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## Original Research

An analysis of the natural course of compensatory sweating following thoracoscopic sympathectomy<sup>☆</sup>A.C. Currie<sup>b</sup>, J.R. Evans<sup>a</sup>, P.R.S. Thomas<sup>a,\*</sup><sup>a</sup> Department of Surgery, Epsom and St Helier University Hospitals NHS Trust, Wrythe Lane, Carshalton, Surrey SM5 1AA, United Kingdom<sup>b</sup> Department of Surgery, Division of Surgery and Cancer, Imperial College, London W2 1NY, United Kingdom

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## ABSTRACT

**Background:** To evaluate the long-term results of thoracoscopic sympathectomy in the treatment of hyperhidrosis.

**Methods:** Theatre log books were used to identify all patients who underwent thoracoscopic sympathectomy between 2000 and 2006. Details of pre-operative symptoms, surgical procedure and post-operative complications were collected from the patient notes. Each patient was sent a questionnaire regarding success of the procedure, compensatory sweating and overall satisfaction.

**Results:** 46 hyperhidrosis patients (34 females) age range 14–57 years. 20 patients suffered with hyperhidrosis in a combination of areas, 14 in the axillae alone, 9 palms alone and with 2 facial symptoms. There were 2 early post-operative complications, 1 haemothorax which required a chest drain and a chest infection. 3 patients required redo procedures. Of follow-up of 42 months (range 6–84), 32 (69.5%) patients reported complete dryness or a significant improvement in symptoms and 15 a substantial improvement in quality of life. However 43 patients (93%) suffered with compensatory sweating, of these 27 had to change clothes more than once daily. Compensatory sweating was graded as severe in 18 and incapacitating in 2. Of note only 5 patients noticed an improvement in the compensatory sweating over time. Only 26 (56%) would recommend thoracoscopic sympathectomy to others with hyperhidrosis.

**Conclusion:** Thoracoscopic sympathectomy is effective in the treatment of hyperhidrosis. However compensatory sweating seems unavoidable and infrequently improves with time. Patients need to be carefully counselled before committing to surgery.

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Primary hyperhidrosis is a relatively common condition, affecting between 0.6% and 1% of the general population.<sup>1</sup> Video-assisted thoracoscopic sympathectomy has become the treatment of choice when medical treatment has failed because of the high visibility of the surgical field and the ease with which the intrathoracic anatomy is identified, the low morbidity, the short hospital stay, and the excellent cosmetic results.<sup>2,3</sup> Although reports of efficacy have been excellent, there can be significant complications, in particular, compensatory sweating (CS). Some reports indicate compensatory sweating can severely negatively impact on the quality of life, even in a successful operation.<sup>4</sup> Very few studies to date have investigated the natural course of compensatory sweating.

This study reports the scores on long-term success, satisfaction, and complication rates of patients who had undergone thoracoscopic sympathectomy, with emphasis on the presence of patient reaction to CS.

## 1. Methods

## 1.1. Study design and patients

Between 2000 and 2006, 46 patients with palmar or axillary hyperhidrosis underwent thoracoscopic sympathectomy at the Department of Surgery, St Helier Hospital, Carshalton, Surrey. Diagnosis was based on clinical feature. Written, informed consent was obtained from all patients. All data, including sex, age, medication, and complications, were obtained from clinical records. Clinical follow-up data were obtained by reviewing hospital records and direct communication with the patients. All patients answered a questionnaire concerning changes in sweating and quality of life (scale: strongly improved, improved, unchanged, worsened) as well as compensatory sweating (very strong, strong, moderate, mild, no compensatory sweating), its natural course and overall satisfaction with the results of the operation.

<sup>☆</sup> This work has been presented previously to the Annual Scientific Meeting of the Association of Surgeons of Great Britain and Ireland, Glasgow, UK (13th–15th May 2009).

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## 1.2. Operative details

Patients were positioned supine with 20° anti-Trendelenberg tilt of the table. This position allows gravity to assist in revealing the spine and the sympathetic chain. Under general anaesthesia, with double lumen tracheal intubation, the patient's arms were abducted exposing the axilla. The procedure was performed with two ports: a 5-mm port in the mid-axillary line at the fifth intercostals space for the introduction of telescope, and a 5-mm port in the anterior axillary line at the third intercostals space for working instruments. Subsequent to the introduction of the first 5-mm cannula, CO<sub>2</sub> was insufflated and pulmonary collapse was instituted. Upon pulmonary collapse, the visualization of the pleural cavity was undertaken and the second port was introduced under direct vision. Pleural adhesions if any were released.

The ribs were carefully identified. At the level where the sympathetic chain crosses the third rib, the parietal pleura were opened with the diathermy hook. The sympathetic chain just below the T2 and T3 levels was gently cauterized and transected completely, but the ganglion was left in position. The ramus arising laterally from the sympathetic chain is the Nerve of Kuntz, which is slightly larger than the other rami and must be interrupted to achieve adequate sympathetic denervation of the upper extremity. This also was transected by diathermy hook. The lung was inflated after the procedure under vision to make sure that it was well expanded. Chest drains were not inserted at the end of the procedure. No stitches were required for the 5-mm port, which were closed by steristrips. The same procedure was performed on the contralateral side if indicated. Post-operatively, orally administered analgesics were adequate for pain control. The patients were mobilized early and while some patients went home the evening of surgery, most patients were discharged the next day.

