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Ultra-thin needle thoracoscopic surgery for hyperhidrosis with excellent cosmetic effects ☆

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Abstract

Background: In spite of its cosmetic benefits over open surgical techniques, endoscopic sympathectomy using 5 mm or larger instruments still has the problems of operative scar as well as pain on the trocar sites. Recently we have begun using 2 mm endoscopic instruments. The purpose of this study was to confirm the safety and feasibility of fine needle endoscopic instruments in thoracic sympathetic ablation. **Methods**: We have exclusively used 2 mm endoscopic instruments since January 1997, and from that time to May 1999 417 patients were underwent surgical procedures for hyperhidrosis. T2 or T2/T3 sympathectomy was performed for the first 56 patients, after June 1997, in 361 patients the interconnecting sympathetic trunk was divided instead of ganglion resection, and this procedure was named sympathicotomy. Palmar hyperhidrosis was presented in 375 patients (89.9%) and facial in 28 (6.7%) and axillary in 14 (3.4%). The level of division or resection of the ganglion differed according to the patient's symptoms. **Results**: Sympathicotomy and sympathectomy were successful and all patients were satisfied with immediate dryness of affected sites. There were not any cases of bleeding or reoperation or hospital mortality. A large endoscope was required to eliminate the pleural adhesion in fourteen cases (7.7%). Thoracotomy conversion was required in two pleural adhesion cases. Minor complications were occurred in 17 patients (4.1%); such as closed thoracostomy in ten cases, peripheral nerve injury in three, pulmonary parenchymal injury in two, Horner's syndrome in two and atrial fibrillation in one. We have five cases of recurrent symptoms (1.2%). **Conclusion**: Our experience indicates that, for the treatment of hyperhidrosis, 2 mm ultra-thin needle endoscopic instruments are safe and effective to operate on palmar and facial hyperhidrosis patients. © 2000 Published by Elsevier Science B.V.

Keywords: Hyperhidrosis; Needle endoscope; Sympathicotomy; Sympathectomy; R3 sympathicotomy

1. Introduction

Although the first report on endoscopic sympathectomy appeared more than a half-century ago [1], this procedure did not initially achieve general acceptance and was performed only sporadically in Europe. However nowadays, upper thoracic endoscopic sympathetic ablation is a well-known and established procedure for palmar and facial hyperhidrosis [2–12]. Although many advances were made in the past decade in procedures such as limited resection and smaller incision, there were some problems such as incisional site pain and relatively large operative wounds, when for 5 or 10 mm endoscopic instruments were used. A 2 mm fine needle endoscope (needlescope), developed more than 10 years ago, has been used in various gynecologic and urologic procedures. Although the needlescope is narrow, it has enough capacity to carrying adequate images and light to operate. We reviewed our results using a fine needle type thoracoscope exclusively for sympathetic ablation in hyperhidrosis and evaluated its effectiveness and safety.

2. Patients and methods

Since the first introduction of a fine needle endoscope in our department for hyperhidrosis in January 1977, 417 patients underwent sympathectomy or sympathicotomy in the period until May 1999. There were 228 male and 189 female patients and the mean age was 26.3 ± 9.9 years, ranging from 11 to 60 years old. The indications for surgery were palmar hyperhidrosis in 375 patients (89.9%), facial hyperhidrosis in 28 (6.7%) and axillary in 14 (3.4%). Three different procedures were used in different time periods (Table 1). From January to May 97 *sympathectomy* was performed in 69 patients, with T2 sympathectomy meaning resection of T2 sympathetic ganglion. The second procedure was *sympathicotomy* performed in the period from June 1997 to September 1998 in 254 patients. The term T2

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Table 1
Demographic summaries of all 417 patients

Group	Sympathectomy	Sympathicotomy	R3 sympathicotomy
Time period	Jan 1997–May 1997	June 1997–Sept 1998	Oct 1998–May 1999
Number	69	254	94
Men/women	34/35	147/107	47/47
Age (years)	24.1 ± 9.4	27.2 ± 10.0	25.3 ± 9.5
Operative time (min)	65.2 ± 21.8	43.0 ± 22.8	47.8 ± 40.5
Postoperative hospital stay (days)	0.19 ± 0.55	0.07 ± 0.15	0.04 ± 0.41
Symptom relief (%)	98.6	100	95.7

sympathicotomy means simple division of two levels of the sympathetic trunk, above and below the T2 sympathetic ganglion. The most recently developed procedure was *R3 sympathicotomy*, i.e. third rib sympathicotomy, and this was performed from October 1998 to May 1999 in 94 patients, and in this procedure only one sympathetic trunk over the third rib was divided (caudad to the second sympathetic ganglion).

