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Thoracoscopic Sympathectomy for Distal Upper Limb Ischemia

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ABSTRACT

Background: The sympathetic nervous system (SNS) regulates vasomotor activity, piloerection, and sweating. So, thoracoscopic sympathectomy can be utilized to treat upper extremity vascular insufficiency caused by artery blockage when revascularization is not an option due to the obstructions' distant placement.

Objective: The study aimed to evaluate the results of revascularization after thoracoscopic sympathectomy in distal upper limb ischemia due to peripheral lesions.

Patients and methods: This is a randomized retrospective study was done in Khamis Musheit General Hospital. The sample included 30 patients with upper extremity distal ischemia, operated in the period from February 2023 to December 2024.

Results: The average follow-up period was eight months, with a range of one to twelve months. Following the procedure, every patient showed apparent clinical improvement: 12 patients had their ulcers and trophic lesions completely heal, and 5 patients had their lesions improved and the necrotic regions clearly defined. The majority of our patients showed pain improvement.

Conclusion: Thoracoscopic sympathectomy helped for maximal limb saving and effective symptom management in patients with severe distal ischemia of the upper limb extremities. The operation should be taken into consideration earlier in the therapeutic choices since it is safe, minimally invasive, with a low risk of complications.

Keywords: Thoracoscopic, Sympathectomy, SNS, Ischemia, Upper limb, VATS.

INTRODUCTION

Vasomotor activity, piloerection, and sweating are all regulated by the sympathetic nervous system (SNS) in the upper extremities [(1)]. According to this fact, surgical intervention upon the SNS are approved to treat many complaints. Raynaud's disease, reflex sympathetic dystrophy, regional pain syndrome, and hyperhidrosis are the main indications [(2)].

An essential indication is symptomatic vascular insufficiency of the upper extremities caused by arterial blockage, when revascularization is not possible due to distal obstructions. In this group of patients, sympathectomy causes the liberation of vasomotor control and hyperactive tone in the small arteries and arterioles, enhancing circulation to the peripheral extremities soft tissue and allowing ulcers and trophic lesions to heal while minimizing tissue necrosis [(3)].

The open sympathectomy procedure is now only recommended in cases when facilities don't allow video-assisted thoracoscopic surgery (VATS) from being performed. Surgeons may now do sympathectomy with a few tiny incisions less than an inch because of advancements in VATS. Small surgical tools and a fiberoptic camera let the surgeon to precisely identify the sympathetic chain [(4)].

The precise visualization of the surgical field, improved identification of the intrathoracic anatomy, minimal morbidity, improved cosmetic outcomes, and a brief hospital stay are the benefits of VATS over traditional open thoracotomy or neck approach operations [(2)].

This study's objective was to evaluate the early outcomes of VATS in distal upper limb ischemia due to peripheral lesions regarding pain, need of pain relief medications, coldness and tissue loss.

PATIENTS AND METHODS

This randomized retrospective interventional study was done in Khamis Musheit General Hospital. The sample included 30 patients who had VATS through the period from February 2023 to December 2024.

Inclusion criteria: Patients who presented with distal upper limb ischemia due to significant stenosis and obstruction of the palmar or digital arteries as proved by computed tomographic angiography (CTA) that are not amenable for revascularization (surgical bypass or endovascular).

Exclusion criteria:

- Patients presented with proximal upper limb ischemia suitable for revascularization.
- Diabetic patients as they are considered auto-sympathectomized due to peripheral neuropathy.
- Patients presented with wet gangrene involving the hand that needs amputation to avoid septicemia.

Intervention: Under general anesthesia, using a double lumen endotracheal tube (for lung isolation), we placed our patients in semi-setting position (45 degrees) with the trunk elevated by 2 small cushions below the shoulders with another pillow below the

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knees to avoid patient sliding downwards table belt around the lower part of the body to prevent the body from movement during table tilting laterally. We used two ports 5-mm. the first for the camera in the fifth intercostal space the second port for the instrument in the third intercostal space with CO_2 insufflation (maximum 10 mmHg) to help in lung collapse.

