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The Comparison of VATS Ramicotomy and VATS Sympathicotomy for Treating Essential Hyperhidrosis

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This study was undertaken to determine if better results could be achieved by comparing the results of a thoracic sympathetic ramicotomy (division of rami communicantes) with a conventional thoracic sympathicotomy (division of sympathetic trunk) for treating essential hyperhidrosis. From August 2001 to February 2002, 29 consecutive patients underwent surgery of the sympathetic nerves in order to treat severe essential hyperhidrosis. Of these patients, a ramicotomy was performed under VATS (VATS-R) in 13 patients, sympathicotomy under VATS (VATS-S) in 13, a unilateral ramicotomy and contralateral sympathicotomy under VATS (VATS-RS) in 2 and a sympathicotomy via a thoracotomy (T-S) in 1. There was no significant difference between the VATS ramicotomy group (VATS-R, n=13) and VATS sympathicotomy group (VATS-S, n=13) in terms of gender, pleural adhesions or comorbidities. However, the age of the VATS-S group at surgery was higher than that of the VATS-R group (p=0.050). The operation times, and hospital stays of the groups were 51.5 and 41.9 minutes, and 2.0 and 2.3 days, respectively. The recurrence rate of the operated sites according to the surgical methods (ramicotomy and sympathicotomy regardless of VATS) was 21.4% (6/28) in the ramicotomy group and 6.7% (2/30) in the sympathicotomy group, but there was no statistical significance (p=0.101). This study compared the dryness of the enervated sites and the severity of compensatory sweating among the ramicotomy (n=11, excluded 2 re-operated cases from 13 VATS-R), sympathicotomy (n=14, VATS-S 13 and T-S 1) and the synchronous or metachronous ramicotomy/sympathicotomy groups (n=4, included 2 reoperated cases of VATS-R). The sympathicotomy group had an over-dryness of the enervated sites (dryness 1.4, from 1 to 3; 1:over-dried, 2:humid, 3:persistent sweating) and complained of severe compensatory sweating (severity 3.5, from 1 to 4; 1:absent, 2:mild, 3:embarrassing, 4:disabling). However, the patients whounderwent a ramicotomy maintained some humidity of the enervated sites (dryness 2.0, p=0.012) and showed milder compensatory sweating (severity 2.7, p=0.056) than those in the sympathicotomy group. Furthermore, the dryness of the ramicotomy side was different from that of the sympathicotomy side in 3 out of 4 ramicotomy / sympathicotomy (R+S) patients (the side of the ramicotomy was humid and that of the sympathicotomy was over-dried). The average dryness and the compensatory sweating at these sites were in the midst of the two groups (dryness and severity 1.6 and 3.0, respectively). A ramicotomy can prevent over-dryness of the enervated area and decrease the severity of compensatory sweating through the selective division of the rami communicantes of the thoracic sympathetic ganglia. Postoperatively, almost all ramicotomy patients had no functional problems in daily life or in their occupational activity, because they could maintain hand humidity. Moreover, they showed no more than a mild degree of compensatory sweating and reported high long-term satisfaction rates. Therefore, a sympathetic ramicotomy rather than a conventional sympathicotomy is recommended as a more selective and physiologic modality for treating essential hyperhidrosis.

Key Words: Hyperhidrosis, ramicotomy, sympathicotomy

INTRODUCTION

Although video-assisted thoracoscopic surgery (VATS) is widely accepted for treating essential hyperhidrosis, an ideal procedure without the undesirable complication of compensatory hyperhidrosis is still needed.[1-3] The optimal technique has remained a subject of controversy because the conventional VATS procedures of the sympathetic nerve, such as sympathectomy (excision) and

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sympathicotomy (electrocautery) result in over-dryness of the enervated area and an irreversible compensatory hyperhidrosis of the lower trunk. Based on the anatomy of the thoracic sympathetic nervous system, the communicating rami of the upper thoracic sympathetic ganglia frequently become involved in essential palmar hyperhidrosis. The technique of the dividing sympathetic rami communicantes whilst preserving the thoracic sympathetic ganglia and nerve chain (ramicotomy) was first introduced by Wittmoser, which was later reported by Gossot.[4,5] In addition, it was reported that a T2-3 ramicotomy was a more selective and physiological surgical method for palmar hyperhidrosis than a conventional sympathicotomy. However, a higher recurrence rate had to be accepted as the price for the lower compensatory hyperhidrosis rate.6 The aim of this study was to compare the two different techniques (VATS ramicotomy and VATS sympathicotomy) and to determine the better of the two based on the results achieved.

