LONG-TERM RESULTS OF THORACIC SYMPATHECTOMY FOR PRIMARY HYPERHIDROSIS

TOMASZ J. STEFANIAK, MARTA ĆWIGOŃ

Department of General, Endocrine and Transplant Surgery, Medical University in Gdańsk
LOPSAP, Laboratory for Psychology of Surgery and Psychosomatics, Department of General, Endocrine and Transplant Surgery, Medical University in Gdańsk

The aim of the study was the evaluation of the results of the endoscopic sympathectomy with clips with emphasis on the frequency of side effects following the operation.

Material and methods. Two-hundred-eighty-three patients were qualified to thoracic T3-T4 sympathectomy with clips. In all cases bilateral procedure in prone position with CO₂ insufflation was performed. The subjective intensity of disease was evaluated by VAS scale (0 – no sweating; 10 – maximal possible sweating) while the recurrence of the sweating in primary localization, intensity and dynamics of compensatory and plantar sweating were evaluated post-operatively. Follow-up data were obtained during office visits 3, 12 and 36 months after surgery. The overall follow-up response was 74.6%.

Results. There was no mortality. Perioperative morbidity included 6 cases of pneumothorax. The mean duration of surgery was 57 minutes bilaterally. The postoperative intercostal pain was present in all patients (100%) with mean duration of 21.88 days but in 72.6% of cases it did not demand any medication as early as 48 hours after surgery. Strong or very strong compensatory sweating was observed in 17.5% of cases 3 months after ETS, in 14.1% after 12 months and in 23.6% after 36 months.

Conclusions. Thoracic sympathectomy with clips is a safe treatment that provides satisfactory long-term results. The incidence of side-effects (intercostal pain, compensatory sweating) is high and does not change with time in most of the cases.

Key words: primary hyperhidrosis, sweating, facial, palmar, axillary, sympathectomy, thoracic

Primary hyperhidrosis (PHH) is a disorder of unknown cause characterized by excessive sweating due to sympathetic sudomotor nerves hyperactivity, most often in the palms, axillae and feet in response to emotional and thermal stimuli which very often have no conscious trigger (1). The disorder frequently begins in early childhood and may affect up to 2.8% of the general population (2). PHH leads to a significant reduction of quality of life and often leads to emotional and social problems (3, 4). Local treatment with topical antiperspirants and systemic anticholinergic drugs is usually ineffective (4, 5), with only some of the cases responding well to subcutaneous injections of botulinum toxin (6). Unfortunately, this form of treatment demands regular repetitions and is not refunded by National Health Fund.

In most severe cases of PHH, thoracoscopic destruction of the sympathetic trunk is the only effective form of treatment (7, 8). This operation can be performed by sympathectomy (removal of the trunk and/or ganglia) or sympathectomy (destruction of the connection between the ganglia). The results of the surgical treatment are usually very satisfactory (7, 8), nevertheless, the side effects of the treatment may lead to severe impairment of quality of life and influence significantly the overall perception of the treatment (9-12).
Compensatory sweating (reflex sweating) is the increase in sweating of the trunk as a consequence or side effect of the surgery (9, 10). Its incidence is variable, ranging from 10% to 100% in different studies. Phantom sweating is an unexplained phenomenon that occurs in early postoperative period. It is the temporary recurrence of sweating in the primary localization 24 to 72 hours after surgery (9). Post-sympathectomy syndrome is a transient pain sensation of burning character that can be experienced for 5 to 20 days by the patients after ETS. Its incidence and dynamics have not been sufficiently studied. There is also insufficient amount of research concerning the postoperative thoracic pain following sympathetic surgery. This side-effect is the most intensively influencing early satisfaction, and, as such should be always involved in the evaluation of the effects of sympathectomy.

The aim of this study was the evaluation of the results of the endoscopic sympathetic block with emphasis on the frequency of side effects following this operation.

MATERIAL AND METHODS

Two-hundred-eighty-three PHH patients were treated with ETS in our Department from June 2006 until June 2012. Mean age of the patients was 31.16 years (range 17 – 68) and women:men ratio was 0.68:0.32.