We isolated the side we will begin in by the double lumen and the CO_2 insufflation, then we identified the sympathetic chain and identified the level we will cut. Then, we opened the parietal pleura, resected and interrupted the sympathetic chain (T2-T3 level) by monopolar electrocautery.

Ethical approval: Khamis Musheit General Hospital Ethics Committee accepted this study. After receiving all of the information. Each participant signed an informed permission. The Helsinki Declaration was followed throughout the course of the investigation.

Statistical analysis

The data were handled using the SPSS version 22 computer software. The means of all variables and clinical data were compared using suitable parametric or nonparametric tests. The data were displayed as tables and figures using Microsoft Office computer suite. The quantitative parametric data were analyzed using an unpaired student t-test and provided as mean ± SD. Qualitative data were analyzed using the Fisher's exact or X^2-tests, if applicable, and reported as frequency and percentage. A P value of ≤ 0.05 indicates a significant association between variables.

RESULTS

Patients' data were collected between February 2023 and December 2024, including 30 patients 24 (80%) men and 6 women (20%) presented with distal upper limb ischemia in the hands and digits that can't be revascularized surgically and conservative medical treatment was ineffective. Patients in the study showed risk factors for atherosclerosis including hypertension, ischemic heart disease, dyslipidemia and smoking as shown in table (1). Results showed a strong association between hypertension and smoking as a major risk factor for distal ischemia.

Table (1): Risk Factors and chronic illnesses

Total No. of Patients		**30**
Age (Years)		28 - 72
Gender	Males Females	24 (80%) 6 (20%)
Risk factors and Chronic Illness	Hypertension Ischemic Heart Disease Dyslipidemia Smoking	20 (66.67%) 15 (50%) 17 (56.67%) 28 (93.33%)

Patients presented with multiple presentations, mainly pain in the peripheries in addition to discolouration with or without tissue loss (Table 2).

Table (2): Clinical Presentation.

Clinical Presentation	
Pain	20 (66.66%)
Discoloration	28 (93.33%)
Tissue loss (ulcers)	22 (73.33%)

Pre-operative diagnosis of our patients shown in (Table 3 and figures 1 & 2).

Table (3): Preoperative diagnosis.

Pre-operative diagnosis	
Atherosclerosis	8 (26.67%)
Burger disease	9 (30%)
Raynaud's disease	9 (30%)
Intra arterial drug injection	4 (13.33%)

Figure (1): Case presented with finger ischemia due to burger disease.

Figure (2): Case presented with fingertips dry gangrene after intra-arterial drug injection.

We performed seven (23.3%) bilateral staged interventions and twenty-three (76.67%) unilateral interventions (mean interval duration was three months). The average post-operative hospital stay was 4.8 ± 0.4 days, and the average post-operative chest drainage time was 1.5 ± 0.3 days. We had no mortality in our study group as well as no operative and post-operative complications (Table 4).

Table (4): Operative complications

Operative and postoperative complications	
Wound complication	1
Dry hands	1
Rib fracture	0
Atrial fibrillation	0
Pleural effusion	0
Vascular complications	0
Neurologic: **Transient** **Permeant**	1 0

Follow-up of our study group ranged between 1 and 12 months. Following the procedure, all patients showed substantial clinical improvement: 5 (16.67%) patients had improved lesions and a distinct delineation of necrotic regions, and 12 (40%) patients had finished healing their ulcers and trophic lesions.

Doppler ultrasonography demonstrated an increase in local flow and blood velocity. Pain reduction was found in 24 patients (80%). The severity of pain was assessed preoperatively and postoperatively using a graphically displayed numeric rating scale (0 = no pain; 5 = pain interferes with daily/work activities; 10 = severe pain unexpected) and compared using the Student's t-test.

