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Endoscopic thoracic sympathectomy for primary palmar hyperidrosis

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Abstract
Background Primary hyperhidrosis is a disorder that is characterized by excessive sweating in disproportion to that required for thermoregulation. In most cases, this is aggravated by emotional factors and by heat. Hyperhidrosis can be seen in the palms of the hands, armpits, soles of the feet and face. The principal characteristic of this disease is the intense discomfort of patients, which affects their social and professional life. Treatment modalities include topical application of aluminum chloride, iontophoresis, anticholinergics, botulinum toxin injection, liposuction, excision of sweat glands, and thoracic sympathectomy.
Methods Between January 1998 and August 2007, a prospective study of endoscopic thoracic sympathectomies for palmar hyperhidrosis was undertaken based on case histories and a prospective pre- and postoperative questionnaire survey. The sample comprised of 322 patients with a mean age of 24 years. At Apollo Hospital, New Delhi, India, bilateral video-assisted thoracoscopic T3 level sympathectomies were performed in all cases.
Results All patients had immediate cessation of palmar hyperhidrosis. The mean postoperative stay was 1.1 days. A questionnaire was completed based on their response to a telephone conversation or e-mail. A paired *t* test and Wilcoxon test was performed on these data and it showed significant improvement in quality of life. Compensatory sweating was found to be the most troublesome side effect for all patients. It was seen in 63% of the patients. This is similar to other reports of compensatory sweating; however, the figure decreases to 29% if we disregard the percentage of patients who reported only mild compensatory sweating.
Conclusion In view of the low morbidity and zero mortality rate of this surgical technique, we recommend it as a method of treatment for palmar hyperhidrosis. Thoracic sympathectomy eliminates palmar hyperhidrosis with minimal recurrence (1% in our series) and produces a high rate of patient satisfaction.

Keywords Palmar hyperhidrosis · Endoscopic thoracic sympathectomy · Compensatory sweating

Primary or essential hyperhidrosis is a disorder characterized by excessive sweating in disproportion to that required for thermoregulation and dissipation of body heat [1]. In most cases this excessive sweating is aggravated by emotional factors and by heat [2, 3]. Hyperhidrosis can be seen in the palms of the hands, armpits, plantars of the feet, and face. The incidence is in the region of 0.6 to 1% of the population [4]. Approximately 20% of affected people are born with hyperhidrosis. This fact and the occurrence of hyperhidrosis among members of the same family have led to the conclusion that in some cases there is a hereditary factor [5]. There is no racial bias, although a slight increase in its incidence has been observed among Jews and Asians [6]; apparently it has a predominantly familial character.

Hyperhidrosis can be disseminated or localized. The disseminated form is denominated secondary hyperhidrosis, presenting due to conditions that increase the sympathetic activity, such as hyperthyroidism, diabetes, obesity, paraneoplastic syndrome, psychiatric disturbances, physical exercise, and emotional factors.

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Localized or regional hyperhidrosis (palmar, axillary, plantar, and craniofacial) may occur in association or isolation, the intensity of which can cause considerable morbidity, including maceration of the skin as well as secondary bacterial and skin infections. However, the principal characteristic of this disease is the intense discomfort of patients, which affects their social, affective, and professional life [7]. This form of hyperhidrosis is denominated primary and its cause remains unknown [8]. The sudoriferous glands of the involved area are histologically and numerically normal, thereby indicating that a hyperstimulation mechanism is involved [4].

Most patients report the onset of symptoms in childhood with exacerbation during puberty and adolescence, although it can present at birth. The incidence is equal in both sexes [4].

Treatment modalities reviewed by White [9], include topical application of aluminum chloride, iontophoresis [10], topical anticholinergics and therapies based on conditioning and biofeedback, all of which are effective only in mild cases. Other treatments, including botulinum toxin type A injection, liposuction, and excision of the sweat glands, have been attempted with limited success [11].

