Original Article

Thoracoscopic Sympathectomy for Palmaris Hyperhidrosis

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Introduction: Palmaris hyperhidrosis is a disorder mediated by the sympathetic nervous system. It causes excessive sweating. This study evaluated the safety, efficacy, and outcome after thoracoscopic sympathectomy in patients with palmaris hyperhidrosis.

Methods: We reviewed the medical records of 18 patients (10 male) who underwent bilateral thoracoscopic sympathectomy between July 1998 and June 2001.

Results: The patients' mean age was 34 years. No conversions to thoracotomy occurred. Three 2- to 5 mm trocars were used. The thoracic sympathetic chain was resected from ganglia T2–T4, except in one patient with axillary hyperhidrosis requiring resection to T5. The mean operating time was 112 minutes, the mean blood loss was 50 ml, and the mean postoperative hospital stay was 1.2 days. Two patients had a unilateral pneumothorax requiring tube thoracostomy; one patient developed a chest wall hematoma at a trocar site that resolved without treatment, and one patient developed a transient unilateral Horner's syndrome. There have been no hospital readmissions. After a mean follow-up period of 14 months, 11 patients (56%) reported compensatory sweating. Sixteen patients (89%) were satisfied with their outcomes. One patient was dissatisfied because of excessive compensatory sweating, and another continues to have mild unilateral sweating on one hand and compensatory sweating of the face.

Conclusion: Thoracoscopic sympathectomy is a safe and effective alternative treatment for palmaris hyperhidrosis. Compensatory sweating occurs in more than 50% of patients but is tolerable in most. The majority of patients are satisfied with their short-term outcomes.

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Essential hyperhidrosis is a condition of unknown origin that causes excessive sweating, which is defined by a sweat production rate of 8 to 15 $\mu g/cm^2/min$.[1–3] Severe essential hyperhidrosis commonly occurs in the palmar, axillary, facial, plantar, and truncal regions and can cause professional, psychological, and social problems.[1,2,4,5] The incidence in the general population is estimated to be 1 in 100.[6] Medical treatments can be effective for mild essential hyperhidrosis but are ineffective with severe cases. Patients who are severely affected may require surgical treatment to resect the sympathetic ganglia that innervates the sweat glands.[2]

Thoracoscopic sympathectomy has been an effective surgical method for treating patients with essential hyperhidrosis and other sympathetically mediated disorders, including reflex sympathetic dystrophy (now commonly referred to as *complex regional pain syndrome*), chronic pancreatitis, and long QT syndrome.[1] Past surgical options for the treatment of patients with these conditions required open thoracotomy or large posterior incisions.[1,2] For this reason, physicians were reluctant to recommend surgery for these patients who do not have a life-threatening disorder. Thoracoscopic sympathectomy, however, is a minimally invasive procedure requiring only three 2- to 5-mm incisions to view the sympathetic chain for dissection. In addition to better cosmetic results, potential advantages include shorter recovery time, shorter length of hospital stay, and reduced morbidity. The purpose of this report is to evaluate the efficacy, safety, and short-term results of thoracoscopic sympathectomy for palmaris hyperhidrosis.

Key Points

- Thoracoscopic sympathectomy is a safe and effective alternative treatment for palmaris hyperhidrosis.
- Compensatory sweating occurs in more than 50% of patients but is tolerable in most patients.
- Almost 90% of patients are satisfied with their short-term outcome.

Patients and Methods

Indications Endoscopic Thoracic Sympathectomy

We reviewed the medical records of 18 patients who underwent bilateral thoracoscopic sympathectomies between July 1998 and June 2001. All patients had palmaris hyperhidrosis, and one patient had concomitant axillary hyperhidrosis. The criteria for including patients undergoing the operative procedure were based on the severity of the patient's hyperhidrosis. Patients were offered thoracoscopic sympathectomy after medical and nonsurgical treatments had failed or if they had longstanding or severe disease.

Positioning and Placement of Ports

Early in our series, the patient was placed in supine, with both arms abducted 90 degrees to expose both axillary regions. Both the surgeon and the assistant stood on the operative side of the patient, with a video monitor placed on the opposite side of the table. To provide better access to the axillary region, patients were subsequently placed in the lateral decubitus position. Both the surgeon and the assistant stood facing the patient and the video monitor. When one side was completed, the patient was turned to the opposite lateral decubitus position to approach the opposite hemithorax. The thoracoscopic sympathectomy technique consisted of three ports arranged in a triangular fashion. Depending on the size and muscularity of the patient, 2- to 5-mm ports (U.S. Surgical Corp., Norwalk, CT) were used.

