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ORIGINAL ARTICLE

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# Transthoracic endoscopic sympathectomy for palmar and axillary hyperhidrosis in children and adolescents

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**Abstract** Primary hyperhidrosis (PH) often starts in childhood and adolescence and can be a troublesome condition. In Taiwan, there is a high incidence in childhood (1.6%–2.0%) and adolescence (2.2%–2.6%). There are few reports regarding transthoracic endoscopic sympathectomy (TES) for PH in children and adolescents. From July 1994 to April 1998, a total of 438 patients underwent TES. There were 174 males and 264 females with a mean age of 14.2 years (range 5–17 years). All patients were placed in a semi-sitting position under single-lumen intubation anesthesia. We performed ablation of the T2 ganglion and any Kuntz fibers in 350 patients with palmar hyperhidrosis and a similar procedure on the T2 and T3 ganglia in 88 patients with palmar and axillary hyperhidrosis using either a 6- or 8-mm thoracoscope via one 0.8-cm incision just below each axilla. In the 438 patients, 875 sympathectomies were performed. There was 1 technical failure due to severe pleural adhesions. TES was usually accomplished within 15 min (range 7–20 min). All except 5 patients were discharged within 4 h after operation. The surgical complication rate was minimal: 1 pneumothorax (0.23%) and 2 segmental lung collapses (0.46%). There was no surgical mortality. The mean postoperative follow-up period was 25.2 months (range 4–45 months). The result was highly satisfactory in 408 patients (93.2%), although 377 (86%) developed compensatory sweating of the trunk and lower limbs, the distribution affecting the back (86%), abdomen (48%), lower limbs (78%), and soles (1.4%). The recurrence rate of palmar hyperhidrosis was 0.6% in the 1st, 1.1% in the 2nd, and 1.7% in the 3rd year. TES is thus a safe and effective method for treating palmar and axillary hyperhidrosis in children and adolescents.

**Key words** Hyperhidrosis · Endoscopic sympathectomy

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## Introduction

Primary hyperhidrosis (PH) is defined as sweating beyond physiological needs, particularly in response to heat or emotional stimuli. The etiology is still unclear. Epidemiologic studies are scanty, but Adar et al. have reported an incidence of 0.6% to 1% [1]. It usually affects the palms, axillae, and soles [1–3], and occasionally occurs on the face, groin, and legs. PH may cause severe embarrassment, presenting not only psychological and social problems, but also educational and occupational handicaps. The existing nonoperative therapeutic options such as systemic anticholinergic drugs, topical astringents, or absorbing powders, biofeedback, iontophoresis, and percutaneous phenol block seldom give sufficient relief and their effects are usually transient.

Transthoracic endoscopic sympathectomy (TES) is the treatment of choice for palmar and axillary hyperhidrosis: it has a high success rate and minimal morbidity [4–8]. PH often commences in childhood or adolescence [3, 4], but there are few reports of TES for PH in these patients [4]. We present our experience in treating PH in children and adolescents, and discuss the perioperative management and complications.

## Materials and methods

From July 1994 to March 1998, 438 patients under 17 years of age underwent a total of 874 TES. There were 174 males and 264 females with a mean age of 14.2 years (range 5–17 years); 350 patients had palmar hyperhidrosis and 88 had both palmar and axillary hyperhidrosis. TES was performed with the patient under general anesthesia with a standard single-lumen endotracheal tube. Throughout the procedure, the patients were ventilated with 100% inspired oxygen and were anesthetized with propofol (Diprivan).

Peripheral arterial oxygen saturation ($SaO_2$) was monitored with a pulse oximeter to prevent hypoxemia.

All patients were placed in a semi-sitting position with abduction of both arms. An 0.8-cm incision at the 3rd intercostal space was made below the axillae bilaterally just posterior to the pectoralis major muscle (Fig. 1). The endotracheal tube was briefly disconnected to deflate the lung, and then the pleural cavity was entered using mosquito forceps to avoid damaging the lung parenchyma. A 0° thoracoscope, either 6- or 8-mm (Storz, Germany), was introduced into the pleural cavity through an obtuse head trocar. Pneumolysis was sometimes needed for pleural adhesions before identification of the sympathetic trunk, which was easily identified crossing perpendicularly on the ribs. Ablation of the T2 ganglion and any Kuntz fibers was performed at the 2nd and 3rd rib beds with conventional electrocautery in patients with palmar hyperhidrosis (Fig. 2). A similar procedure on the T2 and T3 ganglia was performed at the 2nd, 3rd, and 4th rib beds in patients with both palmar and axillary hyperhidrosis (Fig. 3).