General anesthesia was used in all patients. In the early days of these series one-lung ventilation was performed with a double lumen endotracheal tube. From May 1997, the CO_2 gas insufflation technique was used with a single lumen endotracheal tube. The patient was laid in semi-Fowler's position with both arms abducted. The legs were compressed with bandages for prevention of venous stasis. Both sides of the anterior chest including axillae were draped and exposed. If there was a possibility of thoracotomy due to adhesions, the patients were placed in a lateral decubitus position with arm abduction. The axillary area was draped.

A tiny stab wound was placed around nipple areola in men and at the lateral breast line for women. A MiniSite® Introducer (USSC, Norwalk, CT) loaded with a Verres type needle was gently pushed into the pleural space. The sharply edged inner needle of the Verres needle could be withdrawn quickly after once a sudden pressure yield was felt, indicating that the needle had been safely introduced into the pleural space. The CO_2 gas line was attached to the side

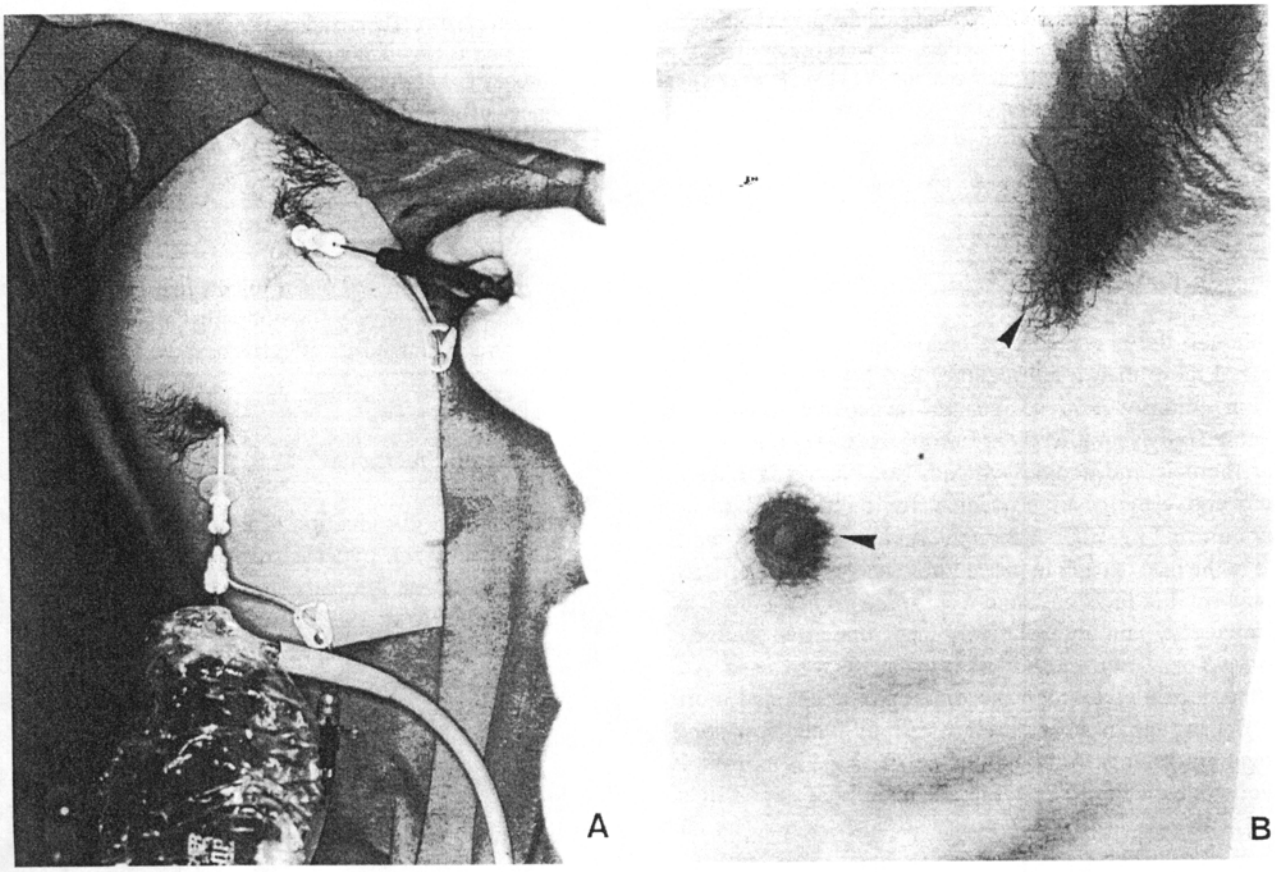

Fig. 1. (A) Surgery for sympathicotomy using two instruments. One trocar port is at the areola of a nipple and another is in the axilla. (B) Postoperative wound in same patient. Surgical wounds (arrows) are hardly visible.

port of the mini-trocar, and gas was insufflated to 1000 ml for men and 800 ml for women with careful monitoring of pleural pressure, gas flow and hemodynamics. A Fine MiniSite® 2 mm laparoscope (needlescope, USSC) was introduced to examine the pleural cavity and sympathetic trunk. A second trocar was placed at the infra-hairline in the axilla and usually this trocar site was determined under intrathoracic visualization. Through the second port the probe was inserted and the exact rib count determined. Then insulated endoscopic scissors (Wolf Co, Knittingen, Germany) replaced the probe and the sympathetic trunk was divided with electocoagulator cutting power over the second and/or third and/or fourth rib, depending on the symptoms (Fig. 1). For palmar hyperhidrosis we simply divide the trunk overriding the third rib using the R3 sympathicotomy technique. For facial symptoms the sympathetic trunk over the second rib was divided (R2 sympathicotomy) and for axillary symptoms the sympathetic trunk over the third and fourth rib were divided (R34 sympathicotomy). The divisions were extended laterally for 1–2 cm to disrupt possible coexistent collateral fibers. This two trocar technique was employed for sympathicotomy and R3 sympathicotomy procedures.

