The Comparison of VATS Ramicotomy and VATS Sympathicotom 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 sympathicotom (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, sympathicotom under VATS (VATS-S) in 13, a unilateral ramicotomy and contralateral sympathicotom under VATS (VATS-RS) in 2 and a sympathicotom via a thoricotomy (T-S) in 1. There was no significant difference between the VATS ramicotomy group (VATS-R, n=13) and VATS sympathicotom 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 (ramicotom and sympathicotom regardless of VATS) was 21.4% (6/28) in the ramicotom group and 6.7% (2/30) in the sympathicotom 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 ramicotom (n=11, excluded 2 re-operated cases from VATS-R), sympathicotom (n=14, VATS-S 13 and T-S 1) and the synchronous or metachronous ramicotomy/sympathicotom groups (n=4, included 2 reoperated cases of VATS-R). The sympathicotom 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 who underwent a ramicotom 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 sympathicotom group. Furthermore, the dryness of the ramicotom side was different from that of the sympathicotom side in 3 out of 4 ramicotom / sympathicotom (R+S) patients (the side of the ramicotom was humid and that of the sympathicotom 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 ramicotom 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 ramicotom 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 ramicotom rather than a conventional sympathicotom is recommended as a more selective and physiologic modality for treating essential hyperhidrosis.

Key Words: Hyperhidrosis, ramicotom, sympathicotom

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. The optimal technique has remained a subject of controversy because the conventional VATS procedures of the sympathetic nerve, such as sympathectomy (excision) and
sympaticotomy (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 hyper-
hidrosis. The technique of the dividing sympa-
thetic rami communicantes whilst preserving the
thoracic sympathetic ganglia and nerve chain
(ramicotomy) was first introduced by Wittmoser,
which was later reported by Gossot. In addition,
it was reported that a T2-3 ramicotomy was a
more selective and physiological surgical method
for palmar hyperhidrosis than a conventional
sympaticotomy. However, a higher recurrence
rate had to be accepted as the price for the lower
compensatory hyperhidrosis rate. The aim of this
study was to compare the two different tech-
niques (VATS ramicotomy and VATS sympa-
theticotomy) 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 under-
went the surgery of the sympathetic nerves.
Thirteen patients of these received VATS ramicot-
omy, and 14 patients sympathicotony. One of the
14 sympathicotomies was performed via bilateral
thoracotomy under VATS because of severe pleu-al adhesion. This study performed two combined
unilateral ramicotomy and contralateral sympathi-
cotomy procedures due to the incidental inter-
ruption of the sympathetic chain during a
dissection. Among the 13 patients who underwent
a ramicotomy, two patients received additional
surgery (sympaticotomy) 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, complica-
tions, recurrence, the satisfaction rate, the surgical
result, and compensatory sweating. Three cate-
gories (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 develop-
ment 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 sympathicotony
(VATS-S, n=13) patient groups. The recurrence
rate was investigated according to the surgical
methods (28 sides of ramicotomy and 30 sides of
sympaticotomy 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/sym-
paticotomy group, the ramicotomy (R, n=11),
sympaticotomy (S, n=14) and ramicotomy/
sympaticotomy (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 hemothorax or pneumothorax. Most patients were discharged from the hospital the day after surgery except for those who required closed thoracotomy 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 pleurodesis.

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 hyperhidrosis (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 sympathectomy group. Furthermore, the dryness of the ramicotomy side differed from that of the sympathectomy side in 3 out of 4 ramicotomy/sympathectomy patients (the side of ramicotomy was humid and that of the sympathectomy 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 tech-

Table 1. Comparison of VATS Ramicotomy and VATS Sympathectomy

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

VATS-R, VATS ramicotomy; VATS-S, VATS sympathectomy.

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

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

<table>
<thead>
<tr>
<th>Surgical methods</th>
<th>R* (n=28)</th>
<th>S* (n=30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recurrent rate (%)</td>
<td>21.4 (6/28)</td>
<td>6.7 (2/30)</td>
</tr>
<tr>
<td>Site of recurrence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hand (%)</td>
<td>66.7 (4/6)</td>
<td>0 (0/2)</td>
</tr>
<tr>
<td>Axilla (%)</td>
<td>33.3 (2/6)</td>
<td>100 (2/2)</td>
</tr>
<tr>
<td>Type of recurrence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bilateral</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Unilateral</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

R, ramicotomy (VATS-R); S, sympathectomy (VATS-S and T-S).

* Each operation including ramicotomy/sympathectomy (2 cases).

† p>0.05.

DISCUSSION

Patients with essential hyperhidrosis usually have normal anatomical structures but show an overfunctioning of the sympathetic nervous system. With the rapid progression of video-assisted endoscopic technique, a thoracoscopic sympathectomy or sympathectomy has become an established procedure for treating essential hyperhidrosis, since the early nineties. However, a resection of the sympathetic trunk and ganglia
Table 3. Comparison of the Humidity and Compensatory Sweating According to the Surgical Methods Used

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

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. 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.

Based on the anatomical evidences, Wittmuser 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. 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. 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 sympathicotomies 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.
With regard to the clinical application of a rami-
cotomy, the anatomy in the communicating rami
of the upper thoracic sympathetic chain is very
important for achieving a more satisfactory surgi-
cal result and for lowering the recurrence rate.
Therefore, based on the anatomical and histologi-
cal 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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