Clinical anatomic study of the lower lumbar anterolateral vein: with respect to retroperitoneal endoscopic surgery

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Objective: To study the anatomy of veins of the lower lumbar spine and provide the anatomic basement for laparoscopic lumbar surgery.

Methods: A total of 15 formaldehyde-preserved cadavers were studied with special attention to the variety and surrounding structure of ascending lumbar vein (ALV) and iliolumbar veins (ILV), and their relationship with lumbar plexus.

Results: ALV and ILV can be found on every side, which have four variants including separate entry and common entry. The ascending vein and iliolumbar vein separately enter common iliac vein in 18 cases, and as a common stem enter the common iliac vein in 12 cases. Retracting common iliac vein medially both the ascending lumbar and the iliolumbar veins are always at risk of avulsion on exposure of the disc space. The injury of obturator nerve and lumbosacral trunk of lumbar plexus should be avoided.

Conclusion: Awareness of these anatomic variation can prevent the hemorrhage and be helpful for the surgeon in performing a careful ligation of these veins before medial retraction of the common iliac vein. Our findings emphasize the need for proper dissection of ALV and ILV before ligation during exposure of the lower lumbar spine.

Key words: Laparoscopy; Lower lumbar; Ascending lumbar vein; Iliolumbar vein

Recently, as the development of less invasive spine surgery, the retroperitoneal endoscopic surgery has been applied in the anterior lumbar interbody fusion, infection, tumor, trauma and so on. Retroperitoneal endoscopic technology avoids the limitation that transperitoneal endoscopy has only been applied in L4-S1 disc space and complication of retrograde ejaculation. It can be applied in the L1-S1 disc space and have a good foreground. But it is needed to retract the common iliac vein medially in exposing the lower lumbar. If the common iliac vein has been retracted more medially, the avulsion of the ascending lumbar vein (ALV) and iliolumbar vein (ILV) can be induced, which is the main cause of open conversion and failure. Some authors mentioned that ILV and ALV should be ligated before retracting the common iliac vein medially for preventing hemorrhage during operation. We expected to provide the anatomic basis according to the characteristics of ALV and ILV in the retroperitoneal laparoscopic lumbar surgery.

METHODS

We dissected ALV and ILV from 15 formaldehyde-preserved cadavers, 8 males and 7 females. The diameters of ALV and ILV, the distance between confluence of the common iliac vein and ALV or ILV and the angle of veins were measured by vernier caliper. The drainage pattern of veins and their relationship to nearby structures were observed. An assessment of the avulsion risk was made for each vein by medially retracting the common iliac vein in order to expose the L1-L5 disc space bilaterally.

RESULTS

Types of ALV and ILV

ALV and ILV can be found on every side. According to the variants of veins draining into the common iliac vein including separate entry and common entry, there
are two types: the type I is that ALV and ILV separately enter common iliac vein in 22 cases (73.3%). ALV is always single stem, and there are two subtypes according to variant of ILV in which the A subtype is common stem in 16 cases (53.3%) and B subtype is separate in 6 cases (20%). The type II is that ALV and ILV enter the common iliac vein as a common stem in 8 cases (26.7%). The A subtype is common stem in 5 cases (16.7%) and B subtype is separate in 3 cases (10%, Fig. 1).

**Anatomic measurement of ALV and ILV**

The anatomy of the ALV and ILV on both sides was identical in 4 cases and different in 11 cases (8 cases on left side and 7 cases on right side). ALV was located in the superior anterolateral edge of L5 in type I, the angle with the common iliac vein was 28.4° (15.8°-43.7°), and average diameter was 4.2 mm (2.9-4.6 mm). ILV was located in L5 or lumbosacral disc, the angle with the common iliac vein was 87.8° (76.7°-108.4°), average diameter was 7.12 mm (4.35-8.93 mm), and length of stem was 7.1 mm (3.1-12.5 mm). The diameters of two tributaries are different, in which the wide tributary was 4.3 mm (3.4-2.1 mm), thin tributary was 2.7 mm (1.9-3.7 mm) and the distance between two veins was about 28.9 mm (15.2-40.9 mm). The distance between confluence with common iliac vein and ALV was 11.6 mm (8.2-16.8 mm), and ILV was 35.2 mm (21.9-48.2 mm). The distance of the ALV and ILV was 26.8 mm (13.5-46.8 mm). In type Δ ALV, located in the anterolaterally L5 or lumbosacral disc, was always superior to ILV and had a cephalic orientation. Its diameter was 3.8 mm (2.4-5.3 mm). The length of stem was 5.6 mm (3.5-6.8 mm), and diameter was 9.4 mm (5.8-10.3 mm). The wide tributary diameter of ILV was 3.6 mm (2.4-5.3 mm), and thin tributary diameter was 2.2 mm (1.2-3.8 mm). The tension of ALV and ILV increased especially in the proximal tributary on retracting the common iliac vein medially. ALV was torn in the 25 cases (83.3%) and ILV was torn in 14 cases (46%).

