

A Study of Investigations and Management of Upper Limb Digital Gangrene

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Abstract:

Gangrene is defined as macroscopic death of tissues in situ with or without putrefaction. Digital gangrene of the upper limb is relatively rare in comparison with those of the lower limb. It may be most commonly due to ischemia (decreased blood supply). A large number of diseases can affect the arterial tree of upper limb. Upper extremity vascular reconstruction is much less common than the lower limb and it accounts for less than 5% of patients with upper limb ischemia. The good collateral around the elbow and shoulder explains the reason why most of the chronic occlusive diseases are asymptomatic. Upper extremity vascular diseases can be classified based on anatomic location or on the basis of etiology. Limb arterial tree are rare and may present with ischemia due to emboli and thrombosis.

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Introduction

Gangrene is defined as macroscopic death of tissues in situ with or without putrefaction. Digital gangrene of the upper limb is relatively rare in comparison with those of the lower limb. It may be most commonly due to ischemia (decreased blood supply).

A large number of diseases can affect the arterial tree of upper limb. Upper extremity vascular reconstruction is much less common than the lower limb and it accounts for less than 5% of patients with upper limb ischemia. The good collateral around the elbow and shoulder explains the reason why most of the chronic occlusive diseases are asymptomatic.

Upper extremity vascular diseases can be classified based on anatomic location or on the basis of etiology. Limb arterial tree are rare and may present with ischemia due to emboli and thrombosis [2].

Aims & Objectives of the Study

The purpose of this study was to review the various modalities of investigations and medical and surgical management and its outcome that are commonly employed for revascularization of ischemic upper limb complicated by upper limb digital gangrene.

Materials and Methods

Study Design: Prospective and interventional study

Duration: June 2019 to May 2021

Setting: Patients Visiting Tertiary care centre

Inclusion Criteria:

- Dry gangrene of digits resulting from Chronic arterial occlusion of upper limb
- Patients in the age group between 10 to 60 years

Exclusion Criteria:

- Wet gangrene
- Gangrene extending beyond digits.
- Gangrene resulting from Acute limb ischemia, Aortic Arch Lesions and Trauma and aneurysms
- Venous gangrene

Methodology

All 30 patients who were admitted with upper limb digital gangrene at Tertiary care centre were identified from prospectively maintained case sheets and hospital records. Patients were included based upon inclusion and exclusion criteria.

After Documentation of Clinical history, physical examination, all patients had undergone baseline blood investigations, antinuclear antibody profile, x ray cervical spine, duplex scan as initial primary screening radiological investigation and CT Angiography of upper limb arteries as definitive radiological investigation of choice. These investigations were done for all 30 patients. Based on the angiographic findings patients were treated by either surgery for revascularisation or treated conservatively with medical management.

Observations & Results

The total number of patients who presented with upper limb digital gangrene was 30. In this study of the 30 patients, 20 cases were female and 10 cases were males. This gives a male to female ratio of 1:2.

The predominant cause for upper limb digital gangrene is due to vasculitis which was present in 20 patients.

Table 1: Age Group Affected

Age Group	Number	Percentage
11-20	1	3.33%
21-30	8	26.67%
31-40	11	36.67%
41-50	8	26.67%
51-60	2	6.67%

In our study, the majority of patients belonged to 31-40 years of age, mean age of patients affected by upper limb digital gangrene is 36.

Table 2: Limb Affected

Upper limb involved	No. of Patients	Percentage
Right	8	26.67%
Left	7	23.33%
Bilateral	15	50%
Total	30	100%

In our study, out of 30 cases, most of the digital gangrene cases were involving both upper limbs which accounted for 15 cases(50%),rest of the 7 cases (23.33%) were involving left upper limb only and remaining 8 cases (26.67%) were involving right upper limb.

Table 3: Symptoms & Signs Associated With Upper Limb Digital Gangrene

Symptoms & Signs	No. of Patients	Percentage
Work Claudication	15	50%
Critical Limb ischemia	15	50%
Gangrene /Tissue loss	30	100%

In our study, all the patients 30 out of 30(100%) patients had gangrene affecting the digits,15 patients(50%) were having associated work claudication and another 15 patients(50%) having associated critical limb ischemia affecting one or both limbs.

Table 4: Vessels Involved

Artery	No. of patients	Percentage
Subclavian	4	13.33%
Axillary	2	6.67%
Brachial	6	20%
Radial	10	33.3%
Ulnar	8	26.67%

In the present series, radial artery is the most commonly involved vessel which accounts for 10(33.3%) cases; following that ulnar artery involved in 8(26.67%) cases, brachial artery involved in 6(20%) cases, subclavian artery involved in 4(13.33%) cases and least common axillary artery involved in 2(6.67%) cases.

