

Case Report

A case series on iatrogenic vascular injuries: Challenges and outcomes

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Abstract

Iatrogenic vascular injuries are rare but serious complications of orthopedic and vascular procedures, often resulting in acute limb ischemia and potential limb loss if not promptly recognized and managed. These injuries can occur due to surgical fixation, instrumentation, or intraoperative vessel trauma. Early diagnosis and appropriate surgical interventions are crucial for optimizing patient outcomes. This case series presents four patients who had iatrogenic vascular injuries following screw fixation, varicose vein stripping, K-wire fixation, and external fixator application. All patients were managed at a tertiary trauma center. Diagnosis was confirmed using computed tomography (CT) angiography, which revealed arterial occlusion or injury. Surgical intervention included thrombectomy, arterial repair, and reconstruction using vein grafts or primary anastomosis. Fasciotomy was performed in three cases to prevent compartment syndrome. All patients demonstrated restored limb perfusion and were discharged with favorable motor and sensorial functional outcomes. This series highlights the importance of early recognition, advanced imaging, and prompt surgical management in ensuring successful limb salvage following iatrogenic vascular trauma. A multidisciplinary approach, including trauma and vascular surgeons, is essential for improving outcomes and minimizing complications.

Keywords: Vascular system injuries, iatrogenic diseases, postoperative complications, fracture

INTRODUCTION

Iatrogenic vascular injury refers to injuries that occur during diagnostic or therapeutic procedures. Such injuries may occur during surgical or interventional procedures and intravascular catheter placements, often leading to significant complications if not promptly recognized and managed. The consequences include hemorrhage, vascular occlusion, ischemia, and in severe cases can lead to limb loss [1]. The term was first coined by William Hunter, who noted such injuries caused by barbers performing therapeutic phlebotomy [1]. The increasing complexity of medical procedures and advancements

in technology, has increased the risk of such injuries. Understanding the mechanisms, risk factors, and potential outcomes of iatrogenic vascular injuries is crucial for healthcare professionals to minimize complications and improve patient safety. A thorough analysis of case series can provide valuable insights into the prevalence, management strategies, and outcomes associated with these injuries, ultimately contributing to enhanced clinical practices and training [2]. Our case series highlights the clinical presentations, diagnostic challenges, and management strategies of four patients who sustained iatrogenic vascular injuries during surgical interventions.

CITATION

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CASE REPORT

Case 1

A 22-year-old male presented with a history of screw fixation operated for right medial condyle of femur and tibial plateau fracture followed by severe bleeding from screw site leading to exploration and ligation of bleeding vessel by operating surgeon. Patient was referred to our centre for further management. Patient reached our centre 4 hours after referral. On arrival, a comprehensive vascular examination was performed upon presentation, including inspection of limb color, temperature, capillary refill, and palpation of distal pulses. Clinical examination findings of right lower limb were as follows- cold and clammy, peripheral pulses were not palpable and sutured wound of size 12cm over medial aspect of right thigh. Right knee joint X-ray showed cancellous screw fixation of the comminuted fracture of medial condyle of femur and tibial plateau fracture (Figure 1A). Right lower limb computed tomography (CT) angiography revealed lack of contrast opacification in 5cm segment of superficial femoral artery in the mid thigh (Figure 1B). Patient was shifted to operating room after obtaining informed consent. Sutured wound was opened and incision extended upwards. Layer by layer dissection was performed to expose the superficial femoral artery and vein which were found to be ligated with suture (Figure 2A). Proximal and distal vascular control was obtained using vessel loops before proceeding with arteriotomy. The ligature was removed, and an arteriotomy was performed. Thrombectomy was carried out both proximally and distally to restore arterial blood flow (Figure 2B). Calf fasciotomy was performed as a precautionary measure to prevent compartment syndrome. On post-operative day 5, split thickness skin graft was performed over fasciotomy site. The patient was discharged on postoperative day 15 and he is on regular follow-up.

