

## Predicting changes in the distribution of sweating following thoracoscopic sympathectomy

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**Background** Compensatory sweating is a common symptom following thoracic sympathectomy; however, the reported incidence of this complication varies greatly, and its severity has not been quantified.

**Methods** In this study changes in the distribution of sweating following bilateral T2-3 thoracoscopic sympathectomy for hyperhidrosis were assessed in 42 patients. Sweat production in the palms, axillae, face, trunk and feet was assessed using a linear analogue scale.

**Results** The operation was most successful in reducing sweat production in the palms, axillae and face (in descending order). The operation also reduced pedal sweat production in 12 of the 29 patients who suffered concomitant pedal hyperhidrosis. Compensatory truncal sweating occurred in 36 of the 42 patients; it was severe in ten, moderate in 16 and minimal in ten.

**Conclusion** Patients should be warned about compensatory sweating before thoracic sympathectomy.

Sympathectomy is currently the most acceptable surgical treatment for disabling upper limb hyperhidrosis. The incidence of palmar hyperhidrosis may be as high as 1 per cent<sup>1</sup> and a positive family history can be obtained in 30-50 per cent of cases. Hyperhidrosis affects the skin of the whole body but its clinical effects are seen in areas with a high density of eccrine sweat glands (palms, axillae and soles)<sup>2,3</sup>.

The primary surgical treatment is to divide, or ablate with diathermy, the second, third and possibly the fourth thoracic sympathetic ganglia. The approach may either be supraclavicular<sup>4</sup> or transaxillary using an open or endoscopic technique<sup>5</sup>. The results of a successful thoracic sympathectomy are predictable with the hands being rendered completely anhydrotic and the axillae being dried by a factor of 80 per cent. The effects of sympathectomy appear to be permanent.

The complications of thoracoscopic sympathectomy include compensatory sweating, gustatory sweating, phantom sweating, a transient increase in upper limb sweating, facial anhidrosis, ptosis, meiosis, excessively dry skin of the hands and recurrence of hyperhidrosis. Pulmonary complications include dyspnoea, pneumothorax, haemothorax and pleural effusion. Two cases of intraoperative cardiac arrest have also been reported during thoracoscopic sympathectomy<sup>6</sup>.

Compensatory sweating is one of the most troublesome and commonly noted complications. The reported incidence of compensatory sweating following thoracic sympathectomy varies from 24 to 81 per cent<sup>7,8</sup> but few reports mention its distribution and severity. In this study the changes in distribution and extent of sweating following a T2-3 thoracoscopic sympathectomy were defined with the aim of investigating which, if any, factors could predict the occurrence of postoperative compensatory sweating.

### Patients and methods

Forty-two consecutive patients (28 women, 14 men) undergoing a T2-3 thoracoscopic sympathectomy for primary hyperhidrosis

were included in the study. The mean (s.d.) age of the patients was 32 (10) years and the mean age at onset of symptoms was 11 (8) years. Thirty-four patients suffered hyperhidrosis affecting the hands, the axillae were affected in 28 patients, and the face in 11. Pedal hyperhidrosis affected 29 patients. In all cases hyperhidrosis was bilateral. Although the operation was usually performed to treat hyperhidrosis of the hands and axillae, in eight patients the hands were not involved and it was done to treat hyperhidrosis affecting either the face and/or axilla. Nine subjects had a family history of hyperhidrosis.

A preoperative chest radiograph was taken to identify any pulmonary pathology that may cause pleural adhesions. Under a general anaesthetic a T2-3 thoracoscopic sympathectomy was performed using the method described previously<sup>9</sup>.

To quantify the amount of sweating at various sites (hands, axillae, face, feet and trunk) before and after the operation, patients were asked to complete a linear analogue scale. The scale ranged from 0 to 10; a score of 0 indicated no sweating at rest, and a score of 10 indicated visible sweat droplets at rest.

Mean (s.d.) follow-up was 11 (17) months. Student's *t* test was used for the statistical analysis.

### Results

The overall results of the operation can be seen by comparing the amount of sweating at a particular site before operation with that following surgery (Fig. 1). Palmar hyperhidrosis was reduced from a mean score of 7.1 before operation to 0.4 after sympathectomy ( $P < 0.001$ ); for the axillae the scores were 6.1 and 2.3 respectively ( $P < 0.001$ ) and for the face 2.6 to 1.5 ( $P = 0.054$ ). Interestingly a small reduction in pedal sweating was also noted from a preoperative score of 6.3 to 5.1 after operation ( $P = 0.032$ ). The principal complication of the operation was compensatory sweating affecting the trunk. Truncal sweat production increased from a mean preoperative score of 1.7 to a postoperative score of 5.4 ( $P < 0.001$ ).

To demonstrate the effect of the operation on sweating at a particular site, the scored amount of sweating at that site after operation was subtracted from the preoperative score, to give the sweat score. The sweat score measured the perceived change in sweat production at a particular site following surgery. It quantifies both the efficacy of surgery, and the severity of complications (compensatory

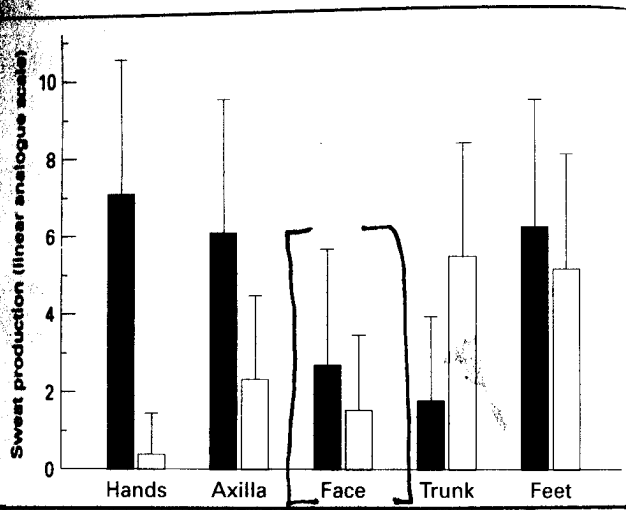


Fig. 1 Sweat production at different sites before (■) and after (□) T2-3 thoracoscopic sympathectomy. Values are mean(s.d.) score on a linear analogue scale