Qualification to surgery

The patients were qualified to surgery basing on the subjective perception of the hyperhidrosis confirmed by objective gravimetric method. Gravimetry has been already described by our team (12, 13, 14) and other authors (15, 16). In short, the patients were given five pre-weighted gauze pads (used for wound dressing) and then asked to wipe five areas of their body: face, hands, armpits, abdomino-lumbar area and feet. The pads were then weighted again and amount of sweat was calculated. To obtain a standardized value, the results were divided by body surface of the patient calculated with Mosteller’s method. All measures were performed in standardized temperature (25 degrees) and humidity (20-30%) with a very precise weight-scale (d=0.1 mg) (WPS 110/C/S, Radwag, Poland).

According to our previous publications (12, 14), hyperhidrosis was diagnosed when exceeding normative values observed in general Polish population. The qualification to surgery was done on the basis of 2.5-fold exceeding of the upper limit of the normative value.

Surgery

Thoracic sympathetic block has been performed bilaterally from posterior approach, as described previously (7). In brief, the patients were operated in prone position, in general anaesthesia, with single-lumen tracheal intubation. Two abdominal smooth trocars were inserted into each side of thoracic cavity. The first one, 5 mm 1 cm medially from the tip of scapula after stopping of the insufflation of the lungs was inserted blindly; the second one, 10 mm abdominal trocar in posterior axillary line in the 4th intercostal space was inserted under the scope’s vision. 5 mm Karl Storz 30 degrees scope was used. Carbon dioxide to the level of 8 mm Hg was insufflated into the thoracic cavity. The volume of the insufflation of the lung was kept about 400 mls. Sympathetic trunk was identified and ganglia defined according to the rib they were visible under. The pleura was incised and sympathetic trunk dissected with a laparoscopic hook from the level above T3 till the level under T5. Then medium size laparoscopic clips were applied with 10 mm clip applier above T3, above T4 and above T5. Then, a 12 Fr Redon drain was inserted under vision into the thoracic cavity. Insufflation of carbon dioxide was then stopped and suction through Redon drainage commenced. The inflation of the lung was observed and confirmed. Then the suction was continued for 10 more manual breath performed by the anaesthetist. The anaesthetist stopped the breathing at the maximal inhalation and the Redon drain was removed. The procedure was then performed on the contralateral side.

Outcome evaluation

The subjective intensity of disease was evaluated by VAS scale (0 – no sweating; 10 – maximal possible sweating) both for gen-
eral impression and specific localizations. Objective intensity of sweating was evaluated by gravimetry in hands, armpits and abdominolumbar area. After surgery this evaluations were repeated together with additional questions on: (i) recurrence of the sweating in primary localization (yes vs no, if yes, then when), (ii) intensity of compensatory sweating (none, hardly noticeable, acceptable, visible, strong, very strong), (iii) presence of phantom sweating and (iv) intensity and medication for post-operative intercostal pain (only in 3-month follow-up).

Follow-up data were obtained during office visits 3, 12 and 36 months after surgery. The overall follow-up response was 74.6%.

Statistical evaluation

All measurements were performed with STATISTICA 11.0 PL licensed to Medical University of Gdansk, Poland, The analyses included t-Student tests, u-Mann-Whitney test, Chi-Square tests, ANOVA. Any plower than 0.05 was considered significant.

Ethical issues

The study has been approved by Local Ethical Committee for Medical University in Gdańsk.

RESULTS

Five hundred-sixty-seven thoracoscopic sympathectomies were performed in two-hundred-eighty-three PHH patients. In 1 patient (0.35%) bilateral sympathectomy was not possible due to multiple adhesions in right thoracic cavity due to severe pneumonia in the past. In 2 other cases (0.7%) a unilateral revision and re-sympathectomy had to be performed due to the unilateral lack of effect of the operation.

There was no mortality. There were 6 cases (2.1%) of capnothorax. Only in one case (0.35%) thoracic drainage was needed and it lasted for 24 hours. In all other cases, capnothorax resolved spontaneously within 24 hours.

The mean duration of surgery was 57 minutes bilaterally. The mean hospitalization time was 1.3 days (72% of the patients were hospitalized for 24-30 hours).

The postoperative intercostal pain was observed in all cases (100%). The mean duration of postoperative intercostal pain was 21.88 days. In all cases the demand for opioids (pethidine, morphine) did not exceed 24 hours after surgery. Later it was successfully managed with NSAIDs. In 75.6% there was no need for any medication 48 hours after surgery. That frequency reached 92.17% 72 hours after surgery.

