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Surgical Case Report

Microvascular free tissue transfer in the setting of COVID-19 associated coagulopathy: A case report

Amer H. Nassar, Amy M. Maselli, A. Samandar Dowlatshahi

1. Introduction

In December 2019, as the novel coronavirus COVID-19 (SARS-CoV-2) began to spread across the globe, accounts surfaced of a Covid-19-associated coagulopathy (CAC) [1]. While the pathophysiology remains poorly understood, viral infection triggers a hypercoagulable state in certain individuals, with autopsy findings notable for deep vein thrombosis in 58% and pulmonary emboli in 33% of patients [2].

In the absence of long-term data regarding CAC, it remains unclear whether free tissue transfer can be safely performed in patients with COVID-19 infection. We describe our recent experience with a COVID-19 positive patient whose associated coagulopathy resulted in free flap loss and need for further operations.

2. Case presentation

A healthy 37-year-old male underwent open reduction and internal fixation of closed right tibial pilon and left Sanders grade IV calcaneus fractures. Although asymptomatic, he tested positive for COVID-19 infection on routine preoperative screening with a nasopharyngeal swab and continued to test positive on a weekly basis for two months. Three weeks post-operatively, the patient developed peri-incisional skin necrosis followed by wound dehiscence and hardware infection (Fig. 1). The Orthoplastic Surgery service was consulted to assist with soft tissue coverage.

Routine preoperative workup including bilateral lower extremity duplex and CT angiography was unremarkable with no evidence of deep venous thrombosis and normal arterial anatomy. We proceeded first with reconstruction of the larger right tibial wound using a 15 × 7 cm fasciocutaneous anterolateral thigh flap supplied by a single, robust perforator with 25 cm/s flow on duplex ultrasonography. The posterior tibial artery and its venae comitantes were used as the recipient vessels. Per our institutional protocol, the flap was flushed with heparinized saline solution immediately following ischemia. The microvascular anastomosis was performed as a hand-sewn end-to-end anastomosis and the two venous anastomoses were completed using vascular couplers (Synovis MCA, Birmingham, AL). At the conclusion of the operation, the flap had strong arterial and venous signals, as well as a stable real-time continuous tissue oximetry reading (ViOptix Inc., California, USA). Postoperatively, the patient received aspirin 162 mg daily and enoxaparin 30 mg subcutaneously twice a day, per our institutional protocol.

On postoperative day three, the patient had an acute drop in his continuous tissue oximetry reading with loss of arterial signals on handheld doppler. The flap was noted to appear pale with delayed capillary refill. The patient was taken emergently to the operating room for re-exploration after receiving a loading dose of 5000 units of intravenous heparin followed by a continuous infusion. A D-dimer drawn prior to anticoagulation was elevated at 509 ng/mL. Intraoperatively, the pedicle was found to have compressible veins.
but no evidence of arterial flow. The arterial anastomosis was taken down and thrombectomies were performed with a 2mm Fogarty balloon catheter, confirming the presence of small, scattered thrombi throughout the arterial pedicle and the posterior tibial artery. The flap was excluded from the systemic circulation and infused with tissue plasminogen activator. The proximal posterior tibial artery initially had strong pulsatile flow, however this tapered off over several minutes with repeat thrombectomy yielding additional small, pale clots. A segment of artery was resected and the remainder infused with papaverine, producing sustained pulsatile flow. The flap was then flushed with heparinized saline and re-anastomosed. Following reperfusion, arterial doppler signal and tissue oximetry were both of good quality. The flap was loosely re-inset and the patient returned to our microsurgical unit with a continuous heparin infusion and had no reported flap-related complications [8].

On postoperative day 4, the flap again lost an arterial signal and was ultimately abandoned. The patient then underwent two additional lower extremity free flaps while therapeutically anticoagulated: a gracilis muscle flap to the left calcaneal defect and a rectus abdominis flap to the right ankle. Both flaps were anastomosed in an end-to-side fashion (Fig. 2), and both were successful.

3. Discussion

The clinical and operative findings in this patient suggest that a systemic hypercoagulable state likely contributed to the failure of his initial free tissue transfer. Although the patient never displayed symptoms of COVID-19 infection, his lack of any other risk factors on history and laboratory testing, except for an abnormal TEG suggest that this coagulopathy was possibly related to COVID-19.

Proposed mechanisms of hypercoagulability in COVID-19 patients have included a dysregulated inflammatory state leading to activation of the coagulation cascade and development of disseminated intravascular coagulation (DIC) [4,5]. Additionally, a COVID-19 vasculitis has been described involving immune complex deposition primarily within the tunica media and producing a fibrinoid necrosis similar to that observed in HIV infection [6]. Few free tissue transfers in COVID-19 positive patients have been described in the literature with none involving lower extremity reconstruction. Benmoussa et al. reported a late postoperative failure of a free fibula and thoracodorsal artery perforator flap for head and neck reconstruction in an undiagnosed COVID-positive patient [7] while Lhuaire et al. described a case of recurrent intraoperative arterial anastomotic thrombosis during free latissimus dorsi flap reconstruction of a hip defect. In this case, the patient was treated with a continuous heparin infusion and had no reported flap-related complications [8].

There are currently no clear consensus guidelines regarding the treatment and prevention of CAC in surgical patients, raising the question of whether reconstruction should be delayed in COVID-19 patients. For cases in which reconstruction cannot safely be delayed, we recommend the use of muscle flaps due to their low vascular resistance and resulting higher blood volume compared with fasciocutaneous flaps [9]. In fact, the senior author routinely uses muscle flaps in all hypercoagulable patients. Additionally, we prefer an end-to-side arterial anastomosis in these cases as division of the vessel for an end-to-end anastomosis can lead to shortening and spasm, especially in young patients.

With regards to anticoagulation, the International Society on Thrombosis and Haemostasis (ISTH) interim guidelines recommends the use of prophylactic low molecular weight heparin in patients with severe COVID-19 infection [5,11]. With guidance from our hematology service, we have modified our practice to include 6 weeks of full/therapeutic anticoagulation in addition to our usual 3 months of antiplatelet therapy. We also suggest obtaining a TEG study intraoperatively to help guide the decision regarding postoperative anticoagulation if there is any doubt as to the presence and severity of CAD, with the understanding that heparin can affect the TEG results and lower the Coagulation Index making the test appear normal. If despite heparin the patient still has a high abnormal TEG result, as in our patient, then this indicates a significant hypercoagulable state, and suggests a potential need for postoperative systemic anticoagulation.

Ethical approval

Was not necessary for this study.

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Author contribution

Dr Dowlatshahi: Conceptualization; methodology; project administration; writing- review and editing. Dr Nassar: Conceptualization'
writing – original draft; methodology. Dr Maselli: writing – review and editing; supervision

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The Guarantor is the one or more people who accept full responsibility for the work and/or the conduct of the study, had access to the data, and controlled the decision to publish

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Written informed consent

Was obtained from the patient for publication of this case report and accompanying images.

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Conflict of interest statement

None.

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