The Endoscopic Thoracic Sympathectomy Procedure

The lung on the operative side was deflated using general anesthesia with double-lumen endotracheal intubations. If the lung failed to depress completely, CO_2 insufflation was administered to pressurize the pleural space to 5 mm Hg. After the left lateral chest and axilla were prepped, a 5-mm trocar was placed in the anterior axillary line at the 5th to 6th intercostal space. A 30-degree angle, 5-mm endoscope was then inserted to view the pleural space and to allow visual placement of the other ports. Two more trocars were then placed, one in the anterior axillary line at the 3rd to 4th intercostal space and the other in the midaxillary line at the 6th or 7th intercostal space.

Once the trocars were in place, the sympathetic ganglia and the thoracic ribs (T1–T5) were identified. To gain exposure, the parietal pleura was elevated with a grasper and opened from the second to the fifth rib head. The sympathetic chain from T2 to T4 was resected, then sharply divided proximally and distally between clips with scissors (Fig. 1). Division of the posterior rami at the T2 ganglion was the minimum requirement to sever the sympathetic innervation to the upper extremity. Patients were routinely offered sympathectomy down to the T4 level to denervate the axilla. In one patient, sympathectomy was performed to the T5 level because of severe axillary sweating. After the sympathetic chain was completely divided, the chain and the ganglion were extracted. Hand temperature monitoring was used during the operation at the discretion of the operating surgeon to monitor an increase in temperature that might occur with sympathectomy. No data were recorded for analysis regarding hand temperature elevation and perioperative outcomes. The chain was sent to pathology to obtain a permanent histologic section.

Fig. 1 **Left-sided sympathectomy beginning inferior to the stellate ganglion and T1.**

After completion of the sympathectomy, the lung was reexpanded, and CO_2 was suctioned from the pleural space with a 14-French red rubber catheter. The skin incision of the 5-mm port was approximated with a single, 4-0 subcuticular suture. The procedure was then repeated on the other side. A chest x-ray was obtained in the operating room to rule out a residual pneumothorax. A chest tube was placed at the surgeon's discretion if a pneumothorax was detected on a postoperative or intraoperative chest x-ray.

Results

Eighteen patients (10 men) with a mean age of 34 years (range, 21–58 yr) underwent a bilateral thoracoscopic sympathectomy for palmaris hyperhidrosis between July 1998 and June 2001. There were no conversions to thoracotomy. All procedures were performed with the use of three trocars (2–5 mm). Eight patients were operated on while placed in a lateral decubitus position, and 10 patients were supine. The thoracic sympathetic chain was resected to include thoracic ganglia T2–T4, except in one patient with concomitant axillary hyperhidrosis who required resection to include the fifth thoracic ganglia. The mean operating time was 112 minutes (range, 102–157 min), mean blood loss was 50 ml, and mean postoperative hospital stay was 1.2 days (range, 0–2 d). Two patients had a unilateral pneumothorax greater than 15%, requiring tube thoracotomy while under general anesthesia. Two patients with a unilateral pneumothorax less than 5% were followed expectantly. Postoperatively, one patient developed a chest wall hematoma at a trocar site that resolved without treatment, and one patient developed a transient unilateral Horner's syndrome, which resolved during an 8-week period. There have been no hospital readmissions. After a mean follow-up period of 14 months (range, 1–34 mo), 11 patients (56%) complained of compensatory sweating. Sixteen patients (89%) were satisfied with their outcomes according to self-report during office follow-up visits. One patient was dissatisfied because of excessive compensatory sweating, and another continued to have mild unilateral sweating on a hand and compensatory sweating of the face.

Discussion

Essential hyperhidrosis is a condition of unknown origin that affects 0.6 to 1% of the population and causes excessive sweating, primarily in the hands, feet, and axilla.[6] Severe essential hyperhidrosis can cause professional, psychological, and social problems.[1–5,7] Patients with excessive sweating have a slippery grip and a cold, wet handshake. Simple tasks such as typing on a computer keyboard or writing with a pen can also be hampered by the sweat.[8]

