0	0	0	0	0	0
Reisfeld et al., 2000, USA	1	1	0	0	0	0	0	0	0	0
Drott et al., 1998, Ruotsi	1	1	1	0	1	1	0	0	0	0
Kopelman et al., 1998, Israel	1	0	0	0	0	0	0	0	0	0
Lin et al., 1998, Taiwan	0	0	0	0	0	0	0	0	0	0
Gossot et al., 1997, Ranska	1	0	0	0	0	0	0	0	0	0
Drott and Claes, 1996, Ruotsi	1	0	1	0	1	0	0	0	0	0
Noppen et al., 1996, Belgia	1	0	1	0	0	1	1	1	0	1
Kao et al., 1994, Taiwan	1	0	0	0	0	0	0	0	1	0
Shachor et al., 1994, Israel	1	0	0	0	0	0	0	0	0	0
Chao et al., 1993, Taiwan	1	0	0	0	0	0	0	0	0	0

Note. 1, fully or partially reported; 0, not reported.

Table 3. Description of Patients, Follow-up Time, Indication, and Intervention

Researcher, year, country	N	Male (%)	Age, average in years (range)	Follow-up time (range)	Indications	Intervention
Gossot et al., 2003, France	125	27	28 (15–56)	46 (24–84) months	Patients with excessive sweating on: soles and palms 30%; palms, soles and underarms 51%; palms, soles and face 6%; palms, soles, underarms and face 5%; underarms 8%.	General anesthetic. Ganglia resection with electrocoagulation and surgery on T2-T3 or T2-T4 carried out on 111 patients (underarm sweating). Selective sympathectomy carried out on 14 patients.
Leséche et al., 2003, France	134	26	28 (21–35)	44 (7–100) months. Monitoring 1, 3, 6 and 12 months after the operation, then annually. E11	Patients with excessive sweating on: palms 62%, underarms 5%, palms and underarms 32% , soles 68%.	General anesthetic. Sweating of the hands: Resections: 8 on T1-T2; 4 on T1-T3; 8 on T2-T3; 64 on T2-T4.
Reisfeld et al., 2002, USA	1312	56	30 (10–66)	23 (1–50) months	Patients with excessive sweating on: palms 90%, soles 84%, underarms 11% and face 18%. Flushing 9%.	653 patients given general anesthetic. Early electrocoagulation (pre-1999) T2; 305 recent electrocoagulation (1999 or later) T2; 354 clamped.
Gossot et al., 2001, France	467	35	31 (15–59)	1 month	Patients with excessive sweating on: upper limbs 100%.	General anesthetic. Ganglia resection with electrocoagulation and surgery carried out on 398 patients (underarm sweating) on T2-T3 or T2-T4. Selective sympathectomy carried out on 69 patients.
Neumayer et al., 2001, Austria	406	56	Conventional ETS 30, video-assisted ETS 27. Range not stated.	196 (6–360) months	Conventional ETS: Patients with excessive sweating on: palms 70%, underarms 13%, palms and underarms 17%. Video-assisted ETS: Patients with excessive sweating on: palms 60%, underarms 9%, palms and underarms 31%.	General anesthetic. Sympathetic nerve trunk cut completely at the T2-T4 level. Kuntz nerve branch cut, if identifiable.

Table 3. Continued

Researcher, year, country	<i>N</i>	Male (%)	Age, average in years (range)	Follow-up time (range)	Indications	Intervention
Reisfeld et al., 2000, USA	650	52	Average age not stated. Range 10–70 (49% under 30 years of age).	Exact monitoring period not stated.	Patients with excessive sweating on palms and soles 90%. Patients with excessive sweating in the face and flushing 10%.	General anesthetic. Electrocoagulation on T2.
Drott et al., 1998, Sweden	244	50 (219 monitored)	34 (15–67)	Telephone interview 1 month and questionnaire 8 months after the operation.	Flushing 100%. Recently developed, associated with emotional stress (permanent redness of the face not included). Flushing in stressful situations, averaging 8.5 on the visual analogue scale and tachycardia 3.5 (0–10).	Not described.
Kopelman et al., 1998, Israel	116	36	24 (14–49)	25 (3–44) months	Patients with excessive sweating on: palms 31%; palms and feet 49%; palms and underarms 2%; palms, underarms and feet 16%; palms, feet, underarms and back 3%.	General anesthetic. 5 mm endoscope into the second intercostal space on the medial line of the clavicle, diathermy through the second intercostal space on the anterior axillary line. Severing of the nerve T2–T3 and removal of ganglia. Same procedure carried out on both sides, in all 106 sympathectomies.
Lin et al., 1998, Taiwan	326	42	21 (5–52)	Telephone interview after approx. 6–12 months.	Excessive sweating on the palms.	General anesthetic. T2 ganglia: 16 sympathectomies, 326 clamped.

