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Intercostal Nerve Reconstruction for Severe Compensatory Hyperhidrosis: The Gebitekin Technique

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Compensatory sweating (CS) is the most common and disabling complication of endoscopic thoracic sympathectomy and represents an unmet clinical challenge. Our surgical hypothesis is to generate a parallel pathway to the damaged part of the sympathetic nerve, similar to the Kuntz nerve, by reconstructing the 2 healthy intercostal nerves, thus treating CS. Here, we present a novel videothoracoscopic technique involving bilateral intercostal nerve reconstruction in patients with severe CS after endoscopic thoracic sympathectomy.

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The most common and hampering complication of endoscopic thoracic sympathectomy (ETS) is compensatory sweating (CS). The incidence of CS varies between 3% and 98% and manifests as sweating in the unaffected areas before ETS[1] and may be mild, moderate, or severe.[1,2] Severe CS (sCS) is the main culprit for patient regret after ETS and dramatically impairs the quality of life (QOL). There is an insufficient number of studies on the treatment of CS, as many authors agree that CS is untreatable and unavoidable.

Here, we present our new technique for the treatment of sCS. We hypothesized that we could construct a parallel pathway to the damaged part of the sympathetic nerve, similar to the Kuntz nerve, with reconstruction of 2 healthy intercostal nerves that receive sympathetic nerve fibers above and below the damaged level of the sympathetic nerve, hence decreasing sCS.

TECHNIQUE

PATIENT SELECTION AND PREOPERATIVE PREPARATION. Patients with sCS were considered as candidates for reconstruction surgery, excluding patients with mild or moderate CS. Preoperative psychiatric consultation was compulsory in all patients to confirm that sCS was the predominant reason for the impaired QOL. Patients were provided with detailed information of the surgical procedure and other nonsurgical treatment options.

PROCEDURE. General anesthesia with a double-lumen intubation tube is routinely performed. The patient is initially positioned in the left lateral decubitus position, and the surgeon and assistant stand in front of the patient. A 10-mm incision is made at the midaxillary line in the fifth intercostal space that is used for 30-degree telescope and camera (Figure 1). The second incision is made at the anterior axillary line in the third intercostal space (Figures 2A-2D) and a 12-mm Thoracoport (Medtronic, Minneapolis, MN) is inserted.

The level of the ETS (cutting, clipping, etc.) on the sympathetic nerve is identified and the intercostal nerves above and below the interruption are examined for a possible reconstruction (Figures 3A, 3B).

INTERCOSTAL NERVE PREPARATION. The length of the intercostal nerves available for anastomosis are measured, and the parietal pleura covering the related intercostal nerve is opened using the hook without cauterization to avoid damage to the nerve (Figures 3C, 3D). The intercostal vascular pedicle is always identified but not routinely ligated to prevent bleeding; if injured, bleeding is controlled using hook cautery or clip. The distance between the upper and lower intercostal nerves is measured, and the nerves are cut at the point of measurement to achieve tension-free anastomosis (Figures 3E, 3F). The first intercostal nerve needs special attention, as it is dissected at least 3 cm distal to the first ganglia in order to avoid Horner's syndrome. The fifth nerve is avoided in female patients in order to prevent nipple paresthesia. The

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FIGURE 1 Equipment for the procedure. (A) Endoscopic hook, (B) endoscopic knot pusher, (C) basic videothoracoscopic equipment, (D) 5-mm or 10-mm, 30-degree telescope, (E) 5-0 polydioxanone (Ethicon, Somerville, NJ) suture, (F) two 10-mm to 12-mm trocars, and (G) fibrin glue (TISSEEL; Baxter, Deerfield, IL).

clips used during the ETS are removed without dissection (Figure 3G).

INTERCOSTAL NERVE ANASTOMOSIS. Instrumentation is avoided to handle the nerves to prevent possible damage. The tension-free anastomosis is carried out using one or two 5-0 polydioxanone sutures (Ethicon, Somerville, NJ) and allowed to stay on the pleural surface (Figure 3H). In case of tension, the proximal ends of the nerves are further dissected toward to the sympathetic chain. The anastomosis is rechecked to make sure that the nerve endings have come together and are covered with fibrin glue (TISSEEL; Baxter, Deerfield, IL) (Figure 3I).

After hemostasis, a 20F chest tube is placed in the thorax. The same procedure is performed on the other side.

POSTOPERATIVE FOLLOW-UP. Postoperative pain management included preemptive analgesia along with intercostal nerve block in which the incisions are made and an intravenous nonsteroidal anti-inflammatory drug is administered. Chest x-ray is performed on the day of surgery and on the first postoperative day (POD). Drains are removed on the first POD unless air leak, drainage, or hematoma is noted. Patients are discharged 24 hours to 36 hours after surgery, unless any postoperative complication is observed.