A small piece of metal wire was loaded into a 2 mm suction cannula and dislodged into the second or third intercostal space. This wire allowed the target area to be exactly calculated postoperatively or intraoperatively. Since January 1999 we placed metal wires in all 54 cases bilaterally, and the operative level was confirmed on chest X-films in the operating room or postoperative recovery room. Before that time metal positioning was only done sporadically when there was any suspicion of rib mistaken counting. The axillary trocar was replaced with a 16 Fr polyethylene catheter through which insufflated gas was evacuated. The trocar site was not sutured but the edges were approximated with sterile tapes. After few minutes of generous ventilation of both lungs, the contralateral side was treated in the same fashion, usually beginning with the right side. In the recovery room a chest film was taken to make sure of the exact location of the sympathicotomy by mean of the metal marker and to make sure there was no residual air in the pleural cavity (Fig. 2). A few hours later the chest film was taken again and then the patient returned home the same day.

In early cases in the present series three trocars were required for the sympathectomy procedure, one for needle-endoscope, another for the endo-grasper and the other for the endo-scissors. This procedure was performed under one-lung ventilation using a double lumen endotracheal tube. The trocar sites were slightly different from the above-mentioned two trocar procedures. The MiniSite® laparoscope site was located in the 4th or 5th intercostal space at the mid-axillary line, the two instrumental sites were at the 2nd intercostal space at slightly lateral to the mid-clavicular line, and at the anterior axillary line (Fig. 3).

Data were expressed as means ± standard deviation. Comparisons between two groups were made by Student's *t*-test and those among three groups were made by analysis of variance (ANOVA). A P value of less than 0.05 was considered to indicate statistical significant.