Topical methods of treating localized hyperhidrosis are expensive, have limited efficacy, and provide only transitory benefits. This, together with increasingly greater availability of video-assisted thoracic surgery, have contributed decisively to the establishment of sympathectomy as the current standard in the definitive treatment of severe cases of palmar and axillary hyperhidrosis, presenting >98% effectiveness and a high rate of patient satisfaction [12]. The first sympathectomy by thoracoscopy was performed in 1951 [13]. Since then, different levels of sympathetic trunk have been approached for the treatment of excessive sweating. The evolution of video-assisted thoracoscopic techniques has allowed thoracic sympathectomy to be performed quite safely, with good results and minimal morbidity [14–21].

The complications related to the manipulation of the pleural cavity, such as hemothorax, pneumothorax, wall infection, and pulmonary decompression-induced edema, have been occasionally described, although the incidence has always been <1% [12]. Some difficulties, such as those caused due to pleural adherences and the need for a second sympathectomy (<3%), have been reported, although all such cases were attributed to some anatomic variant [12]. Without a doubt, the most significant complication of sympathectomy is reflex compensatory sweating. In most studies, this has been observed in the majority of patients [22–28].

This paper describes our experience with this technique as well as the pre- and postoperative degree of satisfaction and quality of life of our patients.

Materials and methods

Between January 1998 and August 2007, a prospective study of endoscopic thoracic sympathectomies for palmar hyperhidrosis was undertaken based on case histories and a prospective pre- and postoperative questionnaire survey. The sample comprised 322 patients: 4% were women and 96% men; the mean age at intervention was 24 (range, 14–42) years. Bilateral video-assisted thoracoscopic T3 level sympathectomies were performed in all cases.

Patients were positioned supine with 20° anti-Trendelenberg tilt of the table. This position allows gravity to assist in revealing the spine and the sympathetic chain. Under general anesthesia, with single lumen tracheal intubation, the patient's arms were abducted exposing the axilla. The procedure was performed with two ports: a 10-mm port in the mid-axillary line at the fifth intercostal space for the introduction of telescope, and a 5-mm port in the anterior axillary line at the third intercostal space for working instruments (Fig. 1). Subsequent to the introduction of the first 10-mm cannula, CO_2 was insufflated at 5–10 mmHg to achieve partial pulmonary collapse. Upon pulmonary collapse, the visualization of the pleural cavity was done and the second port was introduced under direct vision. Pleural adhesions if any were released.

The ribs were carefully identified. The first rib was mostly not visualized because it lies in a completely different plane and direction from the others. Thus, identification of the second and third rib was critical and constituted the most important landmark for sympathectomy procedure (Fig. 2). The sympathetic chain is seen coursing over the rib heads near the costovertebral junction and the lateral aspect of vertebral bodies. The sympathetic chain and ganglia are usually visualized through the pleura

