Surgical Treatment of Distal Ulnar Artery Aneurysm

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In the past 7 years, we have encountered six patients with finger ischemia as a result of digital artery occlusion associated with seven distal ulnar artery aneurysms. Our experience with the management of these patients forms the basis of this report. All patients were men, with a mean age of 29 years, and all experienced repetitive trauma to the involved upper extremity. Each patient presented with the acute onset of cool and painful digits, with no previous history of cold sensitivity or Raynaud's syndrome. None of the patients had any serologic or clinical evidence of autoimmune disease. Angiography revealed occlusion of the ulnar artery on the affected side in two patients and patent ulnar artery aneurysms in the remaining five patients. There was occlusion of multiple common and proper digital arteries in all patients. One patient with bilateral ulnar artery aneurysms underwent operative repair consisting of aneurysm excision and replacement with autogenous vein grafts from the lower extremity. All patients have improved symptoms, and the grafts remained patent over a mean follow-up of 24 months (range: 13 to 57 months). Based on these results, we recommend that excision and grafting be considered for patients with symptomatic patent ulnar artery aneurysms. Selected patients with thrombosed aneurysms with ongoing digital ischemia may also benefit from surgical intervention.

Available evidence indicates that about half of the patients presenting with symptomatic hand and finger ischemia have one or more of a variety of systemic disease processes, of which autoimmune diseases are the most frequent. Many of these patients have one of their manifestations occlusion of palmar and digital arteries. The remaining half of patients with digital ischemia have potentially correctable arterial obstruction proximal to the superficial palmar arch.

Ulnar artery aneurysms, with or without thrombosis, are an uncommon but well-recognized cause of digital ischemia, usually from digital artery embolization. The most common presenting complaint is the sudden onset of Raynaud's syndrome of the affected digits.

Patients frequently give a history of repeated hypothenar trauma, as is commonly seen in carpenters and mechanics who use this portion of their hand as a hammer. The repetitive trauma presumably causes intimal damage with aneurysm formation and thrombosis [1]. Neurologic symptoms from irritation of the adjacent ulnar nerve may be seen [2]. The clinical syndrome, including hand ischemia with repetitive blunt hypothenar trauma, has been identified [3-6] and was labeled the "hypothenar hammer syndrome" by Conn and co-workers [7].

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MATERIAL AND METHODS

Over the past two decades, the Division of Vascular Surgery at Oregon Health Sciences University has prospectively studied more than 1,000 patients with hand and finger ischemia. A number of routine tests were obtained on each patient including complete blood count, erythrocyte sedimentation rate, multi-chemical panel, anti-nuclear antibody, serum protein electrophoresis, rheumatoid factor, cold agglutinin, and hepatitis serology.

Each of these six patients underwent arteriography from the aortic arch to the fingertips, using the transfemoral Seldinger approach for selective axillary artery catheterization. Both upper extremities were studied to provide comparison. Magnification hand arteriograms were obtained before and after cold exposure and tolazoline challenge, as previously described [8]. A representative hand arteriogram appears in Figure 1, illustrating a distal ulnar artery aneurysm with embolization to digital arteries.

In each patient, the ulnar artery was exposed using a longitudinal incision from the wrist crease to the superficial palmar arch. The ulnar aneurysm was mobilized and excised. Autogenous vein was interposed in an end-to-end fashion. Vein grafts were obtained from the foot or from calf or ankle branches of the greater saphenous vein. The electromagnetic flow meter was used to confirm adequate
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Figure 1. Preoperative arteriogram illustrating the irregular lumen characteristically identified in patent distal ulnar artery aneurysms (large arrow). There is a poorly developed superficial palmar arch (medium arrow), and there is diffuse embolization of the proper digital arteries of the third, fourth, and fifth fingers, as well as the ulnar aspect of the second finger (small arrows).

Figure 2. Postoperative arteriogram of the repair of the aneurysm shown in Figure 1. A short segment of reversed vein graft is identified (arrow), extending from the hook of the hammate to the superficial palmar arch.

graft flow. Postoperative patency of the repairs was confirmed by repeat angiography or by duplex scanning (Figure 2).

RESULTS

All patients were men and had occupations or recreational activity that subjected the distal ulnar artery to trauma. There were two carpenters, a machinist, a boilermaker, an auto mechanic, and a student who had sustained a deep laceration to the involved hand 3 years before his acute occlusive event, which occurred while playing basketball. The mean age of this group was 29 years (range: 18 to 46 years). With the exception of the single patient who had a penetrating injury, all patients gave clear-cut histories of repetitive use of their hands as hammers. None of the patients had any previous symptoms of Raynaud's syndrome or of cold sensitivity.

All six patients presented with the acute onset of cool painful digits, which was unilateral and ulnar in distribution. Five patients had ischemia of the third, fourth, and fifth fingers, and one patient's ischemia was limited to the third digit. Four of the patients were nonsmokers, with no history of intravenous drug abuse in any of the patients.

Serologic and hematologic test results were normal in all six patients, with no additional clinical evidence of autoimmune disease. Photoplethysmography revealed dampened, occlusive arterial waveforms in the affected digits, with normal waveforms of the corresponding fingers in the contralateral hand. Finger blood pressure in the involved digits was lower than in the corresponding asymptomatic digits. Cold challenge revealed a positive digital hypothermic challenge test in only one patient. Three of the six patients had callus formation over the hypothenar eminence, which was not tender.

