Biportal thoracoscopic sympathectomy for palmar hyperhidrosis in adolescents

Clinical article

SCOTT D. WAIT, M.D., BRENDAN D. KILLORY, M.D., GREGORY P. LEOVIC, M.D., PH.D., AND CURTIS A. DICKMAN, M.D.

Division of Neurological Surgery, Barrow Neurological Institute, St. Joseph’s Hospital and Medical Center, Phoenix, Arizona

Object. Palmar, axillary, and plantar hyperhidrosis is often socially, emotionally, and physically disabling for adolescents. The authors report surgical outcomes in all adolescents treated for palmar hyperhidrosis via bilateral thoracoscopic sympathectomy at the Barrow Neurological Institute by the senior author.

Methods. A prospectively maintained database of all adolescent patients undergoing bilateral thoracoscopic sympathectomy between 1998 and 2006 (inclusive) was reviewed. Additional follow-up was obtained as needed in clinic or by phone or written questionnaire.

Results. Fifty-four patients (40 females) undergoing bilateral procedures were identified. Their mean age was 15.4 years (range 10–17 years). Average follow-up was 42 weeks (range 0.2–143 weeks). Hyperhidrosis involved the palms alone in 10 patients; the palms and axilla in 6 patients; the palms and plantar surfaces in 17 patients; and the palms, axilla, and plantar surfaces in 21 patients. Palmar hyperhidrosis resolved completely in 98.1% of the patients. Resolution or improvement of symptoms was seen in 96.3% of patients with axillary and 71.1% of those with plantar hyperhidrosis. Hospital stay averaged 0.37 days with 68.5% of patients discharged the day of surgery. One patient experienced brief intraoperative asystole that resolved with medications and had no long-term sequelae. Otherwise, no serious intraoperative complications occurred. No patient required chest tube drainage. The percentage of patients who reported satisfaction and willingness to undergo the procedure again was 98.1%.

Conclusions. Biportal, bilateral thoracoscopic sympathectomy is an effective and low-morbidity treatment for severe palmar, axillary, and plantar hyperhidrosis. (DOI: 10.3171/2010.5.PEDS09225)

Key Words • hyperhidrosis • sympathectomy • thoracoscopy

Idiopathic hyperhidrosis is a disorder of autonomic dysfunction that results in excessive perspiration. Hyperhidrosis can have devastating effects on the social, emotional, and physical development of adolescents. Its prevalence is estimated to be 1%–3% in the total population, with Southeast Asians being the most affected. A recent survey in China reported an incidence of 0.37% in adolescents. Common locations affected by hyperhidrosis include the palms, axillae, plantar surface of the feet, and head/face. Generally, one or more trials of nonsurgical treatment are used prior to considering surgical treatment; however, a recent report suggests that surgical management is far superior to medical management and should be recommended as first-line treatment. Thoracoscopic sympathectomy works to resolve excessive palmar perspiration by interruption of sympathetic tone and impulses from the sympathetic ganglia to the eccrine sweat glands. An often-realized benefit of the procedure is resolution or improvement in axillary and/or plantar hyperhidrosis.

Methods

Patient Population

Based on a prospectively maintained database of all patients undergoing thoracoscopic sympathectomy for hyperhidrosis from 1996 to 2008 (inclusive), 356 consecutive patients underwent bilateral procedures. Fifty-four patients (40 females, 14 males; mean age 15.4 years, range 10–17 years) underwent 108 procedures for disabling hyperhidrosis. Information from the database was reviewed and supplemented with follow-up telephone calls. Data points were drawn from clinical visits and examination, follow-up questionnaires, and operative records. The mean duration of follow-up was 42 weeks (range 1–143 weeks).
Every patient presented with palmar hyperhidrosis alone (10 patients, 18.5%) or with additional affected areas (Table 1). Twenty-one patients (38.9%) had a family history of hyperhidrosis. Hyperhidrosis was a lifelong condition in 43 patients (79.6%). Its onset was in childhood in 2 patients (3.7%) and in puberty in 9 patients (16.7%).