MATERIALS AND METHODS

Patients

Between August 2001 and February 2002, 29 consecutive patients(37.9% males and 62.1% female) with severe essential hyperhidrosis underwent the surgery of the sympathetic nerves. Thirteen patients of these received VATS ramicotomy, and 14 patients sympathicotomy. One of the 14 sympathicotomies was performed via bilateral thoracotomy under VATS because of severe pleural adhesion. This study performed two combined unilateral ramicotomy and contralateral sympathicotomy procedures due to the incidental interruption of the sympathetic chain during a dissection. Among the 13 patients who underwent a ramicotomy, two patients received additional surgery (sympathicotomy) to treat the recurred side only (1 in the right, 1 in the left). The mean age of these 29 patients was 25.4 years ranging from 17 to 58 years. Most patients had one or more sites of excessive sweating but the main problems were palmar (72.4%), axillar (13.8%) and craniofacial (13.8%). A retrospective review of the medical records was performed, and the variables were as follows: pleural adhesion, comorbidity, the operation time, the hospital stay, complications, recurrence, the satisfaction rate, the surgical result, and compensatory sweating. Three categories (1 : over-dried, 2 : humid, 3 : persistent sweating) were used to evaluate the surgical results. Compensatory sweating was classified into 4 degrees (absent, mild, embarrassing, and disabling) according to severity. A linear analogue scale was used to assess the satisfaction rate (range 0 to 10, where 0=very unsatisfied and 10= very satisfied). The average follow-up period was 6 months. The summer season was included in the follow-up period in order to compare the development of compensatory sweating. All the patients were interviewed 2 weeks after surgery at an outpatient clinic and later, the long-term results were evaluated by a telephone questionnaire.

Of all the variables examined, this study compared the incidence of pleural adhesion, the presence of comorbidity, the operation time, the hospital stay, the postoperative complications and the recurrence rate between the VATS ramicotomy (VATS-R, n=13) and VATS sympathicotomy (VATS-S, n=13) patient groups. The recurrence rate was investigated according to the surgical methods (28 sides of ramicotomy and 30 sides of sympathicotomy regardless of VATS) and was expressed as the recurred sides/operated sides. After the 2 cases of ramicotomy group, who underwent additional surgery, were moved from ramicotomy group to the ramicotomy/sympathicotomy group, the ramicotomy (R, n=11), sympathicotomy (S, n=14) and ramicotomy/sympathicotomy (R+S, n=4) group were compared in terms of the surgical results and compensatory sweating.

Surgical procedure

The operations were performed under general anesthesia with a double lumen endotracheal tube in order to permit the ventilation of a single lung. The patient was positioned in the half-sitting position with both arms abducted. The operating table was inclined to the opposite side to induce the lung of the operated side to fall toward the mediastinum and diaphragm. After beginning the

single-lung ventilation, a tiny stab wound was placed around the nipple areola in the men, and at the lateral inframammary line for the women. A 2-mm trocar was inserted into the pleural cavity in order to guide the thoracoscope. Once the endoscope was in place, another small skin incision was made at the infra-hairline in the axilla and a second 5-mm trocar was placed through the same incision. As the lung collapsed due to the single-lung ventilation, an excellent view of the upper thoracic cavity was obtained. After visual confirmation of the sympathetic chain, insulated endoscopic scissors were guided in through the 5-mm trocar of the axilla. For palmar hyperhidrosis, the sympathetic chain was simply divided over the third rib (caudal to the second thoracic sympathetic ganglion) in the sympathicotomy group or the sympathetic rami communicantes of the third thoracic sympathetic ganglion was resected, whilst preserving the thoracic sympathetic ganglia and the nerve chain in the ramicotomy group. In the axillary hyperhidrosis the fourth rib (sympathicotomy) or the fourth thoracic sympathetic ganglion (ramicotomy) was included, and in cases with craniofacial symptoms the sympathetic trunk over the second rib was divided only. After a full expansion of the lung following the contralateral single-lung ventilation, the operation was repeated on the other side. A chest radiography was performed a few hours after surgery in order to exclude a progressive hemo- or pneumo-thorax. Most patients were discharged from the hospital the day after surgery except for those who required closed thoracostomy due to a pneumothorax or pleurodesis for prolonged air leakage.

Statistical analysis

The results in this retrospective study are expressed as mean values. The comparisons between the two groups were made by either the Student t-test or Fischer's exact test. A p value < 0.05 was considered significant.