Gossot et al., 1997, France	124	34	28 (15–52)	11 months. Check-up 3 months after the operation + telephone interview.	Patients with excessive sweating on: palms 52%, palms and underarms 43% and underarms 6%.	124 patients, 240 actions. General anesthetic. TS group: T2- (T4-5) ganglia removed. In the SS group, branches of the sympathetic nerve chain were cut, but the sympathetic nerve trunk was left. Same procedure carried out on the other side 2–3 weeks later. In the TS group, conventional sympathectomy 54 and division of rami 62.
Drott and Claes, 1996, Sweden	1163	39	27 (7–72)	31 (1–85) months	Patients with excessive sweating on: palms 77%, underarms 20%, and face 3%.	General anesthetic. Ganglion resection with electrocoagulation at the T2-T3 level (excessive sweating of palms T2-3; excessive underarm sweating T4; excessive facial sweating T1).
Noppen et al., 1996, Belgium	100	37	27 (11–48)	Preoperative tests, 1 week and 1 month after the operation.	Patients with excessive sweating on: hands 100%, soles 81% and underarms 66%.	General anesthetic. Ganglion resection with electrocoagulation of T2-T3.
Kao et al., 1994, Taiwan	300	42	27 (6–63)	2/3 patients >12 months	Patients with excessive sweating on palms 90%. In addition to this, about 60% of patients suffered from excessive underarm sweating.	General anesthetic. Ganglion resection with electrocoagulation and laser at the T2 or T2-T3 level (10%).
Shachor et al., 1994, Israel	150	41	Average age not stated (13–55).	60/150 patients 12 months	Patients with excessive sweating on the palms 100%.	General anesthetic. Ganglia electrocoagulation at the T2-T4 level.
Chao et al., 1993, Taiwan	150	51	24 (10–44)	7 (1–12) months	Patients with excessive sweating on the palms 100%.	General anesthetic. Ganglion resection with electrocoagulation at the T2-T3 level, open resection carried out on 1 patient.

Table 4. Description of Immediate Adverse Effects and Compensatory Excessive Sweating in Studies on Endoscopic Thoracic Sympathectomy

Researcher, year, country	N	Immediate adverse effects (N)	Compensatory excessive sweating
Gossot et al., 2003, France	125	Horner's syndrome 3.	In 86% of patients: mild 61%, disturbing 31%, disabling 8%.
Leséche et al., 2003, France	134	Pneumothorax 2, Horner's syndrome 4 (one permanent), intercostal neuralgia 1, hemorrhage 1.	In 72% of 132 patients: minor and intermittent 53%, embarrassing 16%, disabling 3%.
Reisfeld et al., 2002, USA	1,312	Pneumothorax 3, hemothorax 6, Horner's syndrome 1.	Mild 51% of men and 69% of women, severe 8% of men and 3% of women.
Gossot et al., 2001, France	467	Pneumothorax 12, chylothorax 2, pleural effusion 1, Horner's syndrome 4, thoracotomy 1, subclavian tear 1, hemorrhage 25.	1 month after surgery in 51% of patients: acceptable 67%, disturbing 25%, debilitating 8%.
Neumayer et al., 2001, Austria	406	Conventional thoracic sympathectomy: Pneumothorax 12, pleural drainage 6, pleural effusion 6, Horner's syndrome 22, thoracotomy for arterial hemorrhage 1. Video-assisted thoracic sympathectomy: Pneumothorax 2, pleural drainage 2, pleural effusion 1, Horner's syndrome 1.	Conventional thoracic sympathectomy: 68%. Video-assisted thoracic sympathectomy: 56%.
Reisfeld et al., 2000, USA	650	Hemothorax 7, pneumothorax 1, hemorrhage 7.	In 83% of 321 patients, mild to moderate 67% and severe 8%.
Drott et al., 1998, Sweden	244	Pneumothorax 2, pulmonary embolus 1.	On the body 75%.
Kopelman et al., 1998, Israel	116	Pneumothorax 5, hemothorax 1, atelectasis 2, pneumonia 2, pleuritic pain 1, Horner's syndrome 11, neuralgic pain 11, C5–C8 paresis 1.	First stage: 67% of patients, mild 53% and severe 15%. Second stage: 48% of patients, mild 39% and severe 9%.
Lin et al., 1998, Taiwan	326	Complications were not specified.	2% of patients.
Gossot et al., 1997, France	124	Chylothorax 1, pneumothorax 3, pleural effusion 1, 1 new operation carried out immediately due to missing results.	Truncal sympathectomy: 72% of patients, moderate 22%, embarrassing 46%, and disabling 4%. Selective sympathectomy: 71% of patients, moderate 50%, embarrassing 21%.
Drott and Claes, 1996, Sweden	1,163	Pneumothorax 5, hemothorax 5, Horner's syndrome 4.	After surgery 55%.
Noppen et al., 1996, Belgium	100	Pleural effusion 2, Horner's syndrome 1, neuralgia 6, phantom sweating 34, facial flushing 2.	Increased sweating 45% (associated with heat and exercise).
Kao et al., 1994, Taiwan	300	Pneumothorax 5, subcutaneous emphysema 5, neuralgia 3, hemorrhage 2.	After surgery 50% of patients (usually mild).
Shachor et al., 1994, Israel	150	Pneumothorax 7, hemothorax 3, subcutaneous emphysema 8, Horner's syndrome 2, 1 tachycardia + hypotension.	Of the 60 patients monitored, 50% experienced compensatory sweating on their back, stomach, and thighs.
Chao et al., 1993, Taiwan	150	Hemothorax 1, in 3 cases technical complications occurred in the operation.	Almost all patients experienced some degree, 22% uncomfortable.

