SURGERY ORIGINAL ARTICLE

Anterior lumbar spine exposure with vascular surgeon assistance

M Pizzamiglio[1], A González García[1], C Aparicio Martínez[1], PL Torres Lebruno[1], J Díaz Cruz[1], CL Mengis[2], JM Gallego Bustos[2], F Tomé-Bermejo[2], L Álvarez Galovich[2]

[1]Department of Vascular Surgery. Hospital Universitario Fundación Jiménez Díaz. Madrid, Spain.

[2]Spine Unit. Department of Orthopaedic Surgery. Hospital Universitario Fundación Jiménez Díaz. Madrid, Spain.

submitted: Nov 15,2022, accepted: Dec 29, 2022, EPub Ahead of Print: Dec 30, 2022
Conflict of interest: None

DOI: 10.24019/jtavr.150 - Corresponding author:Dr. Matteo Pizzamiglio, mpizzamiglio.3@gmail.com

Abstract Objective: Evaluate access related complications contributing to adverse outcomes in patients undergoing retroperitoneal anterior lumbar interbody fusion (ALIF).

Methods: A retrospective analysis was conducted of prospectively collected data on patients undergoing ALIF in a multidisciplinary setting at our institution from January 2007 to December 2021. Patients' demographics, comorbidities, exposure related and postoperative complications within 30 days were included. Main outcome measures included vascular and visceral injuries requiring repair, nerve injuries, blood transfusion requirements, myocardial infarction, stroke, erectile dysfunction, retrograde ejaculation, length of stay and death.

Results: Seventy-four consecutive patients were included. Forty-seven were female and 27 male. The median body mass index was of 25.46 ± 4.76. Mean age was of 45.74 years. Twelve had a history of previous abdominal surgery and 31 a previous spinal surgery. The level operated on was L5/S1 in 58 patients (78.37%), L4/L5 in 2 patients (2.7%) and multi-level in 14 patients (18.91%). Sixteen patients had both anterior and posterior approach. There were no major intra-operative vascular injuries. Two patients had an intestine serosal tear. Seven patients had sexual dysfunction after surgery, of which 5 suffered impotence and 4 retrograde ejaculation. Two patients had both. There were no cases of disc space infections. There were no postoperative deaths.

Conclusions: In a multidisciplinary setting, ALIF can be performed safely with a reasonably low overall complication rate. Impotence and retrograde ejaculation are, even if generally temporary, important issues that have to be informed to the patient and inquired at follow up.

Keywords Anterior spinal exposure; Vascular injuries; Access-related complications; access surgeon; impotence; retrograde ejaculation.

Introduction

Anterior approach for thoracolumbar spine exposure (ALE) has the advantage to have an applicability to a variety of degenerative lumbar spine conditions in addition to infection, failed previous transforaminal lumbar interbody fusion, trauma, tumor, and removal of misplaced or migrated previous implants. However, the anterior approach is still not the first choice for many surgeons due to the potential risk of serious vascular and visceral injury[1].

The most significant complication of the anterior lumbar exposure is vascular injury, and the reported rate varies greatly; ranging from 1.9 % to 26 % [2-3]. Vascular complications are usually related to the need to mobilize the great retroperitoneal vessels and other adjacent structures to gain exposure to the disc space of interest. This requires vascular and general surgical skills on the part of the operating surgeon in order to both perform the exposure and deal with any resulting complications.

Table I
Demographic and baseline characteristics

Characteristics	N (%) / mean ± SD
Female sex	47 (64)
Age	45.74 ± 11.8
Body mass index	25.46 ± 4.76
Tobacco use	-
- Never	48 (65)
- Current	25 (34)
- Former	7 (9)
Hypertension	5 (7)
Diabetes	5 (7)
Hyperlipidemia	7 (9)
Previous abdominal surgery	12 (16)
Previous spine surgery	31 (42)

Vascular surgeons have been involved as 'access surgeons' due to their great familiarity with the retroperitoneum and it is suggested their routine involvement minimizes the perioperative complication rate especially the risk of vascular injuries.

The purpose of this study was to report our experience for anterior access to the lumbar spine. We have focused on the outcomes that relate to the surgical access and the exposure of the lumbar spine.

Methods

We reviewed our operative database between January 2007 and December 2021. Patient's records, operative notes and outpatient follow-up have been reviewed to identify all patients who underwent anterior lumbar inter-body fusion (ALIF). We also included patients with both anterior and posterior approach.

