Endovascular Repair of Arterial Injuries Complicating Spinal Surgery

Spinal Cerrahi Komplikasyonu Olarak Gelişen Arteriyel Yaralanmalarin Endovasküler Tamiri

Emrah UĞUZ,[a]
Kemal Eşref ERDOĞAN,[a]
Emre BOYSAN,[b]
Murat CANYIĞIT,[c]
Sina ALI[d],
Mehmet ERDOĞAN,[d]
Mete HIDIROĞLU,[a]
Erol ŞENER[a]

[a]Kalp ve Damar Cerrahisi Kliniği,
Atatürk Eğitim ve Araştırma Hastanesi,
[b]Kalp ve Damar Cerrahisi Kliniği,
Etimed Hastanesi,
[c]Radyoloji Kliniği,
Atatürk Eğitim ve Araştırma Hastanesi,
[d]Kardiyoloji Kliniği,
Atatürk Eğitim ve Araştırma Hastanesi,
Ankara

Geliş Tarihi/*Received:* 09.12.2015
Kabul Tarihi/*Accepted:* 20.05.2016

Yazışma Adresi/*Correspondence:*
Emrah UĞUZ
Atatürk Eğitim ve Araştırma Hastanesi,
Kalp ve Damar Cerrahisi Kliniği,
Ankara,
TURKIYE/TURKEY
emrahuguz@gmail.com

doi: 10.9739/uvcd.2015-47363

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 in order to prevent poor outcomes. Here, we report two cases of arterial injury during lumbar disc surgery with different presentations. One patient's injury was realized during operation whereas the other patient's condition was diagnosed six hours after surgery, with a pseudonaneurysm formation. Both patients were treated with endovascular methods. Endovascular stent grafting offers an effective method for treatment of aortic and iliac artery injuries.

Key Words: Intervertebral disc displacement; endovascular procedures; vascular system injuries; diskectomy

ÖZET Spinal cerrahi sırasında majör damar yaralanması nadiren gelişmesine rağmen ölüme yol açabilecek en rahatsız edici komplikasyonlardan biridir. Hızlı tanı ve tedavi olumsuz sonuçların önüne geçilebilmesi için hayatidir. Bu sebeple, spinal cerrahi sırasında gelişen ve farklı şekillerde bulgu veren iki farklı arter yaralanması olgusunu sunmaktayız. Bir hastada damar yaralanması operasyon esnasında fark edilirken, diğer hastada 6 saat sonra tanı konulabilmiştir. Her iki hasta da endovasküler yöntemlerle tedavi edilmiştir. Endovasküler stent greft uygulamaları, aortik ve iliyak arter yaralanmalarının tedavisinde etkin bir tedavi metodudur.

Anahtar Kelimeler: Vertebralar arası disk kayması; endovasküler prosedürler; vasküler sistem yaralanmaları; diskektomi

Damar Cer Derg 2016

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] Anatomic relationship of the aorta and major vessels to vertebral column puts them at risk during these procedures. The reported incidence of such an injury during lumbar disc surgery is 0.01-0.2%.[1] The incidence of vascular injury during posterior instrumentation of spine occurs in less than every 1 of 2000 procedures. However, mortality rate may be as high as 65% due to injuries to the aorta or iliac arteries.[2] 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 ves-

sels may lead to perforation, resulting in immediate hemorrhage or delayed pseudoaneurysm formation with a risk of rupture or arterio-venous fistula.[4] Conventional surgical approaches for repairing injured vessels may be successful, however invasive procedures may be needed. Endovascular procedures might offer a less invasive alternative to treat those injuries with a lower rate of morbidity and mortality.

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

CASE REPORT 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 occured in the operative field. Compression was useless. The neurosurgeons suspected a possible major arterial injury, and tightly packed the cavity, closed the wound is quickly, and turned the patient to supine position. The operation was terminated. The patient was hemo-dynamically stable, and he was transferred to catheter lab. His hemoglobin level dropped from 15.3 g/dl to 11.2 g/dl, and his hematocrit level dropped from 44.8% to 32.6%. Abdominal computerized tomography angiography (CTA) confirmed a pseudoaneurysm from at the left common iliac artery (Figure 1). After catheterization via femoral artery, a 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 absence of any pseudoaneurysm, and patency of both iliac arteries (Figure 2). One unit of packed red blood cells was transfused after procedure. Postoperative period was uneventful and the patient was discharged after two days of hospital stay with 75 mg clopidogrel, and 100 mg aspirin therapy. CTA revealed a patent iliac covered stent after six months.