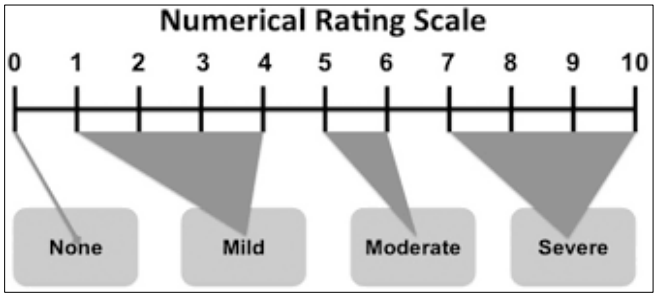

Figure (3): Pain scoring scale used as evaluating tool for post intervention result.

The pain severity score was 8 ± 2 preoperatively and 4 ± 2 postoperatively, with a statistically significant improvement ($p < 0.05$). Pain medication was discontinued in 10 (33%) patients, lowered in 14 (47%) patients and remained stable in 6 (20%) patients.

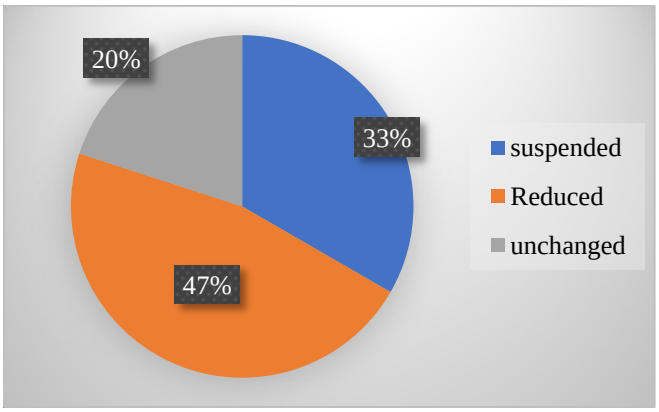

Figure (4): Pain medication modification.

Management of residual lesions:

4 (13.33%) patients required one or more digital debridement with medical treatment.

3 (10%) 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 group of patients who experienced acute ischemia as a result of intra-arterial medication injection, two (6.67) exhibited normal extremities. The two additional patients (6.67%) who experienced tissue necrosis needed several digital debridements and a postponed amputation of one distal phalanx. Results were summarized in the following table.

Table (5): Intervention results.

Case No.	Pre pain score	Post pain score	Pain Medication	Digital Debridement	Amputation	Healing
1.	6	3	+	-	-	+
2.	9	5	++	-	-	+
3.	10	5	++	+	-	+
4.	7	4	+	-	-	+
5.	6	3	+	-	-	+
6.	8	4	+	-	+	+
7.	7	3	-	-	-	+
8.	7	4	+	-	-	+
9.	7	4	-	-	-	+
10.	9	5	+	-	+	-
11.	6	3	+	-	-	+
12.	8	4	+	-	-	-
13.	8	4	+	+	-	-
14.	6	2	-	-	-	+
15.	10	6	++	+	-	+
16.	9	5	+	-	-	+
17.	8	3	-	-	-	+
18.	8	4	+	-	-	+
19.	9	4	-	-	-	+
20.	10	5	++	+	+	-
21.	9	5	++	-	-	+
22.	6	3	+	-	-	+
23.	6	3	-	-	-	+
24.	7	4	-	-	-	+
25.	9	5	+	-	-	+
26.	10	5	++	-	+	-
27.	8	4	+	-	-	+
28.	7	4	-	-	-	-
29.	7	4	-	-	-	+
30.	6	3	-	-	+	+

DISCUSSION

Endovascular surgical management are the best management option for arterial occlusive disease[5]. However, arterial revascularization is nonfeasible due to the peripheral vascular lesions. In fact, patients with artery blockages in the midpalm and fingers that are not suitable for direct surgical repair can benefit significantly from sympathectomy, local tissue care, and vasodilating medications [6].