The examined variables included: patients age, sex, body mass index, cardiovascular risk factors, previous abdominal surgery, previous lumbar surgery, and level of the lumbar disc(s) operated on. These variables were prospectively collected on admission and recorded in the patients' records and electronic discharge letters. Perioperative vascular, visceral and neurological complications were recorded in the operative notes. Length of hospital stay (LOS) was calculated retrospectively from the electronic discharge letters.

The primary endpoints were defined as the rate of intraoperative vascular or general surgical complications. Minor vascular complications were defined as any vascular injuries not controlled intraoperatively by direct pressure or bipolar diathermy and requiring simple suturing. Major vascular complications were defined to be any vascular injury fulfilling one or more of the following criteria: intraoperative injuries requiring multi-suturing repair or vascular reconstruction[3].

Postoperative hospital stay was also reviewed to determine the rate of complications, length of hospital stay and the mortality rate. Sexual complications such as erectile dysfunction and retrograde ejaculation were assessed by a direct questioning at outpatient follow-up and during data collection were contacted by phone to detect sexual dysfunction not reported after surgery.

The study protocol was approved by the Spine Unit department in our institution and no ethical approval was required.

Surgical Technique

Access was performed by two spinal surgeons with the help of a vascular surgeon. In order to guide the incision, localize the level of vena cava and aortic bifurcation, assess the degree of vessel calcification or the presence of an aneurysm, and locate the ureters and other anatomic variations, careful review of preoperative plain radiographs, computed tomography scans, and/or magnetic resonance imaging is conducted before every operation. After a paramedian skin incision is made, the fascia is transected and every effort is taken not to breach the peritoneal layer in order to prevent the colon and omentum from projecting into the surgical field while attempting to effectuate fusion. Careful dissection preserves the inferior epigastric arteries that are present when L4 to S1 levels are exposed. Nevertheless, surgical clips or bipolar electrocautery can be used to quickly reduce bleeding of these vessels. Once the left psoas muscle is reached, retractors are used to move the abdominal contents and left ureter to the far right of the patient, allowing the sacral promontory to be seen. The genitofemoral nerve, which runs anterior to the psoas muscle, must be protected against damage.

To reduce the likelihood of retrograde ejaculation, we refrain from using monopolar in this area and do not isolate iliac vessels with silastic loops. We take care not to injure the genitofemoral nerve, which travels anterior to the psoas muscle.

By removing the iliolumbar veins(s), the L4 to L5 interbody space is made visible. It is essential to identify all branches of this vein before retracting the left iliac vein to the far right of the patient, revealing the L4 to L5 interbody space.

Damage of the sympathetic chain is prevented by gently releasing it with a Knitter and retracting it to the patient's left. In some patients we use a Pfannenstiel rather than a paramedian incision to expose the L4 to S1 disk

spaces, which gives better aesthetic results but has the disadvantage that encounters more difficulties in managing complications.

Results

A total of 74 consecutive patients who underwent ALIF between January 2007 and December 2021 were included. Forty-seven were female and 27 male. The median body mass index (BMI) was of 25.46 ± 4.76. The study population were of middle-age group with a mean of 45.74 years (range of 25–77). Thirty-two had a history of tobacco abuse, of which 25 were active smokers. Five had Hypertension, five Diabetes and 7 dyslipidemia. Twelve had a history of previous abdominal surgery and 31 a previous spinal surgery. Demographics and cardiovascular risk factors are included in Table I.

The level operated on was L5/S1 in 58 patients (78.37%), L4/L5 in 2 patients (2.7%) and multi-level in 14 patients (18.91%). Sixteen patients had both anterior and posterior approach. The skin incision was paramedian in 64 patients and Pfannestiel in 10. In 61 patients arthrodesis was performed and in 9 a prothesis was placed. In 3 patients with multi-level approach, both arthrodesis and prothesis placement were executed. The planned procedure was completed successfully in all cases and adequate exposure was achieved in all cases for the disc level of interest.

There were no intra-operative visceral injuries. Applying the predefined criteria of vascular injury, there were no major vascular complications. 1 patient and a minor vascular complication, which was a left common iliac venous injury repaired directly with a 5-0 Prolene suture. Two patients had an intestine serosal tear.

