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Thoracoscopic Sympathectomy for Symptomatic Arterial Obstruction of the Upper Extremities

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Background. Severely symptomatic arterial insufficiency of the hand and upper extremities requires adequate treatment. Medical therapy and local care are usually unsuccessful, and thoracic sympathectomy can represent an effective procedure to control pain, to help ulcer healing, and to prevent or delay amputation.

Methods. We performed 20 thoracoscopic sympathectomies in 15 patients (13 men and 2 women) with upper extremity ischemia. Mean age was 47 years (range 21 to 72 years). All patients were thought to have organic block l age of digital arteries. The condition was unilateral in 10 patients and bilateral in 5. Primary diagnosis was digital arteriosclerosis in 8 patients, Buerger's disease in 4 patients and the remaining 3 were drug abusers with severe ischemia due to accidental intra-arterial injection of drugs. Eleven patients (73%) presented with terminal digital necrosis, gangrene, or ulceration of the fingers associated with severe pain. Four ~patients complained of coldness, pain, and some degree of soft tissue infection without permanent loss of tissue.

Results. We performed 10 unilateral and five bilateral staged (mean interval was 3 months) thoracoscopic sympathectomies. We had two minor complications and no mortality. Mean duration of postoperative chest drainage was 2.5 + 0.4 days and mean postoperative hospital stay was 5.3 + 0.5 days. Follow-up ranged from 3 to 71 months, with a mean of 33 months. All patients demonstrated clinical benefit after operation.

Conclusions. Thoracoscopic sympathectomy in patients with severe ischemia of upper limb extremities permits optimal symptomatic control and maximum tissue salvage. Because the procedure is minimally invasive, safe, and associated with a low rate of complications, it should be considered earlier the natural course of this disease.

Thoracic sympathectomy has been substantially improved with the use of video-assisted thoracoscopy (VAT) because it offers better visualization of the anatomic structures with minimal invasiveness [1-3]. Major indications include hyperhidrosis [4], Raynaud's disease [5], causalgia [6], and reflex sympathetic dystrophy [7]. A less common indication is represented by symptomatic vascular insufficiency of the upper extremities due to arterial obstruction, when revascularization is not feasible because of the peripheral location of the lesions [8]. In this subset of patients, sympathectomy induces the release of vasomotor control and hyperactive tone of the small arteries and arterioles, improving circulation to the skin, peripheral extremities, and bone, allowing healing of ulcers and trophic lesions and limiting tissue necrosis [9]. Because little information is available in the literature about the efficacy of VAT sympathectomy in this subset of patients, we describe our initial experience.

Patients and Methods

From January 1995 to December 2001, we performed 20 VAT sympathectomies in 15 patients with upper extremity ischemia. Thirteen patients were male and 2 female, with a mean age of 47 years (range 21 to 72 years). All patients were referred to our department with clinical and radiologic evidence of organic blockage of digital arteries unresponsive to maximal medical therapy and not treatable with direct surgical revascularization. The condition was unilateral in 10 patients and bilateral in 5. Primary diagnosis was digital arteriosclerosis in 8 patients, Buerger's disease in 4, and the remaining 3 were drug abusers with severe ischemia due to accidental intra-arterial injection of drugs. Eleven patients (73%) presented with terminal digital necrosis, gangrene, or ulceration of the fingers associated with severe pain. Four patients complained of coldness, pain, and some degree of soft tissue infection without permanent loss of tissue. Severity of pain was evaluated preoperatively and post operatively using a visually presented numeric rating scale (0 = no pain; 5 = pain interferes with daily/work activities; 10 = worst pain imaginable) and compared using Student's t test. Preoperative severity pain score, expressed as mean + standard deviation, was 6.66 + 1.47 (Table 1).

Case No.	Diagnosis	Necrosis or Loss of Tissue	Pain Score	Pain Medications
1	Atherosclerosis	+	6	+++
2	Atherosclerosis	+	5	++
3	Atherosclerosis	+	6	+++
4	Atherosclerosis	+	7	+++
5	Atherosclerosis	+	7	+++
6	Atherosclerosis	−	5	++
7	Atherosclerosis	−	5	++
8	Atherosclerosis	−	4	++
9	Buerger's Disease	+	7	+++
10	Buerger's Disease	+	7	+++
11	Buerger's Disease	+	8	+++
12	Buerger's Disease	+	7	+++
13	Drug injection	+	8	+++
14	Drug injection	+	10	+++
15	Drug injection	−	8	+++

+++ = every 4–6 hours; ++ = every 8–12 hours.

