



Overview on Causes and Management of Upper Extremity Ischemia- A Review

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Acute upper limb ischemia (AULI) occurs less often than acute lower limb ischemia, contributing for even less than 5% of all limb ischemia instances. It is known to be rare vascular emergency with serious long-term effects if not treated promptly. Timely detection and localization of the arterial occlusion are critical for effective revascularization and limb salvage. Surgical procedure, most

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commonly embolectomy, has become the standard of care for embolic or thrombotic AULI. Vascular repair is synonymous with morbidity and death, which can be avoided in some circumstances. Nonsurgical options such as endovascular procedures, thrombolytic agents, and anticoagulation therapy continue to advance, but their function in upper extremity ischemia remains unclear. In this Review, we discuss causes and management of acute upper extremity ischemia. The paper concluded that longer symptoms mean greater likelihood of functional sequelae. Surgical management is the most commonly used and best treatment. It is also possible that conservative management is being underreported. The prognosis of upper extremity ischemia is related to prompt and appropriate treatment and is predictable based on initial serum LDH levels.

Keywords: Acute upper limb ischemia; revascularization; management.

1. INTRODUCTION

Acute upper limb ischemia (AULI) occurs less often than acute lower limb ischemia, contributing for even less than 5% of all limb ischemia instances. It is known to be rare vascular emergency with serious long-term effects if not treated promptly [1-5]. According to clinical statistics, the annual burden of AULI is 1.3 cases per 100,000 patients, contributing for 2% to 18% of surgical operations for critical limb ischemia [6-7].

Upper extremity ischemia manifests differently depending on the severity of the underlying condition, and can be graded as large vessel disorder (acute or chronic arterial occlusive disease proximal to the wrist) whereas small vessel disease (chronic arterial occlusive disease distal to the wrist) [8]. Patients present with symptoms of persistent limb ischemia such as discomfort, a weak feeling in the arm, or ulceration. Because of the excellent collateral circulation in the upper limb, severe signs are uncommon. Clinical characteristics are similar to those of the lower limb, and the patient typically has around six hours from the start of symptoms to undergo limb-saving treatment [9].

Because of their well-developed collateral circulation, the shoulder and elbow are much more resilient of ischemia in a clinical setting, and ischemic signs are therefore more frequent below the elbow [10]. Thromboembolic disorder, trauma, or iatrogenic conditions are often the underlying causes of AULI. Patients also manifest with several chronic conditions, complicating disease control [11,12]. Because of the vast number of disease entities involving the small arteries of the upper extremity, the clinical diagnosis of upper extremity ischemia is much more challenging than that of lower extremity ischemia. The differential diagnosis necessitates a thorough clinical and radiological examination [8].

Timely detection and localization of the arterial occlusion are critical for effective revascularization and limb salvage. Surgical procedure, most commonly embolectomy, has become the standard of care for embolic or thrombotic AULI. Vascular repair is synonymous with morbidity and death, which can be avoided in some circumstances. Nonsurgical options such as endovascular procedures, thrombolytic agents, and anticoagulation therapy continue to advance, but their function in upper extremity ischemia remains unclear [13].

In this paper, we summarize current evidence regarding causes and updated management of acute upper limb ischemia.

Upper limb ischemia from arterial thromboembolism: Arterial thromboembolism causes acute ischemia of the affected limb, resulting in a vascular emergency that needs immediate diagnosis and care. Upper limb thromboembolism is around four times less common than lower limb thromboembolism in limb ischemia. Sudden occlusion of limb arteries may occur as a result of an acute embolic or thrombotic incident [14].

Acute embolism of upper limbs arteries: The majority of arterial emboli occur in the left heart or, less commonly, in other areas of the vascular bed and spread to the upper limb arteries, causing acute occlusion and ischemia. Thromboemboli are thrombus particles that form on the aortic wall's surface as a result of atherosclerotic plaque erosions or ulcerations. Atheroemboli, on the other hand, are formed by the fragmentation of the atherosclerotic plaque lipid center [15]. Thromboemboli are greater in size and typically indicate an acute occlusion of a medium to large location of the vascular bed. Atheroembolism, on the other hand, occurs predominantly as a "shower" of small emboli that induce gradual occlusion of small arteries. This

causes organ failure and inflammatory response, which is known as cholesterol embolization syndrome (CES) [16].

