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CASE REPORT

Emergency treatment for iatrogenic lumbar arterial injury occurred during posterior lumbar interbody fusion: a case report

Sangun Nah[1,†], Sangsoo Han[1,†], Young Soon Cho[1,*]

[1]Department of Emergency Medicine, Soonchunhyang University Bucheon Hospital, 14584 Bucheon, Republic of Korea

***Correspondence**
emer0717@schmc.ac.kr
(Young Soon Cho)

[†] These authors contributed equally.

Abstract

An iatrogenic vessel injury occurring during lumbar fusion is a rare but potentially serious complication. In this case report, we present a case of hypovolemic cardiac arrest attributable to an iatrogenic lumbar artery injury that occurred during posterior lumbar interbody fusion (PLIF), which is difficult to diagnose using CECT. A 70-year-old woman underwent PLIF surgery in a primary hospital for the treatment of degenerative spondylolisthesis (L2–L5). During the procedure, she experienced a blood loss of 3 liters, which necessitated the transfusion of packed red blood cells (6 units, about 200–250 mL per unit), fresh frozen plasma (6 units, about 150–170 mL per unit). Despite the transfusions, her vital signs remained unstable, leading to her transfer to our hospital. Upon arrival at our facility, the patient went into cardiac arrest, but spontaneous circulation was successfully restored after two cycles of cardiopulmonary resuscitation. In the emergency department, her hemoglobin level was measured at 2.7 g/dL, platelet level at 56,000/μL, and prothrombin international normalized ratio at 3.56. CECT did not indicate any active bleeding. For the initial 2 hours, her vital signs remained stable with a blood pressure of 92/53 mmHg, heart rate of 104 bpm, respiratory rate of 22 bpm. However, her blood pressure suddenly dropped to 78/43 mmHg. Subsequent angiography revealed active bleeding from the right fourth lumbar artery, prompting the performance of embolization. Following the procedure, the patient's vital signs stabilized, and she was discharged on the 16th day of hospitalization. Iatrogenic vessel injuries during PLIF may pose challenges in their detection using CECT, especially when extravasation is not definitively visible or when artifacts are created by metal implants. Therefore, it is advisable for emergency physicians to consider emergency angiography in the diagnosis and treatment of such vessel injuries.

Keywords

Iatrogenic injury; Posterior lumbar interbody fusion; Angiography

1. Introduction

Lumbar fusion is an effective treatment for various degenerative diseases [1]. Posterior lumbar interbody fusion (PLIF) provides safe stabilization of the anterior column and enables posterior decompression without necessitating an anterior approach [2]. However, PLIF is a technically challenging procedure, and like other lumbar fusion techniques, it carries the risk of complications [2, 3]. Specifically, vascular injuries, though rare (0.01–0.22%), should not be overlooked, as delayed diagnosis can result in severe consequences such as massive hemorrhage and life-threatening shock [4, 5]. While angiography is considered the gold standard for diagnosing vessel injuries [4, 6], it can be associated with potential complications, invasiveness and reliance on on-call staff. Consequently, contrast-enhanced computed tomography (CECT) is often employed as an equally effective alternative for diagnosing vessel injuries [6]. In this context, we present a case report detailing a hypovolemic cardiac arrest caused by an iatrogenic lumbar artery injury during PLIF, which is difficult to diagnose using CECT.

2. Case presentation

A 70-year-old woman was diagnosed with degenerative spondylolisthesis (L2–L5) and decided to undergo surgery at a primary hospital due to severe back pain and intermittent lower extremity paresthesia that had persisted for two weeks. Her medical history included hypertension and hyperlipidemia, and she was taking amlodipine and atorvastatin but not any anticoagulant medication. On the day of surgery, laboratory findings indicated a hemoglobin (Hb) level of 12.5 g/dL,