Post-sympathectomy syndrome manifested by neuropathic, burning pain of the skin at the level of nipples was observed in 29 patients (27% of those in whom data upon post-sympathectomy syndrome was available). It was seen on average in 4.27 post-op day (range: 1-14 days) and lasted 30.25 days (range: 1-90 days).

Postoperative phantom hyperhidrosis was a sudden onset of sweating in primary localization that occurred after surgery, lasted for a short time and then disappeared. It was observed in 43 patients (39% of those in whom data upon phantom hyperhidrosis were available). On average it started on 3.87 post-op day (range: 1-9 days) and lasted 1.76 days (range: 1-10 days).

The data on remission and recurrence of the PHH are presented in figure 1. The remission was on average obtained in 93.3%. Recurrence was seen in 8 cases (6.7%), mostly in less than 3 months after surgery. In 2 cases the recurrence was managed by a revision thoracoscopy. In the remaining 6 cases the recurrence was mild and did not meet gravimetric criteria for revisional surgery.

In 7 cases (2.5%), there was a need for reoperation and removal of the clips. In 6 cases, the
procedure was performed in less than 3 months after initial surgery, due to intractable compensatory sweating. In 1 case, the decision on removal of the clips was taken 9 months after surgery and the reason for it was the decrease in libido experienced by the male patient. The recovery of libido was observed during first two weeks after the removal of the clips.

The results of gravimetric evaluation of the results of surgery are presented in tab. 1. The average decrease in objectively evaluated sweating was 91.8% (from 267.5 mg/min/m² in qualification to 22.03 mg/min/m² in average follow-up, p<0.001) in hands and 63.3% in armpits (respectively, 108.3 mg/min/m² versus 39.8 mg/min/m², p<0.05). The sweating in lumbar area decreased insignificantly by 1.7% (respectively, 48.7 mg/min/m² versus 47.92 mg/min/m², p=ns).

Compensatory sweating in any intensity was observed on average in 97.4% of cases. On average, it was considered hardly noticeable in 44.4%, in 10.3% acceptable, in 25.6% noticeable, and in 17% strong or very strong. The intensity of compensatory hyperhidrosis in different time-points of the study was presented in tab. 2.

## DISCUSSION

Our study confirmed a high degree of satisfaction from treatment that is observed among PHH patients treated with ETS. In every follow-up point, the satisfaction from surgery exceeded 90% and it was very stable during the follow-up period, for as long as three years after surgery. Similar results have been previously presented by other authors (8, 17). Nonetheless, our study is the first one in literature that evaluates the success rate progressively with control of dynamics of the results of treatment. This has also been confirmed by the objective evaluation with gravimetric assay of intensity of sweating. The decrease in sweating observed in primary points of the disease (hands, armpits) was significant and stable within the follow-up period up to 36 months after ETS.

Apart from that the study concentrated on frequency of postoperative side-effects, such as post-operative pain, post-sympathectomy syndrome and compensatory sweating. The intensity of post-operative pain was low and, in most cases, did not demand opioids for more 12-24 hours after surgery. Moreover, in most cases any analgesic medication was discontinued after 72 hours. This results confirms that ETS is a very well-tolerated method of treatment of PHH. Similar results were also presented by other authors (7, 18).

The post-sympathectomy syndrome was observed in 27% of the patients. It lasted an average about 1 month and did not demand hospitalziation or any specific medication other that over-counter analgesic drugs.

The compensatory sweating (CS) was strong or very strong only in 17% of cases, though increased sweating of the trunk in any form was experienced by 97.4% of patients. group. In

### Table 1. Frequency of compensatory sweating in different time-points of the study

<table>
<thead>
<tr>
<th>Time-point</th>
<th>3 months</th>
<th>12 months</th>
<th>36 months</th>
<th>p in repeated-measures ANOVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS: strong and very strong</td>
<td>17.5%</td>
<td>14.1%</td>
<td>23.6%</td>
<td>p = ns</td>
</tr>
<tr>
<td>CS: lack, hardly-visible, acceptable</td>
<td>82.5%</td>
<td>85.9%</td>
<td>76.4%</td>
<td>p = ns</td>
</tr>
</tbody>
</table>

