

Analysis of vascular injury in lumbar spine surgery

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ABSTRACTS

Objective: To investigate the incidence of vascular injury in lumbar spine surgery and determine the strategy for its diagnosis and treatment.

Methodology: We retrospectively reviewed 1159 patients in our institution treated with lumbar spine surgery from September 2003 to November 2009. Primary outcomes measured included intraoperative vascular complications, operative blood loss and operative mortality.

Results: The incidence of vascular injury is significantly higher in anterior exposure (9.1%) than posterior exposure (0.29%) ($p < 0.05$) and 84.4% of vascular injury involved in L4-5 segment. Nineteen patients experienced vascular injury in two-level or multi-level exposure and 26 in one-level exposure, no significant difference between two groups was found ($p > 0.05$). One patient died and others got favourable results.

Conclusion: L4-5 segment has high incidence of vascular injury especially when anterior exposure is performed, and spine surgeons should pay more attention to the fatal complication.

KEY WORDS: Anterior lumbar spine exposure, Posterior lumbar spine exposure, Vascular injury, Incidence.

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INTRODUCTION

With the development of bone graft substitutes and artificial discs, lumbar surgeries has become quite popular in spine department, which is performed to treat many lumbar spine disorders such as trauma, degenerative disc disease, tumors, tuberculosis and so on. However, the close anatomic relationship between lumbar spine and great vessels including aorta, inferior vena cava, or iliac vessels result in more complications of vascular injury reported with the widely used procedures. Vascular injury is unusual, life-threatening complication of lumbar

surgery and surgical repair may be successful, but requires a major procedure associated with high mortality of 10%.^{1,2} Consequently, it is essential for spine surgeons to recognize and make the correct strategies to deal with the fatal complication.

Therefore, we retrospectively reviewed the data of 1159 patients in our institution treated with lumbar surgery from September 2003 to November 2009, among which there were 45 patients involved in vascular injury during or after surgery. The purpose of the current study was to document the incidence, the timely diagnosis and treatment plan for this complication.

METHODOLOGY

A concurrent database was kept on 1159 consecutive cases undergoing lumbar surgery in our institution between September 2003 and November 2009. The anterior, posterior or combined anterior and posterior surgeries were performed on the patients for lumbar disorders such as lumbar disc prolapse, degenerative disc diseases, scoliosis, discogenic pain and degenerative

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Table-I: Indications for lumbar spinal exposure.

<i>Indications</i>	<i>n=</i>	<i>Percentage</i>
Anterior exposure	461	39.8
Degenerative disk disease	187	16.1
Failed previous spinal fusion	17	1.5
Scoliosis	24	2.1
Spondylolisthesis	45	3.9
Spinal instability	107	9.2
Spondyloptosis	35	3.0
Artificial disc replacement	46	4.0
Posterior exposure	667	57.5
Degenerative disk disease	318	27.4
Spondylolisthesis	123	10.6
Spinal instability	109	9.4
Lumbar discectomy	117	10.1
Combined anterior and posterior exposure	31	2.7
Lumbar burst fracture	21	1.8
Lumbar tumor	7	0.6
Spondyloptosis	3	0.3

lumbar instability and so on. Vascular injury was defined as any case in which a suture was required to control bleeding. Major vascular injuries were defined as those requiring transfusion, vascular reconstruction or blood loss greater than 300ml.³ Demographics, technique and levels of exposure were recorded. Primary outcomes measured included intraoperative vascular complications, estimated operative blood loss and operative mortality.

Statistical analysis was performed using SPSS 17.0 (SPSS Inc., Chicago, IL, USA). The significance of predictors of vascular injury was determined by Fisher exact test for categorical variables. The association between spinal level exposed and vascular injury was determined with univariate logistic regression analysis. A probability value of < 0.05 was considered to indicate statistical significance.

RESULTS

A total of 1159 lumbar spinal exposures, including 461 anterior spine surgeries, 667 posterior spine surgeries and 31 combined anterior and posterior surgeries, were performed on 1129 patients in our

Table-II: Number of injuries by level exposed.

<i>Spine levels exposed</i>	<i>Number of patients</i>
L1-2	0
L2-3	1
L3-4	4
L4-5	38
L5-S1	2

institution from September 2003 to November 2009. The age at operation ranged from 17 to 78 years old. Seven hundred forty eight (748) patients were men and 381 were women. Operative indications are listed in Table-I, the spinal level exposed are listed in Table-II and the number of injuries by level exposed are listed in Table-III.