Table 5: Causes

Causes	No. of Patients	Percentage
Vasculitis	20	66.67%
Atherosclerosis	7	23.33%
Thoracic Outlet Syndrome	3	10%

Investigations

X-Ray Cervical Spine: X-ray cervical spine both anterior and lateral views was done in all 30 cases to rule out cervical rib. In our study, cervical rib

was found in 3(10%) patients. In other trials of upper limb ischemia and digital gangrene, x-ray cervical spine was hardly done and had very few positive findings. In our study percentage incidence

of cervical rib causing digital gangrene is 10 % which is comparable to previous studies in which cervical rib was present in 9.67% cases.

Duplex Scan: In our study, all 30 out of 30 patients (100%) had undergone duplex scan as primary screening investigation as primary screening investigation, other studies shows less use of duplex scan.

CT Angiography: In our study All 30 patients (100%) were subjected to CT angiography of upper limb arteries as diagnostic radiological investigation of choice. Out of these 30 patients, 10 patients had undergone revascularization procedures after angiogram.

In comparison to other study less than 60% patients were diagnosed under CT angiography.

ANA Profile: In our study, out of 30 cases; 20(66.67%) cases were of vasculitis and all were detected positive for autoimmune antibodies and other 10(33.33%) cases were negative which included causes other than vasculitis.

Management: Out of 30 Patients with upper limb digital gangrene, 20(66.67%) patients were managed conservatively.

Bypass using grafts were performed in 2(6.67%) patients. out of them, 1 patient of subclavian occlusion undergone carotid axillary bypass with PTFE graft. 1 patient of axillary artery occlusion was undergone axillo-brachial bypass using reverse saphenous vein graft.

Thromboembolectomy was performed in 5(16.67%) patients; out of these 5 patients, transbrachial embolectomy was done in 4 patients, out of these 4,3 patients were having brachial artery thromboembolism and 1 have axillary thromboembolism, subclavian thrombectomy was carried out in 1 patient having subclavian artery thromboembolism. Cervical rib excision was done in 3(10%) patients having cervical rib causing digital gangrene.

Table 6:

	No. of Patients	Percentage in our Study
Operated for Revascularisation Procedure	10	33.33%
Conservative	20	66.67%
Total	30	100%

Table 7:

	No. of Patients	Percentage in our Study
Bypass (Carotid-axillary- 1, Axillobrachial bypass-1)	2	6.67%
Cervical rib Excision	3	10%
Thromboembolectomy (Subclavian – 1 ,brachial-4)	5	16.67%
Conservative	20	66.67%

Discussion

Age Group: In our study out of 30 cases, the majority of patients belong to 31-40 years of age; the mean age of our study is 36.17.

According to other studies 45-55 years of age group more likely affected.

Incidence: In our study out of 30 cases, 20 patients (66.67%) were females and 10 patients (33.33%) were males.

While in other studies males were 60% and females were 40% so that suggest no sex predominance.

In our study out of 30 cases, most of the digital gangrene cases were involving both upper limbs

which account-ed for 15 cases (50%), rest of the 7 cases (23.33%) were involving left upper limb only and 8 cases (26.67%) were involving right upper limb. In contrast to other studies most of the cases were involving only unilateral limb; most common limb involved is right upper limb.

Etiology: In our study out of 30 cases, Vasculitis is the most common cause for upper limb digital gangrene which constitutes about 20 cases (66.67%) of upper limb digital gangrene followed by atherosclerosis in 7 cases (23.33%) and followed by thoracic outlet syndrome, which accounts for 3 cases (10%).In comparison to other studies they show thrombo embolism was the most common cause followed by vasculitis, atherosclerosis.

Table 8: Post-Operative Complication

Complication	No. of patients	Percentage
Wound infection	2	20%
Graft Thrombus	1	10%
Amputation	4	40%
Without Complication	4	40%

The following table shows the postoperative complications in patients who underwent arterial reconstruction. Out of the patients operated by revascularization procedures (Total=10) , 2 (20%) developed wound infection, 1(10%) developed graft thrombosis followed by amputation, 3(30%) other patients required amputation and no complications noted in 4(40%) patients. Out of the patients managed conservatively (Total=20), 2(10%) patients required amputation.

Atherosclerotic occlusive disease: 7 patients are diagnosed with atherosclerosis. The mean age was 48 years(age group:41-60 years). Of which six were male and one female. The disease involved subclavian, axillary and brachial artery with partial to complete occlusion of the lumen and monophasic or no flow. One patient had undergone carotid-axillary bypass, one patient had undergone axillo-brachial bypass, four had brachial embolectomy, one had undergone subclavian thrombectomy. All the 7 patients had undergone revascularization procedures .Out of them, one with axillo-brachial bypass and one with brachial embolectomy were successfully revascularised and rest 5 eventually required amputations, with level of amputation being more distal than proposed level of amputation that would be without revascularization procedure. Thus revascularization procedures proved to be successful in salvaging limb. Patients with successful revascularization were followed up regularly.