## 1.3. Statistical analysis

SPSS for Windows (Version 17.0; SPSS Inc., Chicago, IL) was used for statistical analysis. For all variables, cross-tables were generated, followed by calculation of *p*-value by using *v*<sub>2</sub> test/Fisher's exact test. The values of the different groups were compared by using Student's *t*-test. Significance was taken at the 0.05 level.

## 2. Results

### 2.1. Characteristics of the patients

Forty-six patients with hyperhidrosis underwent thoracoscopic sympathectomy in our institution and were eligible for follow-up. Median overall follow-up period was 42 (range, 6–84) months. There was no mortality. Patients' characteristics are listed in Table 1. The median age of the included patients (at time of surgery) was 27 (range, 14–60) years. Thirty-four (74%) patients were female. Bilateral sympathectomy were undertaken in seven patients (15%).

Twenty patients (43%) suffered concomitant palmar and axillary hyperhidrosis, 14 (30%) in the axillae alone, 9 (20%) palmar hyperhidrosis alone and with 2 (4%) patients having excessive facial blushing symptoms. The intensity of the pre-operative sweating was classified as severe in 33 (72%), moderate in 10 (22%), and mild in one patient (2%).

### 2.2. Effects on outcome and quality of life

After sympathectomy, 32 (70%) patients had clinically improved, and 18 (39%) were completely free of sweating in the pre-operatively affected area (Fig. 1). Eight (17%) patients were unchanged and seven (15%) had worsened. According to these findings, the quality of life had substantially improved in 10 (22%) patients, improved in 9 (20%) patients, 11 (24%) patients had minimal improvement, in 6 (13%) patients it was unchanged and in 5 (11%) had worsened. Patients were satisfied with the operation in 27 (59%) of cases and 26 (57%) patients would recommend the operation to other patients with hyperhidrosis.

### 2.3. Side effects of operation

The mortality was zero; the overall morbidity rate was 6%. In one patient, a haemothorax occurred requiring chest drainage and

**Table 1.**

Characteristics of patients undergoing thoracoscopic sympathectomy at St Helier's Hospital NHS Trust (200–2006).

Demographics	
Total patients	46
Median age (Range)	27 (14–60)
Female gender	34 (74%)
Affected hyperhydrotic area	
Axilla	16 (35%)
Hands	10 (22%)
Both	20 (44%)

another patient developed a pneumonia. One further patient suffered from pain for approximately 2 years post-operatively.

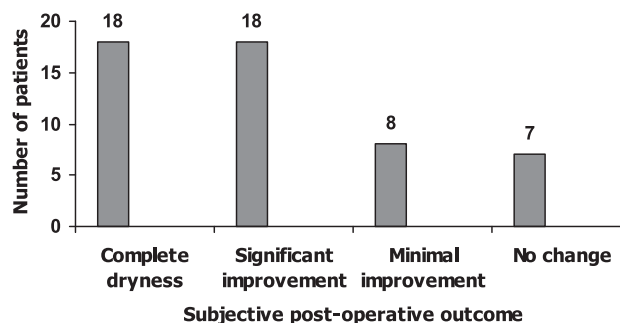
Compensatory sweating was noticed in 43 (93%) patients (Fig. 2). No relationship was noted in the incidence of compensatory sweating depending on laterality of sympathectomy. It was graded as incapacitating in 2 (4%), severe in 18 (39%), moderate in 19 (41%), and mild in 4 (9%) of patients. For 27 patients 59%, the sweating required them change their clothes more than once daily. It was mostly located at the back, chest, and legs. In only 5 (11%) patients, did the compensatory sweating improve over time, usually over months. In the remaining 38 patients, the compensatory sweating was permanent.

## 3. Discussion

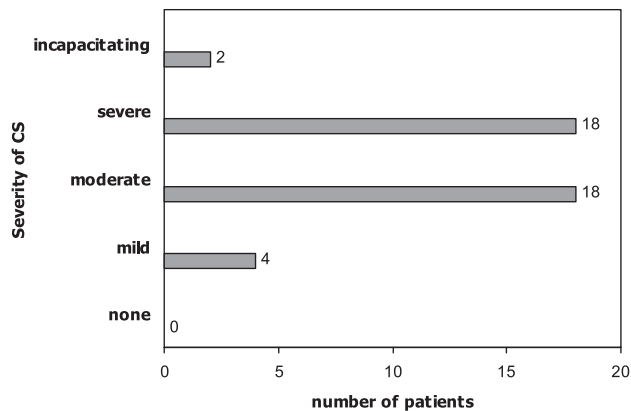
This study confirms the efficacy of thoracoscopic sympathectomy in the management of hyperhidrosis. In addition, it demonstrates that compensatory sweating is an almost unavoidable phenomenon post-operatively and that this sequelae infrequently improves with time.