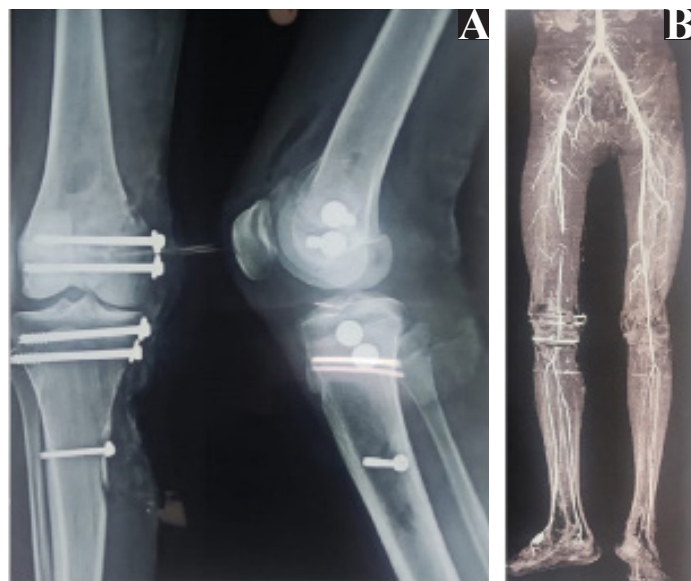


Figure 1. A. X-ray of the right knee joint showing cancellous screw fixation for fracture of medial condyle of femur and tibial plateau fracture; **B.** CT angiography of the right lower limb showing a lack of contrast opacification in segment of the superficial femoral artery in the mid thigh

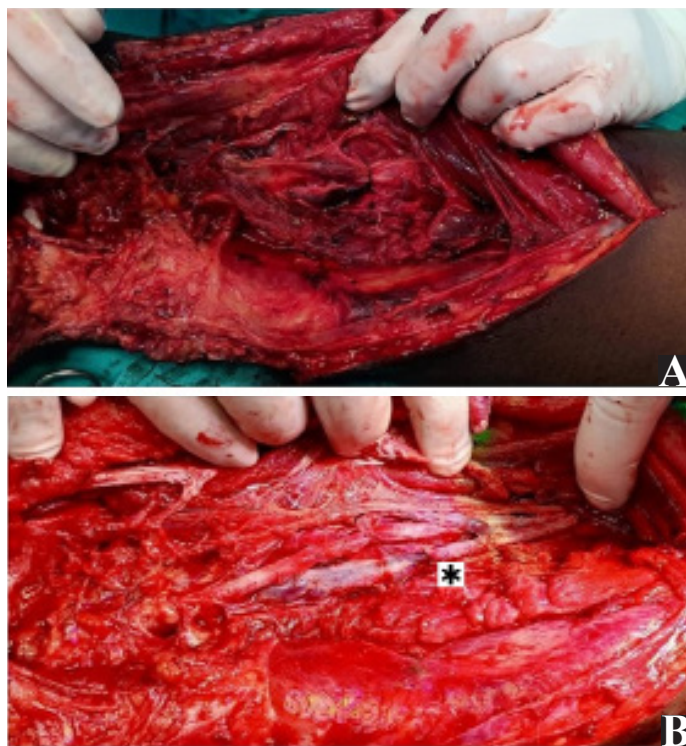


Figure 2. A. Intraoperative image showing the ligated superficial femoral artery and vein exposed during surgical exploration; **B.** Intraoperative image demonstrating post-arteriotomy arterial repair with closure of the arteriotomy site, following thrombectomy and flow restoration in the superficial femoral artery

Case 2

A 30-year-old male patient presented to emergency department following vascular injury sustained during varicose vein stripping surgery. Wound closure and pressure dressing was performed by operating surgeon. Patient was referred to our centre for further management and arrived 12 hours after referral. On arrival, a comprehensive vascular examination was performed upon presentation, including inspection of limb color, temperature, capillary refill, and palpation of distal pulses. Clinical examination revealed a sutured wound of size 10 cm over medial aspect of upper left thigh and 4cm over left medial malleolus region. Limb was cold and clammy. Distal pulses were not palpable and saturation in all toes were nil. CT angiography of left lower limb showed lack of contrast opacification in 15cm segment of left superficial femoral artery (Figure 3A). Patient was shifted to operating room after obtaining informed consent. Sutured wound was opened and incision extended downwards. Layer by layer dissection was performed to expose injury site. Proximal and distal vascular control was obtained using vessel loops before proceeding with arteriotomy. 5cm of superficial femoral artery was contused (Figure 3B). Contused segment was

excised and mechanical thrombectomy was performed both proximally and distally, and the removed thrombus measured approximately 10 centimeters in length (Figure 4A,B). (Figure 4B). A reversed saphenous vein graft interposition technique was used to reconstruct the arterial defect. Anastomosis was performed using 6-0 prolene continuous suturing. Pulses were restored. Wound was closed in layers. Post-operative period was unremarkable and patient was discharged on the 10th post-operative day.