It is advised that sympathectomy be used in the treatment of peripheral ischemia [7]. The effectiveness of sympathectomy in treating gangrene and ulcers caused by occlusive arteriosclerosis of the lower and upper limb arteries has been demonstrated by several investigations in the literature [8]. Severe symptomatic arterial ischemia of the upper extremities is common and can be caused by a variety of factors, including arterial degenerative diseases (atherosclerosis), autoimmune diseases (scleroderma, thromboangitis obliterans and lupus erythematosus, dermatomyositis), trauma, iatrogenic, and others [9].

Intervention is mandatory when ischemia worsens and causes ongoing pain and tissue loss. Prior to the development of VATS, thoracic sympathectomy was carried out through an anterior cervical approach in selected group of patients due to its invasiveness. In these patients, medical treatment and local tissue care were typically insufficient, and sympathectomy can be an effective procedure to control pain and aid in ulcer healing [10]. VAT has significantly improved thoracic sympathectomy With minimal surgical stress , enhanced exposure and visualization of the anatomical components [11].

In our study, the results of intervention in terms of pain relief 24 (80%) patients, ulcer healing 24 (80%) patients, and amputation avoidance or postponement were good, with a minimal incidence of complications, even in patients at increased risk for surgery. After inadequate medical therapy, thoracoscopic sympathectomy proved effective in four patients who acquired severe acute ischemia as a result of illegal drug intra-arterial injection. In comparison with our study results, a study by **De Giacomo *et al.*** [6] on the function of thoracoscopic sympathectomy in upper limb ischemia was conducted on 20 patients at the University of Rome, Italy's thoracic and vascular surgery departments. Following the procedure, all patients showed substantial clinical improvement: Six

patients had improved lesions and a distinct delineation of necrotic sections, and five patients had fully healed ulcers and trophic lesions. Doppler ultrasonography demonstrated an increase in local flow and blood velocity. All patients had a decrease in pain [(6)].

Postoperative severity of pain score was 4.20 ± 1.54, and the improvement from preoperative values was statistically significant. Pain medication was suspended in 6 (40%) patients, reduced in 6 (40%) patient and unchanged in 3 (20%) patients who had two minor complications; 1 patient developed a pleural effusion after chest tube removal, which required one thoracentesis and 1 patient had an atrial fibrillation successfully treated by antiarrhythmic drugs with no mortality. Mean duration of postoperative chest drainage was 2.5 ± 0.4 days and mean post-operative hospital stay was 5.3 ± 0.5 days. Follow-up ranged 3 months, all patients demonstrated clinical benefit after operation [(6)]. Which is consistent with our study.

Another research, by **Coveliers *et al.*** [(12)] discovered that the immediate postoperative favorable impact was documented in 92% of Primary Raynaud disease (PRD) patients and 89% of secondary Raynaud phenomenon (SRP). The long-term positive impact was 58% for PRD and 89% for SRP. 95% of ulcers were healed or improved. Lastly, the information that is now available indicates that thoracic sympathectomy can be used to treat severe PRD and SRP, however it works better for SRP patients than for PRD patients. Thoracic sympathectomy may optimize tissue preservation or avoid amputation in cases of digital ulceration [(12)].

Our study demostrated that Raynaud's syndrome and distal ischemia, both caused by artery blockage, ameliorate dramatically following thoracic sympathectomy. In terms of pain relief, ulcer healing, and necrosis demarcation, increasing nutritional blood supply to ischemic regions appears to be far more important than an increase in overall blood flow. In most of cases, thoracoscopic sympathectomy is regarded as the final measure to avoid severe amputation and limb loss.

CONCLUSION

Thoracoscopic sympathectomy demonstrated effective symptom management and maximal limb preservation in patients with severe distal ischemia of the upper limb extremities. We recommend the intervention to be used as a primary modality in the treatment of these disorders since it is safe, minimally invasive, with low risk of complications.

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