Each patient had undergone at least one failed nonsurgical treatment. The mean number of nonoperative treatments was 1.7 (range 1–4). Drysol (Person & Covey, Inc.), Drionic (General Medical Co.), botulinum toxin A injections, and prescribed medications, such as propranolol, clonidine, or anticholinergic agents were the most common nonsurgical treatments. No patient had undergone previous surgical treatment for hyperhidrosis.

TABLE 1: Presenting sites of hyperhidrosis in 54 patients undergoing thoracoscopic sympathectomy

<table>
<thead>
<tr>
<th>Presenting Site</th>
<th>No. of Patients (%)</th>
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<tbody>
<tr>
<td>palmar</td>
<td>10 (18.5)</td>
</tr>
<tr>
<td>palmar &amp; axillary</td>
<td>6 (11.1)</td>
</tr>
<tr>
<td>palmar &amp; plantar</td>
<td>17 (31.5)</td>
</tr>
<tr>
<td>palmar, axillary, &amp; plantar</td>
<td>21 (38.9)</td>
</tr>
</tbody>
</table>

Fig. 1. Overhead view of the setup of the operating room during thoracoscopic sympathectomy. The patient is in lateral decubitus position. The surgeon and assistant stand on the ventral side of the patient and the anesthesiologist is at the head. Modified from Dickman CA, Mican C: Thoracoscopic approaches for the treatment of anterior thoracic spinal pathology. BNI Quarterly 12(1):4–19, 1996. With permission from Barrow Neurological Institute.

Surgical Technique

The surgical technique has been previously described. Briefly, the patient is intubated with a double-lumen endotracheal tube. Correct positioning of the endotracheal tube is bronchoscopically confirmed by the anesthesiologist. Palmar cutaneous temperature monitors (Mallinckrodt, Inc.) are applied bilaterally. The patient is placed in a lateral decubitus position on a beanbag and taped securely to the bed over the pelvis and shoulder (Fig. 1). The ipsilateral lung is deflated by the anesthesiologist using a double-lumen endotracheal tube. Two 5-mm incisions are made after the skin is injected with 0.5% bupivacaine with epinephrine.

The endoscope is inserted in the fifth intercostal space in the posterior axillary line. The working portal (for the cautery scissors and chest tube) is placed in the middle or anterior axillary line in the third intercostal space. A 6-mm–diameter trocar and stylette are inserted through the skin which is injected with 0.5% bupivacaine with epinephrine. The endoscopic scissors are inserted through the second portal. The patient is rotated ventrally until gravity retracts the lung sufficiently away from the surface of the spine so that the rib heads and sympathetic chain are identified. The second rib is identified at its articulation with the spine.

Fig. 1. Overhead view of the setup of the operating room during thoracoscopic sympathectomy. The patient is in lateral decubitus position. The surgeon and assistant stand on the ventral side of the patient and the anesthesiologist is at the head. Modified from Dickman CA, Mican C: Thoracoscopic approaches for the treatment of anterior thoracic spinal pathology. BNI Quarterly 12(1):4–19, 1996. With permission from Barrow Neurological Institute.

The extent of sympathectomy is dictated by the patient’s symptoms and has evolved across the case series. Early in the series (first 14 cases), we resected the sympathetic chain from T-2 to T-4 or T-5. We then adopted a policy of tailored chain division over the rib head (sympathotomy) guided by the patient’s preoperative symp-

toms (presence or absence of axillary hyperhidrosis) and by intraoperative palmar temperature monitoring. The sympathetic chain is tented laterally and transected with cautery to create a gap of 5 mm or more between the ends of the sympathetic chain. That is, a T-2 sympathectomy is performed by dividing the chain (sympathotomy) over the second and third rib heads. Care is taken to preserve the surrounding vascular structures. After the sympathetic chain is transected, the surrounding soft tissue is inspected to confirm complete transection and to search for accessory sympathetic nerves (nerves of Kuntz). The anesthesiologist records palmar temperatures during the procedure. A temperature increase of 1°C is commonly thought to confirm adequate sympathectomy. When the working portals were removed, a 20 Fr chest tube is inserted through the vacated hole. Reinflation of the lung is observed directly before the thoracoscope is removed from the chest cavity. The 2 incision sites are closed in a standard fashion.

