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Irradiated Superficial Femoral Artery Rupture After Free Flap

A Case Report and Review of the Literature

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Abstract: Radical oncologic resection can result in large soft tissue defects with exposure of underlying vessels. Unless immediately covered with viable soft tissue, these vessels are vulnerable to desiccation from air exposure and mechanical trauma. Local radiation treatment also contributes to a decline in vessel wall strength. We present an index case of a patient with prolonged exposure of her femoral bone and superficial femoral artery after an initial failed reconstruction of a soft tissue sarcoma resection defect. We provided coverage using a free latissimus dorsi muscle flap. Two weeks after the initial free flap operation, the patient was readmitted to emergency service with profuse bleeding from beneath the free flap. Intraoperative inspection revealed a 2-cm defect of the irradiated superficial femoral artery. The defect was repaired with cryopreserved human arterial graft, and the flap was reset. This case highlights the importance of immediate coverage of soft tissue defects after oncologic resection. If any vessels are left exposed, they should be closely inspected before a delayed flap coverage to rule out future sources of bleeding that may jeopardize the outcomes of an otherwise successful free flap operation.

Key Words: femoral artery blowout, latissimus dorsi muscle flap, radiotherapy, soft tissue sarcoma

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Radiotherapy consistently leads to vessel injury. Most often, it is the microvasculature that is affected, resulting in rupture or thrombosis of the capillaries. Medium-sized vessels usually show neointimal proliferation, fibrinoid necrosis, thrombosis, or acute arteritis. Damage to large vessels, as in this case, is less common and is more likely to occur in arteries than veins. The typical lesions include neointimal proliferation, atheromatosis, and thrombosis. Large arteries rarely rupture because of radiation injury.[1] However, if the vessels are exposed to air for prolonged periods in addition to radiotherapy, this can lead to desiccation, infection, and potential mechanical trauma, all of which may cause the vessel to be more prone to rupture.[2–4]

We report a case of delayed major arterial bleeding after latissimus dorsi musculocutaneous free flap reconstruction of a posterior thigh defect. We attributed this delayed rupture to vessel injury from desiccation, long-term negative-pressure wound therapy, and prior irradiation.

CASE REPORT

The patient was a 63-year-old woman with a history of undifferentiated pleomorphic sarcoma of the right posterior thigh. A wide resection was performed including killing of the right sciatic nerve. The resultant defect was reconstructed with a gracilis transposition flap. Her postoperative course was complicated by a wound infection that required operative debridement by the plastic surgery team on postoperative day 35 with wound vacuum assisted closure device placement. A trial of conservative management with negative-pressure wound therapy was planned, and the patient was discharged. Unfortunately, she was readmitted to the hospital approximately a month and a half later with evidence of recurrent wound infection, including a foul smell, further devitalized tissue, and a computed tomographic (CT) scan showing stranding with foci of air. She was taken to the operating room by the surgical oncology team, where a more extensive debridement was performed. Because of concern for deep space infection, the overlying muscle was divided to allow for wider drainage. After division of the muscle, the femoral artery was partially visualized in the wound bed. Wound care was changed to wet- to-dry dressings, and the plastic surgery team was alerted to the intraoperative findings.

Before definitive coverage 2 weeks later, CT scans were obtained, which confirmed local control of the disease with no positive lymph nodes or distant metastasis. Considering the size of the defect and history of radiotherapy, we chose to reconstruct the defect with a latissimus dorsi free musculocutaneous flap. A preoperative CT angiogram was performed to evaluate the recipient vessels around the defect. Because all vessels were patent and of appropriate caliber, we decided to use the superficial femoral artery (SFA) and the superficial femoral vein distal to the wound as recipient vessels. A photograph just before free flap reconstruction, 3 months after her initial resection, shows a right posterior thigh wound measuring approximately 30 × 12 cm with exposed femoral vessels and femur in the wound bed (Fig. 1).

In the operating room, the patient was placed in the right lateral decubitus position, allowing the use of a 2-team approach. The latissimus dorsi musculocutaneous flap was elevated on the basis of the thoracodorsal artery and vein, with a skin paddle measuring 4 × 15 cm. The flap was then transferred to the right posterior thigh. The thoracodorsal artery was anastomosed end to end to a branch of the SFA, and the thoracodorsal vein was anastomosed end to side to the superficial femoral vein using 9-0 nylon sutures in an interrupted fashion. The flap was then inset into

FIGURE 1. The picture shows the defect before latissimus dorsi free flap coverage. White arrowheads mark the trajectory of the femoral artery exposed at the wound base.