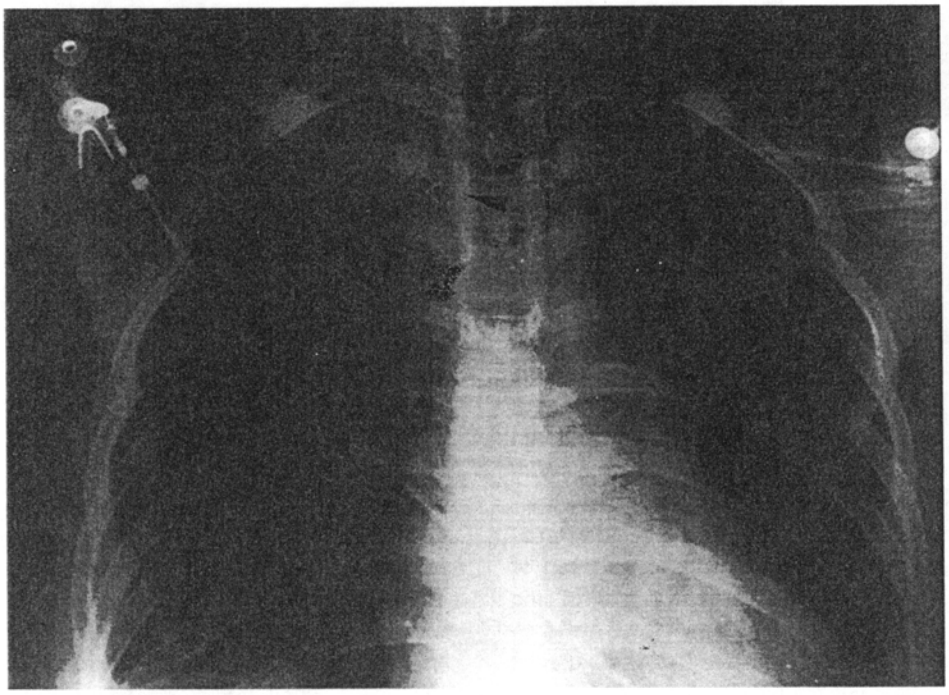

Fig. 2. Chest film taken in the operating room after inserting two pieces of metal wire in the 3rd intercostal space. A wire is visible in the right 3rd intercostal space (arrows).

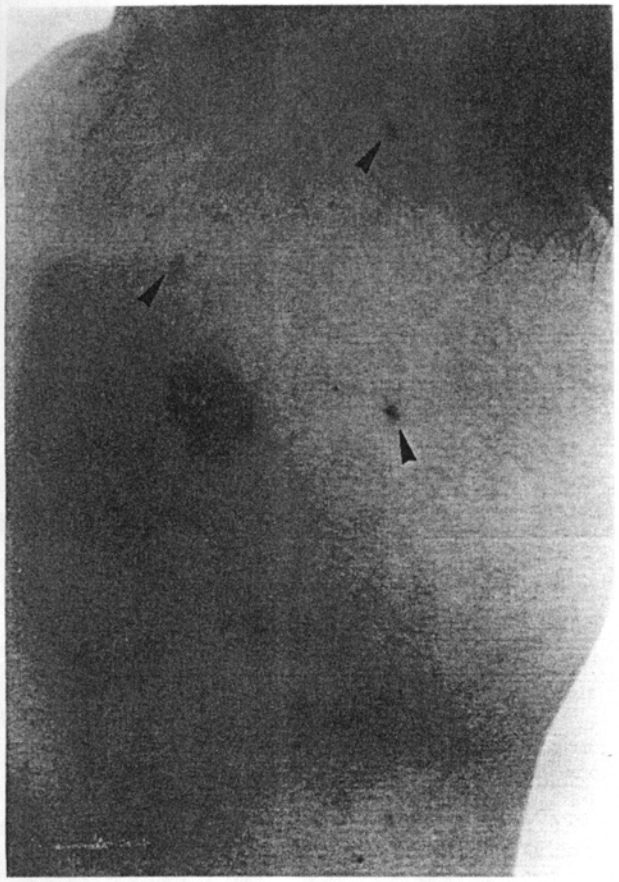

Fig. 3. Three tiny trocar sites are faintly discernable in this sympathectomy patient (arrows).