RESULTS

The VATS ramicotomy or sympathicotomy was performed in 28 (13 VATS-R, 13 VATS-S, 2 VATS-RS) of the 29 patients. The other patient underwent bilateral sympathicotomy through a thoracotomy (T-S) due to severe pleural adhesions. No mortality or life-threatening complications occurred. Postoperative pain developed in 13 patients (44.8%) and paresthesia was encountered in three (10.3%). The pneumothorax in two patients was treated by a closed thoracostomy. One patient who underwent a thoracotomy due to severe pleural adhesions developed a prolonged air leak, which was resolved by chemical pleurosesis.

There was no statistical difference between the VATS ramicotomy (VATS-R, n=13) group and the VATS sympathicotomy (VATS-S, n=13) group in terms of gender, the incidence of a pleural adhesion, the presence of comorbidity, the operation time, the hospital stay, the postoperative complication or recurrence rate. The operation times, and hospital stays of each group were 51.5 and 41.9 minutes, 2.0 and 2.3 days, respectively. The patients age was higher in the VATS-S group than in the VATS-R group. This is because, the VATS-S group had older patients with craniofacial hyerhidrosis (Table 1). The recurrence rate according to the surgical methods used was 21.4% (6 sides /28 ramicotomy procedures) in the ramicotomy group and 6.7% (2 sides/30 sympathicotomy procedures) in the sympathicotomy group. Despite the higher recurrent rate in those undergoing a ramicotomy, this was not statistically significant (Table 2).

After the 2 cases, who underwent additional surgery, were moved from the ramicotomy group to ramicotomy/sympathicotomy, the dryness of the enervated sites and the severity of the compensatory sweating among the ramicotomy group (R, n=11), the sympathicotomy group (S, n=14)and synchronous or metachronous ramicotomy/sympathicotomy group (R+S, n=4)were compared. The sympathicotomy group experienced over-dryness of the enervated sites, dryness score 1.4 (from 1 to 3; 1 : over-dried, 2 : humid, 3 : persistent sweating) and complained of severe compensatory sweating, severity score 3.5 (from 1 to 4; 1 : absent, 2 : mild, 3 : embarrassing, 4 : disabling), while the patients who underwent a ramicotomy maintained some humidity of the enervated sites, dryness score 2.0(p=0.012) and showed milder

compensatory sweating, severity score 2.7 (p= 0.056) than the sympathicotomy group. Furthermore, the dryness of the ramicotomy side differed from that of the sympathicotomy side in 3 out of 4 ramicotomy/sympathicotomy patients (the side of ramicotomy was humid and that of the sympathicotomy was over dry). The average dryness and compensatory sweating of these patients were between the two groups, with a dryness and severity of 1.6 and 3.0, respectively (Table 3).

In terms of the satisfaction rate, the mean value of the sympathicomomy for craniofacial hyperhidrosis according to a linear analogue scale was 3.0 (range 0 to 10, where 0=very unsatisfied and 10=very satisfied) because of the severe compensatory sweating. The patients who had combined axillary hyperhidrosis showed a similar result (mean value 5.2) regardless of the surgical technique used. With the exception of the cases of ramicotomy group that recurred, the mean satisfaction rate in the sympathicotomy and ramicotomy group for the isolated palmar hyperhidrosis were 5.5 and 6.5, respectively.

DISCUSSION

Patients with essential hyperhidrosis usually have normal anatomical structures but show an overfunctioning of the sympathetic nervous system.[7] With the rapid progression of video-assisted endoscopic technique, a thoracoscopic sympathectomy or sympathicotomy has become an established procedure for treating essential hyperhidrosis, since the early nineties.[8-11] However, a resection of the sympathetic trunk and ganglia

Table 1. Comparison of VATS Ramicotomy and VATS Sympathicotomy

Variables	VATSR (n=13)	VATSS (n=13)	p value
Age (mean)	21.5	29	0.05
Gender (male:female)	5 : 8	5 : 8	1.00
Pleural adhesions (%)	15.4	15.4	1.00
Comorbidities (%)*	7.7	7.7	1.00
Operation time (minutes)	51.5	41.9	0.16
Hospital stay (days)	2.3	2.0	0.15

VATS-R, VATS ramicotomy; VATS-S, VATS sympathicotomy.
*1 hyperthyroidism (VATS-R), 1 rheumatoid arthritis (VATS-S).

