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Case Report
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Periarterial Digital Sympathectomy for Severe Ischaemia of Raynaud`S

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Abstract

Objective: The aim of the present study was to evaluate the results of periarterial digital sympathectomy in cases of severe ischaemia of digits manifesting as digital ulceration and ischemic pain refractory to medical treatments.

Methods: We reviewed all digital sympathectomise performed at our vascular unit between 2006-2014. Demographics and outcomes were analyzed along with review of literature.

Results: Eleven patients representing 48 digits underwent periarterial digital sympathectomy for severe ischaemia. Rest pain was resolved in all patient but in 2 patients recurrence occurred in cold environment. Digital ulceration was healed completely in 92.8% (13/14). There were no major complications of the surgery.

Conclusion: Our study findings demonstrate that digital artery sympathectomy is an effective technique for diminution of pain, healing of ulcers and preservations of the digits in patients with chronic digital ischemia. However we accept that multicentric prospective studies with standardized inclusion criteria, timing for intervention and consistent follow up should be performed to evaluate the efficacy and safety of digital sympathectomy before recommending the surgery to all cases of chronic digital ischaemia.

Keywords: Digital sympathectomy; Raynaud`s Phenomenon; Ischaemia; Ulceration

Introduction

Digital ischemia in upper and lower extremity, with ulceration and gangrene can be a manifestation of Raynaud's phenomenon (RP). It is a difficult and frustrating problem to solve. The early manifestation of RP may be in form of cold intolerance, ischemic pain and numbness; and in severe cases manifested as ulceration and gangrene. The patients are usually referred to the vascular surgeons when they have already developed refractory ulcers and necrosis of finger and toes. The current conservative treatment includes pharmacological agents (calcium channel blockers and prostaglandins); behavioural modifications (smoking cessation, avoidance of cold exposure and use of gloves) and biofeedback therapies [1]. Although many pharmacological, behavioural and surgical treatments have been reported, there is still no cure or gold standard therapy.

RP is excessively reduced blood flow in response to cold and emotional stress with manifestation of discoloured fingers and toes. This was named after French Physician Maurice Raynaud (1834-1881) who defined the first case in 1862 as episodic, symmetric, acral vasospasm characterized by pallor, cyanosis, suffusion, and a sense of fullness or tautness, which may be painful [2]. RP is classified as primary (Raynaud`s disease - cause unknown) and secondary (Raynaud`s syndrome - identifiable cause). It is unusual to develop digital ulcers in primary RP but in secondary RP repeated episodes of spasms can cause pitted scars and fingertip ulcers.

In severe cases of RP medical treatment is ineffective and this may lead to partial or complete loss of digit. In cases refractory to medical treatment, surgical options in the form of open cervical sympathectomy, endoscopic thoracic sympathectomy (ETS) and digital sympathectomy has been used with varying results. Cervical sympathectomy has been used with either poor long term results, as preganglionic sectioning does not remove all the sympathetic stimulations to the hand or unpleasant side effects such as post operative compensatory hyperhidrosis. Both open and ETS have high rate of initial relief but higher rates of recurrence [3]. Digital sympathectomy may be the only salvage procedure to prevent amputation in cases refractory to medical treatment.

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Table 1: Demographic and clinical features.

Characteristic	N = 11
Female	7 (63.6%)
Age in years (Mean/Range)	55.6 (37-76)
Race Caucasian	11 (100%)
Smoker	5 (45.4%)
Primary RP	7 (63.6%)
Secondary RP	4 (36.3%)
Digital ulcers	4 (36.3%)

Table 2: Medications treatment used before sympathectomy.

Nifedepine	10 (90.9%)
Amlodipine	2(18.1%)
Diltiazem	1 (9%)
Phosphodiesterase inhibitors	7(63.6%)
Aspirin	7 (63.6%)
Statins	7 (63.6%)
Naftidrofuryl	1 (9%)

The aim of the present study was to evaluate the results of digital sympathectomy in cases of severe ischaemia of digits manifesting as digital ulceration and ischemic pain refractory to medical treatments.

Materials and Methods

A retrospective analysis of all digital sympathectomies performed in our vascular unit between 2006-2014 was done. Eleven patients (7 females & 4 males) representing 48 affected digits (42 fingers and 6 toes) underwent digital sympathectomy for severe ischaemia. Patient ages ranged from 37 to 76 years. All patients were Caucasian. Five of the patients were heavy smokers (one of them had digital ulcers). Digital ulcers were present in 11 digits. Preoperative pain was present in all patients. All patients presented with cold intolerance, numbness and worsening ischemic pain and had proximal vessel disease excluded by arterial duplex scan and were refractory to medical treatments. A written informed consent was given by all the patients. Institutional review board approval was not needed as it was a retrospective review. (Table 1) shows patient demographics.