3. Results

The symptoms disappeared completely in all patients (100%) immediately after the operation. Of the 417 patients, 414 (99.3%) received adequate operation in terms of exact ablation of the targeted ganglion. In three patients (0.7%) accurate ablation of sympathetic ganglion was not achieved, but in all three cases the targeted level was one segment lower than the intended one. In two patients a lower level than intended was recognized by the marking wire on chest X-ray taken in the recovery room and returned to the operating room again to divide one more cephalad sympathetic trunk. One patient complained of return of symptoms 2 weeks after the operation. This patient did not undergo wire positioning and consequently 2 weeks later at redo-operation we found the previous lower division of sympathetic trunk. An additional division of one cephalad sympathetic trunk was done. These patients were all relieved of symptoms after re-do operations. Currently five of the patients (1.3%) with palmar hyperhidrosis have mild to moderate symptom recurrence and are being managed conservatively. Of these, four belonged to the R3 sympathicotomy group and one case to the sympathectomy group. The rate of incompleteness of operation was slightly higher in the R3 sympathicotomy group than in the sympathicotomy group (4.3 vs. 0.3%, $P < 0.05$).

During procedures incidental pleural adhesions were found in 32 cases (7.7%). Focal mild adhesions could be eliminated with fine needlescopes. However a moderate degree of pleural adhesions or adhesions over the whole lung field required larger endoscopes and instruments for removal of adhesions. Eighteen of these cases (56.3%) underwent needle thoracoscope procedures, although in four cases (12.5%) an additional 2 mm trocar was needed. In 13 patients (40.6%) the needlescope was replaced by a larger thoracoscope and/or instruments. One patient in the conversion to thoracoscope group required axillary thoracotomy. Only two cases (6.3%) required conversion to axillary thoracotomy, both of which had dense adhesions due to previous history of either thoracotomy for pneumothorax or pulmonary tuberculosis in each. Chest tubes were required in six patients (18.7%) among 32 cases of pleural adhesions for the management of air leak.

Operation time was 47.4 ± 28.4 min for all patients. Sympathectomy required slightly longer time than the sympathicotomy and R3 sympathicotomy groups; 65.2 ± 21.8, 43.0 ± 22.8 and 47.8 ± 40.5, respectively ($P < 0.05$). The patients who were switched to thoracoscope needed operation times as long as 103 ± 21 min ($P < 0.05$). Postoperatively 400 patients (95.9%) could be discharged on the same operation day. Seventeen patients (4.1%) were discharged 1.8 ± 0.9 days after operation because of ten chest tube insertions and seven wound pain. Two thoracotomy patients stayed hospital for four days after operation. Overall hospital stays after operation was 0.1 ± 0.4 days. Hospital stays were not statistically differing among the procedures (0.19 ± 0.55 for sympathectomy and 0.07 ± 0.15 for sympathicotomy and 0.04 ± 0.41 for R3 sympathicotomy, $P > 0.05$).

Operative complications were noticed in 23 patients (5.5%). There were ten chest tubes (2.4%) placed in six patients with pleural adhesion, three of pneumothorax and one with associated bleb wedge resection. We encountered 15 cases of pneumothorax in entire series (3.6%). Twelve were clinically insignificant pneumothoraces caused by incomplete removal of insufflated gas and did not require indwelling chest tube placement. This problem was solved by positioning a long venous polyvinyl catheter in the apex of the chest via a previously used axillary port after finishing sympathicotomy. One case of sympathectomy and two cases of sympathicotomy required a chest tube because significant pneumothorax appeared postoperatively. Three patients complained of temporal peripheral upper extremity nerve injuries such as paresthesia and movement restriction of the upper arm. Pulmonary parenchymal injury occurred in two patients: one was related to trocar puncture into the lung and the other was caused by electrical burn injury. Both injuries were small enough to be sealed with tissue fibrin glue (Tissel®, Immuno AG, Vienna, Austria) and did not require a chest tube. Two patients had transient Horner's

Table 2
Complications

Complications	Incidence (%)
Mortality	0 (0)
Chest tube indwelling	10 (2.1)
Incomplete relief of symptom	5 (1.2)
Temporal peripheral nerve injury	3 (1.0)
Lung parenchymal injury	2 (0.5)
Honer's syndrome	2 (0.5)
Atrial fibrillation	1 (0.2)

syndrome. One patient had atrial fibrillation. The operative mortality rate was zero (Table 2). Currently five patients (1.3%) who had had palmar hyperhidrosis have mild to moderate symptom recurrence and are being managed conservatively as stated before.