### Table 2. Intensity of sweating measured by gravimetry in qualification and different points of follow-up

<table>
<thead>
<tr>
<th></th>
<th>Qualification</th>
<th>3 months</th>
<th>12 months</th>
<th>36 months</th>
<th>p in repeated measures ANOVA within FUs</th>
<th>p in repeated measures ANOVA vs FUs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hands</td>
<td>267.5 ± 131.4</td>
<td>22.3 ± 9.3</td>
<td>20.3 ± 6.5</td>
<td>23.5 ± 10.2</td>
<td>p &lt; 0.001</td>
<td>p = ns</td>
</tr>
<tr>
<td>Armpits</td>
<td>108.3 ± 78.8</td>
<td>36.9 ± 11.2</td>
<td>39.4 ± 13.7</td>
<td>43.0 ± 11.2</td>
<td>p &lt; 0.05</td>
<td>p = ns</td>
</tr>
<tr>
<td>Abdominolumbar</td>
<td>48.7 ± 23.12</td>
<td>59.3 ± 21.3</td>
<td>50.7 ± 15.5</td>
<td>33.76 ± 8.3</td>
<td>p = ns</td>
<td>p = ns</td>
</tr>
</tbody>
</table>
study by Currie et al. (19), the intensity of CS was as high as 93%, while, in contrary, in the study by Ibrahim et al. (18) it was as low as 4%. The differences in the incidence of CS in different groups mostly arise from different definitions of CS and differences in applied methodology of evaluation. The intensity of CS seems to be more significant factor than the presence of any increased sweating in the abdominolumbar area (14). In that context, our results can be perceived as satisfactory, compared to incidence of severe sweating reported by others (19, 20) and ranging between 30% and 40%. It has been presented previously by our team (13, 14) and the others (19), that the preoperative intensity of abdominolumbar sweating is minimal. Therefore, any increase observed postoperatively will be perceived by the patients as compensatory sweating. Nevertheless, the intensity of such sweating is most frequently within the reference values observable in normal population (13, 14). Concerning the fact, that PHH patients are very sensitive to any increase in sweating, it is very likely that simple retrospective studies based on questionnaires sent by mail will produce falsely increased frequencies of sweating.

As mentioned previously (21, 22), our team emphasizes the importance of office visits in the follow-up period. The main goal is to evaluate objectively the intensity of CS and to explain to the patients that this phenomenon does not have to be much more intensive than trunk sweating observed in healthy individuals (14, 23). In our study, we presented, that the gravimetric evaluation of the intensity of sweating of the abdominolumbar area does not change with ETS. It can be explained by a fact that the patients claiming high CS do not state that it occurs all the time. It is mostly associated with physical exercise or increased air temperature. Therefore, it can be seen as a normal thermoregulatory effect, not seen prior to surgery by the patients, due to the specificity of the symptoms of PHH.

The decision on removal of the clips have been taken in 3% of the patients. Similar frequency of reversals have been reported by Sugimura et al. (17) (1.8% of all T3+T4 sympathectomies). It has been presented by our team previously, that the remission of CS and recurrence of primary sweating was seen on average after 2.5 years after the removal procedure (14, 23). Sugimura et al. also revealed that substantial decrease in compensatory sweating have been reached in 67% of patients in whom the clips were removed earlier than 6 months after initial surgery (17). This finding are in contrary to the report of Loscertales et al., who presented in experimental study that clipping of the sympathetic trunk is irreversible (24). Nevertheless, it should be emphasized that the experimental context of the study by Loscertales et al. might state its main bias. First, it obviously could not take into account the fact that human emotions play a role in the perception of compensatory sweating after the removal of the clips. Furthermore, irreversible changes at one level of sympathetic trunk do not fully coincide with the fact that signals within the spinal cords can exit through other levels above or below the damaged segment.

In conclusion, it should be underlined that thoracic sympathectomy is a safe method of treatment of PHH. It is associated with a stable, long-term remedy for primary hyperhidrosis. The extent early and late of side effects is significant and, therefore, the patients should be thoroughly evaluated and informed on them prior to surgery. They should also be qualified and follow-up with additional use of objective methods such as gravimetry of vapometry.

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Received: 8.03.2013 r.
Adress correspondence: 80-217 Gdańsk, ul. Smoluchowskiego 17, e-mail: wujstef@gumed.edu.pl