Table 1. *Primary Diagnosis, Preoperative Presence of Necrosis or Permanent Loss of Tissue, Severity of Pain Score, and Need of Pain Medication.*

Preoperative brachial angiography was performed in 10 patients at our hospital, whereas the remaining patients were studied in other institutions and referred to us for operation. Usually, the most common site of flow blockage was at the level of the proximal interphalangeal joint, but lesions sometimes originated more proximally in the metacarpal arteries (Fig 1). Doppler ultrasound in most instances confirmed the physical findings. Blood gas analysis and spirometry were also performed, and FEV1 was less than 40°/O of predicted value in 3 patients. Associate conditions were hypertension in 10 patients, cardiac ischemia with history of angina or myocardial infarction in 3, mild diabetes in 2, and chronic obstructive pulmonary disease in 4. Thoracoscopic sympathectomy was performed under general anesthesia with double lumen intubation, with the patient placed in the thoracotomy position with the upper limb abducted and raised. Two or three entry sites in the axillary area were used: one in the V intercostal space for a 5- or-10 mm 0-degree scope. Instruments were inserted through the third or fourth intercostal space. Anterior rotation of the operative table was helpful in lung retraction. In 5 patients, diffuse pleural adhesion was encountered, and it was necessary to partially mobilize the lung to expose the sympathetic chain; in 4 patients, moderate thickening and opaqueness of the parietal pleura caused difficulties in identifying the nerve. To dissect the sympathetic chain, the parietal pleura was opened and the nerve was progressively isolated using scissor or hook dissector. The main trunk was prepared between T2 and T4, taking care to avoid lesion to the Stellate ganglion, and gently lifted up. This maneuver allows identification and resection of all collateral branches. Finally, the trunk was divided proximally immediately after the Stellate ganglion, distally at the level of T4, and removed. The nerve of Kuntz was isolated and resected, when evident. At the end of the operation, after accurate control of the hemostasis, a chest drainage was left in place and the skin incision was closed in the usual fashion.

Fig 1. *Arteriogram demonstrates segmental obstructions in digital arteries and further lesions in palmar arch.*

Results

We performed 10 unilateral and five bilateral staged (mean interval time was 3 months) thoracoscopic sympathectomies. There were no perioperative deaths. Two minor complications occurred: 1 patient developed a pleural effusion after chest tube removal, which required one thoracentesis; and 1 patient had an atrial fibrillation successfully treated by anti-arrhythmic drugs. No Horner's syndrome or other collateral effects were noticed. Mean duration of postoperative chest drainage was 2.5 + 0.4 days and mean postoperative hospital stay was 5.3 + 0.5 days. Follow-up ranged between 3 and 71 months, with a mean of 33 months. All patients demonstrated evident clinical benefit after the operation: 5 patients had complete healing of the ulcers and trophic lesions; and 6 patients had improvement of their lesions and clear demarcation of necrotic areas. Doppler ultrasound proved that blood velocity and local flow increased. Reduction of pain was observed in all patients. Post-operative severity of pain score was 4.20 + 1.54, and the improvement from preoperative values was statistically significant ($p < 0.05$) (Fig 2). Pain medication was suspended in 6 (40%) patients, reduced in 6 (40%), and unchanged in 3 (20%) (Table II). Two patients died during follow-up: 1 of myocardial infarction and 1 of cerebral ischemia, 24 and 32 months, respectively, after the operation. Five patients required one or more digital debridments and medications. Four patients with tissue necrosis ultimately required delayed amputation at one or more distal interphalangeal joints; in each case, amputation was delayed until clear tissue demarcation developed, which allowed maximal preservation of viable tissue. In the group of patients with acute ischemia due to intra-arterial injection of drug, 2 had a normal extremity. The remaining patient, who developed tissue necrosis, required several digital debridments and delayed amputation of a single distal phalanx; he also had a permanent neurologic dysfunction with inability to flex the distal phalanx of his thumb and weakness of grip.