platelet level of 239,000/μL, and a prothrombin international normalized ratio (PT-INR) of 0.92. The patient underwent PLIF at the L2–L5 level. Approximately 2 liters of blood loss occurred during the procedure and as a result, she received normal saline (1 liter) and packed red blood cells (PRBCs) (3 units, about 200–250 mL per unit). An additional 600 mL of blood loss was observed, and the surgeon suspected that it originated from the spinal epidural artery. Consequently, additional PRBCs (3 units) and fresh frozen plasma (6 units, about 150–170 mL per unit) were transfused. A hemostatic agent was injected into the surgical site, followed by suturing and confirmation of hemostasis. Diagnostic fluoroscopy was not available. Further blood loss (400 mL) occurred *via* the Hemovac drainage tube, resulting in a decrease in the patient's blood pressure to 54/28 mmHg. Subsequently, she was transferred to our tertiary hospital.

She experienced cardiac arrest upon arrival at our hospital, but spontaneous circulation was restored after two cycles of cardiopulmonary resuscitation. Hypovolemic cardiac arrest caused by massive bleeding was suspected, and as a result, the patient received transfusions of PRBCs (6 units), fresh frozen plasma (6 units) and platelet concentrate (6 units, about 50 mL per unit). Upon arrival in our emergency department, the patient's laboratory findings showed a Hb level of 2.7 g/dL, platelet count of 56,000/μL and PT-INR of 3.56. No other specific findings were noted. Abdominopelvic CECT was performed to identify the bleeding site, and the radiologist diagnosed "multifocal hematoma at the PLIF site" but did not detect any evidence of active bleeding in other areas, including the intraperitoneal cavity (Fig. 1A,B). The patient's vital signs (blood pressure 92/53 mmHg, heart rate 104 bpm, respiratory rate 22 bpm, SpO_2 98% and temperature 36.3 °C), supported by continuous transfusion and fluid resuscitation, remained stable for 2 hours, leading the emergency physician to decide on the patient's observation in the intensive care unit. However, the patient's blood pressure subsequently dropped to 78/43 mmHg, prompting the scheduling of emergency angiography after consultation with the radiologist. Active contrast extravasation was observed on the right side of the fourth lumbar artery, and the bleeding branch was successfully embolized using a mixture of n-butyl cyanoacrylate/lipiodol and Gelfoam (Fig. 2A,B). Following the procedure, the patient's vital signs stabilized, and she was admitted to the intensive care unit.

The patient's laboratory findings on the second day of hospitalization revealed a Hb level of 10.3 g/dL, platelet count of 93,000/μL and PT-INR of 1.25. Once the patient regained consciousness, the endotracheal tube was removed. She was discharged on the 16th day of hospitalization with no complications, and during a follow-up visit two weeks later, no specific findings were observed.

3. Discussion

Iatrogenic lumbar artery injuries during surgery are typically caused by pedicle screw insertion or discectomy. Although rare, these injuries can lead to serious complications [7]. Table 1 summarizes five cases of iatrogenic lumbar artery injury after PLIF, including our own case [5, 7–9]. The most common symptoms reported were back and abdominal pain. CECT is the preferred imaging modality for identifying organ and vessel injuries [6]. Angiography can serve as an alternative to conventional open surgery for both diagnosis and treatment when vascular injuries are suspected [6, 9]. Maturen *et al*. [6] reported a sensitivity of 94.1% and a negative predictive value of 97.6% for CECT in detecting active bleeding, although detecting bleeding can be challenging in the absence of active extravasation. Furthermore, the presence of metal implants, as seen in our patient, can create artifacts that hinder diagnosis [10]. In the cases presented in Table 1, most lumbar artery injuries were diagnosed using CECT. However, in our case, CECT did not reveal any obvious active bleeding focus, and the diagnosis was only possible through angiography.

