Hypothesis: Video-assisted thoracic surgery sympathectomy is efficacious for patients with hyperhidrosis.

Design: An experience with patients undergoing bilateral video-assisted thoracic surgery sympathectomy was reviewed to evaluate the operative technique and to determine morbidity and outcomes.

Setting: Academic health center.

Patients: The cohort included 31 patients (22 women and 9 men). All but 2 patients were of Asian descent, and the average age was 24.9 years. All patients had palmar hyperhidrosis. Two patients also had craniofacial hyperhidrosis, and another 2 had pedal hyperhidrosis.

Interventions: Bilateral video-assisted thoracic surgery sympathectomy with resection of the second and third ganglia was performed in all patients. Small chest tubes were removed on the first postoperative day. In 30 patients, the procedures were simultaneous; and in 1, it was staged to accommodate lumbar sympathectomy for pedal disease.

Results: Perioperatively, no patients died. The only hospital complication was an intraoperative injury to an intercostal artery that required conversion to an open thoracotomy. The average hospital length of stay was 1.2 days (range, 1-3 days). No patient developed Horner syndrome. Long-term follow-up was 2.6 years (range, 3 months to 7 years). Both hands in all patients were warm and dry at the last follow-up, as were the face and scalp in the 2 with craniofacial hyperhidrosis. Ten patients (32%) experienced compensatory sweating, which improved within 6 months.

Conclusions: In this experience, palmar hyperhidrosis is predominantly a disease of young Asian women. Simultaneous bilateral video-assisted thoracic surgery sympathectomy is effective and can be accomplished with minimal morbidity and a short hospitalization. Compensatory sweating occurs in a third of patients, but is generally self-limiting.

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Hyperhidrosis is the condition of excess sweating thought to be due to an idiopathic disorder of autonomic nervous function.1,2 Palmar hyperhidrosis is the most common location. The axillae and the feet can also be involved. Even less frequently, hyperhidrosis can affect the scalp and face; this is called craniofacial hyperhidrosis.1,2 When the palms are involved, the entire hand is frequently also cold, giving the patient the socially distressing situation of grossly excessive sweating associated with a cold and clammy hand.

Symptoms typically appear at puberty so that patients usually present in their second or third decade of life. Although there is no evidence that there are ethnic or geographic differences in the distribution of the disease, hyperhidrosis is somewhat more common in women than in men.1

The aim of this patient review was to evaluate one surgical experience, to evaluate selection criteria and surgical technique, and to determine perioperative and long-term outcomes.

Methods

The cohort included 31 patients (22 women and 9 men). All but 2 patients were of Asian descent, and the average age was 24.9 years. All patients had palmar hyperhidrosis, with excessive sweating and coldness of their palms. Two patients also had craniofacial hyperhidrosis, and another 2 had concomitant pedal hyperhidrosis. While all patients found their condition socially embarrassing, such that they tried to hide their hands in public and avoided shaking hands, they also reported that this condition interfered with home and occupational
activities, such as holding dishes, using computer keyboards, and performing other manual tasks.

Twenty-four patients (77%) had received some form of medical intervention without satisfactory relief. Five patients with axillary hyperhidrosis had responded satisfactorily to an intradermal injection of botulinum toxin type A (Botox). However, botulinum toxin type A injections had failed to satisfactorily treat their palmar hyperhidrosis because of the discomfort involved with the repetitive nature of injections, which was required.

The operative technique was as follows. In one patient, the procedure was staged and an ipsilateral lumbar sympathectomy was performed for pedal hyperhidrosis at the same time. Bilateral video-assisted thoracic surgery sympathectomy was performed in all other patients according to the following technique. Patients were placed on the operating table in the lateral decubitus position with a double-lumen endotracheal tube in place. Correct positioning of the double-lumen tube was confirmed bronchoscopically by the surgeon (A.G.L.). An axillary roll was placed just below the axilla, and the nondependent arm was placed in an abducted position to provide full access to the axilla and elevate the scapula.

The ipsilateral lung was deflated by the anesthesiologist. Initial entry was gained through a 1-cm incision in the anterior axillary line in the third or fourth intercostal space. In women, the skin incision was in the inframammary crease. A 10-mm port was used. Under direct vision, a 3-mm port was then placed in the posterior axillary line in the sixth or seventh intercostal space and a third 5-mm port was placed just inferior to the scapula. The endoscope was inserted through the anterior port and the lung allowed to collapse, exposing the sympathetic chain. Rotating the patient anteriorly resulted in the collapsed lung shifting medially, and aided in this exposure.

