

Endovascular repair of arterial injuries as a complication of spinal surgery

Spinal cerrahi komplikasyonu olan arteriyel yaralanmaların endovasküler tamiri

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ABSTRACT

Major vessel injury during spinal surgery is a rare, but one of the most distressing complications and it may be fatal. Prompt diagnosis and management are crucial to prevent poor outcomes. Herein, we report two cases of arterial injury during lumbar disc surgery with different presentations. Injury was detected during operation in one patient and six hours after surgery with a pseudoaneurysm formation in another patient. Both patients were treated with endovascular methods. Endovascular stent grafting offers an effective method for the treatment of aortic and iliac artery injuries.

Keywords: Discectomy; endovascular procedure; intervertebral disc displacement; vascular system injury.

ÖZ

Spinal cerrahi sırasında majör damar yaralanması nadiren gelişmekle birlikte, en sıkıntılı komplikasyonlardan biridir ve ölümcül olabilir. Hızlı tanı ve tedavi olumsuz sonuçların önüne geçilebilmesi için çok önemlidir. Bu yazıda, lomber disk cerrahisi sırasında farklı tablolarla seyreden iki arteriyel yaralanma olgusu sunuldu. Yaralanma bir hastada ameliyat sırasında, diğerinde ise ameliyattan altı saat sonra psödoanevrizma oluşumu ile tespit edildi. Her iki hasta da endovasküler yöntemler ile tedavi edildi. Endovasküler stent greftleme, aortik ve iliak arter yaralanmalarının tedavisinde etkin bir tedavi yöntemidir.

Anabtar sözcükler: Diskektomi; endovasküler işlem; vertebra arası disk kayması; vasküler sistem yaralanması.

Iatrogenic vascular injury during spinal surgery is rare, but it is one of the most distressing complications. Most cases have been associated with lumbar discectomy; however, major vascular complications associated with spinal stabilization procedures have been described as well.^[1] The anatomic relationship of the aorta and major vessels to the vertebral column puts them at risk during these procedures. The reported incidence of such an injury during lumbar disc surgery is 0.01 to 0.2%.^[1] The incidence of vascular injury during posterior instrumentation of spine occurs in less than every 1 of 2,000 procedures. However, the mortality rate may be as high as 65% due

to the injuries to the aorta or iliac arteries.^[2] Several studies have indicated that vascular injury is only recognized intraoperatively in 36% of cases, and 28% of the presentations occur within the first 24 hours following surgery.^[3] Trauma to the vessels may lead to perforation, resulting in immediate hemorrhage or delayed pseudoaneurysm formation with a risk of rupture or arteriovenous fistula.^[4] Conventional surgical approaches for repairing injured vessels may be successful; however, invasive procedures may be needed. Endovascular procedures may offer a less invasive alternative to treat those injuries with a lower rate of morbidity and mortality.

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Herein, we report two cases of vascular injury during lumbar spinal surgery with different presentations treated with endovascular methods.

CASE REPORT

Case 1- A 42-year-old male patient underwent right L4-L5 discectomy. After removal of the subcapsular superior migrated disc fragment, pressurized rapid pulsatile bleeding occurred in the operative field. Compression failed. The neurosurgeons suspected a possible major arterial injury, and tightly packed the cavity, closed the wound quickly, and turned the patient to supine position. The operation was terminated. The patient was hemodynamically stable, and he was transferred to the catheter lab. Hemoglobin level dropped from 15.3 g/dL to 11.2 g/dL, and hematocrit level dropped from 44.8 to 32.6%. Abdominal computed tomography angiography (CTA) confirmed a pseudoaneurysm from at the left common iliac artery (Figure 1). After catheterization via femoral artery, diagnostic angiography was performed, and a covered stent (Fluency® Plus 13.5 mm-40 mm [Bard PV, Tempe, AZ, USA]) was inserted over a guidewire via 10F sheath. Final angiography demonstrated the absence of any pseudoaneurysm, and the patency of both iliac arteries (Figure 2). One unit of packed red blood cells was transfused after the procedure. The

postoperative period was uneventful, and the patient was discharged after two days of hospital stay with 75 mg clopidogrel, and 100 mg acetylsalicylic acid therapy. Repeated CTA revealed a patent iliac covered stent at six months.