FIGURE 1: Abdominal computerized tomography angiography revealing a pseudoaneurysm at left common iliac artery (arrow).

CASE REPORT 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 on the 4th postoperative hour. Progressive aggravation of pain, tachycardia and hypotension developed within two hours. Tenderness and distension were detected on his physical examination. The patient's hemoglobin level dropped from 14.9g/dl to 8.4g/d,l and his 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 3 units of fresh frozen plasma were transfused, and urgent abdominal CTA was performed. CT findings showed a large pseudoaneurysm at the terminal abdominal aorta (Figure 3). Angiography was performed after surgical exposure of both common femoral arteries. Zenith Flex (Cook Inc., Bloomington, IN, USA) stent graft main body (24 mm-84 mm), and ipsilateral iliac leg of the stent graft (16 mm-55 mm) were inserted from the left common femoral artery. Contralateral iliac leg (16 mm-55 mm) was inserted from the right common

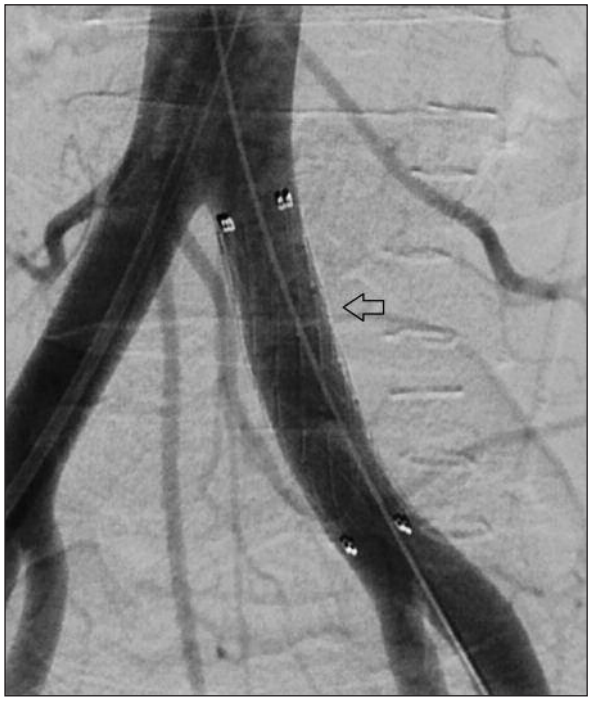

FIGURE 2: Diagnostic angiography showing the implanted covered stent (arrow), and patency of both iliac arteries without any leakage.

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, on dual antiplatelet therapy (100 mg acetylsalicylic acid and 75 mg clopidogrel). CTA revealed a patent aortic stent-graft six months later.

DISCUSSION

Although the exact rate of vascular injuries associated with spinal surgery is not known, it is usually reported in the range of 0.01-0.2%.[1] However, overall mortality rate ranges between 15 and 65%.[2,5] The mortality rate may be as high as 20-80% 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 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] The 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, 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 CT studies of instrumentation in spinal surgery, the incidence of misplacement of 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, and cause pseudoaneurysm or rupture in the long term. In the chronic phase, symptoms occur depending on the development of pseudoaneurysm, rupture or arterio-venous fistula.[9]

FIGURE 3: Abdominal computerized tomography angiography showing a large pseudoaneurysm at the terminal abdominal aorta.

Previously described risk factors for vascular injury during lumbar discectomy are 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 first investigation as it identifies the cause, the location, and the extent of the bleeding, and it helps to differentiate between arterial and venous injuries.[5-7,11]

Fortunately, our patients' 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 can carry a morbidity rate up to 50%, See all References namely, from 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, and 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 the complications mentioned above.[9] Nowadays, the use of endovascular procedures avoiding open surgery results in a clear decrease of the morbidity associated with vascular surgery in such circumstances.[12] The advantages of endovascular techniques in patients are the absence of a thoracic or an abdominal incision, decreased blood loss, and a shorter anesthesia time, and a shorter hospital stay. Endovascular stent grafting is a preferable choice for patients with increased risks of aortic injuries in spinal surgeries, and in patients with multiple traumas who are unsuitable 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. reported that those procedures yielded very good long-term results, and suggested that endovascular procedures should be considered as first-line treatment options in arterial injuries after spinal surgery.[7]