By using thoracoscopic graspers and dissectors, the pleura overlying the thoracic chain is opened from the fourth to fifth rib to the level of the first rib. The Figure illustrates the relevant anatomical features, with an accessory nerve of Kuntz connecting thoracic sympathetic nerves T1 and T2. When fat obscures the visibility of the first rib, it is identified by palpation with the endoscope. The sympathetic chain is beneath the parietal pleura, just lateral to the spine. Exposing the nerve by dividing the overlying pleura is a straightforward beginning. Then, the nerve is elevated from its bed; a thoracoscopic right-angle clamp is useful for this maneuver. The nerve is then transected between the third and fourth ganglia. By using either an electrocautery hook or a dissector, the sympathetic nerve is excised from its bed, moving superiorly until the stellate ganglion is identified and reached. If present, the accessory nerve of Kuntz must also be divided to confirm complete transection, and to search for the accessory nerve. This accessory nerve must be divided to interrupt fibers originating in the stellate ganglion, supplying sympathetic innervation to the hand, and compromising the final result if left intact. All instruments are then removed, and a small chest tube is placed through the anterior incision. The lung is inflated, the incisions are closed, and the patient is reintubated for control. This patient did not require a transverse incision of the chest. The stellate ganglion is identified and resected. In the first 10 patients, both chest tubes were removed the morning after the operation. In the subsequent patients, the first chest tube was removed in the postanesthesia care unit after the patient underwent extubation and a chest x-ray film confirmed full lung expansion. The second chest tube was then removed on the first postoperative morning.

PERIOPERATIVE RESULTS

No patients died. The only intraoperative complication was an injury early in the experience to an intercostal artery; this necessitated conversion to an open thoracotomy for control. This patient did not require a transfusion, but was the only patient requiring a 3-day hospitalization. Twenty-four patients (77%) were discharged from the hospital on postoperative day 1, 6 on postoperative day 2, and 1 on postoperative day 3. The average hospital length of stay was 1.2 days. No patient developed Horner syndrome.

LONG-TERM RESULTS

The average length of follow-up was 2.6 years (range, 3 months to 7 years). Satisfactory relief of palmar hyperhidrosis was experienced by all patients; at last follow-up, all patients had warm and dry hands. The 2 patients with craniofacial hyperhidrosis were greatly improved.
Although these patients had some sweating at the apex of their scalp, their faces became dry, as did the anterior part of their scalp. They expressed satisfaction with this outcome.

Ten patients experienced compensatory sweating. Eight of these patients considered this a mild symptom and found that this condition resolved within 6 months of the operation. Compensatory sweating has been more profound in 2 of the more recent patients, particularly over their trunk. While both expressed contentment with this condition compared with their preoperative one, it diminished their overall satisfaction.

**COMMENT**

Palmar hyperhidrosis is estimated to occur in 0.5% to 1% of the population, and is manifested by hypersecretion of sweat mediated by the autonomic nervous system.\(^1\)\(^2\) Significant surgical experiences with treatment of this disorder have been reported, but almost completely by groups from outside of North America.\(^2\)\(^3\)\(^4\)\(^-\)\(^12\)

These patients, most typically young women, as in this experience, are significantly affected by this disorder. While there are social and cosmetic ramifications that deserve consideration, this is by no means the whole issue. These patients have difficulty holding objects and can be professionally affected; for example, one of the patients was training to be a professional violinist, but had great difficulty in holding the violin and the bow. Why this patient population was skewed toward an Asian predominance is unexplained.

Medical treatment does exist, but is typically only really satisfactory for axillary hyperhidrosis, which is responsive to subcutaneous botulinum toxin type A injections.\(^1\) While botulinum toxin type A injections can be used to treat palmar hyperhidrosis, there are adverse effects and a short duration of effectiveness; repeated injections into the palmar spaces are required, which is uncomfortable for the patient because of the limited capacity of these spaces. For this reason, and based on the good results with video-assisted thoracic surgery sympathectomy, I believe that the presence of palmar and/or craniofacial hyperhidrosis constitutes a sufficient indication for surgical treatment.

This modest experience is consistent with and corroborates reports\(^2\)\(^3\)\(^-\)\(^12\) from other groups. While patients must understand the (small) risks of Horner syndrome should the stellate ganglion be injured and the real possibility of compensatory sweating for at least a few months after the operation, results for the treatment of palmar hyperhidrosis are quite good. These results are achieved with a short hospitalization, which should be no more than 1 day in most patients, and little morbidity.

Different surgical techniques have been reported, ranging from ablation of the nerve with electrocautery to different techniques of resection.\(^2\)\(^3\)\(^-\)\(^12\) I prefer resection because it is clearly the most definitive approach and because it provides some evidence that the proper operation was performed.

As the patient with bleeding illustrates, the nerve is in close relationship to intercostal vessels and care must be taken to avoid injury to them. The nerve is divided at the base of the stellate ganglion under direct vision using scissors so that there is no chance of cautery injury to the ganglion. I did use a relatively large (10-mm) port for camera placement, but for cosmetic reasons plan to switch to a 5-mm port and camera. I am most comfortable keeping the patients overnight, but chest tubes can be removed shortly after the operation because air leak from the lung is not an issue.

Compensatory sweating is postsympathectomy sweating in previously unaffected areas, such as the trunk or lower extremities. This phenomenon, which has been speculated to serve a thermoregulatory function,\(^7\) is reported to occur in 30% to 50% of patients, and the patient needs to be aware of this possibility.\(^1\)\(^2\)\(^-\)\(^3\)\(^4\) As with many complications, if patients are alerted and fully educated, they tolerate this typically mild and short-lived, but occasionally (although not in this experience) more severe, condition well and are happy to trade it for their initial condition.