In this study approximately 70% of patients had significant improvement in symptoms of hyperhidrosis in the pre-operatively affected areas. This is in keeping with the published outcomes in the literature. Early studies by Drott et al.<sup>5</sup> reported a success rate of 98.6% on 850 patients treated and Lin et al.<sup>6</sup> published the results of sympathectomy performed on 2200 patients, reporting a successful treatment in 99%. The Drott et al's. study<sup>5</sup> showed a recurrence rate of 2% from a mean follow-up of 31 months, while a study from Israel demonstrated no recurrence in 203 patients over a four year period.<sup>7</sup> More recently, a meta-analysis of 841 patients from studies undertaken between 2000 and 2010 revealed efficacy rates of 95.6–100%.<sup>8</sup> However, this analysis was complicated by combination of randomised and non-randomised studies, which may complicate assessment of the data.

Compensatory sweating occurred in almost all this patients in this study and in almost all cases was persistent throughout the mean 42-month follow-up period. Compensatory sweating is a well-



**Fig. 1.** Post-operative outcome of all patients undergoing thoracoscopic sympathectomy at St Helier's Hospital NHS Trust (200–2006).



**Fig. 2.** Experience of compensatory sweating in all patients undergoing thoracoscopic sympathectomy at St Helier's Hospital NHS Trust (200–2006).

recognised post-sympathectomy phenomenon and the incidence in this study is similar to published rates. Its rate in some recent series ranged between 60% and 90%, and it was considered severe in one-third of them.<sup>4–6,9</sup> In a recently reported paediatric population,<sup>10</sup> the rate was 70.3%, with around one-third of respondents reporting it as severe. In this series, 15.5% of patients were not satisfied and approximately one-fifth would not have undergone the operation as a result of operative failure and severe CS. Gossot et al.<sup>9</sup> studied 125 patients undergoing thoracoscopic sympathectomy and reported a success rate of 91.2% and the presence of CS in 86.4% with a mean 2-year follow-up. Compensatory sweating was considered embarrassing by 31.5% and disabling by 7.5%. Conversely, 94% of respondents were satisfied, and 92% of their patients would have undergone the operation in retrospect. In a study of 263 patients, Leseche et al.<sup>11</sup> found a compensatory sweating rate of 72%, and only 3% considered it disabling. These studies demonstrate the complexities of evaluating quality of life post-sympathectomy and that in some populations, compensatory sweating has more influence on patient-reported outcomes than in others.

The occurrence of compensatory sweating has previously been proposed to be reduced by the leaving the ganglia in-situ following sympathectomy. Conversely, Leseche's series of 264 patients treated by T1–T2, T1–T3, T2–T3 and T2–T4 resection did not demonstrate significant differences in the incidence and severity of compensatory hyperhidrosis.<sup>11</sup> However, the meta-analysis<sup>8</sup> discussed earlier indicated a slightly reduced risk of compensatory sweating with single-ganglion sympathectomy when compared with multiple-ganglion procedures. A recent study of 88 patients indicated no significant difference in the development of compensatory sweating between T2–T4 sympathectomy and T3–T4 blockade procedures.<sup>12</sup> It is difficult to draw firm conclusions from the published data as a result of the varying methods of reporting and assessing compensatory sweating. Further studies with more consistent, objective measures will be indicated in the future.

However, little is known of the natural course of compensatory sweating following thoracoscopic sympathectomy. The current study indicates that in the vast majority of cases, compensatory sweating is a persistent problem for patients post-operatively. There is limited data on the temporal course of compensatory sweating; however, other studies have indicated a more variable response. Steiner et al.<sup>10</sup> report immediate development of compensatory sweating in half of respondents, in 80% after 3 months, and in 90% after 3 more months. In 70% of patients there was no temporal change in compensatory sweating; it increased in severity in 10% and decreased in severity in 20% within 2 years post-operatively. A study from China reports development of compensatory sweating within 2 weeks in nearly one half of their patients, with around

three-quarters after 1 year.<sup>13</sup> There was spontaneous improvement within 3 months after sympathectomy in around 20% of patients. Our data indicate a more permanent response in our population.

The study is limited by its relatively small sample size, however the points raised have significant relevance nevertheless. No quality of life measurement was undertaken pre-operatively and it may be the case that post-operative quality of life is intrinsically linked to this in our population, but the wide spectrum of patients means this is unlikely. There has been no objective measurement of the volume or severity of hyperhidrosis or compensatory sweating, however the decision to undertake thoracoscopic sympathectomy is often based primarily on the patients subjective experience of their symptoms so it is unlikely that objective measurements would assist with decision-making in the future.

#### 4. Conclusion

This study demonstrates that when medical treatment of hyperhidrosis has failed, that thoracoscopic sympathectomy can provide efficacious management. However, the occurrence of compensatory sweating is almost universal and infrequently improves with time. Patients must be carefully counselled with respect to these issues, before committing to surgery.

#### Conflicts of interest

None declared.

#### Funding

None declared.

#### Ethical approval

None declared.

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