In case 1, 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, injury site and the pseudoaneurysm were at the terminal abdominal aorta. The probability of graft migration was low, and sufficient proximal and distal graft fixation were done easily. In this case, the possibility of luminal compromise of iliac arteries was a matter of concern. Hence, we used Zenith Flex (Cook Inc., Bloomington, IN, USA) stent graft main body (24 mm-84 mm), and two Zenith Flex (Cook Inc., Bloomington, IN, USA) iliac legs (16 mm-55 mm). Spinosa et al. recommended that if a stent is placed at the origin of a common iliac artery, a stent should also be placed in the contralateral common iliac artery, even if it was normal.[13] It has been proposed that those kissing stents would prevent compromise of the contralateral iliac artery. On the other hand, Smith et al. reported that contralateral protection during proximal common iliac artery stenting was not needed.[14] In our case, we

used a bifurcated stent graft since the injury was at the terminal aorta.

CONCLUSION

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

Conflict of Interest

Authors declared no conflict of interest or financial support.

REFERENCES

1. Erkut B, Unlü Y, Kaygin MA, Colak A, Erdem AF. Iatrogenic vascular injury during to lumbar disc surgery. Acta Neurochir (Wien). 2007; 149(5):511-5.
2. Skippage P, Raja J, McFarland R, Belli AM. Endovascular repair of iliac artery injury complicating lumbar disc surgery. Eur Spine J. 2008 Sep; 17 Suppl 2:S228-31.
3. Van Zitteren M, Fan B, Lohle PN, de Nie JC, de Waal Malefijt J, Vriens PW, Heyligers JM. A shift toward endovascular repair for vascular complications in lumbar disc surgery during the last decade. Ann Vasc Surg. 2013 Aug; 27(6):810-9.
4. Brewster DC, May AR, Darling RC, Abbott WM, Moncure AC. Variable manifestations of vascular injury during lumbar disk surgery. Arch Surg. 1979 Sep;114(9):1026-30.
5. Papadoulas S, Konstantinou D, Kourea HP, Kritikos N, Haftouras N, Tsolakis JA. Vascular injury complicating lumbar disc surgery. A systematic review. Eur J Vasc Endovasc Surg. 2002 Sep; 24(3):189-95.
6. Yildiz R, Oztas M, Sahin MA, Yagci G. Abdominal aortic injury due to lumbar surgery. Ulusal Cer Derg 2013; 29: 192-196.
7. Canaud L, Hireche K, Joyeux F, D'Annoville T, Berthet JP, Marty-Ané C, et al. Endovascular repair of aorto-iliac artery injuries after lumbar-spine surgery. Eur J Vasc Endovasc Surg. 2011 Aug;42(2):167-71.
8. Szolar DH, Preidler KW, Steiner H, Riepl T, Flaschka G, Stiskal M, et al. Vascular complications in lumbar disk surgery: report of four cases. Neuroradiology. 1996 Aug; 38(6):521-5.
9. Ünlü Y, Dağ Ö, Vural Ü, Ceviz M, Koçak H. Vascular complications in lumbar disc hernia surgery based on a case. Turk J Vasc Surg 1999; 3: 127-130.
10. Loh SA, Maldonaldo TS, Rockman CB, Lamparello PJ, Adelman MA, Kalhorn SP, et al. Endovascular solutions to arterial injury due to posterior spine surgery. J Vasc Surg. 2012 May; 55(5):1477-81.
11. Döşoğlu M Iş M, Pehlivan M, Yildiz KH. Nightmare of lumbar disc surgery: iliac artery injury.Clin Neurol Neurosurg. 2006 Feb; 108(2):174-7.
12. Jin SC, Park SW, Cho do S. Management of Proximal Iliac Artery Injury during Lumbar Discectomy with Stent Graft. J Korean Neurosurg Soc. 2012 Apr;51(4):227-9.
13. Spinosa DJ, Angle JF, Hagspiel KD, Pyle DA, Matsumoto AH. Iliac artery stenting: a review of devices and technical considerations. Appl Radiol 1998; 27:10-24.
14. Smith JC, Watkins GE, Taylor FC, Carlson LA, Karst JG, Smith DC. Angioplasty or stent placement in the proximal common iliac artery : is protection of the contralateral side necessary? J Vasc Interv Radiol.2001;12:1395–1398.