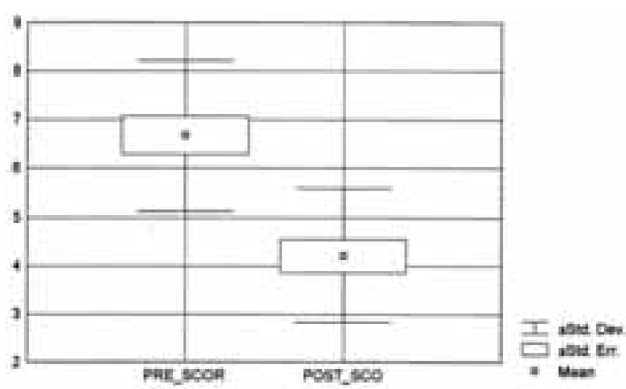

Fig 2. *Comparison between preoperative and postoperative severity pain score (p<0.05).*

Case No.	Pain Score	Pain Medication	Digital Debridement	Amputation	Healing
1	4	++	+	−	−
2	4	++	+	−	−
3	5	++	+	−	−
4	3	−	+	−	−
5	5	++	+	−	−
6	2	−	−	−	+
7	3	−	+	−	+
8	2	−	−	−	+
9	6	+++	−	+	−
10	6	+++	−	+	−
11	6	++	+	+	−
12	5	++	+	+	−
13	4	−	−	−	+
14	5	++	+	+	−
15	2	−	−	−	+

++ = every 8–12 hours; + = once a day; − = no pain medication.

Table 2. *Postoperative Severity Pain Score, Need of Pain Medication, and Follow Up*.

Comment

The efficacy of sympathectomy in the management of peripheral ischemia is not a new concept [10,11]. Many reports in the literature confirm the efficacy of sympathectomy for treating gangrene and ulcers due to occlusive arteriosclerosis of lower and upper limb arteries [12, 13]. Nevertheless, with the development of arterial reconstruction techniques, the optimal surgical therapy for arterial occlusive disease has shifted from sympathectomy to direct revascularization. However, arterial reconstruction is frequently not feasible because of the peripheral location of the vascular lesions. In fact, patients with arterial disease limited to the mid-palm and fingers, at levels not suitable for direct surgical reconstruction, can obtain significant improvement with sympathectomy, local tissue care, and vasodilating drugs. Severely symptomatic arterial insufficiency of the hand and upper extremities is an uncommon clinical problem due to many different conditions: arterial degenerative diseases (arteriosclerosis), systemic diseases (scleroderma, thromboangitis, lupus erythematosus, dermatomyositis), trauma, iatrogenic, and others [14]. When ischemia be comes severe and causes constant pain and loss of tissue, appropriate treatment is necessary. Medical treatment and local tissue care are usually unsuccessful, and in this subset of patients, sympathectomy can represent an effective procedure to control pain, to help ulcer healing, and to prevent or delay amputation. Before the advent of VAT, thoracic sympathectomy was performed only in highly selected patients because of its invasiveness, and often sympathectomy for upper limb disorders was accomplished by the anterior cervical route. Thoracic sympathectomy has been substantially improved with the use of VAT, which offers better exposure and visualization of the anatomical structures with less surgical trauma. Unlike Raynaud's disease, that usually relapses after sympathectomy, secondary Raynaud's phenomenon and ischemia, both due to arterial occlusion, improve significantly after thoracic sympathectomy [15]. Pain control, ulcer healing, and demarcation of necrosis appear to be much more related to post surgical correction of abnormal arteriovenous shunting and to improved nutritional blood flow to ischemic areas than to the increase of total blood flow [9]. Thoracoscopic sympathectomy is considered in most cases as the last resort to prevent extensive amputation. In our experience, the results in terms of symptoms improvement, ulcer healing, and prevention or delay of amputation were satisfactory, with a low rate of complications even in patients with higher surgical risk. Thoracoscopic sympathectomy, after unsuccessful medical treatment, proved effective even in 3 patients who developed severe acute ischemia due to intra-arterial injection of illicit substances. In these cases, peripheral ischemia is due to the direct toxicity of the injected drug to the vascular endothelium [16], particulate emboli altered pH with crystal formation [17, 18], increased platelet aggregation, thromboxane release, and vasospasm sympathetic mediated [19]. The combination of these effects can lead to irreversible tissue destruction. Sympathectomy in these cases proved to be helpful, and even when amputation is necessary, it may be delayed until a clear demarcation of necrosis is obtained, allowing the preservation of the maximal viable tissue.

In conclusion, we believe that thoracoscopic sympathectomy in patients with severe ischemia of upper limb extremities permits optimal symptom control and maximum tissue salvage. Because the procedure is minimally invasive, safe, and associated with a low rate of complications, it should be considered earlier in the natural course of this disease.

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