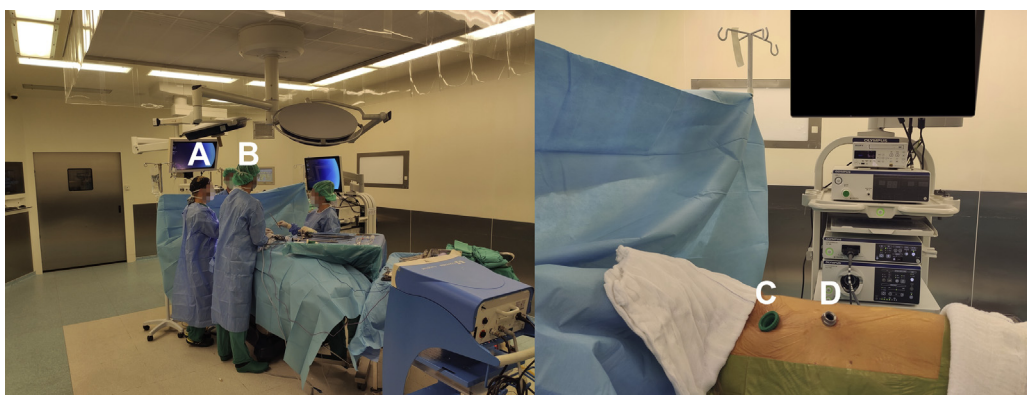

FIGURE 2 Position of (A, B) surgeons and (C, D) trocars.

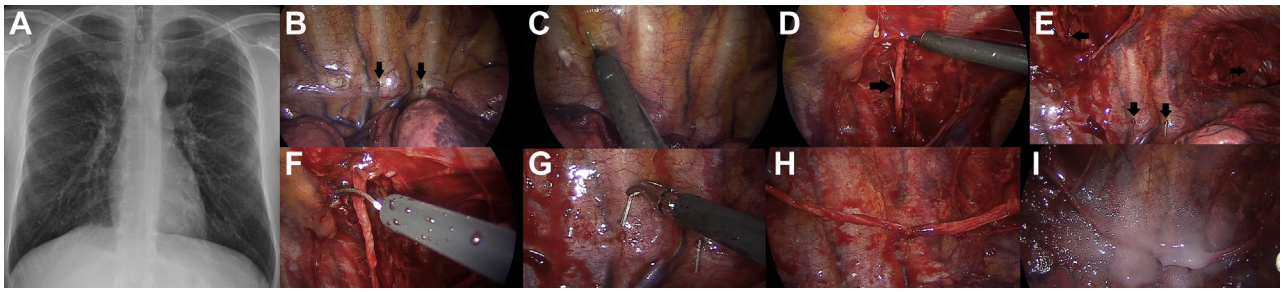

FIGURE 3 (A-I) Steps showing the Gebitekin technique.

COMMENT

Our technique is based on 3 factors.

1. The Kuntz nerve is the most important factor for failure of hyperhidrosis surgery. If the Kuntz nerve can cause relapse by providing an alternate pathway to the sympathetic nerve, then creating a similar pathway may reduce CS.
2. Chou and colleagues[3] defined the pathophysiology of CS as a deficiency in the negative feedback to the hypothalamus that is provided by the efferent nerves. ETS completely blocks the negative feedback provided by this pathway. Anatomically, each intercostal nerve gives and receives branches to and from the sympathetic chain. By creating an alternate pathway, the negative feedback mechanism could be restored.
3. Intercostal nerves have been successfully used as nerve grafts for years by surgeons.

Because of the unsatisfactory results we observed when transposing the intercostal nerve to the sympathetic chain, we developed the present novel technique (the Gebitekin technique) and used it in 15 patients with sCS (mean age 31.9 years [range, 25-40 years]) over 2 years (2014-2015); a total of 30 procedures were performed. ETS was achieved by cutting the nerve in 7 patients and clipping in the other 8. Additionally, depression and fatigue were observed in all patients. The median time interval between the primary and secondary operations was 32.6 (range, 7-96) months. The reconstruction of the intercostal nerves was between T1 and T4 in 1 case, between T1 and T5 in 3 cases, between T2 and T4 in 6 cases, between T2 and T5 in 4 cases, and between T3 and T5 in 1 case. The median surgery time was 90 (range, 75-120) minutes. Minor venous hemorrhage was the only major morbidity without mortality. Transient paresthesia developed in 1 patient at the dermatome of respective intercostal nerve, but none of the patients had permanent motor or sensitive intercostal nerve pedicle neuropathy. The improvement of sCS after surgery was rated excellent or good in 7 (46.7%) patients, satisfactory in 7 (46.7%) patients, and unchanged in 1 (6.6%) patient. None of the patients had a recurrence of primary hyperhidrosis, and there was no difference in sweating reduction between the right and left sides. Also, dryness of hands improved in 5 (33.3%) patients. The symptoms of depression and fatigue disappeared in all but 1 patient. All but 1 patient responded that they would recommend this surgery to the other patients suffering from sCS along with other symptoms.

The reasons for achieving more successful results compared with other techniques may be the following:

1. The intercostal nerve contains more sympathetic nerve fibers and is, therefore, more suitable than the sural nerve for a reconstruction.
2. Intercostal nerves are prepared and handled with care without using cautery in the same setting of surgery. However, the sural nerve requires separate incision and detailed dissection.
3. Because the intercostal nerve is used as a pedicle graft, adequate blood supply is provided.
4. There is a single anastomosis that may reduce problems of 2 anastomoses.
5. Dissection on the sympathetic chain is avoided.
6. Because there is no anastomosis on the sympathetic chain, anastomosis is avoided in the degenerated area of the sympathetic chain.

Our novel technique is an effective and successful treatment of severe compensatory sweating that changes the QOL in the vast majority of the patients. Our preliminary results also revealed that using the first intercostal nerve provides more favorable results compared with the second intercostal nerve. Furthermore, the ETS technique (clipping, cutting, sympathectomy) did not affect the success of our novel technique.

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