Arteriovenous fistula of the superior gluteal artery as a complication of posterior iliac crest bone graft harvesting: 3D-CT angiography and arterial embolization

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Abstract Superior gluteal artery injuries are rare, but potentially serious complications that occur during posterior iliac crest bone graft harvesting. The authors reported an arteriovenous fistula of the superior gluteal artery, which occurred as a complication during posterior iliac crest bone graft harvesting and was diagnosed with 3D-CT angiography, then treated with arterial embolization.

Keywords Arteriovenous fistula · Superior gluteal artery · Posterior iliac crest bone graft harvesting · 3D-CT angiography · Arterial embolization

Introduction

Vascular injuries, such as arteriovenous (AV) fistulas, pseudoaneurysms, and lacerations, are rare, but potentially serious complications that occur during bone graft harvesting from the posterior iliac crest [2, 8, 10, 14]. To date, few cases of vascular injuries involving the superior gluteal

artery have been reported during posterior iliac crest bone graft harvesting [3, 5–7]. The prompt diagnosis and treatment of a superior gluteal artery injury is difficult, but critical for the prevention of morbidity and mortality. CT angiography, especially 3D-CT angiography, is a useful diagnostic tool for evaluating vascular injuries and also readily available in emergency situations [4, 11, 12]. Arterial embolization is a minimally invasive therapeutic modality to manage vascular injuries, especially in cases that are difficult to access by an open surgical approach [7, 8]. Herein, we report a rare complication involving a delayed-onset AV fistula of the superior gluteal artery, which was associated with posterior iliac crest bone graft harvesting.

Case report

A 57-year-old man underwent a total laminectomy and posterolateral fusion with pedicle screw fixation and autogenous iliac bone graft for neurogenic claudication secondary to spinal stenosis at L3–5. During bone graft harvesting from the left posterior iliac crest through a separate incision, the tip of the retractor was dislodged and penetrated into the sciatic notch. Suddenly, massive arterial bleeding occurred from the sciatic notch. It was impossible to control the bleeding by electrocoagulation and difficult to identify the source of the bleeding. Therefore, based on the advice of the senior spine surgeon, we packed a large amount of gel foam and gauze into the sciatic notch and applied direct pressure for about 15 min. After removal of the gauze packing, the area was inspected and hemostasis had been achieved. Because the patient was hemodynamically stable, it was thought that the bleeding had been adequately controlled. The remainder of the surgery was

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completed uneventfully. One week postoperatively, the patient was discharged from the hospital with improvement of his neurogenic claudication.

Six weeks postoperatively, however, the patient returned to the outpatient clinic complaining of a fist-sized painful swelling at the bone graft donor site. With knowledge of the intraoperative hemorrhage and the findings on physical examination, a conditional diagnosis of a hematoma was made. Evacuation of the hematoma was performed through a small opening in the previous incision. Upon evacuation of the hematoma, massive arterial bleeding was encountered. Despite applying a large pressure dressing for 10 min, the bleeding could not be controlled and approximately 1 unit of blood was lost through the bone graft donor site. The patient was immediately taken to the CT suite to identify the source of bleeding.

On 3D-CT angiography, an AV fistula of the superior gluteal artery was identified, extending from the sciatic notch to the pelvic cavity (Fig. 1a, b); axial views also demonstrated that the AV fistula of the superior gluteal artery extended both inside and outside of the pelvic cavity with a massive hematoma (Fig. 1c, d). An open surgical approach could not be performed to directly ligate the fistula due to its location and extent; therefore, an arterial embolization was performed through the right femoral artery. A catheter was advanced into the left superior gluteal artery and the dye was noted to promptly extravasate from it. As was noted from the 3D-CT angiography, an AV fistula of the superior gluteal artery and vein was identified (Fig. 2a). The fistula was successfully embolized using coils. After arterial embolization, repeat angiography showed rapid cessation of bleeding and no further extravasation of dye at the fistula site (Fig. 2b). At the 1-year follow-up examination, the patient was doing well without any further sequelae.

Discussion

The superior gluteal artery is a main branch of the internal iliac artery and leaves the pelvis through the most proximal portion of the sciatic notch, staying against the bony notch [13]. Therefore, injury to the superior gluteal artery is the most common vascular injury associated with posterior iliac crest bone graft harvesting. The superior gluteal artery can be injured at the sciatic notch by either a dislodged retractor, as in our case, or an osteotome [3, 5–7]. The risk of superior gluteal artery injury is reported to be higher when the bone graft is procured through the same incision in which the spine surgery is performed through a separate incision [1]. In the case reported herein, the bone graft was obtained through a separate incision; however, the incision was inadvertently extended too far inferiorly from the

posterior superior iliac spine, which led to the superior gluteal artery injury. Diagnosis should not be delayed like in the case report. To prevent iatrogenic superior gluteal artery injury during posterior iliac crest bone graft harvesting, it is important for surgeons to be familiar with the anatomy of the posterior iliac crest region and the concept of the “safe zone” as suggested by Kahn (Fig. 3) [6, 13].