4. Discussion

Thoracoscopic sympathectomy or sympathicotomy have been well known procedures for hyperhidrosis since the early nineties [2–12]. Surgical techniques vary in different hospitals [2,4,6–12]. Usually a rigid endoscope 5–10 mm in diameter was used for sympathectomy. Although the operative scars were very small compared to open thoracotomy, they could be cosmetically objectionable, especially for young ladies. Many young girls do not want to undergone the operation because of these remaining operative wounds.

Some girls and young women have narrow intercostal spaces and conventional endoscopes can cause pain by intercostal nerve compression. Use of small 2 mm cannula can avoid pressure injury to the intercostal nerves. No patients experienced any pain at the incisional site with the MiniSite trocar. The operative wound scar was also more acceptable than those caused by 5–10 mm endoscopes in terms of scar length and appearance. Also trocar stab wounds were rarely visible because they were placed at sites that would naturally conceal them, such as the nipple areola and axilla. Even young women did not complain of operative wound disfigurement following the needle-endoscopic operations. For a big endoscope punch and the purse-string suture technique is another good option to minimize the operative wound scar [13].

We encountered three cases of improper site of ablation of the sympathetic nerve. One of these was noted due to persistent symptoms 1 week after the operation and the other two were detected by chest films taken in the postanesthetic recovery room (PAR), indicating the wrong positioning of the metal wire. These three patients were reoperated to ablate one more proximal sympathetic trunk. We have learned that there is an error rate of 1–2% in rib counting endoscopically, even by experienced endoscopists. To avoid this kind of complication we now routinely position a small piece of metal wire at the ablated intercostal space on each side and confirm the location on chest films taken in the PAR or operating room. The sympathetic nerve is sometimes obscured by subpleural fat but can be identified by palpation with the thin probe. To identify the second rib endoscopically, it should be remembered that the first rib is hard to see for a certain length. As it separates from the vertebra the first rib turns acutely in a cephalad direction, while the 2nd and 3rd and 4th ribs run horizontally for some distance. Another important technique is to palpate the first rib directly with the probe and then number the ribs. Whenever there is a question about rib counting, chest films taken in the operating room after placement of a piece of wire in an intercostal space could yield accurate information (Fig. 2).

Recently for palmar symptoms, we divide the sympathetic trunk over the third rib only. We call this operation R3 sympathicotomy. Although we have not fully analyzed the differences between T2 sympathicotomy and R3 sympathicotomy, R3 sympathicotomy appears better because it has same effect in eliminating symptoms but has a lower degree of compensatory sweating.

The fine needle endoscope was originally developed for gynecologic and abdominal diagnostic procedures. Because of the low resolution and low illumination of the fiberoptic bundle, it was not considered for endoscopic surgery. However the new version 'gold MiniSite®' (USSC) has increased numbers of fiberoptic bundle (50 000) and has better resolution than first generation instrument, making sympathicotomy much easier than previous MiniSite® scope. Although the resolution is not comparable to the rigid rod lens system endoscope, needle endoscopic images are good enough to divide or remove the sympathetic ganglion as in other [6] and our reports [3,4]. We accomplished sympathetic ablation successfully in 96.4% of cases with the needle endoscope. Only 14 cases (3.4%) required a larger endoscope or conversion to thoracotomy due to pleural adhesion or previous thoracotomy. Furthermore, the complication rate was only 4.3%, and if we consider those complication related to needle endoscopic instruments, there were only two cases of pulmonary parenchymal injury (0.5%). This means precise operations using a 2 mm needle endoscope are possible for hyperhidrosis. These results suggest that 2 mm fine needle endoscopes and accessory instruments allow safe and effective thoracic sympathicotomy or sympathectomy for the treatment of hyperhidrosis. Needle endoscopes may also be used for pleural examination and biopsy but not for other pulmonary diseases.

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