Acute thrombosis of upper limbs arteries: Atherosclerosis is a systemic disease that causes gradual lumen narrowing and, as a result, chronic limb ischemia. As thrombosis develops, it promotes collateral flow into the ischemic zone, contributing in a less serious clinical environment with acute ischemia. Atherosclerotic plaque may also form within the arteries of the upper limbs, causing acute thrombosis due to plaque degradation or ulceration [14].

Arterial embolism: The most common cause of acute upper extremity ischemia is thromboembolism, which accounts for 61% of cases [17,18]. It primarily impacts the elderly (74 and 78 years in one study). The most considered to be common etiologies are atrial fibrillation (51%) and valvular heart failure (6%), as well as isolated ischemic heart disease with left ventricular hypokinesia (4%).

Arterial access complication: The arterial access of arterial hemodynamic control or diagnostic or therapeutic arteriography can cause Acute Hand ischemia. Hand ischemia caused by radial artery access is a rare but serious complication [19]. The combination of active arterial occlusion and indirect peripheral vasoconstriction, along with the underlying cardiovascular dysfunction that required invasive control in the first place, often results in a significant magnitude of ischemia [20].

Acute arterial dissection: An acute aortic dissection (type A aortic dissection) may result in ischemia in the upper limbs as it crosses into the large arteries [21].

Arterial thoracic outlet syndrome: The rarest disorder in comparatively young, involved and otherwise stable people is arterial thoracic outlet disease (TOS). Subclavian artery compression inside the scalene triangle is the leading cause of arterial TOS at the level of the first rib. As a function of the compressions of the subclavian artery, mural thrombus and distal embolic cases arise in the upper limb [14]. TOS-related symptoms of upper-extremity ischemia usually result from distal aneurysm thromboemboli instead of progressive stenosis or thrombotic occlusion of a stenosis [8].

Trauma and iatrogenic causes: Trauma is not often recorded and iatrogenic causes. A

penetrating or brutal damage to the top limb may cause the top extremities to be damaged. Amputations in upper limbs are mostly due to complicated injuries in soft tissue, arteries, nerves and osseous fractures [22]. Their effects are very complex. Vascular trauma of the traumatic upper limb can also include transection, blunt avulsion, or the contusion of the brachial plexus or of individual upper limb nerves.

Dialysis access steal syndrome: The dialysis access stealing syndrome (DASS) is also known as hand ischemia access-related hand ischemia (ARHI), or dialysis-related access-induced ischemic syndrome (DAIIS), as a forearm or hand ischemia, after the formation of an arteriovenous (AV) entry for hemodialysis. Any 3% of the people are affected [8]. The most common cause of ischemic symptoms is a "steal syndrome." Extremity symptoms range from mild to severe (coolness, sensory abnormalities) (ischemic rest pain, ulceration, gangrene).

Autoimmune disease/arteritis: Digital artery occlusion causing finger ischemia in patients of up to 54% is attributed to an autoimmune disease, while this population patient is also very smoke-involving (68%) [23].

2. MANAGEMENT

In emergency departments, patients with AULI health indication have vascular personnel available for diagnosis and care 24 hours a day 365 days a year. Given AULI's high rates of amputation and death, 24 hours a day, seven days a week, vascular surgery, vascular and/or interventional therapy are needed. The therapeutic approach depends on form of occlusion (thrombus or embolus), position, type of pipeline (graft artery), class of Rutherford's, longevity of ischemia, probability and effects of co-morbidity and associated treatments [24]. The literary review agreed that the most widely practised and best-in-class treatment of AULI is surgical control (embolectomy). No trials using conventional anti-coagulation therapy, this is primarily for people considered inadequate for interventional care [25].

Nonsurgical Treatment: Endovascular procedures (e.g. percutaneous catheter embolectomy, catheter-directed thrombolysis and stents) and medicinal administration provide non-surgical solutions for AULI care (such as anticoagulation) [26].

Endovascular Techniques: The catheter based procedure is intended to restore blood to the endangers whilst practicable using a combination of reperfusion options using medicines, mechanical instruments or both [24].

