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Injury to the Medial Superior Genicular Artery After Isolated Posterior Cruciate Ligament Reconstruction

A Case Report

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Investigation performed at Patras University Hospital, Greece

Abstract

Case: A 19-year-old male patient with isolated posterior cruciate ligament (PCL) rupture underwent arthroscopic reconstruction using reinforced synthetic ligament (LARS system). Three weeks postoperatively, he presented with active bleeding from the medial side of his knee, near the proximal interference screw. An angiogram revealed extravasation from the medial superior genicular artery which was successfully embolized. One week later, he returned with active bleeding from the same area, located just under the initial coiling; a second embolization during superselective angiography was successful.

Conclusion: Although rare, minor vascular injuries are a risk inherent to PCL surgery.

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Isolated posterior cruciate ligament (PCL) injuries are rare with an estimated annual incidence of 2/100,000, requiring a thorough clinical evaluation to rule out any concomitant structural knee injury[1]. Males are more prone to sustained PCL tear, mainly after high-energy road-traffic accidents (57%) or athletic activity[2]. Although excellent results have been reported with conservative management of isolated PCL injuries[3], recent reports highlighted the long-term consequences of untreated PCL tearing in terms of meniscal pathology and symptomatic arthritis[1,4]. Arthroscopic PCL reconstruction is a challenging procedure with well-recognized risk of neurovascular injury at the popliteal fossa, especially in the context of simultaneous multiligamentous reconstruction[5-7]. Laceration or pseudoaneurysms of popliteal vessels have been reported sporadically after arthroscopic PCL reconstruction[8-10]. To the best of our knowledge, there has been no report describing an intraoperative injury to the medial superior genicular artery (MSGA) during PCL reconstruction. This case report aims to increase the awareness of this severe complication, to support the use of superselective angiography, and to emphasize the need for close patient monitoring after such an interventional treatment.

The patient was informed that data concerning the case would be submitted for publication, and he provided consent.

Case Report

A previously healthy, 19-year-old male motorcyclist was transferred to our hospital after a frontal collision with a car. On initial evaluation, he was conscious, with normal vital signs, complained only of severe pain at his left knee. He had a swollen, bruised, and painful knee with strong evidence of posteromedial instability. No evidence of neurovascular damage or compartment syndrome was noted. An injury to the PCL and medial collateral ligament was confirmed the following day with MRI (Fig. 1-A) together with a medial meniscus tear, a partial popliteus tendon laceration, and extensive bone bruising in the medial femoral condyle. He remained hospitalized for 9 days for daily monitoring of knee and calf swelling, also performing physiotherapy with a continuous passive motion machine. The patient was consented for arthroscopic PCL reconstruction using synthetic ligament. The operation was performed on the 10th postinjury date. Three doses of second-generation cephalosporin were administered for infection prophylaxis together with compressive stockings and low-molecular-weight heparin for a period of 1 month. The patient was positioned in the supine position with the affected leg at 90° of flexion using a stop and a sided leg holder. A tourniquet was placed around the upper thigh and inflated to approximately 300 mm Hg pressure[11]. Diagnostic arthroscopy using standard portals, revealed a complete PCL rupture, an intact anterior cruciate ligament (ACL), a parrot-peak tear of the medial meniscus (managed with meniscectomy), and a grade III cartilage injury of the medial femoral condyle (which underwent debridement only).