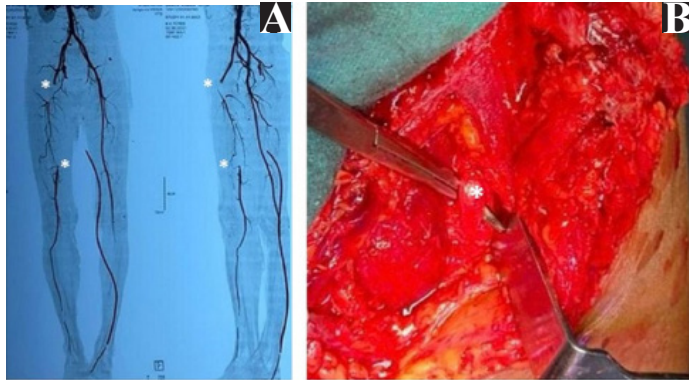


Figure 3. A. CT angiography of the left lower limb showing segment of the superficial femoral artery with lack of contrast opacification; B. Intraoperative image showing contused superficial femoral artery exposed during surgical exploration

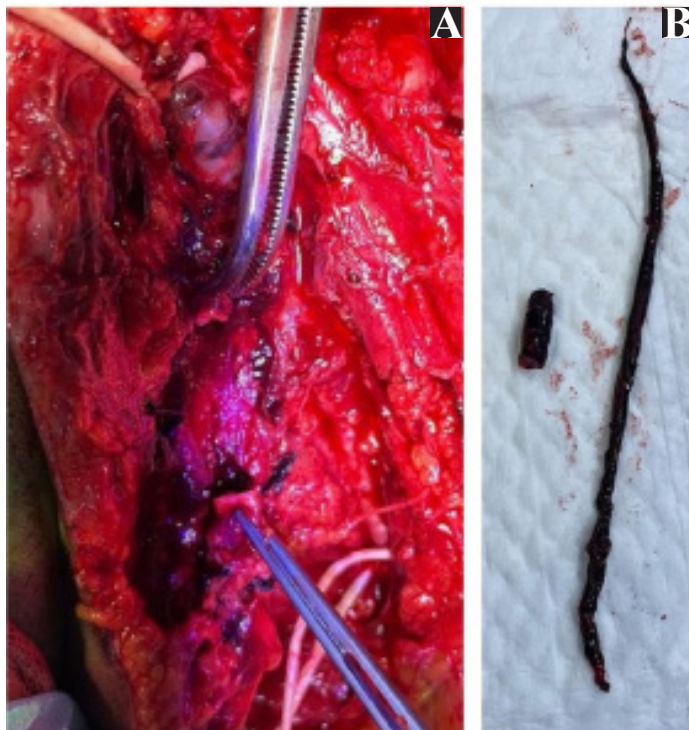


Figure 4. A. Intraoperative image showing proximal and distal end of artery after excision of contused segment; B. Removed thrombus measuring approximately 10 cm in length

Case 3

A 12-year-old male patient presented with a history of vascular injury followed by K-wire fixation for right supracondylar humerus fracture at a peripheral centre. On postoperative day 2, the operating surgeon noted that the left upper limb was cold and clammy, and the patient was referred to our center for further management. Patient reached 2 hours after referral. On arrival, a comprehensive vascular examination was performed upon presentation, including inspection of limb color, temperature, capillary refill, and palpation of distal pulses. Clinical examination revealed the presence of two K-wire tips protruding over the left elbow. Left arm with elbow joint X-ray revealed K wire insitu (Figure 5A). CT angiography revealed 10cm cut off of left brachial artery with distal reconstruction (Figure 5B). Patient was shifted to operating room after obtaining informed consent. Incision was given along the course of brachial artery, layer by layer dissection was performed and artery was exposed. Proximal and distal vascular control was obtained using vessel loops before proceeding with arteriotomy. A 5 cm segment of the brachial artery was found to be contused, with the tip of the K-wire located in close proximity to the injured site (Figure 6). The K-wire was subsequently removed. Contused segment was excised and thrombectomy was performed proximally and distally. Reversed saphenous vein graft from the right thigh was interposed for arterial repair. Anastomosis was performed using 6-0 prolene continuous suturing. Pulses were restored. Forearm fasciotomy was performed, and a split-thickness skin graft was placed over the raw area on postoperative day 5. Post-operative period was unremarkable. The patient was discharged on postoperative day 15 and is on regular follow-up.