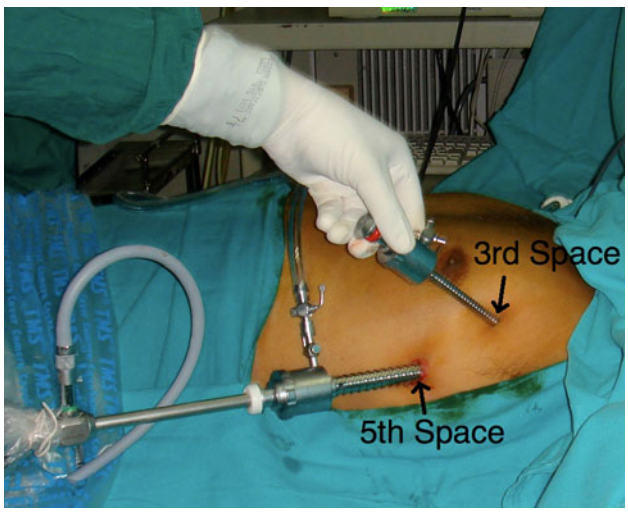

Fig. 1 Port placement

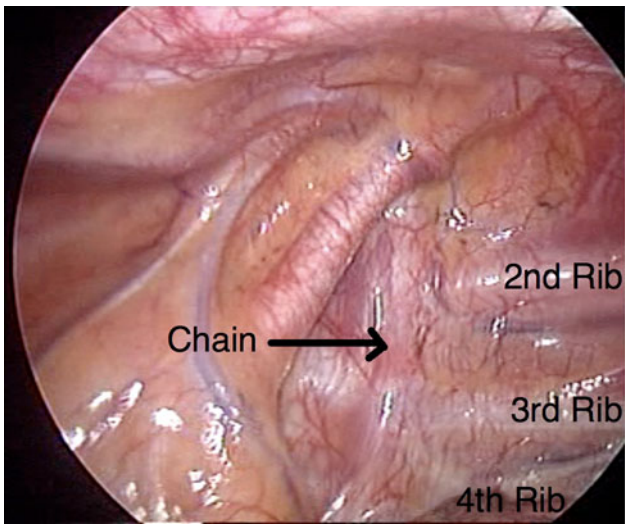

Fig. 2 Identifying the chain

but should not be "palpated" with endoscopic instruments that will cause hyperemia of the pleura and obscure visualization during the procedure. At the level where the sympathetic chain crosses the third rib, the parietal pleura were opened with the diathermy hook. The sympathetic chain just below the T3 level was gently cauterized and transected completely, but the ganglion was left in position without removal by manipulation (Fig. 3). The ramus arising laterally from the sympathetic chain is the Nerve of Kuntz, which is slightly larger than the other rami and must be interrupted to achieve adequate sympathetic denervation of the upper extremity. This also was transected by diathermy hook. The lung was inflated after the procedure under vision to make sure that it was well expanded. Chest drains were not inserted at the end of the procedure. No stitches were required for the 5-mm port, whereas a single intradermal stitch was necessary for the 10-mm port. Skin was approximated by using cyanoacrylate glue. The same procedure was performed on the contralateral side.

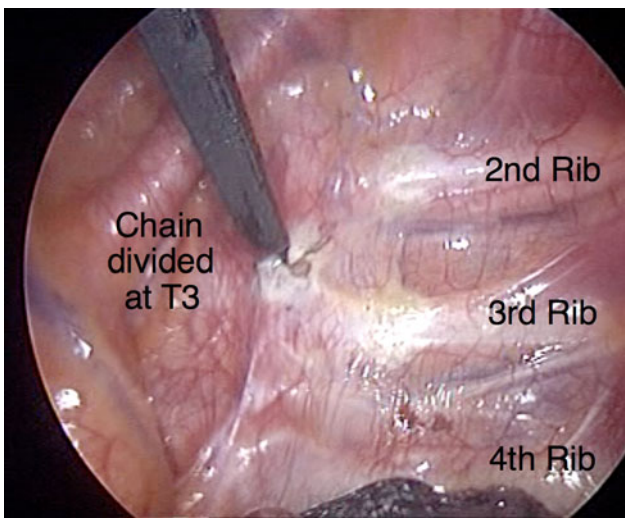

Fig. 3 T3 sympathectomy

Postoperatively, orally administered analgesics were adequate for pain control. The patients were mobilized early and while some patients went home the evening of surgery, most patients were discharged the next day.

Results

Endoscopic thoracic sympathectomy at T3–T4 level was performed in 322 patients. All patients had immediate cessation of palmar hyperhidrosis. Recurrence was seen in three patients, but none of them wished to undergo a redo procedure at a different level because, despite recurrence, their symptoms were less than before. The mean postoperative stay was 1.1 (range, 0.5–3) days, with a mode of 1 day in 290 patients.

Complications were minor and were seen in six patients (2%; Table 1). None of the patients needed any intervention. There was minimal pain at the two port sites, which resolved with analgesia, and minor skin bleed was controlled by pressure and change of dressing.