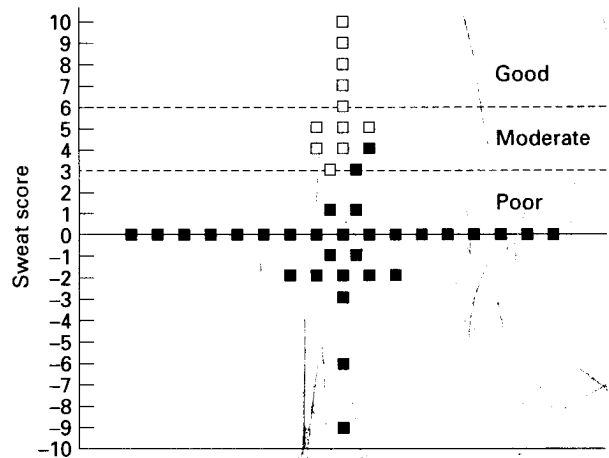


Fig. 2 Change in facial sweating caused by sympathectomy, expressed as sweat scores (rounded to the nearest whole number: -10 to -1, gustatory sweating; 1 to 10, facial anhidrosis), in patients with preoperative facial hyperhidrosis (□) and patients with normal preoperative facial sweating (■). Good, 6 to 10; moderate, 3 to 6; poor, 0 to 3

sweating, gustatory sweating and facial anhidrosis). On a scale of +10 to -10, the higher the positive sweat score the drier the area and the higher the negative sweat score the wetter the area; a sweat score of zero indicates that the operation had no effect on sweat production at that site.

**Palmar sweating**

Hyperhidrosis of the palms affected 34 patients; the operation produced a good result in 32 and a moderate result in two patients. Those without palmar hyperhidrosis before operation noticed little or no change in palmar sweat production.

**Axillary sweating**

Twenty-eight patients had axillary hyperhidrosis. The operation produced a good result in 14, a moderate result in eight and a poor result in five; one patient was worse following surgery. The operation had no effect on axillary sweating in patients who had not complained of preoperative axillary hyperhidrosis.

**Facial sweating**

The 11 patients who had excessive preoperative facial sweating were all helped by the operation. The result could be classified as good in five and moderate in six. Of the 31 patients with normal preoperative facial sweating two noticed significant facial anhidrosis, and ten gustatory sweating which was severe in two patients (Fig. 2).

**Pedal sweating**

Twenty-nine patients complained of preoperative pedal hyperhidrosis; five had a marked improvement in their symptoms whilst seven had a moderate improvement. In 17 patients the operation had little or no effect. Of the 13 patients with normal preoperative plantar sweating five noticed an increase in plantar sweating which was severe in one.

**Truncal sweating**

Only one patient complained of preoperative truncal hyperhidrosis and he noticed a marginal improvement in his symptoms after operation. Compensatory sweating affected 36 of the 42 patients after sympathectomy and was severe in ten, moderate in 16 and minimal in ten.

**Discussion**

The greatest change in sweating after sympathectomy was noticed in the hands. The results for axillary hyperhidrosis were not as impressive; five of 28 patients with preoperative axillary hyperhidrosis had a poor result. It has been suggested that a more extensive sympathectomy (T2-6) should be performed if axillary hyperhidrosis is to be treated<sup>10</sup>, but this might increase compensatory sweating.

Gustatory sweating may become excessive after thoracic sympathectomy. This has been attributed to aberrant regeneration of sympathetic nerves<sup>11</sup>, but increased activity or budding of intact sudomotor fibres might be an alternative explanation. In this series gustatory sweating affected ten of 31 patients with normal preoperative facial sweating.

Compensatory sweating may affect the abdomen, back, thighs, feet and face. Most patients conclude that compensatory sweating is preferable to palmar hyperhidrosis. The mechanism of compensatory sweating remains poorly understood. Compensatory sweating appears to be a generalized phenomenon affecting any sweat glands that remain innervated. Following a bilateral T2-3 sympathectomy approximately 40 per cent of the body's sweat function is lost, and truncal hyperhidrosis is a compensatory mechanism of thermoregulation<sup>12</sup>. Compensatory sweating tends to increase in response to an increase in temperature.

Excessive truncal compensatory sweating is worst in patients who have bilateral thoracic and lumbar sympathectomies. Hederman<sup>7</sup> reported that upper limb sympathectomy could be achieved by excision of the second thoracic ganglion only, with a reduced incidence of

compensatory sweating (64 per cent following T2-4 sympathectomy reduced to 24 per cent by isolated excision of the T2 ganglion). Hsu *et al.*<sup>8</sup> and Kao and co-workers<sup>13</sup> however, reported the incidence of compensatory sweating as 81 and 66 per cent respectively following T2 sympathectomy.

The concentration of sweat glands on abdominal skin is variable<sup>14</sup> and the extent to which these glands are stimulated depends both on the maintenance of thermoregulation and on emotional sympathetic activity. Emotional stimulus increases sweat production proportionately over the whole body<sup>2</sup>. For these reasons it is difficult to predict accurately which patients will suffer from severe compensatory sweating after operation. In this study, although most patients (36 of 42) suffered from truncal compensatory sweating, it was severe in ten. Patients should be warned about compensatory sweating before thoracic sympathectomy.

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