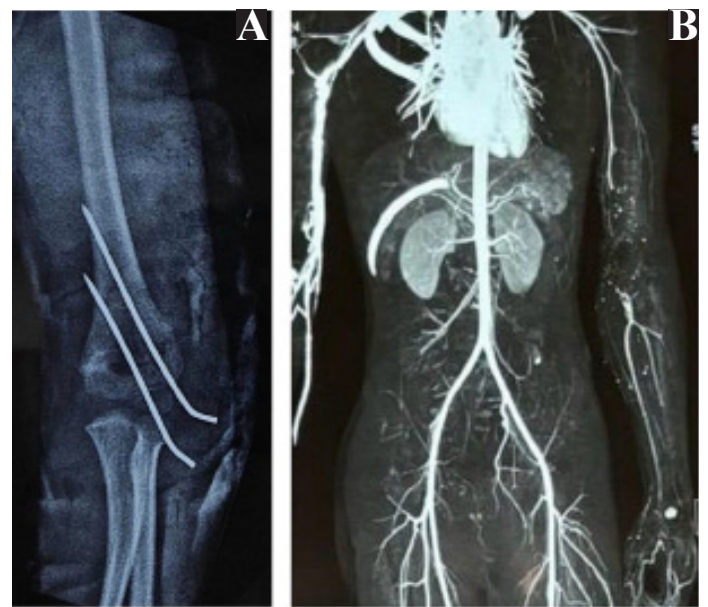


Figure 5. A. X-ray of the left arm with elbow showing K-wire fixation in situ for supracondylar humerus fracture; B. CT angiography showing cut-off of the left brachial artery



Figure 6. Intraoperative image showing K-wire tip which injured brachial artery

Case 4

A 32-year-old male patient presented with a history of vascular injury following external fixator application for an open shaft fracture of the left femur at a peripheral center. On postoperative day 2, the operating surgeon noted that the patient's left lower limb was cold and clammy, and referred him to our center for further management. Patient reached 1 hour after referral. On arrival, a comprehensive vascular examination was performed upon presentation, including inspection of limb color, temperature, capillary refill, and

palpation of distal pulses. Clinical examination revealed knee spanning external fixator over left lower limb. Left thigh with knee joint X-ray showed shaft of femur fracture with exfix insitu (Figure 7A). CT angiography revealed 4cm cut off of left superficial femoral artery (Figure 7B). Patient was shifted to operating room after obtaining informed consent. A medial incision was made over the left thigh, followed by layer-by-layer dissection to expose the artery. Proximal and distal vascular control was obtained using vessel loops before proceeding with arteriotomy. 4cm of superficial femoral artery was contused. K-wire was removed. Contused segment was excised and mechanical thrombectomy was performed proximally and distally. Reversed saphenous vein graft was used to bridge the defect (Figure 8). Pulses were restored. Fasciotomy was performed, and a split-thickness skin graft was placed on postoperative day 5. Post-operative period was unremarkable. The patient was discharged on postoperative day 15. External fixator was removed after 4 weeks and distal femur nailing was performed at 8 weeks.

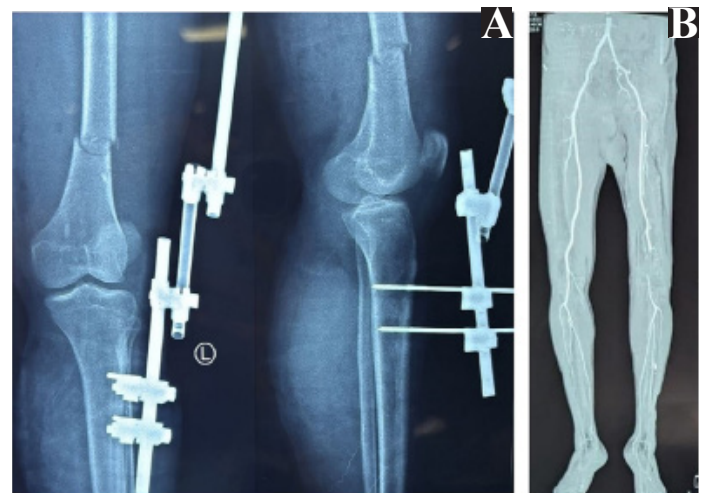


Figure 7. A. X-ray of the left thigh with knee showing a shaft of femur fracture with external fixator in situ; B. CT angiography of the left lower limb showing segmental cut-off of the superficial femoral artery