The aetiology of the digital ischemia was 7 primary RP and 4 secondary RP (3 secondary to scleroderma and 1 vibration white finger). Diagnosis of RP was made after a detailed history and examination. All patients had full blood count, antinuclear antibodies and ESR. We did not do any thermography tests. Out of the 7 primary RP patients, 2 had an unusual presentation with finger tip ulcerations which is not a typical presentation of primary RP, no secondary cause for this presentation was found. All 3 patients with scleroderma were referred by rheumatologists, diagnosed with limited cutaneous systemic sclerosis and were found to be positive for autoantibodies including antinuclear antibodies and anticentromere antibodies. The patient with vibration white finger was a 51 year old male with severe vasospasm and pain affecting the left hand for more than 15 years related to his vibration machinery job and was not responding to any medical treatment.

Preoperative conservative treatment included pharmacological agents, such as calcium channel blockers, prostaglandins, and behavioural modifications such as cessation of smoking, avoidance of caffeinated drinks, and avoidance of cold exposure and use of gloves. (Table 2) shows the different medications used pre operatively. Patients were also evaluated for capillary refill, skin integrity, and the presence or absence of ulcers or gangrenous areas and peripheral pulses. All patients had proximal vessel duplex scans which did not showed any occlusion or stenosis in proximal vessels. Hand held Doppler scans showed triphasic signals which excluded digital artery occlusion. Individual patient presentations are shown in (Table 3).

Parameters of interest included the postoperative resolution/ improvement of pain, ulcer healing and postoperative complications.

Surgical Technique of Digital Sympathectomy

All the procedures were done under general anaesthesia. Perioperative antibiotic prophylaxis was administrated in all cases. For digital sympathectomy in hand, a zigzag incision was made from the distal palmer crease to web area. Using loupe magnification we identified the common digital arteries and its bifurcation to proper digital arteries. After identifying the vessels we stripped the adventitia circumferentially from common digital arteries to proximal part of both proper digital arteries of the affected digits. The length of adventitia stripping was about 2 cms. Another incision was made in the anatomical snuff box for access to the dorsal branch of the radial artery and 2 cms circumferential stripping of radial artery was done. Vessel patency was assessed, as no occluded segments were detected, vascular reconstruction and vein grafting were not required.

For digital sympathectomy in foot a vertical incisions was made over the pre operative mark site in the first web space and another in the mid-medial border of foot (Figure 1 and 2). In the web spaces, dorsal metatarsal artery and it`s bifurcation into dorsal digital arteries were identified, in the medial border of the foot medial plantar artery identified (Figure 3 and 4). Intra operative Doppler was used to confirm the arteries. Two cm circumferential stripping was performed.

Post operatively the temperature and colour of digits were observed, we did not use any vasodilator or therapeutic heparin post

Figure 1: Preoperative surface markings.

Figure 2: Preoperative surface markings.

Table 3: Individual patient Details: Preoperative Presentation**.**

Patient	Aetiology	Age /Sex	Digits	Colour	Pain	Ulcer/Gangrenous Area
1	Secondary RP (Vibration White Finger)	51/M	Thumb	Pale	+	-
			IF	Pale	+	-
			MF	Pale	+	-
			RF	Pale	+	-
			LF	Pale	+	-
2	Primary RP	67/M	IF	Cyanosis	+	Fingertip
			MF	Cyanosis	+	Fingertip
			RF	Cyanosis	+	-
3	Secondary RP Scleroderma	54/F	Thumb(L)	Cyanosis	+	Thumb tip
			IF(L)	Cyanosis	+	-
			MF(L)	Cyanosis	+	-
			RF(L)	Cyanosis	+	-
			LF(L)	Cyanosis	+	-
			Thumb(R)	Cyanosis	+	-
			IF(R)	Cyanosis	+	-
			MF(R)	Cyanosis	+	-
			RF(R)	Cyanosis	+	-
			LF(R)	Cyanosis	+	-
4	Secondary RP Scleroderma	37/F	Thumb(L)	Cyanosis	+	Thumb tip
			IF (L)	Cyanosis	+	Fingertip
			MF(L)	Cyanosis	+	Fingertip
			RF(L)	Cyanosis	+	Fingertip
			LF (L)	Cyanosis	+	-
			Thumb(R)	Cyanosis	+	-
			IF(R)	Cyanosis	+	-
			MF(R)	Cyanosis	+	-
			RF(R)	Cyanosis	+	-
			LF(R)	Cyanosis	+	-
			Great Toe (R)	Cyanosis	+	Toe tip
			Great Toe (L)	Cyanosis	+	Toe tip
5	Primary RP	60/M	LF	Cyanosis	+	-
6	Primary RP	55/F	IF	Cyanosis	+	-
			MF	Cyanosis	+	-
7	Primary RP	43/F	Great Toe	Cyanosis	+	-
			2nd Toe	Cyanosis	+	-
8	Primary RP	57/F	Great Toe	Cyanosis	+	Toe tip
			2nd Toe	Cyanosis	+	Toe tip
9	Primary RP	60/F	RF	Cyanosis	+	-
10	Secondary RP	76/F	Thumb	Cyanosis	+	-
			IF	Cyanosis	+	-
			MF	Cyanosis	+	-
			RF	Cyanosis	+	-
			LF	Cyanosis	+	-
11	Primary RP	52/M	Thumb	Cyanosis	+	-
			IF	Cyanosis	+	-
			MF	Cyanosis	+	-
			RF	Cyanosis	+	-
			LF	Cyanosis	+	-