Of 461 patients who had anterior lumbar spine exposure, 42 patients (9.1%) experienced a vascular injury. In 31 cases undergoing combined anterior and posterior surgery, 1 case (0.03%) experienced vascular injury when anterior surgery was performed. While in the remaining 667 patients who received posterior lumbar surgery, only 2 cases (0.29%) experienced a vascular injury. The incidence of vascular injury in anterior and posterior exposure was 9.1% and 0.29% respectively. Statistical analysis revealed that anterior exposure is associated with increased rate of vascular injury ($p < 0.05$).

Of 45 cases with vascular injury, 38 (84.4%) had exposure of L4-5 while 7 (15.6%) didn't. The incidence of vascular injury is significantly higher in L4-5 segment than that in other segments ($p < 0.05$). In the 1159 cases, 628 cases were performed in two-level or multi-levels, among which 19 patients (3.0%) were involved in vascular injury, while in the 531 patients with one-level spinal exposure, 26 patients (4.9%) experienced a vascular injury. No significant difference between two groups was found in the current study ($p > 0.05$).

In 45 cases involved in vascular injuries, the Left common iliac vein injured in 32 cases, right common iliac vein in 3 cases, left internal iliac artery in 3 cases, left common iliac artery in 4 cases, left internal iliac vein in 2 cases and inferior vena cava in one case. Among the 45 cases, 42 were injured in anterior exposure, one in combined anterior and posterior exposure and 2 in posterior exposure. In 42 cases with vascular injury in anterior exposure, one patient had fresh thrombus found in the left iliac artery and was treated with immediate thrombectomy in surgery. Most of the other cases are vessel laceration, including 13 cases classified as major,

Table-III: Location of vascular injury.

<i>Location</i>	<i>n=</i>	<i>Percentage</i>
Left common iliac vein	32	71.1
Left internal iliac vein	2	4.4
Right common iliac vein	3	6.7
Inferior vena cava	1	2.2
Left internal iliac artery	3	6.7
Left common iliac artery	4	8.9

were repaired using direct suture in surgery, but one case of the left common iliac artery laceration secondary to anterior cage placement was so severe that an anatomic reconstruction with prosthetic graft was performed. The estimated blood loss for the patients with vascular laceration was 300-2000 cc. Of 13 cases, 2 cases with arterial injury were performed fasciotomy on lower leg simultaneously in surgery.

In addition, some injuries can't be recognized during anterior exposure and even remain undetected for years, in the current study, two patients were diagnosed as arteriovenous fistula and two patients as pseudo-aneurysms six months to three years after lumbar surgery, among which one patient were treated using open surgery but died in surgery and 3 treated using endovascular approach and got favourable outcomes with subsequent resolution of symptoms.

Among 667 cases undergoing posterior lumbar spine surgery, two cases were diagnosed as perforation of the left iliac artery and vein during lumbar discectomy. One case was a 46-year-old woman underwent discectomy at L4-5 segment. During the surgical procedure, surgeons did not observe any abnormal bleeding in the operating field and the patient did not show any signs of vascular injury. While, shortly after operation, arterial blood pressure decreased, tachycardia and abdominal pain occurred. Emergent laparotomy was performed and during which a 10mm laceration on the posterior aspect of the left common iliac artery was found and repaired. Another case was a 39-year-old lady undergone L4-5 discectomy and during the surgery the systolic blood pressure dropped, and vascular laceration was suspected and an urgent laparotomy was performed. Retroperitoneal exploration revealed a 13mm laceration on the posterior aspect of the left common iliac vein, a 10mm laceration on the postero-medial aspect of the right common iliac artery. Following clamping of the iliac artery and vein, a primary repair was achieved successfully. After the surgery, the two patients' clinical course was uneventful and discharged from the hospital seven days later.

DISCUSSION

Vascular injury is an unusual but feared complication of lumbar spine surgery and early diagnosis and urgent surgical intervention in patients with early-onset injuries is critical. In the current study, we performed a review of our experience with the treatment of vascular injuries

after lumbar spine surgery to help spine surgeons determine the strategy of diagnosis and treatment of the fatal complication.