It may be difficult to diagnose an AV fistula of the superior gluteal artery in a timely manner. If the diagnosis is delayed, the risk of life-threatening hemodynamic instability increases. Traditionally, patients suspected of having a vascular injury have been examined with emergent conventional angiography, which requires mobilization of the on-call angiography team, transportation of the patient to the angiographic suite, and performance of transcatheter angiography. This process may take up to 2–3 h after arrival of the angiographic team [4, 11, 12]. In clinical situations, therefore, conventional angiography is often delayed until the angiography team is assembled. Although conventional angiography has been used as the most definitive diagnostic method for AV fistulas, conventional angiography is invasive, operator-dependent, and time-consuming. Further, it is often not easily available in emergent situations. CT angiography is available in emergency departments 24 h a day because radiology technicians routinely perform this examination without the direct supervision of attending radiologists. All data are readily accessible via a PACS system, which allows the attending radiologists to quickly review images. CT angiography can be performed within minutes of patient arrival to the emergency department or CT suite because CT angiography only needs additional dye injection via peripheral vessels using a syringe, which is considered to be non-invasive, and radiology technicians routinely perform this examination without attending radiologists. CT angiography has additional advantages that are based in part on the improvement of 3D imaging techniques. Therefore, CT-angiography, especially 3D-CT angiography, is currently recommended as a useful preliminary diagnostic tool for AV fistulas [4, 11, 12]. Not only minimally invasive, rapid, and accurate, 3D-CT angiography provides detailed information regarding the size and location of the fistula to help the surgeons consider the appropriate surgical options. In the case described herein, a large AV fistula of the superior gluteal artery was identified extending both inside and outside of the pelvic cavity on 3D-CT angiography.

Because of the size and location of the fistula, it was anticipated that direct ligation of the fistula via an open surgical approach would be difficult. Had we attempted to directly ligate the fistula via an open surgical approach, it would most likely have resulted in additional massive bleeding, as described in previous reports [5, 6]. Arterial

Fig. 1 3D-CT angiography (**a**, **b**) clearly showed an AV fistula (arrow) of the superior gluteal artery that was located from the sciatic notch to the pelvic cavity. The red asterisk indicates the internal iliac artery and the dark asterisk indicates the external iliac artery. An axial view of CT-angiography (**c**, **d**) also demonstrated the AV fistula of the superior gluteal artery was located on the inside and outside of the pelvic cavity (arrow) with hematoma formation (arrows)

Fig. 2 Transcatheter arteriography demonstrated the extravasation of dye at the fistula site of the superior gluteal artery (arrow) and increased blood flow of the internal iliac artery and vein (narrow arrows) by the AV fistula of the superior gluteal artery (red arrow) (**a**). After arterial embolization with coils, repeat arteriography showed cessation of bleeding and no further extravasation of the dye at the fistula site of the superior gluteal artery (arrow) (**b**)

embolization is a useful therapeutic modality to manage uncontrollable, massive bleeding due to vascular injuries [7–9]. Arterial embolization has significant advantages over a traditional approach, such as open surgical repair, in that, it avoids the risk of another surgical incision and the exploration required for locating, controlling, and ligating the fistula. We found that, despite the massive fistula that had formed, arterial embolization worked well.

In conclusion, superior gluteal artery injury is a relatively uncommon, but potentially serious life-threatening complication that occurs during posterior iliac crest bone graft harvesting. However, the risk of injury can be minimized by having a thorough knowledge of the anatomy of the posterior iliac crest region and using careful bone graft harvesting techniques. Adequate diagnostics with a 3D-CT angiography can confirm the clinical diagnosis of AV

Fig. 3 The anterior margin of the “safe zone” is defined as the superior extension of the posterior border of the superior limb of the articular surface. The inferior margin is a line extending from the posterior superior iliac spine (PSIS) to the apex of the sacroiliac joint and oriented perpendicular to the posterior margin of the superior limb

fistula of the superior gluteal artery without delay and immediate arterial embolization is the preferred procedure to manage this rare complication of posterior iliac crest bone graft harvesting.

Conflict of interest statement None of the authors has any potential conflict of interest.

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