Postoperative chest X-ray was performed only if the patient complained of breathing difficulty. Only 11 patients needed to have an X-ray of which 1 patient showed a minor pneumothorax, which resolved without any intervention.

All patients were followed up for a minimum period of 24 months. A questionnaire was completed based on their response to a telephone conversation or e-mail. Ten parameters were covered. A paired *t* test and Wilcoxon test was performed on this data and it showed significant improvement in quality of life (Tables 2, 3).

Patients were asked about emergence of postoperative side effects, and the results are shown in Table 4. Compensatory sweating was the most common side effect and was seen in 63% of the patients. This was seen in mild to severe form. Subgrouping of this symptom has been done in Table 5.

Patients had variable degree of plantar, axillary, or facial hyperhidrosis in addition. Whereas many patients had isolated palmar hyperhidrosis, some had other forms in varying combinations. We have not subclassified patients

Table 1 Postoperative complications

Port site infection	1
Port site bleeding	3
Hypertrophic scar	1
Pneumothorax	1

Table 2 Quality of life indicators—paired *t* test

S no.	Indicator	Before ETS (X_a)	After ETS (X_b)	($X_a - X_b$)
1.	Hesitation to shake hands	305	2	303
2.	Palm sweating at work/writing/keyboard	322	4	318
3.	Hesitation to go to a party	250	10	240
4.	Hesitation to socialize with opposite sex	106	4	102
5.	Carry a handkerchief	215	2	213
6.	Difficulty in handling sports/ musical equipment/joystick	87	2	85
7.	Affects self-confidence	285	4	281
8.	Difficulty in driving	122	11	111
9.	Angry with the ailment	310	62	248
10.	Dissatisfied with physical attributes	285	95	190

ETS endoscopic transthoracic sympathectomy

$Mean_A - Mean_B = 209.1$; $t = 7.77$; df = 9

P value: one-tailed, <0.0001; two-tailed, <0.0001

Table 3 Quality of life indicators—Wilcoxon test

Pairs	Indicators	Before ETS (X_a)	After ETS (X_b)	S/R of $\lvert X_a - X_b \rvert$
1.	Hesitation to shake hands	305	2	+9
2.	Palm sweating at work/writing/keyboard	322	4	+10
3.	Hesitation to go to a party	250	10	+6
4.	Hesitation to socialize with opposite sex	106	4	+2
5.	Carry a handkerchief	215	2	+5
6.	Difficulty in handling sports/musical equipment/joystick	87	2	+1
7.	Affects self confidence	285	4	+8
8.	Difficulty in driving	122	11	+3
9.	Angry with the ailment	310	62	+7
10.	Dissatisfied with physical attributes	285	95	+4

Values	X_a	X_b	$X_a - X_b$
N	10	10	10
Sum	2,287	196	2,091
Mean	228.7	19.6	209.1
Sum_sq	597,673	13,150	502,417
SS	74636.1	9308.4	65188.9
Variance	8292.9	1034.2667	7243.2111
Standard deviation	91	32	85

Variances and standard deviations are calculated with denominator = $n - 1$

ETS endoscopic transthoracic sympathectomy

$W = 55$; $n_{s/r} = 10$; $Z = 2.78$; P (1-tail) = 0.0027; P (2-tail) = 0.0054

in these categories because all of these patients had come for surgery mainly for the palmar hyperhidrosis only.

Discussion

The indications for using endoscopic thoracic sympathectomy to treat primary hyperhidrosis have been established since the first thoracoscopic interventions were performed [29]. In recent years, numerous articles advocating diverse surgical techniques for accessing the thoracic sympathetic chain have been published. Those articles discuss indications, such as ablation, resection (and its extent), interruption by clips, and more. Hashmonai et al. [30] compared surgical techniques for the treatment of hyperhidrosis—electrocoagulation or resection—based on a review of studies published between 1974 and 1999. Those authors found that resection was significantly better in terms of immediate results and absence of recurrence after intervention.