After adequate sympathectomy, the lung was reinflated under visual control. It is important to have the anesthesiologist exert continuous positive pressure for a few seconds when the skin is closed in order to prevent a pneumothorax and incomplete expansion of the lung. No thoracic drains are needed. The surgical wound was closed with subcutaneous sutures for cosmetic considerations. A routine chest radiograph was checked postoperatively to rule out a hemopneumothorax or incomplete lung expansion. Most patients were discharged on the day of operation and returned to their ordinary activities within 1 week.

## Results

Among the 438 patients, 875 sympathectomies were performed; 82% of patients had developed PH since the onset of childhood and 18% since adolescence. Almost all patients had plantar hyperhidrosis (92%) as well, and some also had axillary hyperhidrosis (20%). The TES was generally carried out within 15 min (range 7–22 min) unless severe pleural adhesions were encountered. Incidental findings during the operation consisted of pleural adhesions (4 cases, 0.91%) and congenital bullae (2 cases, 0.46%).

Successful bilateral sympathectomies were achieved in all patients except 1 who had severe pleural adhesions.

**Fig. 1** Patient in semi-sitting position under single-lumen intubation anesthesia: 0.8-cm incision below each axilla

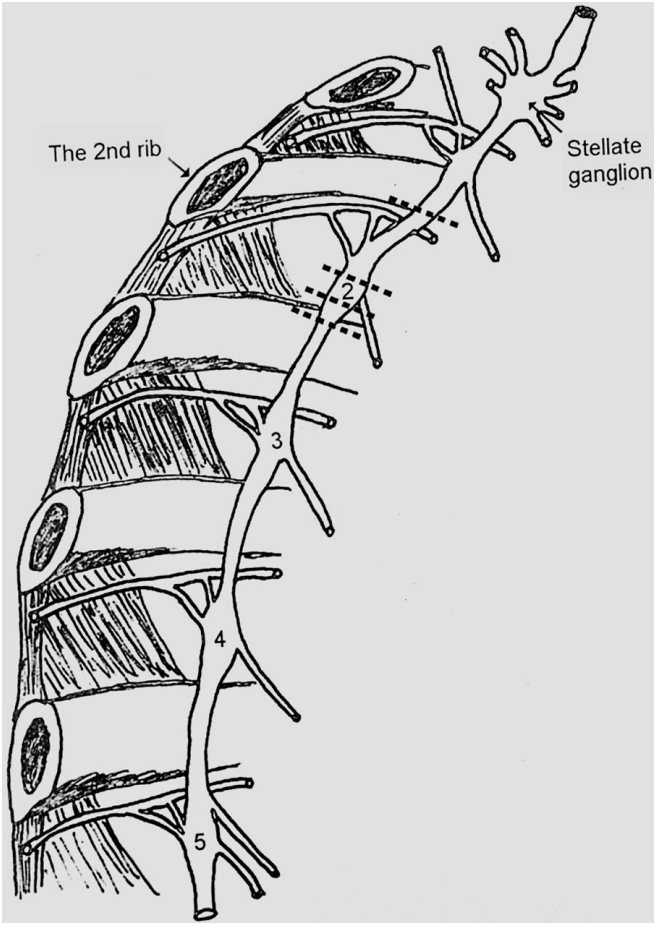


**Fig. 2** Ablation of T2 ganglion at 2nd and 3rd rib beds

All except 5 were discharged within 4 h after operation. The surgical complication rate was minimal: 1 pneumothorax (0.23%) and 2 segmental lung collapses (0.46%). A thoracostomy tube was placed for 2 days in the patient with a pneumothorax; this was not necessary in the patients with incomplete lung expansion. There was no surgical mortality.