Buerger's Disease: Two patients presented with upper limb digital gangrene due to thromboangitis obliterans which included one male and female in age group of 31-40 years with unilateral limb involvement. The disease involved brachial and radial artery with partial occlusion of lumen with monophasic flow. Both the patients were managed conservatively with steroids, immunosuppressants, antiplatelets, anticoagulants, statins and vasodilators. Both the patients had successful outcome with no further extension of blackening and need of amputation.

Vasculitis: Vasculitis group included patients with Raynaud's disease, SLE (Systemic Lupus Erythematosus), APLA(Antiphospholipid Antibody Syndrome), Systemic Sclerosis, Takayasu Arteritis and included 20 patients out of total 30 patients. Out of 20 patients with vasculitis, 5 patients had Raynaud's disease, all of them females within age group 21-50, presenting with blackening of digits in bilateral upper limbs. Radial artery was involved in all with partially occluded to normal lumen with monophasic to triphasic flow. All of them were treated conservatively with medications, and all had successful outcome. All were followed up regularly. 3 patients had Systemic Lupus Erythematosus with bilateral upper limb involvement. All were females in age group 21-40

years. The vessel involved was Radial and Ulnar with partially occluded to normal lumen with biphasic to triphasic flow.

All were managed with conservative means and had successful outcome. No progress of blackening was noted on regular follow up. 5 patients had APLA (Anti-phospholipid Antibody Syndrome), with all of them being females in age group 21-40 years, with bilateral upper limb involvement. The vessel involved was Radial and Ulnar with normal lumen with biphasic to triphasic flow. All were managed conservatively with drugs and had no extension of blackening or eventual need of amputation.

All were assessed on regular follow up.2 female patients had Systemic Sclerosis in age group 21-40 years with bilateral upper limb involvement. The vessel involved was Ulnar with normal lumen with biphasic flow. All were managed conservatively and followed up regularly with successful outcome. 3 patients had Takayasu arteritis with one male and two females in age group of 31-50 years with unilateral limb involvement.

The vessel involved was Radial and Ulnar with partially occluded to normal lumen with monophasic to biphasic flow. All were managed conservatively. One had successful outcome and two of them needed Ray's amputation and Below Elbow amputation respectively. The one managed conservatively was regularly followed up.

Thoracic Outlet Syndrome: Three patients had unilateral upper limb disease, including 1 female and 2 males, in age group of 21-40, had cervical rib in X-Ray and thus had thoracic outlet obstruction. Most of them 2 were on right side & 1 was having left side. The disease involved Subclavian artery with partial to complete occlusion of the lumen and monophasic or no flow. All were managed with cervical rib excision and had successful outcome after procedure. All were followed up regularly.

Conclusion

Though incidence is less, the upper limb critical ischemia and gangrene can result in severe functional impairment and disability. Progression of upper limb digital gangrene results in functional loss than compared to lower limb because of damage to collaterals hence early revascularization is essential. Duplex Scan, CT Angiography provides adequate information to plan for revascularization and obviates the need for Digital subtraction angiography which is invasive with more procedural complications. Vasculitis is the most common cause of upper limb digital gangrene which affects mostly middle age group (31-40 years) predominantly in females (66.67%) & can be effectively & successfully managed conservatively by medical treatment including steroids,

immunosuppressants, antiplatelets, anticoagulants, vasodilators and statins. Though it is uncommon entity detailed history taking, physical examination with prompt recognition of upper limb ischemia and gangrene, active approach to management in the form of Angiogram and Early Medical management and Early Revascularisation procedures are crucial in obtaining a good outcome and reducing the risk of late disabling effects. Majority of patients (66.67%) in this study presented with Vasculitis with bilateral upper limb involvement. Medical or conservative management with steroids, immunosuppressants, antiplatelets, anticoagulants and statins proved to be successful in preventing further disease spread and complications (66.67% managed conservatively in our study with eventual amputation in 10% of them). Uses of novel diagnostic imaging modalities and novel revascularization procedures decreases the severe functional disability and lowers the need of amputation and hence has significant impact on decreasing patient's morbidity. Revascularization procedures like Bypass, Embolectomy, Cervical rib excision was employed in 33.33% of patients and out of them 60% had successful outcome and 40% required amputation but reducing the level of amputation and ultimately results in saving of one or more functional joints, hence preventing functional disability and improving patient's lifestyle. Thus revascularization procedures are vital in management of upper limb vascular disorders and limb saving approach. The principle of revascularization is to preserve the limb if not possible then to save the joints and to preserve maximum stump length for effective fixing of prosthesis and therefore limiting the functional disability & deformity. Regular follow up forms an essential component of management, as other studies showed higher morbidity and mortality due to loss of follow-up, thus timely intervention plays a vital role.

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