IF: Index Finger; MF: Middle Finger; RF Ring Finger, LF: Little Finger; (R): Right; (L): Left; RP: Raynaud`s Phenomenon

Figure 3: shows the medial plantar artery and stripping of the adventitia.

Figure 4: Identification of dorsal metatarsal & Digital arteries.

operatively.

Results

In our study 11 patients underwent digital sympathectomies representing 48 digits (42 hand digits & 6 toes). Rest pain was resolved in all the patients except in two patients where pain returned in cold environment. Ulcerations and gangrenous areas were healed completely in 92.8% (13/14). However recurrent ulcer formation in 2 digits needed digital amputation after 6 months and 1 year respectively. There were no major complications of the surgery except 8 digital paresthesia; 6 resolved and 2 are under surveillance. The duration of follow up ranged from 6-72 months (median follow up of 24 months). Except 1 all patients who were smokers stopped smoking

Table 4: Results following Digital Sympathectomy.

Patient	Follow up	Digits	Colour	Pain	Ulcer/ Progressive Gangrenous Area
1	6 mths	Thumb	Pink	-	-
		IF	Pink	-	-
		MF	Pink	-	-
		RF	Pink	-	-
		LF	Pink	-	-
2	6 mths	IF	Pink	-	Healed 2mths
		MF	Pink	-	Healed 2mths
		RF	Pink	-	-
3	5 years	Thumb	Pink	-	Healed 3mths
		IF(L)	Pink	-	-
		MF(L)	Pink	-	-
		RF(L)	Pink	-	-
		LF(L)	Pink	-	-
		Thumb(R)	Pink	-	-
		IF(R)	Pink	-	-
		MF(R)	Pink	-	-
		RF(R)	Pink	-	-
		LF(R)	Pink	-	-
4	6 years	Thumb(L)	Pink	-	Healed 3mths
		IF (L)	Pink	-	Healed 3mths
		MF(L)	Pink	-	Healed 3mths
		RF(L)	Pink	-	Healed 3mths
		LF (L)	Pink	-	-
		Thumb(R)	Pink	-	-
		IF(R)	Pink	-	-
		MF(R)	Pink	-	-
		RF(R)	Pink	-	-
		LF(R)	Pink	-	-
		Great Toe (R)	Pink	-	Healed 3mths
		Great Toe (L)	Pink	-	Healed 3mths
5	1 year	LF	Cyanosis	+	-
6	3 years	IF	Cyanosis in tip	-	-
		MF	Cyanosis in tip	-	-
7	3 years	Great Toe	Pink	-	-
		2nd Toe	Pink	-	-
8	3 years	Great Toe	Cyanosis	+ only in cold	Healed initially f/b amputation after 6mth
		2nd Toe	Cyanosis	+ only in cold	Healed initially f/b amputation after 1year
9	2 years	RF	Pink	-	-
10	2 years	Thumb	Pink	-	-
		IF	Pink	-	-
		MF	Pink	-	-
		RF	Pink	-	-
		LF	Pink	-	-
11	2 years	Thumb	Pink	-	-
		IF	Pink	-	-
		MF	Pink	-	-
		RF	Pink	-	-
		LF	Pink	-	-

during the follow up period. The details of post operative outcomes are shown in (Table 4). (Figure 5) shows preoperative photograph of the great toe with ulcer. Figure 6 shows three month postoperative photograph showing complete ulcer healing.

Discussion

Patients suffering from severe form of RP may develop critical digital ischemia, with ulceration and gangrene at the fingertips. Although medical treatment with calcium channel blockers and other vasodilators is now widely used in this disease, it is unsuccessful in many cases and digits are at risk needing amputation. Surgical interventions to prevent amputation include cervicothoracic sympathectomy, ETS, digital sympathectomy and microvascular constructions with or without vein graft. Literature search has shown spinal cord stimulation to help refractory cases of digital ischaemia, but it`s effectiveness is limited and associated with complications such as infection, bleeding, dural puncture as well as high cost of treatment [4].

