Anatomical basis of lumboscopy

R. Yiou[1], V. Delmas[2], D. Chopin[1] and C.-C. Abbou[1]

[1] Service d'Urologie, Hôpital Henri Mondor, 51 avenue du Maréchal de Lattre de Tassigny, F-94010 Créteil France
[2] Laboratoire d'Anatomie Necker-Enfants malades, Institut d'Anatomie des Saints-Pères, F-75006 Paris, France

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Correspondence to: R. Yiou E-mail : reneyiou@hotmail.com

Abstract

Lumboscopy provides an approach to the retroperitoneum for the majority of upper urinary tract operations. The technique involves a knowledge of specific anatomical landmarks that differ from those in classical open surgery, because of the inferior approach to the renal pedicle with the kidney initially mobilized in a ventral and cranial position. An anatomical study was conducted on five cadavers, using images from surgical operations, in order to describe the vascular elements of the retroperitoneal spaces as they are approached during lumboscopy, as well as to define specific anatomical landmarks. Identification of psoas major is crucial as it is then possible to locate the renal pedicle opposite and the area of the great vessels medially. During dissection of the renal pedicle the renal vein and its branches are the first elements to be approached. On the left side the distal portion of the renal vein can be confused with a reno-hemi-azygo-lumbar trunk, due to the initial ventral mobilization of the kidney stretching it. Because of the inferior view of the renal pedicle the reno-hemi-azygo-lumbar trunk can obscure part of the renal artery and may be confused with the renal vein. On the right side initial identification of the inferior vena cava on the medial aspect of psoas major facilitates identification of the gonadal, renal and suprarenal veins all located in the same plane.

Laparoscopic surgery has developed rapidly during the past decade and is, at present, suitable for the majority of upper urinary tract operations, including simple and radical nephrectomy, ureteropelvic junction repair, adrenalectomy and the diagnosis of retroperitoneal adenopathies [1, 2, 4, 7, 8, 10, 12, 14, 18, 23]. Due to the small incision used laparoscopic surgery is associated with less postoperative morbidity and a shorter hospital stay [1]. However, the technique, which can be performed either by the transperitoneal or retroperitoneal route (lumboscopy), requires specific training.The main difficulties encountered with lumboscopy are related to the complex anatomy of the retroperitoneal veins, as well as the approach to the renal pedicle, which differs radically from that of classical open surgery. In addition, retroperitoneal insufflation, which initially occurs in the posterior pararenal space, leads to ventral and cranial mobilization of the kidney and its pedicle, resulting in an unfamiliar view of the renal pedicle that may lead to confusion.

The aims of the present study were to describe the normal anatomy of the renal space and the elements within it as they are approached during lumboscopy, as well as identifying potential visual pitfalls created by the modified angle of vision.

Materials and methods

An anatomical study was carried out on five formalin-preserved cadavers (2 males and 3 females). Using an initial xiphopubic incision, the digestive organs were displaced and the posterior parietal peritoneum dissected to reveal the anterior pararenal space. The cadavers were then placed in the lumbotomy position and the renal compartment dissected using the digital maneuver used in our department [10]. A 1.5 cm skin incision was made at the vertex of the angle formed by the erector spinae mm. and the twelfth rib, behind the posterior axillary line.The index finger was introduced through the lumbar wall into the posterior pararenal space in order to begin mobilization of the renal compartment. The different muscle layers crossed were identified. The limits of digital detachment of the posterior pararenal space and the usual tactile landmarks used in lumboscopy were described by the abdominal route. After defatting the components of the renal compartment, the kidney was mobilized ventrally and cranially to reproduce the effects of insufflation of the posterior pararenal space. Drawings and photographs of the renal pedicle, reproducing the operative views, were made from the point at which the trocar supporting the camera was introduced, i.e. at the iliac crest in the mid axillary line. Problems encountered by the change in the direction of viewing and renal mobilization were identified and analyzed.

Results

Anatomical landmarks of lumboscopy

During digital dissection the finger was introduced into the posterior pararenal space at the top of the lumbar quadrilateral space (Grynfelt's space), crossing in sequence latissimus dorsi, the aponeurosis of transversus abdominis, quadratus lumborum and the parietal fascia (Fig. 1). This enabled palpation of the external brim of psoas major medially and mobilization of the renal compartment laterally by gradually separating the parietal fascia from the posterior layer of the renal fascia (Gerota's fascia). Anterior to psoas major the parietal fascia and the posterior layer of the renal fascia were fused with the fascia iliacus, which closed the renal compartment from behind and within. Psoas major represents the internal limit for the digital detachment of Gerota's fascia.

