Chronic thrombosis in the descending genicular artery during harvest of a medial femoral condyle corticocancellous flap: a case report

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Since its original description [10], the vascularized medial femoral condyle (MFC) corticoperiosteal free flap has gained increased popularity due to its versatility and reliability. While the flap was initially proposed for small bone nonunions [5], its favorable characteristics and osteogenic potential have led to its application in long bone nonunions [4]. The advantages of this flap include minimal donor side morbidity, a long noncritical vascular pedicle, and relatively reliable anatomy [7]. To date, there have been few disadvantages or complications of this flap reported in the literature. Those cited include persistent nonunion, seroma formation, knee pain, flap failure, and femur fracture [1, 3]. We present the case of a chronic arterial thrombosis in the descending genicular artery (DGA) identified during the harvest of a MFC corticocancellous flap for a humeral nonunion.

Case Report

A 60-year-old female with a past medical history significant for hypertension, diabetes mellitus, gastroesophageal reflux, and asthma presented to the office with a right proximal humeral shaft nonunion following a fall approximately

1 year earlier. Her fracture had failed to unite after two previous operative procedures. Initially, her comminuted proximal humeral shaft fracture was treated with a humeral intramedullary nail. After 6 months without evidence of healing, she underwent a second attempted treatment using a locking proximal humerus plate with allograft augmentation. Three months after her latest surgery, she developed severe right arm pain. Radiographs revealed a broken proximal humerus plate with displacement at the nonunion site (Fig. 1). Subsequently, she was referred to our center for humeral nonunion repair.

Fig. 1 Oblique radiograph of the humerus demonstrating hardware failure and persistent nonunion

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On presentation, the patient had obvious instability at the nonunion site. She was afebrile, and her wounds were well-healed with no signs of infection. The patient was taken to the operating room for hardware removal, necrotic bone debridement, and placement of an antibiotic-impregnated cement spacer (Fig. 2). No purulence was identified, and cultures ultimately revealed no growth. The patient was subsequently scheduled for revision open reduction and internal fixation (ORIF) of the humeral nonunion with a vascularized MFC corticocancellous flap.

At the time of surgery, the antibiotic spacer was removed, and the humeral nonunion site was prepared for the flap. During harvest of the vascularized MFC, a 2.5-cm thrombosis of the DGA was encountered at the level of the medial femoral condylar flare in the distal periosteal branches of the pedicle. As this had not been previously encountered and was both unexpected and unexplained, the thrombosed segment was resected and sent to pathology. Salvage of the pedicle was attempted by reconstructing the shortened pedicle with a primary end-to-end anastomosis under the operative microscope. After anastomosis, a biphasic Doppler signal was obtained on the flap periosteum for a short period of time before recurrent thrombosis. Due to the vessel's small diameter, poor quality, and previous thrombus, further attempts at revision were deemed unworthy of pursuit. Preoperatively, consent had not been obtained for use of other donor sites. Therefore, an intraoperative decision was made

to proceed with humeral shortening and compression plating with nonvascularized cancellous bone graft from the harvested MFC and its donor site.

Per pathology, the vessel demonstrated chronic thrombosis (Fig. 3). Radiographs revealed humeral union at 3 months postoperatively. At 1 year postoperatively, she denied pain and had continued excellent radiographic alignment and union (Fig. 4a, b).

Discussion

Vascularized MFC corticoperiosteal and corticocancellous flaps have been used to treat nonunions in both small and long bones, respectively [1, 3–5, 10]. We report a case of chronic thrombosis of the DGA as a potential complication of this flap.

The MFC free flap has been applied to recalcitrant long bone nonunions of the clavicle, humerus, radius, ulna, and tibia. The pedicle to the flap can be either the DGA or the superomedial genicular artery. This anatomy is well defined and quite reliable. As such, preoperative angiography has not been routinely performed for MFC free flaps.

Historically, the use of donor leg angiography has been most widely debated in the use of vascularized free fibula flaps. Some authors recommend preoperative imaging only in cases of abnormal clinical examination (including use of a handheld pencil Doppler) or previous lower extremity trauma [8, 9]. In a large prospective study of 120 patients in which 230 angiograms were performed, lower extremity vascular abnormalities were identified in only 3 % of the cases [9]. On the basis of these findings, routine preoperative imaging with its inherent costs and risks to the patient has been deemed by some to be unjustified. However, given the potential devastating complications of lower extremity ischemia, the cost associated with free flap failure, and the potential for anatomic variability, other authors recommend the use of preoperative imaging before free flap harvest [6].

Fig. 2 Oblique radiograph of the humerus following humeral debridement and antibiotic-impregnated spacer placement

Fig. 3 Vessel pathology at $\times 100$ magnification demonstrating a thrombosed fibrin-filled artery

Fig. 4 **a** Anteroposterior and **b** lateral radiograph of the humerus 1 year postoperatively demonstrating union

To avoid the potential risks associated with the contrast administration and radiation, high-resolution magnetic resonance angiography has been offered as a reasonable and safe alternative to digital subtraction angiography [6]. Fortunately, even with the sacrifice of a large caliber vessel, ischemic complications to the lower extremity are rare.

Harvest of a noncritical vessel, such as the DGA, would not be expected to cause lower extremity ischemia. However, free flap failure in the setting of vascular disease is a very realistic prospect when harvesting small- to medium-sized vessels. It is well known that atherosclerosis is a systemic disease that can affect both the donor and recipient vessels. The disease decreases vessel elasticity and narrows the patency of the vascular lumen ultimately resulting in complete occlusion. In fact, atherosclerosis has been previously cited as a factor precluding transfer of a radial artery free flap [2].

In our case, the patient had several risk factors for atherosclerosis and peripheral vascular disease. Because thrombosis of the DGA has not been previously reported, preoperative imaging was not performed. Furthermore, a conditional surgical alternative was not discussed with the patient preoperatively. After unsuccessful attempts to salvage the pedicle, a difficult intraoperative decision was required. Potential operative alternatives included humeral ORIF with corticocancellous autograft bridging the intercalary defect, humeral shortening ORIF with cancellous

autograft without intercalary defect, humeral ORIF with vascularized bone graft from a different donor site (for which there was no consent), and aborting surgery (and discarding the MFC autograft) to have a discussion with the patient regarding future alternatives. We elected to proceed with humeral shortening and compression plating with nonvascularized cancellous bone graft from the MFC harvest site. This fortunately resulted in union.

This case serves to highlight chronic thrombosis of the DGA as a potential complication of vascularized MFC flaps. The true incidence of this pathology remains unknown. To avoid a similar intraoperative scenario, several prophylactic measures could be considered. Preoperatively, conditional surgical alternatives should be discussed with patients in the event that a DGA thrombosis is encountered. Next, in high-risk patients such as those with a known history of severe atherosclerosis, peripheral vascular disease, prior vascular surgery, or failed microsurgical reconstruction, preoperative imaging could be considered. Finally, prior to harvesting the MFC autograft, careful examination of the pedicle for signs of thrombosis in the periosteal branches of the DGA should routinely be performed.

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Conflict of Interest The authors declare that they have no conflict of interest.

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