It is somewhat surprising but true that patients with craniofacial hyperhidrosis obtain relief from this procedure. Similar good results in these patients have been obtained by others,\(^3\)\(^-\)\(^14\) although one group advocates clipping the lower third of the stellate ganglion. I have been reluctant to do that because of the possibility of Horner syndrome, and have found that patients have obtained relief if the sympathetic chain is divided at the base of the stellate ganglion.

This experience confirms that palmar hyperhidrosis occurs in young persons in North America, especially in women, and perhaps is more common in the Asian population. Bilateral video-assisted thoracic surgery sympathectomy is effective and can be accomplished with minimal morbidity and a short hospital stay.

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**REFERENCES**

Kaj Johansen, MD, Seattle, Wash: I have the same results as you. The side effects of this procedure in his series were either nonexistent, such as Horner syndrome, or, alternatively, minimal and self-limited, such as the issue about the compensatory sweating as you heard. At least in Dr Little's hands, the operative procedure appears to be straightforward because more than three quarters of his patients went home the next day, notwithstanding the fact that he performed the procedure bilaterally under the same anesthesia.

A review of the recent literature on hyperhidrosis reveals a bit more turmoil than you might infer from this presentation, however. There are multiple different medical and surgical treatments for hyperhidrosis, an indication that none of them is absolutely perfect. Dr Little has mentioned the use of botulinum toxin, and it really does appear to work well, especially for axillary hyperhidrosis. It doesn't work well for palmar hyperhidrosis, not only for the reason that he mentioned that it hurts to make all these injections in the palms but also because what the patient gets in exchange for dry warm hands is paralysis of the intrinsic muscles of the hand. That's not very helpful. I would like to ask Dr Little to comment upon a series of different medical treatments, such as the use of thalidomide or antiseizure medications, cognitive therapy (ie, psychotherapy), or tap water iontophoresis, all of which have been mentioned favorably in the literature. I will, however, ask him to comment upon a plastic surgical technique which has been favorably discussed in the literature, which is tumescent liposuction and curettage, especially for axillary hyperhidrosis.

As with all good presentations, Dr Little's report raises several other interesting questions, and I would like to ask Dr Little to comment or at least speculate on these: Why does this occur primarily in women, especially young women? And, why does it occur especially in those of Asian origin? This really is a fact, by the way; there is a report, in a journal from Taiwan, that reviewed 2200 thoracoscopic sympathectomies, so it is clearly a major problem in Asia. Why does compensatory sweating occur, and why does it go away? Given my shaky recall of autonomic neuroanatomy and neurophysiology, can Dr Little help me understand how resecting T2 and T3 can have an impact on cranial and facial hyperhidrosis?

Finally, we vascular surgeons are occasionally asked to revascularize the hands or carry out sympathectomy in hands troubled by either complex regional pain syndrome (formally, RSD [reflex sympathetic dystrophy]) or, alternatively, fingertip ulcerations in the circumstance of scleroderma or other rheumatoid conditions. It doesn't work well at all there. It works for 6 months or so and then the sympathetic tone appears to come back. Yet, for hyperhidrosis, Dr Little's and other reports appear to suggest that sympathectomy is curative. What's the difference here?

Dr Little: A thoughtful discussion, although, given some of the questions, I am surprised you don't want to know the meaning of life and death. Axillary hyperhidrosis clearly is responsive to various forms of treatment; in fact, we did not see that as an indication for operation so I really can't comment beyond the accurate observations you've already made. Why women, why Asians? It's either genetics or it is acquired. I don't know. It does occur in men, it does occur in the non-Asian population, not to the same extent, but you are right; actually, my interests first arose by a combination of being in Taiwan and talking with a thoracic surgeon who had done 2 or 3 patients that day and did hundreds per year. I'll also just take the chance to comment that my interest also in terms of putting together this paper was heightened by the fact that so many of these young women found it impossible to get insurance coverage for this procedure because it was considered a cosmetic procedure and I thought it would be useful to have even a modest series in the literature to document the efficacy of the operative approach. Compensatory sweating: I certainly have nothing to add that you are not already aware of, but it does seem like a thermostat problem, if you will, that for whatever reason, the autonomic nervous system is set at maintaining a degree of either temperature or sweating in the palms and when you turn that off, it turns up the thermostat to try and compensate; a very simplistic way of thinking, and I'm sure there is a better physiologic definition or explanation.

Cranial facial sweating: the first patient I saw with that, I told him that (and this was a man) there was really nothing we could do. He had palmar disease, we could treat that; but, then, I went to the literature and found to my surprise that there are some reports suggesting that taking the chain right up to the base of the sympathetic ganglion will help, although one group reports clipping the lower third of the stellate ganglion, which I have not had the courage to try, but it does improve and I presume it's because there are some fibers, as you know, that run up and down in the chain—at least enough to improve this condition significantly, if not cure it. And I would just end by agreeing with your comment about chronic regional pain syndrome. It is said in literature that if you get them quickly and do the operation, it does help, but I never see them quickly so I have the same results as you.