Table 2. Analysis of the Recurrence According to the Surgical Method

Surgical methods	R* (n=28)	S* (n=30)
Recurrent rate (%)†	21.4 (6/28)	6.7 (2/30)
Site of recurrence		
Hand (%)	66.7 (4/6)	0 (0/2)
Axilla (%)	33.3 (2/6)	100 (2/2)
Type of recurrence		
Bilateral	1	0
Unilateral	4	2

R, ramicotomy (VATS-R); S, sympathicotomy (VATS-S and T-S).
*sides of each operation including ramicotomy/sympathicotomy (2 cases).
†$p>0.05$.

Table 3. Comparison of the Humidity and Compensatory Sweating According to the Surgical Methods Used

Groups	Ramicotomy* (n=11)	Sympathicotomy (n=14)	R + S*(n=4)
Humidity (mean, 1-3)†	2.1 ± 0.5	1.4 ± 0.5	1.6 ± 0.5
Incidence of CS (%)	90.1 (10/11)	100.0 (14/14)	100.0 (4/4)
Grade of CS (mean, 1-4)‡	2.7 ± 1.0	3.5 ± 0.7	3.0 ± 0.0
Grade 3 ≥ CS (%)	54.5 (6/11)	92.9 (13/14)	100.0 (4/4)

CS, compensatory sweating; R+S, ramicotomy and sympathicotomy.
*2 reoperated cases were moved from ramicotomy group to R + S group.
†$p<0.05$ (p=0.012): between ramicotomy and sympathicotomy.
‡$p>0.05$ (p=0.056): between ramicotomy and sympathicotomy.

can result in irreversible compensatory hyperhidrosis. The ideal surgical method for treating essential hyperhidrosis, without the undesirable complication of the compensatory sweating, remains unresolved.

The sympathetic ganglion cells are activated mainly by the stimuli received via the afferent preganglionic neurons. The preganglionic neuron cells in the spinal cord are in the lateral portion of the intermediate zone of the gray matter. The preganglionic fibers coming from the spinal cord in the thoracic nerves traverse the ventral roots via the white communicating rami consists of myelinated nerve fibers. After the synapses at various levels in the paravertebral thoracic sympathetic ganglion, the postganglionic neurons which are connected to the thoracic nerves via the gray rami communicantes and are mainly composed of unmyelinated nerve fibers, are distributed to the sweat glands of the hand. The assumption that all the preganglionic fibers for the upper extremities traverse the thoracic sympathetic ganglia caudal to the second thoracic nerve is supported by human and animal studies.[12] In 1927, Kuntz described an intrathoracic nerve connecting the second intercostal nerve and the first thoracic spinal nerve along which sympathetic fibers could reach the brachial plexus, hence bypassing the sympathetic trunk.[13]

Based on the anatomical evidences, Wittmoser described sympathetic T2-T4 or T5 ramicotomy for the treatment of the essential palmar hyperhidrosis in 1992. This technique was repeated and reported by Gossot in 1997, who reported a lower rate of compensatory sweating but a higher recurrence rate (5%) in an 11-month follow-up study.[4,5] Furthermore, Cheng et al. recommended that all the rami communicantes of the ganglia and the surrounding tissue of the sympathetic trunk should be cut down to pull the nerve chain high away from its base.[14] In addition to the less severe compensatory sweating, these results shows better outcomes for the VATS ramicotomy in terms of the humidity of the enervated site, particularly the hands. This has very important functional advantages in daily life and at during normal occupational activity by avoiding over-dryness of the hands. There are a few drawbacks related to a VATS ramicotomy. For example, the time needed to perform a VATS ramicotomy is longer than that using conventional techniques, and the possibility of accidental injury to the intercostals vessels is higher. However, a VATS ramicotomy is worth accepting as an ideal surgical method for treating essential hyperhidrosis despite the much lower incidence of compensatory sweating and absence of over-dryness of the palms. This study confirmed that VATS ramicotomy is a more selective and physiological way of controlling the essential hyperhidrosis than a conventional VATS sympathicotomy.

Although a ramicotomy is a better surgical method for essential palmar hyperhidrosis than either a thoracic sympathectomy or sympathicotomy for decreasing the severity of the compensatory hyperhidrosis and maintaining the humidity at the enervated site, it has still some limitations such as higher recurrence rates and the surgical results differ between the patients and even between the sides in the same individual.[5,6]

With regard to the clinical application of a ramicotomy, the anatomy in the communicating rami of the upper thoracic sympathetic chain is very important for achieving a more satisfactory surgical result and for lowering the recurrence rate. Therefore, based on the anatomical and histological investigations of the communicating rami, a VATS ramicotomy requires modifications in the surgical technique in order for it to be accepted as the method of choice for the treating the disabling essential hyperhidrosis.

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