The LARS (https://www.coringroup.com) instrumentation for PCL was used in a standard manner. LARS synthetic ligament is indicated in acute PCL cases (<3 weeks old) as an

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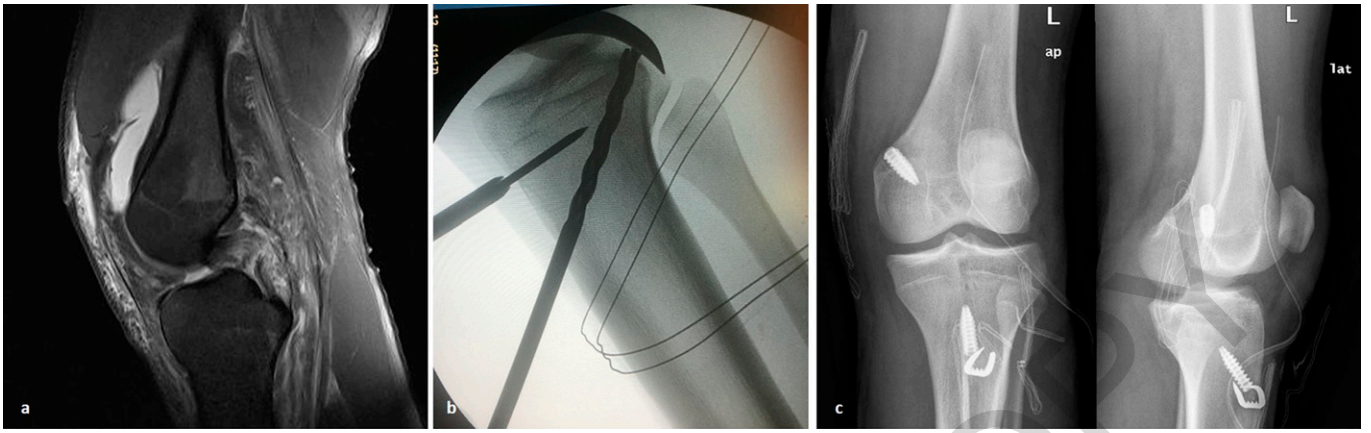

Fig. 1

Fig. 1-A Sagittal magnetic resonance imaging demonstrating complete tear of the posterior cruciate ligament, (**Fig. 1-B**) intraoperative image showing tibial tunnel drilling using the special ligament augmentation and reconstruction system jig and spatula, and (**Fig. 1-C**) postoperative radiographs showing the position of interference screws.

internal fixator, providing immediate strength and allowing later for fibroblastic in-growth of the native PCL[12]. The fixation of the ligament is performed using dedicated cannulated interference screws, which do not damage the ligament and provide maximum contact with the tunnel wall. Excellent results could be expected in isolated PCL injuries or multiligament complex reconstructions and knee dislocations[13-15].

After partial removal of PCL remnants, the spatula of the LARS jig was inserted into the knee through the medial portal and pushed back until its stem lied on the back of the tibia; this was confirmed with an image intensifier. The sharp 6-mm drill was driven through first, toward the spatula, followed by the 6-mm cannulated drill having contact with the spatula at the back of the knee (Fig. 1-B). The tibial wire loop insertion was uneventful, exiting without a force out of the top of the jig. The arthroscopic camera was exchanged to the medial arthroscopic portal, and a freehand technique was used for the femoral pin insertion in a point that corresponded to 40% of a line drawn parallel to the Blumensaat line. The guide pin was driven out of the skin through the medial femoral cortex, and a 6-mm cannulated drill was retrograded inserted for femoral tunnel preparation. The femoral wire loop was inserted through the metallic cannula and retrieved from the medial portal. Using the corresponded wire loops, a LARS P60 synthetic PCL ligament (3,600 N strength) was inserted without difficulty and fixed first in the femur and then in the tibia after posterior sag reduction (Fig. 1-C). The tourniquet was deflated, and a drain was inserted intraarticular, removed the following day. The peripheral pulses on the foot were normal, and no evidence of postoperative bleeding from the wounds was noted. The patient was discharged on the second postoperative day with instructions of touch weight-bearing with the use of a locked hinged brace (for 4 weeks) and full range of motion as tolerated. Synthetic PCL has immediate primary tunnel fixation, and progression to more vigorous exercises is safe and applicable. As soon as our patient started his outpatient physiotherapy sessions, 3 weeks later, he felt a sudden pain in his knee, and he presented with minor active bleeding from the medial side of the knee, at the area where the interference screw has been inserted. He underwent urgent angiography showing active bleeding from the MSGA, subsequently managed with embolization and coiling of the main trunk and some collateral vessels (Figs. 2A through 2-E). He was discharged the following day with instructions to avoid vigorous activities, but 1 week later, he came back with the same symptoms and active bleeding from the same spot. Angiography showed contrast extravasation just under the initial coiling (Figs. 2-F through 2-I). The bleeding vessels were coiling back, and the patient had no other problem, has been able to resume his physiotherapy program, and made an excellent recovery having a stable and functional knee at 1 year postoperatively.