Hyperhidrosis is the primary indication for thoracic sympathectomy.[9] Nonsurgical, medical therapies such as antiperspirants, iontophoresis, anticholinergic drugs, and botulinum toxin A injections have been shown to reduce the rate of sweat production, but only temporarily and with drawbacks.[5,10] Topical application of antiperspirants such as aluminum chloride hexahydrate are ineffective in severe cases and often cause skin soreness and irritation.[8] The iontophoresis method applies low-intensity electric current to the palms and soles immersed in an electrolyte solution to stop the sweating by waterlogging the skin to block the sweat ducts.[10,11] Twenty minutes of iontophoresis in the hospital or clinic, however, involves expensive equipment, commuting and waiting time, and inconvenience.[10,11] Regular treatments are required to obtain short-term success with mean remission periods of 35 days.[12] Anticholinergic drugs such as glycopyrronium bromide and Robinul (First Horizon Pharmaceutical Corp., Alpharetta, GA) reduce the activity of the central nervous system; however, unwanted side effects include difficulties with dry mouth and impaired speech, taste, mastication, and swallowing.[11] Intradermal injection of botulinum toxin A treats essential hyperhidrosis by blocking neuronal acetylcholine release at the neuromuscular junction, resulting in a reduction in impulse transmission. Although side effects seem to be negligible if dosages are kept low, this treatment must be repeated at regular intervals.[5]

Despite the wide variety of medical treatments available, sympathectomy provides the only permanent and effective solution. Thoracic sympathectomy for essential hyperhidrosis was first described in the 1930s, and the first large series of thoracoscopic sympathectomies were reported in 1954.[1,3] In these early cases, the surgical procedure required a posterolateral thoracotomy; however, physicians were reluctant to recommend the procedure, even though they acknowledged its effectiveness.[1] Because of this reluctance, many surgeons today have little experience with thoracic sympathectomy.[1,13] Current minimally invasive techniques have restored interest in the procedure, however. Requiring only three 2- to 5-mm incisions, thoracoscopic sympathectomy treats essential hyperhidrosis by resecting the portion of the sympathetic chain that innervates the sweating. In most cases, resecting the T2–T4 level of the chain is effective in treating palmaris hyperhidrosis; however, for axillary cases, the resection may be extended to the T5 level.

The efficacy of thoracoscopic sympathectomy for palmar hyperhidrosis has been documented in several large, case-controlled series. Reisfeld et al[14] documented that palmar hyperhidrosis resolved in 584 (99%) of 585 patients who underwent thoracoscopic sympathectomy. Incidentally, 62 (95%) of 65 patients with facial hyperhidrosis in this series reported no further facial sweating. In a series of thoracoscopic sympathectomies performed in patients with hyperhidrosis ($n = 467$) reported by Gossot et al,[15] only 11 patients underwent reoperation for failure of long-term control of excessive palmar sweating. The causes of failure include the misinterpretation of the sympathetic chain, regeneration of the sympathetic chain after excision or ablation, and alternative neural pathways out of the field of resection or ablation.[16] Video-assisted "resympathectomy" for recurrent or persistent palmar hyperhidrosis has been successful with long-term follow-up.[17] In a series of 100 procedures, Guijarro et al[18] documented a 9.2/10 patient satisfaction score 1 year after video-assisted thoracoscopy for upper-limb hyperhidrosis.

When describing thoracoscopic sympathectomy, physicians must inform patients of potential complications of the procedure. During port placement or resection, injury to the intercostal nerves may occur, causing intercostal neuralgia.[9] Horner's syndrome, which results from injury to the stellate ganglion, is characterized by a drooping of the eyelid and by a small, constricted pupil, but this condition can be avoided with careful excision to the T2 level.[4,9] Postoperatively, gustatory sweating may result from an abnormal anastomosis between the sympathetic trunk and the vagus nerve.[4] Rarely, gustatory sweating may cause increased sweating while smelling or eating certain foods.[19] The most common complication is compensatory hyperhidrosis. In this condition, sweating of innervated skin (usually in the trunk and thighs) increases to compensate for the loss of thermoregulatory function in the denervated areas. Limiting the extent of sympathectomy to the T2–T4 level may minimize the extent of compensatory hyperhidrosis but may still be reported in as many as two-thirds of patients.[2,20]