**Relationship of ALV and ILV with surrounding structure**

In the dissection, the surgeon should identify the lumbosacral plexus, especially the obturator nerve and lumbosacral trunk, which are closely related to ALV and ILV (Figs. 2 and 3). The obturator nerve crossed superficially to ILV. The obturator nerve crossed the mouths of ILV and ALV at a mean distance of 3.12 cm and 2.46 cm. The lumbosacral trunk passed deep to ILV and the site of entry into the common iliac vein. The distances between lumbosacral trunk and entry into the common iliac vein are about 1.86 cm and 1.64 cm.
DISCUSSION

As Zuckerman reported 2 cases of anterior lumbar interbody fusion by retroperitoneal laparoscopy in 1995, there has been a paradigm shift toward the application of retroperitoneal laparoscopy operative techniques, and now it has mostly been used in the interbody fusion of lower lumbar. ALV and ILV are located in the lower lumbar anterolaterally and can be easily avulsed in the operation for exposing lower lumbar and result in massive hemorrhage, which is the main cause of operation change and failure. So the surgeon should be familiar with the variant of lumbosacral lateral veins in the retroperitoneal endoscopic surgery.6,7 The variant of those veins is complex according to our anatomic observation. There are separate entry and common entry draining into the common iliac vein.

Anatomy of ALV and ILV and its clinical significance

The ALV drains into the common iliac vein and sometimes connects the ILV, azygos and hemiazygos vein system. The ILV drain the iliacus and psoas muscles, and can be seen as fifth lumbar vertebra vessel.8 Though sometimes two veins have common stem, we can distinguish ILV from ALV: the latter is a longitudinal structure draining into the azygos system and the iliolumbar vein has more longitudinal orientation. Doroshenko et al9 reported that 15 corpectomies of L2-L4 vertebrae were performed by the mini-invasive anterolateral retroperitoneal approach and damage to the ascending lumbar vein took place in 4 cases. Our study showed that ALV should be carefully ligated before medial retraction of common iliac vein for exposure to lower lumbar. The ALV and ILV must be ligated for exposure of L5 and lumbosacral, thus prevent the hemorrhage. Mayer et al10 reported ALV has to be ligated in about 15% cases and the common iliac vein only needs slight mobilization and retraction in about 30% cases in anterior lumbar interbody fusion at L4-L5 by minimally invasive methods. In our experiment, most of veins needed to be ligated before retracting the common iliac vein medially. Both the ascending lumbar and main iliolumbar veins were torn in retraction, or the vein would be tore, which may be related to the elasticity of vein decrease due to the immerge into the formaldehyde. The ligation and dissection of the veins for safe exposure is different from the true surgery, which may need little traction. But awareness of those anatomic difference should assist the surgeon in performing a careful ligation of these veins before medial retraction of the common iliac vein and thus prevent hemorrhage.

Variant of two veins and its clinical significance

There are 2 types and 2 subtypes according to the variants draining into the common iliac vein including separate entry and common entry. It is very important to ligate the veins according to their different types. There are several variations in the tributaries of the iliolumbar vein. The presence of multiple tributaries may be hazardous. If the lateral ligature does not include all the tributaries, massive hemorrhage could ensue. As for type $c$, we can ligate ALV and ILV separately or together. In type IIA, we can ligate the long main stem. Its diameter is wide and it is close to that of common iliac vein. It is suggested to separately ligate the vein and decrease the risk of a sidewall injury to common iliac vein. In type IIB, common stem is wide, so the surgeon should separately ligate the tributary for preventing the avulsion of vein. The variation in the length of the main stem makes the ligature difficult, particularly when the vein is virtually short with no stem. Our study confirms that there are variations in the anatomy of ALV and ILV, but those veins are always at risk of avulsion on safe surgical exposure of the disc space by retracting the common iliac vein medially, no matter whether the veins variation is the figure, position, tributaries or number of veins.

Surrounding structures of ALV and ILV

We found that ALV and ILV had the intimate relationship with the obturator nerve and lumbosacral trunk of lumbar plexus. Although the lumbar plexus nerve has not been previously described, there are some possibility of injury in exposing the lower lumbar. The obturator nerve always passes superficially to the vein, lumbosacral trunk almost passes deep to it and the nerves crossed near the mouth of the vein. These nerves could be injured by exposing or ligaturing with the lateral portion of vein if the vein was not adequately exposed. To avoid damaging the obturator nerve, the veins should be ligated near common iliac vein and avoid the dissection of lateral portion of vein. To avoid damaging the lumbosacral trunk, the dissection should be done superficially near the mouth of vein. In inadvertent hemorrhage, the nerves could easily be dam-
aged by clamps or diathermy.

Our findings emphasize the importance of proper dissection of ILV and ALV before ligature during exposure to the anterior lumbar spine and proper exposure to those veins before ligature to allow safe surgical exposure to the anterior lumbar spine. Our study also confirms that there are variations in the anatomy of ALV and ILV, and the surrounding structure such as the obturator nerve and lumbosacral trunk.

REFERENCES


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