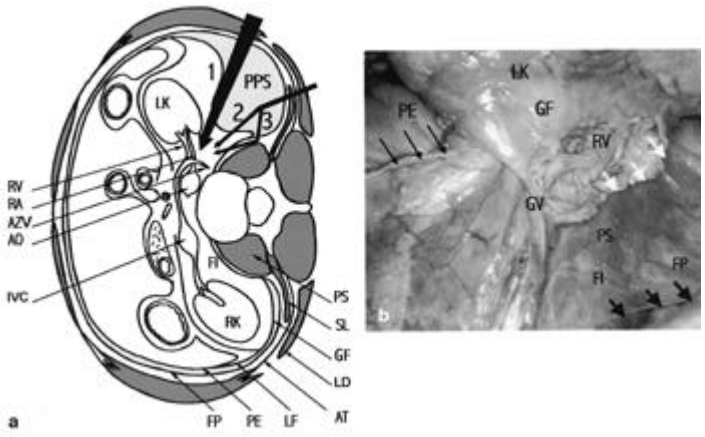

Fig. 1a, b a. Mobilization of the left kidney by detachment of the posterior pararenal space. Arrows indicate the camera support axis (*1*) and the technique to access the renal pedicle during simple (*2*) and radical nephrectomy (*3*). **b.** Cadaver study detachment of the left posterior pararenal space. Veins of the renal pedicle are the first elements approached after opening Gerota's fascia. *White arrows*, external limit of fusion between the parietal fascia and Gerota's fascia ; *large black arrows*, fascia iliacus continuing with the parietal fascia ; *PPS*, posterior pararenal space ; *RV*, renal vein ; *RA*, renal artery ; *AZV*, reno-hemi-azygo-lumbar trunk ; *AO*, aorta ; *IVC*, inferior vena cava ; *FI*, fasciailiacus ; *PS*, psoas major ; *SL*, quadratus lumborum ; *GF*, Gerota's fascia ; *LD*, latissimus dorsi ; *AT*, aponeurosis of transversus abdominis ; *LF*, lateroconal fascia ; *PE*, peritoneum (*thin black arrow*). *FP, parietal* fascia ; *LK*, left kidney ; *RK*, right kidney ; *GV*, gonadic vein

Laterally, digital detachment of the renal compartment was continued between the parietal fascia and the lateroconalfasciadefined by Hureau et al [16, 17] and Meyers [19] *"The two layers of the renal fascia fuse behind the ascending or descending colon to form the lateroconal fascia, which then continues around the flank to blend with the peritoneal reflection forming the paracolic gutter".* Digital detachment of the lateroconal fascia, by applying pressure to the parietal fascia, allowed it to remain within the posterior pararenal space without perforating the peritoneum.

The renal pedicle was lying on psoas major level with the point of finger entry. It could be approached with visual monitoring through Gerota's fascia (Fig 1, arrow 2), or more medially after detachment of the renal compartment beyond the point of fusion of the fascia iliacus and Gerota's fascia (Fig 1, arrow 3). This maneuver, which also brought psoas major into view, allows a large removal of the renal compartment, as recommended in radical nephrectomy.

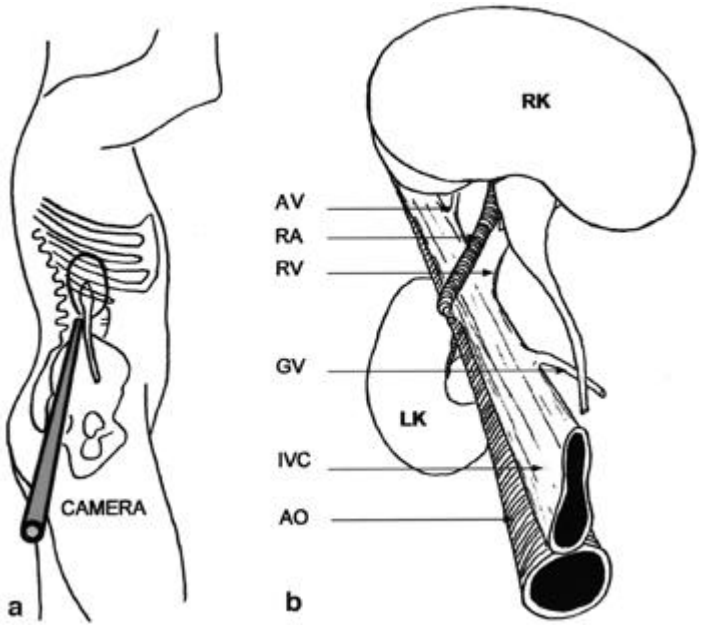

Fig. 2a, b a. Position of the trocar supporting the camera in relation to the right kidney and the great vessels before mobilization of the right kidney. **b.** The right kidney with its pedicle as it appears in lumboscopy.*AV,* suprarenal vein ; *RA,* renal artery ;*RV,* renal vein ; *GV,* gonadal vein ; *IVC,* inferior vena cava ; *AO,* aorta ; *LK,* left kidney ; *RK,* right kidney