In the current study, we found most of vascular injuries occurred in L4-5 segment. During the 45 cases of vascular injuries after lumbar spine exposure, 38 of which occurred at L4-5 level and the incidence of vascular injuries in L4-5 segment are significantly higher than that in other segments, demonstrating L4-5 level is vulnerable to vascular injuries. Our results are consistent with most studies from other authors.^{4,5} From the angle of anatomy, the common iliac arteries and veins, which are immediately anterior to the L4-5 lumbar disc space, are reported as most commonly injured vessels.¹ In addition to that, most disc degeneration disorders occurred at L4-5 or L5-S1 level and corresponding surgeries were performed in these segments. These can be the explanation of why L4-5 level has higher incidence of vascular injury.

At the same time, we found the incidence of vascular injuries is significantly higher in anterior spine exposure than that in posterior spine exposure. In the 667 cases of posterior lumbar spine exposure, only two cases was diagnosed as vascular injury, while in the 461 cases of anterior lumbar spine exposure, 42 cases was diagnosed as vascular injury. The anterior lumbar surgery has more risks in vascular injury, the close anatomy relation between great vessels and lumbar spine are the primary reason, which is not unexpected, as exposure of spinal levels superior to L5-S1 require greater mobilization of the iliac vessels as well as the aorta and vena cava.³ In addition, the retroperitoneal inflammatory processes resulted from pre-existing disc degeneration leading to adhesion between the vessels and the disc may aggravate the risks of vascular injury.⁶ Consequently, much attention should be paid in anterior lumbar spine exposure.

In terms of treatment of vascular injuries during anterior approach surgery, we determine the treatment methods depending on the type of vascular trauma, most of the injuries may be evident and immediately recognized in surgeries, and we perform direct suture or anatomic reconstruction with prosthetic graft intra-operatively. In terms of arteriovenous fistula or pseudo-aneurysms after lumbar surgery, open surgery or endovascular approach can be performed. In the report of seven patients of vascular injuries after lumbar disc surgery, Canaud suggested that the endovascular approach is an effective and reliable method with a lower mortality rate when compared with

open surgical procedures.¹ In the current study, we treated three cases of vascular injury using endovascular approach and the outcome are satisfactory, subsequently we think the treatment of endovascular approach may be a trend in the future, while the sample size of patients treated is relatively small in the current study and more clinical observations need to be performed in the future.

Compared to anterior lumbar spine exposure, the incidence of vascular injury in posterior spine exposure is rare, but the immediate diagnosis and management is usually difficult once the vascular injury occur. In one case, we did not observe any abnormal bleeding or abnormal wound in the operating field during surgery, which could be explained by the self-sealing elastic structure of the anterior longitudinal ligament and disc annulus leading to blood leakage in the retroperitoneal space.⁷ In addition, the delayed hemodynamic signs during procedures may also be related to a compressive effect of the prone position.⁷ Consequently, the vascular injury should be attached more importance during posterior lumbar surgery and any unexplained hypotension during or immediately after lumbar disc surgery is highly suggestive of vascular injury.

Moreover, we suggest the fasciotomy is particularly important in the reconstruction of vascular injuries because the soft tissue trauma, crush injury and venous injury or occlusion result in the higher risk of compartment syndrome.^{8,9} Some scholars suggest that fasciotomy done at the time of arterial repair, but before the development of compartment syndrome, may lower amputation rates particularly.¹⁰ In the analysis of 1315 consecutive patients undergoing anterior lumbar surgery, Brau suggested prophylactic fasciotomies for any patients who are ischemic for more than two hours, especially if they are young or without any evidence of chronic occlusive vascular disease.⁵ Subsequently, in the present study, fasciotomy was performed in two cases simultaneously in the surgery of vascular repair and the two patients got favourable outcomes. Although the present study was not a controlled one, we believe the fasciotomy would play an important role in preventing complications in the treatment of vascular injury.

CONCLUSION

We retrospectively reviewed the data of 1159 patients in our institution treated with lumbar surgery from September 2003 to November 2009 and found L4-5 segment had high incidence of vascular injury, especially when anterior exposure is performed. Most of cases can be treated using suture intra-operatively, but they are life-threatening and spine surgeons should pay more attention to the fatal complication.

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