Case 2- A 62-year-old male patient was admitted to our hospital with the diagnosis of prolapsed intervertebral L3-L4 disc with left lower limb radiculopathy. Left L3-L4 discectomy was performed by the neurosurgeons. The patient was hemodynamically stable during the operation and in the early postoperative hours. He had abdominal pain and dizziness at the fourth postoperative hour. Progressive aggravation of pain, tachycardia, and hypotension developed within two hours. On his physical examination, tenderness and distension were detected. Hemoglobin level dropped from 14.9 g/dL to 8.4 g/dL and hematocrit level dropped from 44.6 to 23.8%. A major vascular injury was suspected, and aggressive fluid resuscitation was started. Three units of packed red blood cells and three units of fresh frozen plasma were transfused, and urgent abdominal CTA was performed which showed a large pseudoaneurysm at the terminal abdominal aorta (Figure 3). Angiography was performed after the surgical exposure of both common femoral arteries. The Zenith Flex (Cook Inc., Bloomington, IN, USA)



Figure 1. Abdominal computed tomography angiography showing a pseudoaneurysm at left common iliac artery (arrow).



Figure 2. Diagnostic angiography showing the implanted covered stent (arrow), and patency of both iliac arteries without any leakage.



Figure 3. Abdominal computed tomography angiography showing a large pseudoaneurysm at the terminal abdominal aorta.

stent graft main body (24 to 84 mm) and ipsilateral iliac leg of the stent graft (16 to 55 mm) were inserted from the left common femoral artery. Contralateral iliac leg (16 to 55 mm) was inserted from the right common femoral artery. Final angiography confirmed that both iliac arteries were patent, and there was no contrast medium filling the pseudoaneurysm. The patient fully recovered and was discharged three days later with dual antiplatelet therapy (100 mg acetylsalicylic acid and 75 mg clopidogrel). Repeated CTA revealed a patent aortic stent-graft at six months.

DISCUSSION

Although the exact rate of vascular injuries associated with spinal surgery is not known, it is usually reported in the range of 0.01 to 0.2%.^[1] However, the overall mortality rate ranges between 15% and 65%.^[2,5] The mortality rate may be as high as 20 to 80% in the acute phase, and particularly in case of aortic injury.^[5] This difference in the mortality rate depends on the site and size of the injury, the time interval between the injury and the diagnosis, and timing of surgical or endovascular intervention.^[6]

Major vessels which are close to the vertebral column are at risk of an intraoperative injury. Intraabdominal vascular injury is more frequently reported during

L4-L5 disc surgery.^[7] The right common iliac arteries are the most commonly injured vessels with 43%, followed by left common iliac artery with 29%.^[7] Injuries predominantly associated with upper lumbar surgery are those to the aorta and inferior vena cava whereas iliac vessel injuries are more common in lower lumbar surgery.^[5] In our cases, the injury sites were the left common iliac artery and terminal abdominal aorta. In general, vascular injury is caused by anterior longitudinal ligament perforation during the excision of the intervertebral disc.^[6]

As reported in previous postoperative computed tomography (CT) studies of instrumentation in spinal surgery, the incidence of misplacement of the pedicle screws ranges between 4% and 25%.^[8] There is no standard to decide whether the removal is necessary, when the malpositioned pedicle screw has an infringement of the aorta. However, considering the aortic pulsation and the migration of the screw resulting from osteoporosis or sometimes infection, pedicle screws adjoining on the aorta may gradually penetrate the aortic wall, leading to a pseudoaneurysm or rupture in the long-term. In the chronic phase, symptoms occur depending on the development of pseudoaneurysm, rupture, or arteriovenous fistula.^[9]

Previously described risk factors for vascular injury during lumbar discectomy include preexisting degenerative disc surgery, retroperitoneal inflammatory processes leading to adhesion between vessels and the disc, aggressive discectomy, possibly increased intraabdominal pressure that may force vessels against or close to the disc, revision discectomy and misplaced hardware during spinal instrumentation.^[8,10]