The mean postoperative follow-up period was 25.2 months (range 4–45 months). The immediate postoperative result was excellent in 436 cases (99.3%). One patient complained of some persistent perspiration on his palms and 1 had no improvement of axillary hyperhidrosis. Compensatory sweating of the trunk and lower limbs developed in 377 patients (86%), the distribution being the back (86%), lower chest and abdomen (48%), thigh and leg (78%), and sole (1.4%); 271 (62%) had improvement of plantar perspiration. Twenty-two patients (5%) were more embarrassed by the compensatory sweating than by the original form of PH, and 6 had increased sweating on the soles. Among 88 patients with both palmar and axillary hyperhidrosis, 10 (11.4%) had more severe compensatory hyperhidrosis. Overall, 408 patients (93.2%) had satisfactory results after TES. Neither permanent nor transient Horner's syndrome occurred in any patient. The recurrence rates

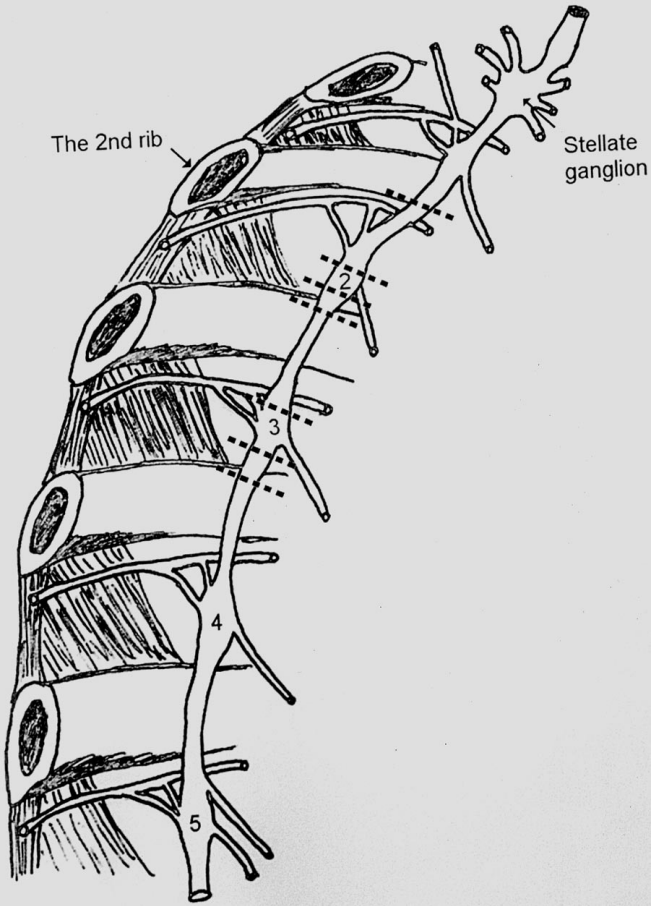


**Fig. 3** Ablation of T2 and T3 ganglia at 2nd, 3rd, and 4th rib beds

of palmar hyperhidrosis were approximately 0.6% in the 1st, 1.1% in the 2nd, and 1.7% in the 3rd year.

## Discussion

Adar et al. reported that the incidence of PH was 0.6%–1% in Israel [1]. The incidence of palmar hyperhidrosis is about 1.6%–2.0% in childhood and 2.2%–2.6% in adolescence in Taiwan. TES is a good choice of treatment for PH. The 2nd thoracic ganglion is the key to innervation of the upper extremity. If it is missed during TES, it may lead to failure of treatment of palmar hyperhidrosis [4, 5]. The T2 sympathetic ganglion lies between the 2nd and 3rd ribs, and hence, transection of the T2 ganglion must be performed on the 2nd and 3rd rib beds [6]. Similarly, ablation of the T3 ganglion should be performed on the 3rd and 4th rib beds.

Ablation of the ganglia T2–T3 or T2–T5 has been advocated to treat PH by some authors [1–3, 5]. Comparing the reports of Kao et al. and Lin [4, 6, 7], we suggest that ablation of only the T2 ganglion is effective in improving palmar hyperhidrosis and has a low recurrence rate. Routine T2 sympathectomy can partially alleviate axillary hyperhidrosis, however, when there is severe axillary hyperhidrosis additional ablation of the T3 segment is needed [7]. Therefore, we recommend ablation of both the T2 and T3 ganglia as adequate and effective treatment of both palmar and axillary hyperhidrosis.