Discussion

Knee arthroscopy is generally a safe procedure with a low incidence of complications. Salzler et al.[5] reported an overall complication rate of 4.7% for 6 common knee arthroscopic procedures, with PCL reconstructions showing the highest complication rate (20.1%). In the past, the Complications Committee of the American Association of Nurse Anesthetists reported only 12 vascular injuries in 375,069 knee arthroscopies[16]. The most devastating intraoperative complication is a major vascular injury of the popliteal artery. Neagoe et al.[17] reviewed major vascular complications after arthroscopic procedures between 1985 and 2014 and identified 62 cases of severe iatrogenic popliteal lesions required open vascular intervention. Interestingly, most of the cases (63%) happened between 1985 and 1995, with meniscectomy being the more common procedure (53%) followed by cruciate ligament reconstruction (10%). Lacerations and pseudoaneurysms of the popliteal artery have been sporadically reported after PCL[8-10] or even ACL[18] reconstruction, but to the best of our knowledge, injury to the MSGA after PCL reconstruction has never been reported. Filho et al.[19] reviewed the literature regarding the incidence of

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pseudoaneurysm formation after arthroscopic knee surgery and found 40 reports with 47 cases in addition to their case report. Among the operations that were associated with the creation of a pseudoaneurysm, 60% were meniscal injuries, and 23% were ACL injuries. In 46% of the cases, the artery affected was popliteal, and in 21%, the inferomedial genicular artery. The MSGA has been injured in 3 cases (6.25%)[16-18]. Omary et al.[20] reported 2 cases, 1 after unicompartmental knee replacement and the other after arthroscopic synovectomy both treated with embolization. Mufty et al.[21] and Lee et al.[22] reported an incident of pseudoaneurysm of the MSGA after partial medial meniscectomy, presented late as pulsating mass near the medial arthroscopic portal. Surgical exploration with excision of the pseudoaneurysm and ligation of the feeding artery was the treatment in the first case and embolization in the other.

Sung-Yoon et al.[23] reported a detailed description of MSGA anatomy in a short cadaveric study, advocating that descending genicular artery can be considered the main branch having 2 terminal branches that divided into the superficial (SMGAs) and deep branches of the SMGA (Fig. 3). A horizontal branch of the descending genicular artery (the superior transverse genicular artery) anastomosed with or solely constituted the superior lateral geniculate artery. This unique arterial anatomy can explain the higher incidence of SMGA injury during minor arthroscopic procedures (meniscectomy-synovectomy) rather than PCL surgery. In our case, as we had no evidence of acute intraoperative bleeding, the location of the injury was probably at the main branch of SMGA and the causative factor was either the femoral pin exciting through the medial cortex or the retrograde drilling during femoral tunnel preparation. Also, it seems that the femoral screw was not entirely flush with the medial femoral cortex and this could have contributed to the formation of the pseudoaneurysm. LARS screws are headless