Endoscopic thoracic sympathectomy (ETS) has been used for years to reduce excessive sweating in face and hands and blushing of the face due to overactivity of sympathetic nerves. In this procedure, the upper thoracic chain of the sympathetic nerve trunk is transected or clamped.

As no previous systematic reviews were identified, we set out to assess the effectiveness and safety of ETS. The results are reported previously in Finnish in a Finolta report (11).

METHODS

Randomized controlled trials, and prospective observational studies (at least 100 patients) on ETS were searched without language restriction in Medline (1966–July 2004) and in the Cochrane Library (2nd Quarter 2004). The Medical Section Heading (MeSH) search terms used were hyperhidrosis, sweating, or blushing. We included papers reporting at least one outcome measure of symptoms among patients with facial blushing or sweating in the face, hands, or elsewhere (trunk or feet).

Two researchers (A.M. and I.A.R.) selected together the full text articles based on titles and abstracts of the articles identified in the literature search. At least two researchers did the data extraction (A.M. and N.K. all the papers, I.A.R. half of the papers). Among the 195 retrieved articles, there were no trials. Fifteen prospective studies were included. Two studies focused on endoscopic thoracic sympathectomy for social phobia; these papers were not included in the present study. Two researchers (A.M. and P.K.) independently assessed the quality of the studies and the description of clinically relevant patient characteristics.

RESULTS

The methodological quality was poor in most studies (Table 1). Few clinically relevant patient characteristics were reported (Table 2). None of the studies provided clear inclusion and exclusion criteria for patients.

Description of patients, follow-up time, indication, and intervention is provided in Table 3. The fifteen studies had recruited 5,767 patients (mean, 384; range, 100–1,312), of which 46 percent were male (range, 26–56 percent). Patients were typically young adults (mean age, 21 to 34 years; age range, 5 to 72 years). Eight studies had included children less than 15 years of age. Five studies had uniform follow-up time for all patients. In three studies, the mean follow-up time was over 2 years, and only one had followed up all patients at least for 2 years (4).

Blushing and excessive sweating of hands, trunk, and feet decreased after ETS in all studies. In the absence of common objective outcome measures, the results cannot be combined.

Complications after ETS included hemo- or pneumothorax, Horner's syndrome, and neuralgias (Table 4). Some

complications caused permanent disability. In all but two studies compensatory sweating after ETS occurred in more than half of the patients, typically on the trunk below the nipples. Of those who experienced hyperhidrosis, 3 to 15 percent considered it to cause significant disability. Excessive dryness of skin and gustatory sweating were also reported.

Patients had given written informed consent to the operation in two studies and oral consent in two others. No paper mentioned approval of the study by an ethical committee or informed about authors' conflict of interest.

DISCUSSION

The effectiveness of ETS in alleviating sweating or facial blushing cannot be evaluated on the basis of studies without control groups. Prospective patient series, however, can provide valid information of side effects of interventions. The studies of this review were seemingly prospective, although very variable follow-up times and other inconsistencies point toward the possibility of retrospective designs.

Endoscopic thoracic sympathectomy is associated with significant immediate and long-term adverse effects. Due to wide variation in the reporting of adverse effects, it is probable that these have been underreported most of the time.

If this procedure is considered safe enough for use, its effectiveness should be evaluated in prospective, controlled trials. Follow-up times should be sufficiently long to inform about possible recurrence of the symptoms. Informed consent for these studies and the ETS operations should be required, especially if minors are subjected to the risk of permanent complications.

CONCLUSIONS

No randomized trial has assessed the effectiveness of ETS. ETS is associated with significant immediate and long-term adverse effects. Compensatory hyperhidrosis after ETS is common and causes marked discomfort or disability in some patients.

POLICY IMPLICATIONS

The results may be used in discussions about the role and necessity of these operations in health care, and they can form a basis for patient information.

CONTACT INFORMATION

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