In addition to essential hyperhidrosis, thoracoscopic sympathectomy may also be used to treat other sympathetically mediated disorders such as complex regional pain syndrome (CRPS), chronic pancreatitis, and long QT syndrome. Poorly understood and often difficult to diagnose, CRPS is characterized by extremity pain, edema, stiffness, sweating, and changes in color and temperature after a minor injury or surgery.[1,21] The condition occurs when a musculoskeletal or nerve injury does not heal normally.[22] CRPS is categorized as Type I or Type II. With similar clinical signs and symptoms, Type I is an area of sympathetic dysfunction that does not follow the course of a peripheral nerve, whereas Type II is associated with a known nerve injury.[21] One useful test in diagnosing CRPS is a sympathetic blockade (ie, stellate ganglion block). Relief after stellate ganglion block virtually confirms the diagnosis, but failure of relief does not rule out this diagnosis.[1] Treatment approaches are complex and have included medication, functional rehabilitation, psychological care, and techniques to block or interrupt the effects of sympathetic nervous system hyperactivity. Surgical sympathectomy is recommended only for refractory cases.[1]

Also a difficult clinical problem, chronic pancreatitis is associated with severe pain and impaired pancreatic function. Most treatment options include medications that have a high risk of drug addiction and that affect the functional capacity of the gland.[23] Decompressive procedures such as longitudinal pancreatojejunostomy, internal drainage of pseudocysts, and sphincteroplasty have been performed in the presence of ductal dilation with a 68% success rate.[24] Denervation procedures such as distal pancreatectomy, Whipple, and thoracic sympathectomies were used with a 75% success rate for recurrent pain or in the absence of ductal dilation.[24] Others have reported good results with the use of thoracoscopic splanchnicectomy, with success rates ranging from 64 to 100%.[1,25] Most studies demonstrating pain relief after thoracoscopic splanchnicectomy for chronic pancreatitis are limited by short-term follow-up; long-term control of pancreatic pain needs to be evaluated and reported.[26] Nevertheless, thoracoscopic splanchnicectomy may offer a more effective alternative to percutaneous neurolytic techniques, because the percutaneous procedures often fail as a result of poor localization and/or inadequate volume infusion of the neurolytic (alcohol or phenol).[27]

The long QT syndrome is an idiopathic prolongation of the QT interval that is associated with recurrent attacks of syncope and cardiac arrest.[28] This condition can have a mortality rate as high as 78% in untreated patients.[28] Primary treatment is β-blocker therapy, which has been well documented to prevent syncope in 75 to 80% of patients; however, a 20 to 25% risk of syncope and sudden cardiac death remains.[29] Since 1970, most reports have shown a significant decrease in sudden death with left stellate ganglionectomy, but other studies have been less successful.[1]

In our review, thoracoscopic sympathectomy with minimally invasive techniques was a safe and effective procedure for the treatment of patients with essential hyperhidrosis. Nevertheless, a randomized, controlled trial of outcomes and costs comparing medical and surgical treatments for essential hyperhidrosis has not been completed. The successful outcomes in our small series for thoracoscopic sympathectomy seem to be comparable to those reported and expected for open surgery, with patients potentially benefiting from a shorter recovery time, hospital stay, reduced morbidity rates, and better cosmetic results after a minimally invasive approach was used.

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References

1. Reardon PR, Preciado A, Scarborough T, Matthews B, Marti JL. Outpatient endoscopic thoracic sympathectomy using 2-mm instruments. *Surg Endosc* 1999;13:1139–1142.
2. Vanaclocha V, Saiz-Sapena N, Panta F. Uniportal endoscopic superior thoracic sympathectomy. *Neurosurgery* 2000;46:924–928.
3. Kux M. Thoracic endoscopic sympathectomy in palmar and axillary hyperhidrosis. *Arch Surg* 1978;113:264–266.
4. Lai YT, Yang LH, Chio CC, Chen HH. Complications in patients with palmar hyperhidrosis treated with transthoracic endoscopic sympathectomy. *Neurosurgery* 1997;41:110–115.
5. Heckmann M, Ceballos-Baumann AO, Plewig G; Hyperhidrosis Study Group. Botulinum toxin A for axillary hyperhidrosis (excessive sweating). *N Engl J Med* 2001;344:488–493.
6. Shachor D, Jedeikin R, Olsfanger D, Bendahan J, Sivak G, Freund U.

Endoscopic transthoracic sympathectomy in the treatment of primary hyperhidrosis: A review of 290 sympathectomies. *Arch Surg* 1994;129: 241–244.