Percutaneous Catheter Embolectomy: In 1963, intravascular balloon catheters able to remove arterial thrombo-emboli using a percutaneous method were introduced by Fogarty and al revolutionization in the management and use of acute arterial occlusion [27,28]. The most common and effective treatment for acute upper limb ischemia is Embolectomy using a fogarty catheter, which also remains the safest option for the removal of brachial embolism (26, 27).

Catheter-directed pharmacologic thrombolysis (CDT): Although its role in high-Extremity Revascularization becomes increasingly commonly recognised as the first-line therapy for acute low-limb ischemia, [29]. A new study [30] has highlighted its potential application for acute and chronic ischemia of the hand. CDT patients had lower procedurally associated disease and death rates compared with the surgical population, but had more hemorrhages. In 75–92% of patients with an occluded native vessel, stent and CDT, total or partial thrombus clearance with appropriate clinical outcome occurs [31]. In addition, AULI with a limb salvage score of 96.5 per cent has outstanding clinical performance. The distal ischemia will be allowed to "declare" by thrombolysis, avoiding potentially further tissue loss. These techniques would be better applied to distal occlusions which cannot readily infiltrate balloon or stent structures. In order to treat dialysis graft occlusion on upper extremities, mechanical thrombectomy devices were used, but they have not been used for occludes on the forearm or hand arteries [32].

Endovascular stents: There are restricted studies that report the use of AULI stents. Endovascular stents offer an alternative to operation for prevention of peripheral artery aneurysms, arteriovenous fistula and arterial perforations [33]. Stent grafts can be expandable or independently expanded by the balloon and can also be filled with drugs to increase vascular patentability [34]. Endovascular stents have only been used on solid arteries around the brachial artery to therapy dissections and aneurysms that cause upper limb ischemia [35].

Anticoagulation and Medical Therapy: The key treatments for AULI were pharmacologic and complementary approaches before the advent of catheters and stents. Two anticoagulants widely used are heparin and warfarin. Calcium blockers, inhibitors of phosphodiesterase, topical nitrates, and injections of botulinum toxins were frequently used to facilitate vasodilation and to mitigate vasospastic disease tissue damage at various efficacy levels [36,37]. In patients who are too ill for surgical / endovascular therapy or with mild effects that exacerbate or stabilise, it is usually recommended as a saving option. It also helps to inhibit the development of catheter-related clots and to delay the spread of emerging thromboses in combination with thrombolization [13]. Supportive treatment usually involves reduction of smoking, better heart production, hydration, warming and vasopressive avoidance.

3. SURGICAL TREATMENT

Revascularization technique: Surgery procedures widely used for upper limbs revascularization are thromboembolectomy, primary or non-patch-angioplasty arterial repair, and autologous or venous bypass-grafting [38]. For those with an endangered or nonviable limb or with a bypass with presumed infection or a sign of thrombolysis, open revascularization is advised. Moreover, surgical therapy is prescribed for people with ischemic symptoms for on two weeks [39]. Many of the operational procedures in ALUI are thrombectomy, using a catheter balloon (Fogarty), bypass operations and adjuncts such as endarterectomy, patch angioplastic and intra-operative thromboly. There are also expectations of a change in these techniques [24]. The procedure chosen is actually the thromboembolectomy of the balloon catheter, using the method Fogarty. This technique involves the use of a catheter, usually performed under local anaesthesia, in the precubital fossa of the elbow, of a transverse brachial arteriotomy and the treatment of thromboembolic fluid [1].

4. CONCLUSION

Acute upper Limb ischemia is a rare vascular emergency with serious long-term effects if not treated promptly. Many causes leading to acute upper limb ischemia include thromboembolic disorder, trauma, or iatrogenic conditions. Longer duration of symptoms is associated with a greater likelihood of functional sequelae.

Operative management is the most commonly used and best treatment. It is also possible that conservative management is underreported. The prognosis of upper limb ischemia is associated with prompt and proper treatment and can also be predicted by initial serum LDH levels. Future studies should scope difference between conservative and operative management and highlight outcomes and prognosis of acute upper extremity ischemia.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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