The chest tube is kept in the first side and placed for suction until the contralateral sympathectomy is completed. The patient is repositioned, and the sympathectomy on the contralateral side is performed using identical techniques. At the conclusion of the second sympathectomy both chest tubes are removed. A sitting anteroposterior plain chest radiograph is obtained to confirm the absence of significant residual pneumothoraces.

Postoperatively, all patients used an incentive spirometer and were treated with narcotic analgesic medication.
for 48–72 hours. At the beginning of the series (in the first 16 cases), patients were typically discharged the next morning. Most patients were then discharged a few hours after surgery. Patients were permitted to return to normal activity 3–7 days after surgery.

### Results

Blood loss was listed as “minimal” in all 54 operative reports. The sympathetic chain was divided successfully in all cases. All chest tubes were removed in the operating room, and no patient had a significant residual pneumothorax demonstrated on chest radiograph.

### Surgical Outcomes

Surgical outcomes at last follow-up were evaluated according to region of preoperative hyperhidrosis (Fig. 2). Hyperhidrosis was completely alleviated at rates of 98.1%, 70.4%, and 13.2% in palmar, axillary, and plantar locations, respectively. Combining resolution and improvement yielded rates of 100%, 96.3%, and 71.1% for palmar, axillary, and plantar locations. In 1 patient (3.7%), axillary hyperhidrosis failed to improve. No patients’ axillary hyperhidrosis worsened. Plantar hyperhidrosis remained unchanged in 10 patients (26.3%) and worsened in 1 patient (2.6%). There were no recurrences of hyperhidrosis at last follow-up. No patient reported gustatory sweating.

Hospital length of stay averaged 0.37 days. Thirty-seven patients (68.5%) were discharged the day of surgery. Since the overnight stay policy was abandoned, 4 of 38 patients required admission to the hospital (3 for pain control, 1 for evaluation of arrhythmia).

Complications were limited to 1 case in which the patient experienced intraoperative asystole requiring cardioversion to restore rhythm during the left side of a bilateral T2–4 sympathectomy. The procedure on the right side, which was treated before the left, was completed uneventfully. The patient had no predisposing factors and an exhaustive evaluation revealed no abnormalities. She required a 2-day hospital stay for evaluation and suffered no permanent morbidity. Her palmar and axillary hyperhidrosis resolved completely. No patient experienced a wound infection, pneumothorax, persistent pain, pneumonia, vascular injury, Horner syndrome, or recurrence.

Thirty patients (54.3%) reported compensatory sweating, a known side-effect of thoracoscopic sympathectomy. Two patients described the compensatory sweating as “severe, bothersome,” and 28 patients described it as “mild/moderate, nonbothersome.” Chi-square analysis of individual levels of sympathectomy showed no significant relationship between compensatory sweating and levels of transection (p = 0.0640). When T-5 sympathectomy was included in the analysis, however, the frequency of bothersome compensatory sweating tended to increase (Fig. 3).

When patients were asked if they were satisfied with their surgical outcome and would undergo the same operation again, 53 patients (98.1%) responded “yes.” The only exception was the patient who experienced the intraoperative asystole.