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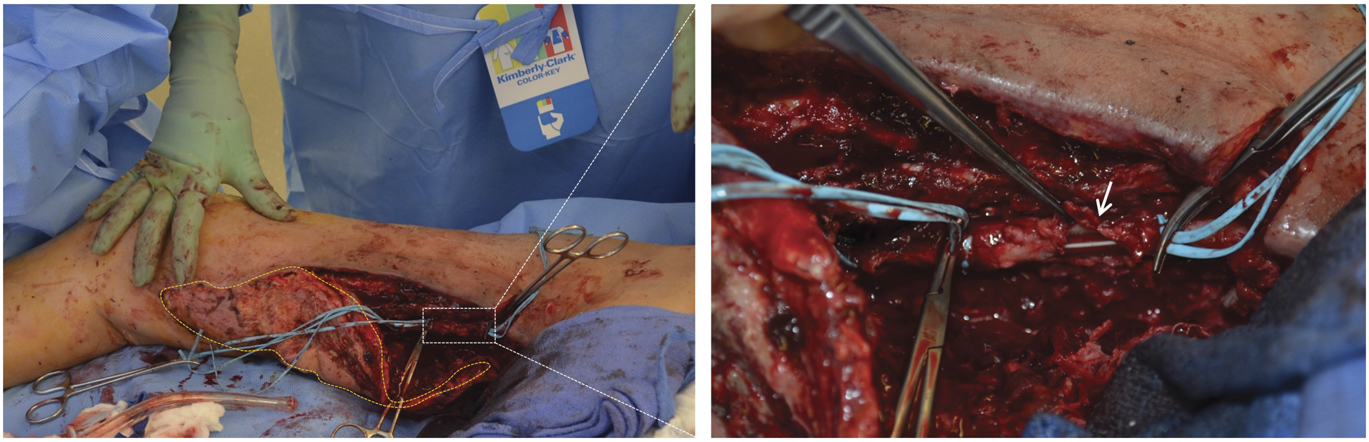


A B

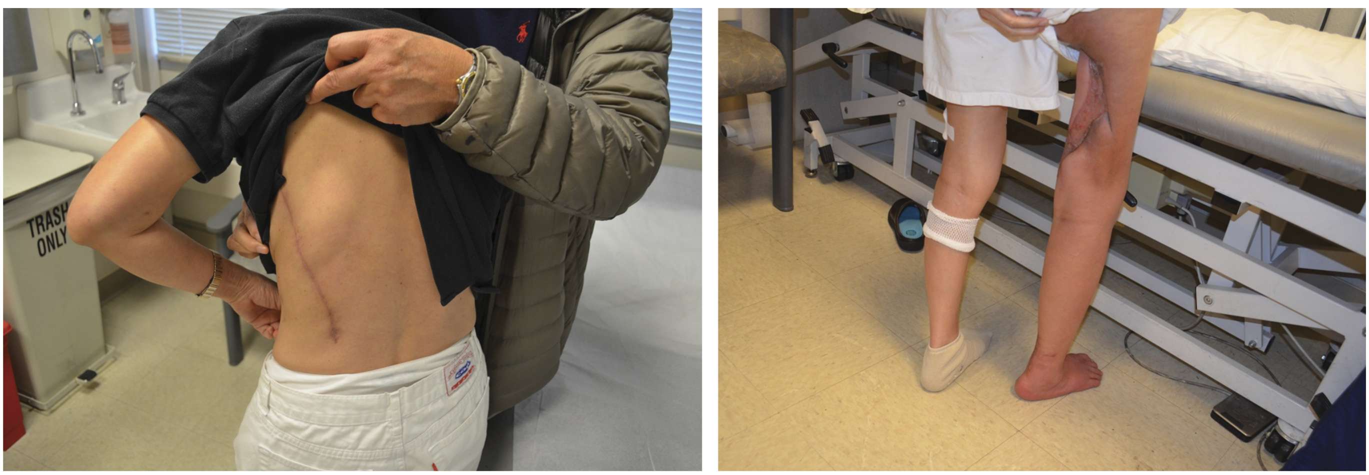
FIGURE 2. A, Intraoperative view of the defect after the rupture of the femoral artery. The yellow dashed line shows the borders of the latissimus dorsi free flap. The proximal part of the flap was re-elevated to expose the ruptured segment of the femoral artery. The white dashed rectangle marks the ruptured segment of the femoral artery. B, A close-up view of the rectangle in pane A. The white arrow marks the extent of the arterial wall rupture.

the defect and secured using interrupted 3-0 polyglycolic acid sutures. We were able to position the flap such that the anastomosis was underneath the skin paddle. A 20 × 40-cm skin graft was harvested from the left thigh and meshed in a 1:1 fashion to cover the latissimus dorsi muscle. The donor site was closed primarily.