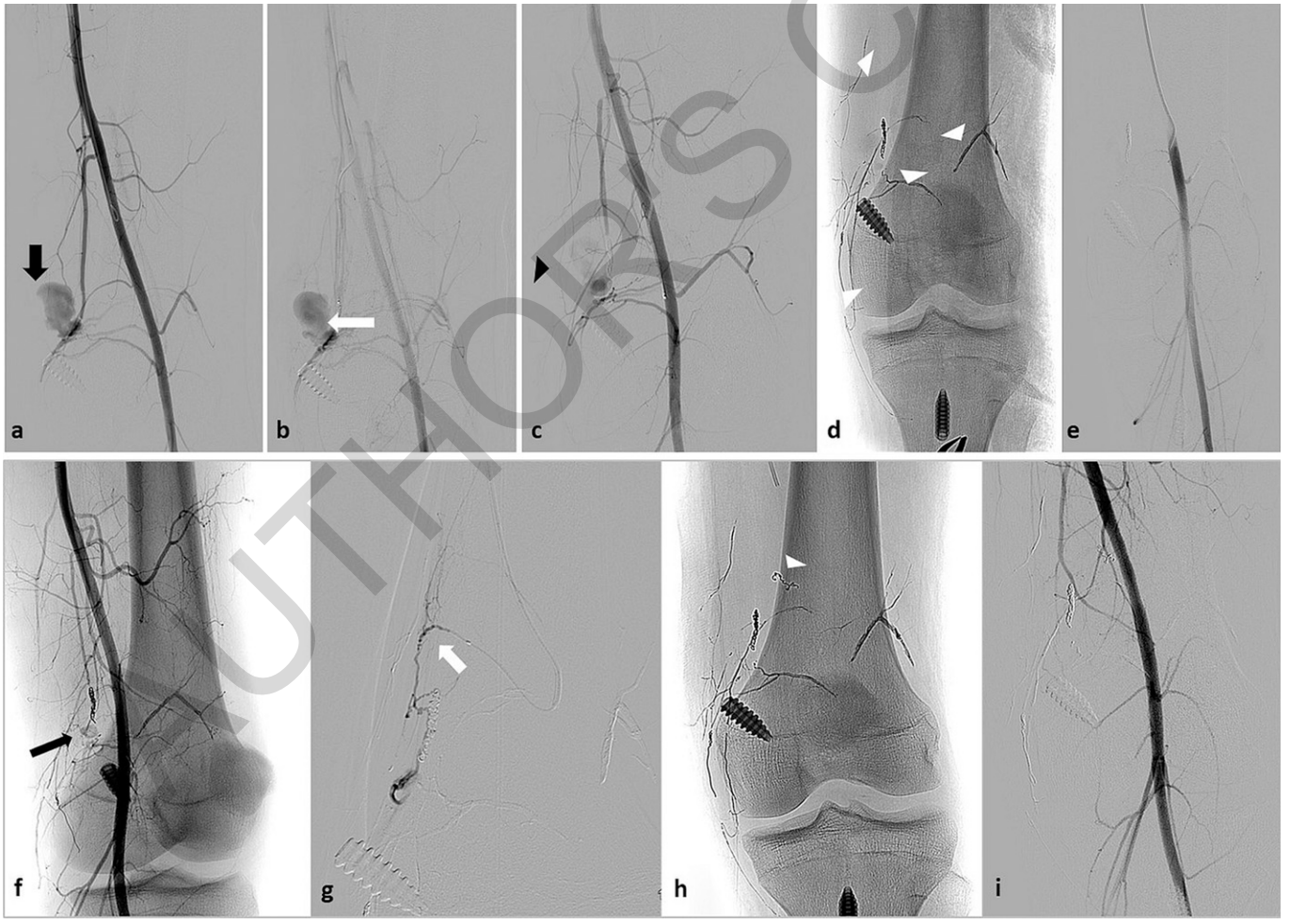

Fig. 2

First embolization: (**Fig. 2-A**) contrast extravasation from the geniculate artery (black arrow), (**Fig. 2-B**) coiling of the feeding artery (white arrow), (**Fig. 2-C**) after coiling, sustained bleeding observed for small collaterals (black arrowhead), (**Fig. 2-D**) collateral embolization with Onyx (white arrowheads), and (**Fig. 2-E**) completion angiogram shows no contrast extravasation. Second embolization: (**Fig. 2-F**) Angiogram shows contrast extravasation just under the initial coiling (black arrow), (**Fig. 2-G**) superselective angiogram shows the vessel of interest (white arrow), (**Fig. 2-H**) vessel coiling (white arrowhead), and (**Fig. 2-I**) completion angiogram shows no signs of extravasation.