The cause of the iatrogenic lumbar artery injury in our patient remains unclear. However, similar to the cases presented in Table 1, our patient experienced an injury to the fourth lumbar artery during PLIF. A cadaveric study has revealed that this artery has a larger diameter compared to other lumbar arteries, making it more susceptible to iatrogenic injury during spinal operations [11]. Furthermore, due to the right lumbar artery being longer than the left lumbar artery, even a slight cortical breach can result in a vessel injury [11]. The fourth lumbar artery is positioned in the cranial third of the vertebral body, whereas the other lumbar arteries are situated in the middle third. As a result, the distance between the fourth lumbar artery and the end plate of the vertebral body is shorter compared to other lumbar arteries [12]. Consequently, if a pedicle screw enters the top of the lumbar body transverse process during PLIF (referred to as "transpedicular insertion") and accidentally penetrates the anterior part of the spine, the fourth lumbar artery is more prone to damage than other arteries [13]. The fourth lumbar artery is generally considered more vulnerable to iatrogenic injury compared to other lumbar arteries.

It may be debatable whether a hemodynamically unstable patient should be transferred to a tertiary referral hospital for better treatment. Various key factors related to a safe transfer, such as pre-transfer stabilization and preparation, necessary equipment and monitoring during the transfer, as well as optimizing the procedure and minimizing waiting time, should be considered to ensure the patient's safety [14]. In our case, the patient was transferred despite hemodynamic instability, which led to cardiac arrest. In such cases, the implementation of resuscitative endovascular balloon occlusion of the aorta (REBOA) may have been needed. REBOA is a useful resuscitation procedure that acts as a bridge to definitive hemostasis by controlling subdiaphragmatic hemorrhage [15]. Therefore, REBOA could be considered as a viable option for achieving hemodynamic stabilization prior to transfer or surgery.

We have described a case of iatrogenic lumbar artery injury, but spontaneous lumbar artery injury is also possible. Advanced age and end-stage renal failure, including renal transplantation, hemodialysis and anticoagulation and antiplatelet therapy, have been reported as risk factors for spontaneous lumbar artery injury [16]. Typically, after the occurrence of a lumbar artery injury, emergency exploratory laparotomy and direct repair of the bleeding site are required [7]. However, such treatments may necessitate a change in patient positioning

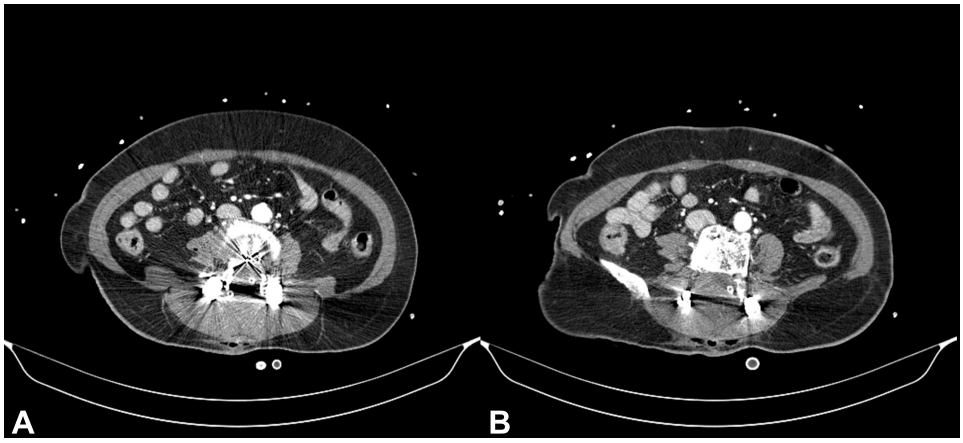

FIGURE 1. Postoperative, arterial-phase, contrast-enhanced computed tomography scans. Axial views of (A) the L3–L4 intervertebral space and (B) L4 level.