Sympathectomy either open or endoscopic is an invasive procedure, most patients have initial improvement in symptoms of RP but a relapse almost occurs after a period of six months [5]. Thune et al. [6] did a retrospective study of patients treated for RP by thoracoscopic sympathectomy and concluded that ETS side effects are frequent, excellent immediate effects and one third achieve a long term effect.

Flatt in 1980 [7] first reported successful digital artery sympathectomy for the treatment of Raynaud's phenomenon. He stripped the adventitia from the common digital arteries and separated the digital nerves from these vessels for a length of 3-4 mm. He advocated that sympathectomy was more effective at more distal levels such as the proper digital artery than proximal levels [7]. Wilgis [8] has reported a modified technique with increased length of adventitial stripping of the proper digital artery or of the common digital artery from 4 mm to 2 cm. El-Gammal and Blair [9] advocated a more extensive approach by stripping the adventitia from the ulnar and radial arteries at the wrist. Koman et al. [10] found a

Figure 5: Preoperative photograph with ulcer.

Figure 6: 3 Month postoperative ulcer healing.

significant improvement in the response to cold stress testing without significant increase of the digital temperature after distal peripheral sympathectomy, including adventitial stripping of the radial and ulnar arteries, for a distance of 2 cm.

Mccall et al. [11] looked at digital sympathectomy as a salvage procedure for severe ischemia in Raynaud`s in 7 patients. Six of the 7 ulcers healed, and one patient needed amputation of a digit. A long term follow up study by Murata et al. [12] questions whether digital sympathectomy should be performed when the digit is ischemic rather than waiting for ulceration and gangrene. They followed up 7 patients with 39 digits with ischemia but no ulceration, digital sympathectomy was performed and patients were followed for over 10 years. All patients were symptom free [12]. A systemic review of the outcome of digital sympathectomy for treatment of chronic digital ischemia found out that 14% of all patients required amputation and 18% had ulcer recurrence [13]. Hotchkiss et al. [14] treated a total of 33 patients and 78 digits surgically with either distal sympathectomy or interposition vein graft or a combination of the two procedures. All 33 patients had eventual healing of ulcers without amputation, 8 patients required a bypass to obtain adequate blood supply distally.

Momeni et al. [15] did a retrospective analysis of 17 patients with scleroderma (26 hands), who underwent digital sympathectomy. Digital ulcers healed in all patients with only 2 patients needing amputation due to recurrence of ulcers. They concluded that peripheral sympathectomy is well tolerated by patients of scleroderma, and it is prudent to offer surgical treatment not as a last resort but rather earlier in the disease.

In our study adventitial stripping for a length of 2 cm of the involved arteries was sufficient to achieve adequate circulation to heal the ulcers both in upper and lower extremities. Our long-term results are similar to those of several previous works [11-14]. The goal is to offer these patients pain relief as well as improve blood flow to the digits and avoid amputation. For most of our patients reperfusion was established intraoperatively, suggesting that both sympathetic denervation and decompression of the ischemic vessels from the fibrotic adventitia are important. Our observations are similar to those of Yee, who has proposed this dual cause of vessel constriction [16]. The narrowing of the vessel lumen is often a combination of sympathetic activity and external compression caused by a thickened adventitia or contraction of the tissues surrounding the arteries. Perfusion of the hand is determined by a sufficient pressure gradient that is achieved by increasing the luminal diameter with sympathectomy and decompression. Thus, a high, increased pressure gradient in the arteries and enhanced collateral circulation via the cutaneous vessels may benefit the ischemic digits.

Although digital artery sympathectomy is effective in preventing amputation, it is technically demanding and is highly dependent on surgical skills. In most series, postoperative and intermediate follow-up has shown good clinical results. However, it is possible that after long time periods, periarterial fibrosis and digital ischemia may recur.

The limitations of the present study include its retrospective design, small number of patients as well as short variable lengths of follow up. The small number of patients with heterogenic etiology of ischaemia precludes a meaningful statistical correlation. One may criticize the fact that we did not perform preoperative angiogram as a part of the preoperative work up.

Although it has been over three decades since Flatt [7] introduced this procedure, it is surprising that surgery is still considered as a last resort option. Our study findings demonstrate that digital artery sympathectomy is an effective technique for diminution of pain, healing of ulcers and preservations of the digits in patients with chronic digital ischemia. However we accept that multicentric prospective studies with standardized inclusion criteria, timing for intervention and consistent follow up should be performed to evaluate the efficacy and safety of digital sympathectomy before recommending the surgery to all cases of chronic digital ischaemia.

Conclusion

Digital sympathectomy as a treatment modality for ischemic digits and toes have shown good outcome and it is a heroic salvage and not a futile exercise. We recommend this procedure to be carried out to salvage the digits in both extremities, in those patients who have disabling symptoms such as ischemic pain or ulceration and those who are refractory to medical therapy.

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