Table 4 Compensatory sweating

Grade	Feature	No.	%
1.	No CS	118	36.6
2.	Noticed sometimes in sweaty situations only	60	18.7
3.	Noticed sometimes in nonsweaty situations	52	16.1
4.	Always aware but not troublesome	44	13.7
5.	Troublesome but controlled by clothing	36	11.2
6.	Severe—causes embarrassment	11	3.4
7.	Regret having had ETS	1	0.3

CS compensatory sweating; *ETS* endoscopic transthoracic sympathectomy

Table 5 Classification of compensatory sweating

No CS	37%
Mild (Grade 2–3)	35%
Moderate (Grade 4–5)	25%
Severe (Grade 6–7)	4%

CS compensatory sweating

As an alternative to extirpation of the thoracic sympathetic segment and with the goal of decreasing the percentage of patients developing compensatory sweating, Lin [31] used endoscopic clipping of the sympathetic thoracic trunk at T3–T4 to block transmission. Lin also reported 42 patients who required a second sympathectomy because of unsuccessful interventions or recurrent palmar hyperhidrosis [32].

Compensatory sweating is, without a doubt, one of the most troublesome postoperative side effects for all patients. Perhaps this is why numerous surgeons have begun to search for the ideal technique to significantly reduce the percentage of cases developing compensatory sweating. Riet et al. [33], in a paper published in 2001, showed that compensatory sweating was nonexistent after limiting thoracoscopic sympathectomy to the third ganglion. Our study revealed the emergence of compensatory sweating in 63% of the patients. This is similar to other reports of compensatory sweating; however, the figure decreases to 29% if we disregard the percentage of patients who reported only mild compensatory sweating.

Another aspect is the positioning of the patient during the procedure. Patients were positioned supine with 20° anti-Trendelenberg tilt of the table. This position allows gravity to assist in revealing the spine and the sympathetic chain along with the partial lung compression using carbon dioxide insufflation [34]. This avoids the need to reposition the patient, saving important surgical time for the patient (who spends less time under anesthesia), the surgeon, and the hospital. Naruse et al. [35] described a similar surgical procedure in 120 endoscopic thoracic sympathectomies performed with 2-mm incisions with the patient in a semi-sitting position, concluding by recommending this procedure as the method of choice for the surgical treatment of palmar hyperhidrosis because it reduces the time in surgery (in his series, operations lasted from 11 to 81 min). The estimated time of our most recent operations with the patient in the supine position with anti-Trendelenberg tilt of table varied from 20 to 45 min, practically the same as most other series.

Level of sympathectomy has been studied in randomized, controlled trials [36, 37], and it was observed that T3 level sympathectomy has same efficacy as T2 level but has lower incidence of side effects, such as compensatory sweating. Intraoperative monitoring of temperature and blood flow has been suggested to establish a standardized reference for finding the correct target level [38].

Studies of patient series in which primary hyperhidrosis has been treated surgically reveal a high degree of patient satisfaction. In personal interviews, patients recognize that hyperhidrosis is a serious social problem that affects them when they interact with other people, work, drive, or try to maintain their self-confidence and character. In our study, >98% of patients reported improved self-confidence and willingness to shake hands after surgery; 20% of patients remained dissatisfied with the ailment despite resolution of the hyperhidrosis (mostly because of the emergence of compensatory sweating).

The emergence of complications varies from one series to the next. The percentage of complications in our study was 2%, including bleeding from the skin site, infection at incision site, residual pneumothorax, and hypertrophic scar formation. We believe that, once the technique has been mastered and refined, both the complication rate and morbidity should be quite low.

In conclusion, in view of the low morbidity and zero mortality rate of this surgical technique, we recommend it as a method of treatment for palmar hyperhidrosis. Thoracic sympathectomy eliminates palmar hyperhidrosis with minimal recurrence (<1% in our series). Although the percentage of compensatory sweating is high (in some cases it tends to decrease spontaneously), it produces a high rate of patient satisfaction.

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