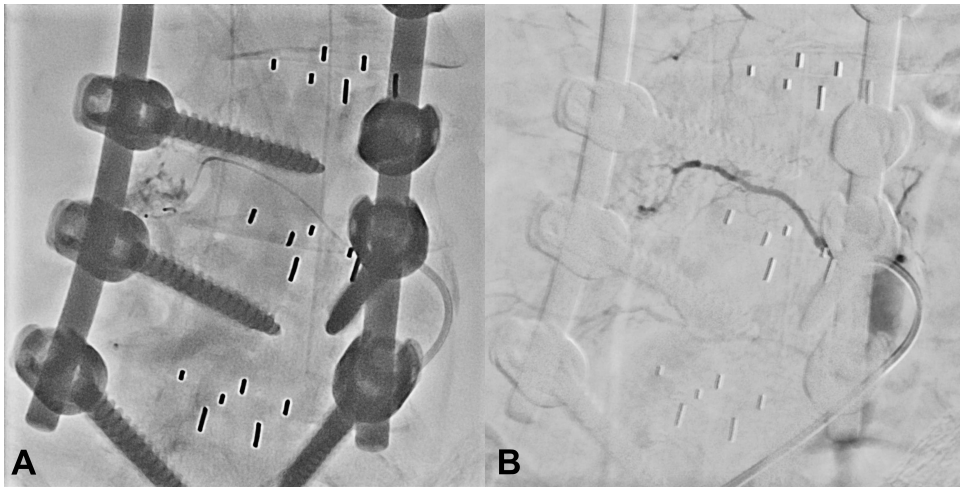

FIGURE 2. Angiography reveals an iatrogenic injury on the right side of the fourth lumbar artery. (A) Before embolization and (B) after embolization.

TABLE 1. Iatrogenic lumbar arterial injuries after PLIF.

Author	Sex/age	Primary disease	Clinical Symptoms and signs	Diagnostic method	Affected vessel	Treatment	Complications
Ruffilli *et al*. [5]	M/53	DLS (L4–L5)	Low-back pain, lower-extremity neuronal symptoms	CECT	Right 4th LA	Embolization	Pseudoaneurysm
Sugimoto *et al*. [7]	M/82	DLS (L4–L5)	Atrial fibrillation, decrease in hemoglobin level	CECT	Left 4th LA	Embolization	Arterial rupture
Nijenhuis *et al*. [8]	M/69	LSS (L4–S1)	Low-back pain, lower-extremity neuronal symptoms	MRI	Right 4th LA	Embolization	Pseudoaneurysm
Makino *et al*. [9]	F/76	DLS (L4–L5)	Abdominal pain, decrease in hemoglobin level	CECT	Right 4th LA, IVC	Embolization, stent-graft implantation	Arteriovenous fistula
Present case	F/70	DLS (L2–L5)	Low blood pressure, decrease in hemoglobin level	Angiography	Right 4th LA	Embolization	Arterial rupture

Abbreviations: PLIF, posterior lumbar interbody fusion; DLS, degenerative lumbar spondylolisthesis; LSS, lumbar spinal stenosis; CECT, contrast-enhanced computed tomography; MRI, magnetic resonance imaging; LA, lumbar artery; IVC, inferior vena cava. M, Male; F, Female.

during surgery, which carries the risk of further incisions [17]. Therefore, embolization is the recommended first-line treatment for iatrogenic lumbar artery bleeding, unless additional procedures are needed.

4. Conclusions

Iatrogenic vessel injury during PLIF may be difficult to detect on CECT when extravasation is not definitive or when artifacts are created by metal implants. Therefore, emergency physicians should consider performing emergency angiography when diagnosing and treating vessel injuries.

AVAILABILITY OF DATA AND MATERIALS

The data presented in this study are available on reasonable request from the corresponding author.

AUTHOR CONTRIBUTIONS

SN—examined the patient and diagnosed the case. SN and SH—wrote the first version of the manuscript. YSC—approved the final version of the paper and edited it. All authors contributed to the final version of the manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was approved by the Institutional Review Board of Soonchunhyang University Bucheon Hospital, South Korea (IRB file no. 2023-01-004). Oral informed consent was obtained from the patient for publication of this case report.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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