Serious hemorrhage during lumbar surgery is often concealed leading to a crucial delay in diagnosis. This is attributed to hemorrhage into the retroperitoneal space rather than into the surgical field, and also due to the durable self-sealing effect of the anterior longitudinal ligament.^[11] Cardiovascular collapse may be the first demonstrable sign of a major vascular injury. Clinicians should, therefore, consider a vascular injury in all patients with hypotension, tachycardia, and abdominal distension.^[11] If vascular injury is suspected and the patient's condition allows, CT scan is the initial examination as it identifies the cause, the location, and the extent of the bleeding, and it helps to differentiate between arterial and venous injuries.^[5,6,7,11] Fortunately, in our cases, hemodynamic statuses were suitable for CT examination and angiography.

In both cases, the patients were immediately prepared for endovascular procedures after CT scans without any delay.

Repair of such injuries to the aorta traditionally involved a thoracotomy or laparotomy with repair of the injured vessel.^[6,8,9,11] Depending on the extent of the defect, this could be performed with direct repair, patch angioplasty, or interposition grafting. However, open surgical repair may pose a morbidity rate up to 50%, namely, due to serious blood loss, transfusion, spinal cord ischemia caused by cross-clamping of the thoracic aorta and pulmonary failure.^[6,8] Avoiding thoracotomy may prevent postoperative pulmonary complications, while avoiding cross-clamping of the aorta prevents loss of circulation to the spinal cord and other vital organs.^[7,10]

Although surgical outcomes are considered good, surgical repair may result in aforementioned complications.^[9] Currently, the use of endovascular procedures avoiding open surgery results in an evident decline in the morbidity rates associated with vascular surgery in such circumstances.^[12] The main advantages of endovascular techniques in these patients are the absence of a thoracic or an abdominal incision, decreased blood loss, and a shorter anesthesia time with a shorter hospital stay. Endovascular stent grafting is a preferable choice for patients with an increased risk of aortic injuries in spinal surgeries, and in patients with multiple traumas who are ineligible for open surgery. Despite the clear short-term advantages of endovascular stent grafting in the thoracic aorta, the long-term durability of this approach has been questioned.^[6,8,9] However, Canaud et al.^[7] reported that those procedures yielded very good long-term results, suggesting that endovascular procedures should be considered as the first-line treatment options in arterial injuries after spinal surgery.

In Case 1, the injury site was in the middle section of the left common iliac artery, away from the aortic bifurcation; therefore, there was very little probability of luminal compromise of the contralateral common iliac artery. Therefore, we used Fluency® Plus 13.5 mm–40 mm (Bard PV, Tempe, AZ, USA), and sealed the arterial injury. In Case 2, the injury site and pseudoaneurysm were located at the terminal abdominal aorta. The probability of the graft migration was low, and sufficient proximal and distal graft fixations were able to be easily performed. In this case, the possibility of luminal compromise

of iliac arteries was a matter of concern; therefore, we used the Zenith Flex (Cook Inc., Bloomington, IN, USA) stent graft main body (24 to 84 mm) and two Zenith Flex (Cook Inc., Bloomington, IN, USA) iliac legs (16 to 55 mm). Spinosa et al.^[13] suggests that, if a stent is placed at the origin of a common iliac artery, another stent should be also placed in the contralateral common iliac artery, even if it is normal. In addition, it has been proposed that those kissing stents would prevent compromise of the contralateral iliac artery. On the other hand, Smith et al.^[14] reported that contralateral protection during proximal common iliac artery stenting was not needed. In our case, we used a bifurcated stent graft, since the injury was located at the terminal aorta.

In conclusion, iatrogenic vascular injury during posterior lumbar disc surgery is a rare, but a potentially serious complication. Endovascular stent grafting may offer a simpler, safer, and less invasive alternative to open surgical repair for aortic or iliac injuries. Therefore, endovascular procedures should be considered as the first-line approaches for such complications.

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