Arteriography showed occlusion of the ulnar artery on the affected side in two patients and five patent ulnar artery aneurysms with considerable intraluminal irregularity in the remaining four patients (one with bilateral
Figure 3. Intraoperative photographs of a typical fusiform ulnar artery aneurysm. The left panel shows the aneurysm in situ (white arrow) with the proximal end on the right. The upper right panel shows the excised aneurysmal segment. The bottom right panel illustrates the typical intraluminal irregularity of these aneurysms, with thrombus formation (black arrow).

aneurysms) (Figure 1). There were occlusions of multiple proper and common digital arteries that coincided with the symptoms of coolness and pain. One patient had occlusions localized to his symptomatic third finger, while the remaining five patients had multiple digital arterial occlusions of the third, fourth, and fifth fingers of the affected hand. One patient, a boilermaker, had bilateral ulnar artery aneurysms, although only one hand was initially symptomatic. Aneurysmal dilatation of the ulnar artery was found at operation in all patients. Five of the seven aneurysms contained visible thrombus (Figure 3), as seen at surgery. Flow measured in the grafts at the completion of the operations ranged from 50 to 90 mL/minute.

All patients had symptomatic improvement after operative intervention, and none had any tissue loss. There were no postoperative complications; all of the patients remain asymptomatic with patent grafts through a mean follow-up of 24 months, with a range of 1 to 57 months. The patients and their employers have been counseled to prevent further use of the palmar surface of the hand as a hammer.

COMMENTS

The superficial palmar branch of the ulnar artery is the major source of arterial inflow for the fingers of the ulnar portion of the hand. This vessel has variable continuity with the radial artery, usually by anastomosis with the radialis indicis or the princeps pollicis artery [9]. The superficial palmar arch is complete in approximately 80% of people [10].

As the ulnar artery passes through Guyon's canal with the ulnar nerve, both structures bifurcate. The ulnar artery passes in close proximity to the hook of the hamate bone, then divides into the deep and superficial palmar branches. The superficial branch courses superficial to the hypothenar muscles and proximal to the protective covering of the palmar aponeurosis. The superficial palmar arch is the terminal branch of the ulnar artery. It is this short segment of artery, proximal to the superficial palmar arch, that is prone to damage from acute and chronic trauma to the hypothenar eminence, since there is no soft tissue protection of this segment except for skin.

Thrombosis of the ulnar artery may occur following intimal damage caused by repetitive trauma [11]. Trauma may also cause medial injury, which may lead to aneurysm formation [12]. Digital arterial occlusions are commonly associated with this syndrome, secondary to distal embolization from patent aneurysms, thus producing symptoms of finger ischemia [13]. The source of the embolism is the thrombus that routinely forms inside the aneurysm, apparently in response to flow disturbances.

Fewer than 100 cases of ulnar artery aneurysm have been reported, the majority of which were related to repeated trauma [14]. Injury classically occurs in workers who use the hypothenar eminence of their hands as a hammer, with repeated traumas to the short segment of exposed ulnar artery proximal to the superficial palmar arch. Given the widespread nature of this practice, it seems clear that most ulnar artery aneurysms do not produce symptoms [15]. Digital ischemia results only from embolic occlusion of the common and proper digital arteries, or from segmental arterial thrombosis in patients without adequate hand collateral circulation [7,16]. Symptoms can occur with both patent and thrombosed ulnar artery aneurysms, although the excellent collateral supply of the hand assures that the majority of patients with acute ulnar artery occlusion will be asymptomatic.

Patients presenting with acute unilateral hand or finger ischemia should be questioned regarding occupational history. Repetitive hypothenar trauma should trigger a detailed evaluation of the distal circulation of the involved extremity. Routine serologic examinations are helpful in excluding autoimmune diseases that may present with similar symptoms. Noninvasive digital hemodynamic studies can aid in confirming and localizing digital artery
obstruction. Arteriography is essential to exclude the possibility of embolic events originating from the subclavian artery and to define the anatomy of the superficial palmar arch and the extent of embolic events in the digital arteries. We employ a pharmacologically assisted magnification technique [13] that routinely provides detailed arteriographic anatomy of the affected hands [8].

Therapeutic interventions for the hypothenar hammer syndrome have included observation alone, cervical sympathectomy, ligation alone, and excision with end-to-end anastomosis [7,12,16-20]. Regional thrombolytic therapy has been suggested for the treatment of ulnar artery aneurysms complicated by distal emboli [14]. Few cases have previously been reported of aneurysm excision and autogenous interposition graft repair for distal ulnar artery aneurysm, and there is little information regarding follow-up [21].

This report describes successful treatment of seven distal ulnar artery aneurysms with excision of the diseased artery and repair with interposition vein grafts. The venous segments from the foot and ankle chosen for these grafts closely approximate the size of the native arteries removed and provide adequate flow, as documented by intraoperative flow measurements. The grafts have proven durable in our experience. The bypass grafts restored arterial flow to an incomplete superficial palmar arch in the two patients with symptomatic occlusion of the ulnar artery, resulting in immediate improvement in symptoms. The procedure removed a source of emboli while maintaining inflow to the superficial palmar arch in the remaining five patients with patent ulnar artery aneurysms. It is currently our opinion that patients with symptomatic thrombosis with digital ischemia should undergo bypass grafting to restore digital perfusion. Patent ulnar artery aneurysms that have embolized to the digital arteries should be excised to prevent future embolization. It seems reasonable, although clearly not always necessary, to place an interposition graft at the same time. Similarly, we believe that a patent asymptomatic ulnar aneurysm should be excised because of embolic potential. An asymptomatic thrombosed aneurysm, or thrombosed ulnar artery segment discovered incidentally, appears to require no treatment.

Regardless of treatment, gangrene and amputation are uncommon outcomes of this syndrome [7]. Due to the disabling nature of the symptoms of hypothenar hammer syndrome and its interference with the performance of occupational tasks, it is our opinion, and that of others [12,16], that surgical treatment is justified for symptomatic digital ischemia caused by ulnar artery aneurysm.

REFERENCES