During the postoperative period, four patients had wound dehiscence. Two had wound infection, of which one was readmitted in hospital. One patient had abdominal hematoma and was also readmitted in hospital. These last two patients readmitted returned to the operating room for wound closure after negative pressure therapy and hematoma evacuation respectively. The patient with wound infection readmitted to hospital had a BMI of 30 kg/ m^2, and two patients with wound dehiscence had BMI > 25 kg/m^2, but given the small number of infections and wound dehiscence we couldn't show a correlation between BMI and wound complications. Fifteen patients had postoperative anemia, of which two required blood transfusion and 13 oral supplements. One patient had postoperative paralytic ileus. One patient had postoperative neuropathy of the left femoral cutaneous nerve diagnosed with electromyography, which cursed with persistent paresthesia in the left thigh. Five patients had erectile dysfunction after surgery and 4 retrograde ejaculation. Two of these patients suffered both complications. The median length of stay was of 3 days. Before 2018, the median length of stay was 5 days. Then the Enhanced Recovery After Surgery (ERAS)[4] protocol was applied, reducing median LOS from 2018 to 2021 to 2 days. LOS for patients with multi-level approach was higher, with a median of 5 days. There were no cases of disc space infections. There were no postoperative deaths (Table II).

Discussion

Because it can be used to treat a wide range of diseases, the ALIF treatment is extremely versatile.

The ALIF procedure's versatility stems from its ability to treat a wide range of diseases, however, it remains far less commonly performed than the posterior lumbar interbody fusion (PLIF) among surgeons. The explanation resides in the overall complication rate, as high as 30% to 40% [5], and the fear of vascular injuries, observed at rate between 1,4 and 26,4% [6,7].

In this series, there were no visceral complication and no major vascular complications. In explaining these results, a number of factors should be considered, including: procedures were performed by experienced surgeons, the access of all procedures have been assisted by a vascular surgeon, the avoidance of drilling in the disc space and the careful use of retractors.

One patient had postoperative injury of the left femoral cutaneous nerve. A review of iatrogenic neurological deficits after lumbar spine surgery showed that the prevalence of anterior approaches ranged from 1.5% to 5.6% [8]. Few data of nerve injury after ALIF has been published, but current evidence shows that it's inferior to PLIF, which ranges from 9 to 16% [9].

Erectile dysfunction and retrograde ejaculation are important complications associated with this type of surgery, especially at L5-S1 levels. A recent systematic review reported an overall incidence of 2.3% of retrograde ejaculation, of which nearly half of patients recovered between 3 and 48 months[10]. Other series report an incidence between 0.1% and 12.5% [2,11]. In our series, male patients were asked at follow up and contacted by phone during data collection. Of the 27 male patients treated, five suffered impotence and 4 retrograde ejaculation. Two patients had both. This implies that 26% (7/27) of the treated men had sexual dysfunction such as impotence, retrograde ejaculation or both. Age of these patients ranged between 28 and 49, with a median of 42. Impotence resolved over time in all patients except one, and in the cases of retrograde ejaculation, just one resolved. These results are higher than the reported in the literature. The modest number of treated cases could be an explanation. Nevertheless, of these 7 patients, only two declared their issue at postoperative follow-up. This raises concerns about the under reporting

of this type of complications and it's important to explain in detail this possible complication to patients. In our opinion, careful selection of patients giving preference to women and older men abstaining those with reproductive desires and during surgery minimizing damage of the superior hypogastric plexus of the sympathetic system by avoiding the use of monopolar in the interbody space and not isolating iliac vessels with silastic loops are key to minimize these type of complications.

It is our belief that good surgical technique (including good visualization), prevention of vascular injury with prompt and robust management of any vascular injuries intraoperatively and are the key factors to minimize the perioperative complications of ALIF. At our institution, the vascular surgeon is present only in the surgical approach to the lumbar spine. Given the complication rate, we have seen that it hasn't been necessary to the vascular surgeon to be present during the entire surgery.

Some authors who found a generally low rate of vascular and visceral damage have pushed for the use of "access surgeons" in surgical procedures[3]. Nevertheless, a meta-analysis questioned the role of it discovering that while the rates of complications with and without the access surgeon were comparable, vascular damage, retrograde ejaculation, and ileus were substantially more frequent when they were present[12]. One explanation could be that the vascular surgeon's approach is less delicate than that of the spinal surgeon due to the familiarity with this access and thus less fear. However, as numerous studies were taken into account, spine procedures were performed by a wide spectrum of spine surgeons and access surgeons with varied levels of experience. It's also possible that vascular surgeons were only consulted in the most challenging circumstances, such as when a high frequency of vascular and visceral issues was already anticipated.

In addition to its claimed advantages for patients, the collaborative method for open ALE has been promoted as one of the few chances left for the preservation of open-surgical skills for the developing vascular surgeons[3].

The current study has several limitations, with the first being its retrospective design, which makes it difficult to identify risk factors for given complications; and second, exposures in all of these patients were performed by an experienced vascular surgeon with a good background in retroperitoneal aortoiliac reconstruction. Less experienced surgeons were always backed up by a more seasoned surgeon who was readily available to assist when needed.