Correct identification of the 2nd rib is imperative. The superior intercostal artery (SIA) plays a critical role here [9]. Chiou and Liao reported this small vessel arising from the subclavian artery in 87.5% of cadavers studied. The SIA artery consistently runs lateral and parallel to the sympathetic chain at an average distance of 10 mm at the 2nd rib [9]. In our limited experience, the SIA may be obscured in children, but the 2nd rib always lies beneath the 1st intercostal muscle. The 1st intercostal muscle can thus be the best method of identification of the 2nd rib.

Drott et al. reported that primary failure occurred in 23 of 1,163 patients (1.9%) and 24 (2%) developed recurrent symptoms during a mean follow-up of 31 months [5]. In our series primary failure of TES occurred in only 1 patient (0.23%), which might be due to fewer pleural adhesions being present in children and adolescents. The incidence of pleural adhesions has been reported to be 3.4%–6.4% during TES [10, 11]. Among our 438 patients, pleural adhesions were found in 4 (0.9%). Kao et al. reported that the long-term recurrence rate of palmar hyperhidrosis was less than 3% at 3 years postoperatively [4]. Among our 350 patients with palmar hyperhidrosis, the recurrence rate was 1.7% in the 3rd year.

Many hypotheses have been introduced to explain the recurrence of PH post-TES. Approximately 10% of patients have extraneural pathways lateral and parallel to the main sympathetic chain (the nerves of Kuntz) via which sympathetic fibers reach the brachial plexus, causing persistent sweating of the hands, without passing through the sympathetic trunk [12, 13]. Therefore, complete ablation of the T2 ganglion and any Kuntz fibers is imperative for treating palmar hyperhidrosis. Regeneration of preganglionic fibers is another explanation for the recurrence of sweating over the palms and axillae [12, 13].

Kux was the first researcher to use endoscopy for sympathectomy after creation of artificial pneumothorax conditions in treating PH [2]. Shachor et al. considered both double-lumen intubation anesthesia and an artificial pneumothorax prerequisites for performing TES [3]. Cohen et al. adopted double-lumen intubation anesthesia in children and adolescents undergoing endoscopic sympathectomy [14]. However, we recommend a semi-sitting position under single-lumen intubation anesthesia without an artificial pneumothorax for TES [6, 15, 16].

In our series, neither a double-lumen endotracheal tube nor an artificial pneumothorax was needed. Double-lumen endotracheal tubes may cause trauma to the upper airway in children. In addition, a good operative field can be achieved without an artificial pneumothorax after total collapse of the lung by transient disconnection of the endotracheal tube. The average operating time is

usually less than 15 min, and hence we do not recommend double-lumen intubation. However, the use of a pulse oximeter is necessary for monitoring perioperative oxygenation [3]. When $SaO_2$ decreases to 92%, the lung should be reinflated to avoid hypoxemia and possible bradycardia.

Compensatory hyperhidrosis is the most common reported complication, developing in 47%–98.5% of cases [1–4, 14, 17]. In our study, 86% of patients developed compensatory hyperhidrosis after TES. The discomfort is maximal during the 1st summer after the operation, but it rarely handicaps the patient's life. Of the patients with palmar hyperhidrosis, 94.5% were satisfied with the result of T2 ganglion ablation, but satisfaction was only 88.6% after T2 and T3 ganglionectomy. Ablation of only the T2 ganglion for palmar hyperhidrosis might lead to milder compensatory sweating, which would be greater after ablation of both the T2 and T3 ganglia for palmar and axillary hyperhidrosis. Other complications including pneumothorax, hemothorax, incomplete lung expansion, and Horner's syndrome usually occur in less than 2% of cases [4, 6] when TES is performed by an experienced surgeon.

In conclusion, TES of the T2 or T2–3 ganglia is a simple, safe, and effective method for treating palmar and axillary hyperhidrosis in children and adolescents. Single-lumen intubation anesthesia and a semi-sitting position are recommended during the procedure.

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