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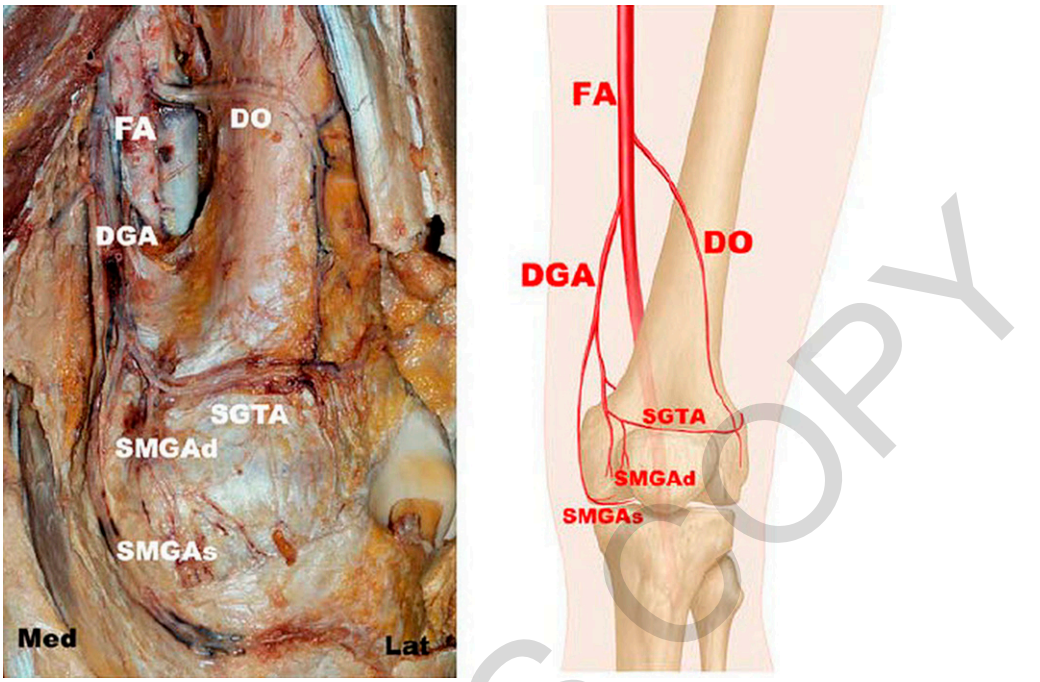

Fig. 3

Overall image of the arterial distribution around the knee (left) and its illustration (right). DGA, descending genicular artery; DO, descending osseous artery; FA, femoral artery; SGTA, superior genicular transverse artery; SMGA, superficial branch of the superior medial genicular artery; SMGAd, deep branch of the superior medial genicular artery (Adapted with permission from Sung-Yoon W, Lee YI, Hun-Mu Y. Anatomy of superior medial genicular artery: A short cadaveric report. *Clin Anat.* 2016;29(6):798-9.).

and a special screwdriver is automatically released (pop-up) when the screw becomes flush with the cortex, providing confidence to the surgeon that the screw has been entirely embedded; fluoroscopic confirmation can resolve this complication. As soon as the patient started more intense kinesiotherapy, the pseudoaneurysm became symptomatic causing active bleeding in the area.

Conclusion

Intraoperative injury to minor vessels around the knee after arthroscopic PCL reconstruction is a rare but severe complication. Surgeons must be aware that not only the popliteal vessels are at risk. Superselective embolization was effective treatment in this patient, but close patient monitoring is essential for a successful outcome. ■

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