7. Bogokowsky H, Slutzki S, Bacalu L, Abramsohn R, Negri M. Surgical treatment of primary hyperhidrosis: A report of 42 cases. *Arch Surg* 1983;118:1065–1067.
8. Collin J, Whatling P. Treating hyperhidrosis: Surgery and botulinum toxin are treatments of choice in severe cases. *BMJ* 2000;320:1221–1222 (editorial).
9. Johnson JP, Obasi C, Hahn MS, Glatleider P. Endoscopic thoracic sympathectomy. *J Neurosurg* 1999;91(1 Suppl):90–97.
10. Fischel RJ, Cooper M. Microinvasive VATS sympathectomy for hyperhidrosis. *Surg Rounds* 2001;24:298–302.
11. Collin J. Treating hyperhidrosis: Author's reply. *BMJ* 2000;321:703 (letter).
12. Karakoc Y, Aydemir EH, Kalkan MT, Unal G. Safe control of palmoplantar hyperhidrosis with direct electrical current. *Int J Dermatol* 2002; 41:602–605.
13. Barnes RW. Sympathectomy: Quo vadis? *Cardiovasc Surg* 1994;2:9–15.
14. Reisfeld R, Nguyen R, Pnini A. Endoscopic thoracic sympathectomy for treatment of essential hyperhidrosis syndrome: Experience with 650 patients. *Surg Laparosc Endosc Percutan Tech* 2000;10:5–10.
15. Gossot D, Kabiri H, Caliandro R, Debrosse D, Girard P, Grunenwald D. Early complications of thoracic endoscopic sympathectomy: A prospective study of 940 procedures. *Ann Thorac Surg* 2001;71:1116–1119.
16. Singh B, Moodley J, Ramdial PK, Ramsaroop L, Satyapal KS. Pitfalls in thoracoscopic sympathectomy: Mechanisms for failure. *Surg Laparosc Endosc Percutan Tech* 2001;11:364–367.
17. Lin TS. Video-assisted thoracoscopic "resympathicotomy" for palmar hyperhidrosis: analysis of 42 cases. *Ann Thorac Surg* 2001;72:895–898.
18. Guijarro JR, Arnau Obrer A, Fernandez Centeno A, Regueiro MF, Perez AA, Canizares Carretero M, et al. Our experience in the treatment of hyperhidrosis of the upper limbs by video-assisted thoracoscopy: An analysis of our first 100 procedures [in Spanish]. *Arch Bronconeumol* 2002;38:421–426.
19. De Berjer D. Treating hyperhidrosis: Treatment options must be balanced against each other. *BMJ* 2000;321:703 (letter).
20. Berguer R, Smit R. Transaxillary sympathectomy (T2 to T4) for relief of vasospastic/sympathetic pain of upper extremities. *Surgery* 1981;89: 764–769.
21. Lindenfeld TN, Bach BR Jr, Wojtys EM. Reflex sympathetic dystrophy and pain dysfunction in the lower extremity. *J Bone Joint Surg Am* 1996;78A:1936–1944.
22. Feinberg SD. Complex regional pain syndrome. *Am J Nurs* 2000;100: 23–24.
23. Ihse I, Zoucas E, Gyllstedt E, Lillo-Gil R, Andren-Sandberg A. Bilateral thoracoscopic splanchnicectomy: Effects on pancreatic pain and function. *Ann Surg* 1999;230:785–791.
24. McHale A, Buechter KJ, Cohn I Jr, O'Leary JP. Surgical management of chronic pain from chronic pancreatitis. *Am Surg* 1997;63:1119–1123.
25. Stone HH, Chauvin EJ. Pancreatic denervation for pain relief in chronic alcohol associated pancreatitis. *Br J Surg* 1990;77:303–305.
26. Moodley J, Singh B, Shaik AS, Haffejee A, Rubin J. Thoracoscopic splanchnicectomy: Pilot evaluation of a simple alternative for chronic pancreatic pain control. *World J Surg* 1999;23:688–692.
27. Wong GY, Sakorafas GH, Tsiotos GG, Sarr MG. Palliation of pain in chronic pancreatitis: Use of neural blocks and neurotomy. *Surg Clin North Am* 1999;79:873–893.
28. Bhandari AK, Scheinman MM, Morady F, Svinarich J, Mason J, Winkle R. Efficacy of left cardiac sympathectomy in the treatment of patients with the long QT syndrome. *Circulation* 1984;70:1018–1023.
29. Dorostkar PC, Eldar M, Belhassen B, Scheinman MM. Long-term follow-up of patients with long-QT syndrome treated with β-blockers and continuous pacing. *Circulation* 1999;100:2431–2436.

Lord help us deal with ugly situations in a beautiful way.

—Mark Link