### Discussion

Hyperhidrosis can be disabling to patients in general and can be especially distressing to adolescents who are developing their self-image, social networks, and self-esteem. Adolescents are affected by hyperhidrosis to various degrees and formalized rating scales exist; however, we find the clinical interview and examination to be more useful in determining who will benefit from this procedure.
procedure.\textsuperscript{3} Patients with severe symptoms often report that sweat spontaneously drips from their hands making activities such as schoolwork, sports, and social interactions embarrassing, uncomfortable, and, in some cases, impossible. It is this group of patients, with severe symptoms, that are offered sympathectomy. Prompt, effective, safe treatment can remove an obstacle that can negatively affect their maturation into adulthood and their ability to function normally and productively in society.

Medical treatments tend to be ineffective and to have significant side effects. They often provide only modest or temporary symptomatic relief.\textsuperscript{2,7,8,9,10,21} In reports that have focused on adolescents, thoracoscopic sympathectomy has been relatively safe and effective (98% complete remission) and associated with few recurrences.\textsuperscript{5,6,17} There is also evidence that younger patients are less inclined to suffer compensatory sweating and more likely to be satisfied with their surgical outcome than older patients.\textsuperscript{17} Numerous reports have documented the safety and efficacy of this procedure in adults. Based on the excellent effectiveness and low risk of this procedure, we recommend early surgical treatment when medical therapy fails to improve severe symptoms.

Compensatory sweating remains the most challenging side effect of this procedure. Adults undergoing sympathectomy for palmar hyperhidrosis report compensatory sweating 12%–100% of the time; however, fewer than 10% regret undergoing the procedure.\textsuperscript{21} Younger patients report less compensatory sweating and a higher satisfaction rate than do older adolescents and adults (69.8% and 92.2% vs 88.5% and 80.7%, respectively).\textsuperscript{17}

We chose to perform chain resections early in the case series and refined the procedure to a tailored selection of sympathectomy levels based on preoperative symptoms and clues from intraoperative palmar temperature. Several attempts have been made to determine the optimal transaction strategy to reduce the incidence of compensatory sweating while maintaining the high palmar hyperhidrosis remission rate in adults.\textsuperscript{4,13,15} There is no consensus about which levels are most appropriate to section.

One of our patients experienced intraoperative asystole that required cardioversion. Most patients experience bradycardia after sympathectomy, and vagal tone is increased once the ganglia have been disconnected.\textsuperscript{8} Lin et al.\textsuperscript{14} reported 2 similar cases during a left T2–3 sympathetic chain transection. Both patients required cardiopulmonary resuscitation and recovered completely without complications. They postulated that continuous stimulation to the left stellate ganglion immediately before transection stimulates cardiac arrest. One case of delayed asystole has also been reported.\textsuperscript{16} In all previously reported cases of asystole, as well as in our case, the patients recovered without sequelae.

The anesthesiologist in our case hypothesizes that paralytic reversal performed by instilling glycopyrrolate mixed in the same syringe with neostigmine in conjunction with sympathetic denervation was responsible for the asystole. He now separately administers the glycopyrrolate followed by neostigmine. This phenomenon underscores the importance of vigilant intraoperative monitoring of the cardiac rhythm by the anesthesiologist and adequate preparation to deal with complications should they arise.

Conclusions
Thoracoscopic sympathectomy is safe, efficient, and effective for the relief of palmar hyperhidrosis in adolescents. Axillary hyperhidrosis and, to some extent, planter hyperhidrosis also may be relieved. Recurrences are rare. Because the procedure is minimally invasive, pain and complications are minimized. Compensatory sweating can be expected in about half of the patients who undergo this procedure.

Disclosure
Dr. Dickman has developed thoracic surgical tools with Medtronic. The remaining authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author contributions to the study and manuscript preparation include the following. Conception and design: Dickman, Wait, Lekovic. Acquisition of data: all authors. Analysis and interpretation of data: Wait, Killory, Lekovic. Drafting the article: Wait, Killory, Lekovic. Critically revising the article: all authors. Reviewed final version of the manuscript and approved it for submission: all authors. Statistical analysis: Wait. Study supervision: Dickman.

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