Figure 8. Intraoperative image showing arterial reconstruction using a reversed saphenous vein interposition graft for the superficial femoral artery

Ethics Statement

Written informed consent was obtained from all patients for the inclusion of their anonymized clinical details in this publication. As per our institutional protocol, formal approval from the Institutional Review Board was not required for retrospective case series.

DISCUSSION

Iatrogenic vascular injuries (IVI) represent significant complications that require immediate identification and management to avoid potentially fatal consequences. Although these injuries are relatively rare, they can arise during various interventions, including orthopedic fixation such as screw fixation, K-wire fixation, and external fixator application, as evidenced by three cases in this series, and varicose vein surgery, as documented in one case. The mechanisms causing IVI are direct injury by surgical instruments, chronic erosion caused by screws, and the use of retracting instruments [3,4]. Shanmugavelayutham et al. reported a higher incidence of iatrogenic vascular injuries among males aged 31–45 years and pediatric populations, highlighting demographic trends that may inform targeted prevention strategies [5]. Effective strategies to prevent IVI include comprehensive pre-procedural evaluations, adequate training for healthcare practitioners, and the application of advanced imaging modalities. The ability to recognize the clinical manifestations of iatrogenic vascular injuries is essential for prompt diagnosis and intervention. Clinical presentations include abrupt onset of pain, swelling, or alterations in limb color and temperature, which signify compromised perfusion to affected limbs [3]. Diagnostic modalities include clinical evaluations, imaging techniques, and occasionally invasive procedures to evaluate the severity of the injury [3]. Inadequately positioned retractors or improperly aligned implants frequently contribute to vascular complications, such as bleeding, hematoma, intimal damage, occlusion, arteriovenous fistula or thrombosis. These observations necessitate continuous education and anatomical training for surgical practitioners. The incorporation of advanced imaging technologies into preoperative planning is also vital for enhanced visualization of vascular structures, thereby reducing the risks of injury and improving surgical outcomes [5]. Management options available include primary repair, ligation, and thrombectomy with graft interposition or angioplasty [6]. Paul et al. in their study reported four cases of iatrogenic vascular injuries after the use of external fixation devices in 121 lower limb fractures, with an incidence rate of 3.3% [7]. In one notable case reported by Staeheli et al., a Type IIIB open femur fracture with extensive soft tissue injury led to an iatrogenic superficial femoral artery occlusion following external fixator placement, highlighting how anatomical distortion in severe trauma can increase the risk of vascular

injury and complicate surgical management [8]. Vishal et al. reported a case involving a pediatric patient who presented with a warm but pulseless upper limb following K-wire fixation for a supracondylar humerus fracture. CT angiography revealed brachial artery occlusion caused by K-wire penetration, and intraoperative exploration confirmed thrombus formation, necessitating thrombectomy [9]. A study by Nitecki et al. involving 4,800 varicose vein surgeries reported 3 cases of arterial trauma, indicating an incidence of 0.06% [10]. Awareness of potential vascular complications during high-risk procedures, such as cardiac catheterization or orthopedic fixation, is critical. By adopting preventive strategies and utilising advanced diagnostic tools, healthcare providers can minimize the incidence of iatrogenic vascular injuries and improve patient outcomes.

CONCLUSION

Iatrogenic vascular injuries, though rare, pose significant risks of limb ischemia and potential loss if not promptly recognized and managed. This case series highlights the critical role of early diagnosis, advanced imaging, and timely surgical intervention in ensuring favorable patient outcomes. Preventive measures such as meticulous surgical technique, proper fixation, and vigilant postoperative monitoring are critical to minimize the risk of iatrogenic vascular injuries. By implementing these strategies, healthcare providers can reduce the incidence of iatrogenic vascular injuries and improve patient recovery.

Patient Consent for Publication: Written informed consent was obtained from all patients for the inclusion of their anonymized clinical details in this publication.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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