At our institution, ALIF is considered always more frequently, especially in reinterventions. Indication for ALIF has increased progressively per year. In 2021 we have performed 28 interventions with ALE. In the present series, a 42% of patients had history of previous spine surgery. It is also important a careful selection of patients. It is offered more frequently to women and older men who have given up the desire to procreate.

Conclusions

Vascular injuries are among the most dreaded complications of the ALIF procedure, most commonly occurring while exposing the L4 to L5 interbody space as a result of failure to ligate and divide the iliolumbar vein. In our series, there have been no cases of vascular injuries. Complications such as erectile dysfunction and retrograde ejaculation are, even if generally temporary, an important issue that has to be informed to the patient and inquired at follow up. Our findings suggest that, in a multidisciplinary setting, this procedure can be performed safely with a relatively low overall complication rate.

Table II
Operating room variables and complications

Operating room variables and complications	N (%)
Venous injuries	1
Arterial injuries	0
Small bowel serosal tear	2 (3)
Sexual Dysfunction	7/27 (26)
- Impotence	5 (19)
- Retrograde ejaculation	4 (15)
Ileus	1 (1)
Wound dehiscence	4 (5)
Wound Infection	2 (3)
Readmission in hospital	2 (3)
Stroke	0
Death	0

References

1) Manunga J, Alcala C, Smith J, Mirza A, Titus J, Skeik N, et al. Technical approach, outcomes, and exposure-related complications in patients undergoing anterior lumbar interbody fusion. J Vasc Surg [Internet]. 2021;73(3):992–8. DOI: 10.1016/j.jvs.2020.06.129

2) Asha MJ, Choksey MS, Shad A, Roberts P, Imray C. The role of the vascular surgeon in anterior lumbar spine surgery. Br J Neurosurg. 2012;26(4):499–503.

3) Chiriano J, Abou-Zamzam AM, Urayeneza O, Zhang WW, Cheng W. The role of the vascular surgeon in anterior retroperitoneal spine exposure: Preservation of open surgical training. J Vasc Surg [Internet]. 2009;50(1):148–51. DOI: 10.1016/j.jvs.2009.01.007

4) Dietz N, Sharma M, Adams S, Alhourani A, Ugiliweneza B, Wang D, et al. Enhanced Recovery After Surgery (ERAS) for Spine Surgery: A Systematic Review. World Neurosurg. 2019;130:415–26.

5) Rajaraman V, Vingan R, Roth P, Heary RF, Conklin L, Jacobs GB. Visceral and vascular complications resulting from anterior lumbar interbody fusion. J Neurosurg. 1999;91(1 SUPPL.):60–4.

6) Garg J, Woo K, Hirsch J, Bruffey JD, Dilley RB. Vascular complications of exposure for anterior lumbar interbody fusion. J Vasc Surg [Internet]. 2010;51(4):946–50. DOI: 10.1016/j.jvs.2009.11.039

7) Bianchi C, Ballard JL, Abou-Zamzam AM, Teruya TH, Abu-Assal ML. Anterior retroperitoneal lumbosacral spine exposure: Operative technique and results. Ann Vasc Surg. 2003;17(2):137–42.

8) Ghobrial GM, Williams KA, Arnold P, Fehlings M, Harrop JS. Iatrogenic neurologic deficit after lumbar spine surgery: A review. Clin Neurol Neurosurg [Internet]. 2015;139(2015):76–80. DOI: 10.1016/j.clineuro.2015.08.022

9) Zhao J, Gum JL, Dimar JR, Buchowski JM. Anterior lumbar interbody fusion. Spondylolisthesis Diagnosis, Non-Surgical Manag Surg Tech. 2015;179–90.

10) Body AM, Plummer ZJ, Krueger BM, Virojanapa J, Nasser R, Cheng JS, et al. Retrograde ejaculation following anterior lumbar surgery: A systematic review and pooled analysis. J Neurosurg Spine. 2021;35(4):427–36.

11) Sasso RC, Burkus JK, LeHuec JC. Retrograde ejaculation after anterior lumbar interbody fusion: Transperitoneal versus retroperitoneal exposure. Spine (Phila Pa 1976). 2003;28(10):1023–6.

12) Phan K, Xu J, Scherman DB, Rao PJ, Mobbs RJ. Anterior Lumbar Interbody Fusion with and Without an “access Surgeon.” Spine (Phila Pa 1976). 2017;42(10):E592–601.