The early postoperative follow-up of the patient was uneventful, and she was discharged from the hospital on postoperative day 10. The patient was partially weight bearing on her right leg at the time of discharge and ambulating with the help of a front-wheeled walker. However, 2 weeks after her discharge, we received a call from the patient's husband, stating that there was frank blood dripping from an old drain site that had stopped with direct pressure. An appointment was made for the following day, but later that night the patient was readmitted with profuse bleeding from the right posterior thigh. Bleeding was controlled with digital pressure, and the patient was taken emergently to the operating room. The proximal portion of the flap was re-elevated, and microsurgical clamps and vessel loops were placed proximally and distally on the SFA. Intraoperative inspection revealed a 2-cm tear on the medial arterial wall, proximal to the anastomosis (Fig. 2). The surrounding tissue was noted to have significant radiation arteritis. A polyvinyl chloride arterial shunt was placed, and the SFA was repaired using a cryopreserved human femoral popliteal artery graft. After the arterial repair, attention was turned back to the flap. The flap was noted to be edematous but with less than a 2-second capillary refill and brisk bleeding from the distal aspect of the flap. We therefore decided to reinset the flap. A suction drain was placed under the proximal portion of the flap. Distal-extremity pulses were noted at the conclusion of the operation. Postoperatively, the patient recovered well, with no further complications. She had excellent wound healing at her postoperative 6-month visit, with complete flap survival (Fig. 3). She was able to ambulate with a walker but continued to have baseline sensory deficits related to her primary oncologic resection.

LITERATURE REVIEW

A review of the literature was performed using PubMed and Google Scholar databases. The key words used for the literature search were *femoral artery*, *rupture*, and *radiation*. Cross-referencing of all



A B

FIGURE 3. A, The appearance of the donor site at the 6-month postoperative follow-up. B, The flap healed well 6 months after the operation. The patient could stand on the operated leg without support.

TABLE 1. Reported Cases of Femoral Artery Rupture After Radiotherapy

	Year	Journal	No. Patients	Disease	Time of Rp	Treatment
Pararajasingam et al[5]	2001	*Eur J Vasc Endovasc Surg*	1	Vulvar carcinoma	11 mo	ePTFE graft
Veraldi et al[6]	2009	*Chir Ital*	1	Liposarcoma of the spermatic cord	?	Extra-anatomic bypass

Rp, rupture; ePTFE, expanded polytetrafluoroethylene.

identified studies was made to ensure that no studies were missed. Results are summarized in Table 1.

DISCUSSION

Radiation-induced arteriopathy usually arises as a chronic condition many years after radiation therapy. However, it may rarely be an acute event leading to spontaneous rupture of the involved vessels. Spontaneous rupture usually affects the carotid artery after radiotherapy of the head and neck region and can occur within 4 to 32 weeks of radiotherapy. This is known as *carotid artery blowout syndrome*.[7–14] In a pooled analysis including 27 published articles and 1554 patients receiving high-dose radiotherapy to the head and neck region, the rate of carotid artery rupture was found to be 2.6% (41 patients).[15] There was a positive correlation between the rate of carotid artery rupture and dose and fractionation of the radiotherapy.[15]

Spontaneous rupture of the femoral artery is a very rare event, and only a few cases have been reported in the literature (Table 1). The first case was reported by Pararajasingam et al[5] in 2001. The patient was a 55-year-old woman who received radiotherapy to the groin for metastatic vulvar carcinoma. The underlying causes leading to arterial rupture and the management of the patient were similar to our case. The second case was reported by Veraldi et al[6] in 2009. In this case, spontaneous rupture of the left femoral superficial artery occurred after adjuvant radiotherapy for liposarcoma of the spermatic cord with multiple local recurrences.

In our case, the SFA rupture was most likely due to a combination of factors. The initial insult was irradiation, followed by a failed local muscle flap reconstruction. As a result, this already injured vessel spent months in a devitalized wound bed and 2 weeks frankly exposed. Desiccation and irradiation both lead to inflammation of the vessel wall and damage to the adventitial layer, rendering the artery more vulnerable to rupture.[2] Moreover, radical dissection must have further decreased the arterial integrity because of loss of surrounding muscle tissue, which is necessary for vessel support and stability.[2] The standard of care in microsurgical reconstruction of oncologic defects is to use vessels outside the field of irradiation as the recipient vessels.[16,17] However, as demonstrated in this case, the entire course of the vessel must be evaluated for injury because an anastomosis outside the field of injury does not preclude vessel complications occurring within the irradiated field.

Although most microsurgical complications occur within the first 24 to 36 hours after surgery, vascular complications after lower extremity reconstruction have additionally been reported during the initial mobilization period after prolonged bed rest.[18] This patient was at high risk for vessel rupture during the initial mobilization period because of

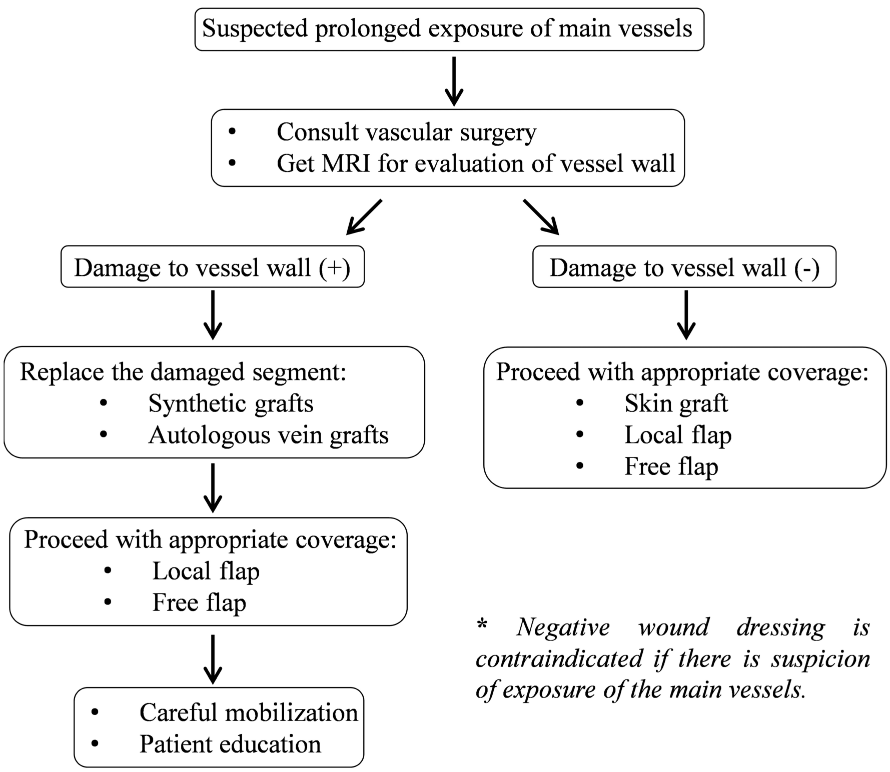


FIGURE 4. Algorithm for management of patients with suspected prolonged exposure of main vessels. MRI indicates magnetic resonance imaging.

her history of radiation and vessel exposure. The perioperative management of patients with a history of radiotherapy and long-term exposure of major vessels should be different from that of patients undergoing standard lower extremity reconstruction. Patients should be made aware of the risk for delayed bleeding and arterial rupture as part of their informed consent for surgery. Educating patients will also promote prompt seeking of medical attention and intervention in case a sentinel bleed or true arterial rupture does occur.

The overall fatality rate of major artery blowout is high (76% in case of carotid artery ruptures), which further emphasizes the importance of the prevention of this complication.[15] Ideally, all oncologic defects should be reconstructed with an immediate 1-stage operation, which allows surgeons to work with healthier recipient tissue and provides early coverage of large vessels.[19,20] In this case, we were able to salvage the extremity of the patient whose only other alternative was a morbid amputation. Because of severe radiation arteritis, consideration of vascular reconstruction should have occurred before her initial reconstruction. In addition, when primary reconstruction failed, earlier definitive coverage of the new defect would have minimized her risk for vessel rupture. Although we believe that it was reasonable to attempt a short course of negative-pressure wound therapy after her initial operation for infection, the patient was not reevaluated by a plastic surgery provider until after her subsequent readmission. Better outpatient follow-up would have shown lack of healing, and reconstruction could have taken place much earlier. By the time of the latissimus dorsi flap coverage, it is likely that the vessel damage was irreversible. On the basis of our experience in this case and the literature review, we propose an algorithm for treating patients with suspected prolonged exposure of main vessels (Fig. 4).

In conclusion, surgeons must closely monitor cases with inadequate vessel coverage. It is necessary to perform a careful inspection of any involved vessels and repair damaged segments before definitive coverage. Such an approach would eliminate the significant morbidity and mortality associated with acute arterial rupture.

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