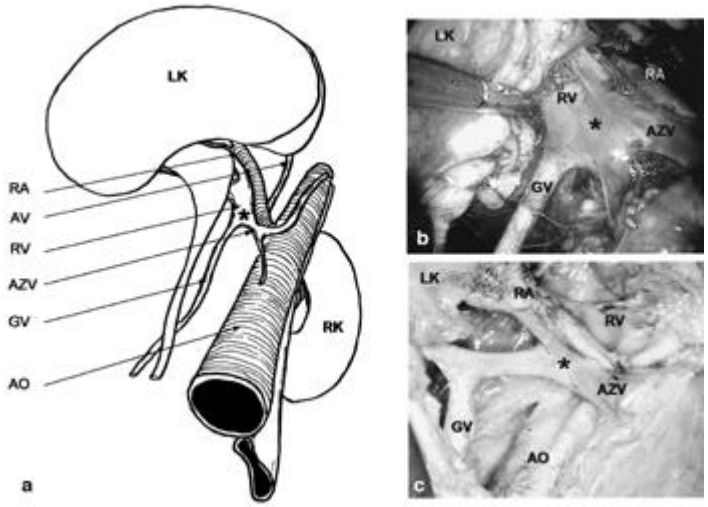

Fig. 3 a-c **a.** The left kidney with its pedicle as they appear in lumboscopy. The left kidney has been ventrally and cranially mobilized. The camera approaches the renal vein in the axilla of the reno-hemi-azygo-lumbar trunk (*). If this is bulky it can be confused with the distal portion of the renal vein and obscure the renal artery. **b.** Corresponding operating view of the left renal pedicle. **c.** Cadaver study view of the left renal pedicle from the point of entry of the camera. The distal portion of the renal vein can be seen above the renal artery ; *RA,* renal artery ; *AV,* suprarenal vein ; *RV,* renal vein ;*AZV,* reno-hemi-azygo-lumbar trunk ; *GV,* gonadal vein ; *AO,* aorta ; *LK,* left kidney ; *RK,* right kidney

On both sides the gonadal vein and ureter were readily identified after opening Gerota's fascia anterior to psoas major.

Description of the renal pedicle in lumboscopy

The camera-supported trocar gave a lower and posterolateral view of the renal pedicle reproducing the peroperative views (Figs. 2-3). The axis of the large vessels appeared to be directed superiorly to the left on the right side and superiorly to the right on the left side. In contrast, the axis of the renal pedicle was directed superiorly to the left on the left side and superiorly to the right on the right side the superior orientation of the renal pedicle was increased by the cranial mobilization of the kidney. The first component of the renal pedicle approached during dissection from inferior to superior was the renal v. (the reno-hemi-azygo-lumbar trunk on the left side) and then the renal a., usually running behind the upper part of the renal v. (Figs. 2-3).

On the left side, when the kidney was displaced anteriorly the proximal portion of the renal v. was directed posteriorly,

whereas the position of the distal preaortic portion of the vein hardly changed because of the mesenteric a. and reno-hemi-azygo-lumbar trunk linking it to the posterior abdominal wall. The viewing axis was orientated toward the reno-hemi-azygo-lumbar trunk (Fig. 3), which could easily be confused with the distal renal v., as it continued in this position in the same direction as the proximal portion of the vein. The renal a. could also be partly hidden by the reno-hemi-azygo-lumbar trunk as it passed beneath it. If the latter was confused with the renal v. the unusual aspect of a pre-venous artery may have been seen (Fig. 3b). A reno-hemi-azygo-lumbar trunk was found in all but one of the five dissections in which case the left renal v. had a retroaortic position and no parietal tributary.

The termination of the left gonadal v. into the renal vein was a valuable marker for locating the suprarenal v., which joined the renal v. superomedially. Owing to the inferior approach to the pedicle the suprarenal v. was only visible after ligation or upward retraction of the renal a. The most appropriate way of approaching the left suprarenal v., as in adrenalectomy, was to separate the renal a. and v. and follow the upper brim of the renal v. medially to the termination of the left gonadal v.

On the right the inferior vena cava was easily identifiable on the medial edge of psoas major after opening Gerota's fascia. Gradual dissection of the inferior vena cava from inferior to superior revealed successively, as during lumboscopy, the gonadal, renal and suprarenal vv., which were all located in the same plane. No reno-azygo-lumbar trunk was found on the right side. Because of its retrocaval position the renal a. appeared to wind around the inferior vena cava when the kidney was mobilized ventrally (Fig. 2b).

Discussion

Compared with open surgery laparoscopic surgery is associated with lower operative blood loss, reduction in postoperative analgesia requirements and a shortened hospital stay [1, 2, 8]. The laparoscopic approach to the retroperitoneum can be achieved by the retroperitoneal route (lumboscopy) or by the transperitoneal route the choice between the two techniques depending on the condition and the surgeon's experience. Studies comparing these two approaches have shown that lumboscopy reduces the time taken to resume normal oral intake and postoperative analgesia requirements. However, transperitoneal laparoscopy and lumboscopy have similar results in terms of complication rates and length of hospital stay [8, 14, 18].

The view of the retroperitoneum provided by the transperitoneal route is similar to that of open surgery because intraperitoneal insufflation does not modify the position of the retroperitoneal organs. During lumboscopy the approach to the renal compartment necessitates insufflation of the posterior pararenal space, which modifies the position of kidney and its pedicle as well as changing the anatomical landmarks.

Anatomical landmarks of lumboscopy

Digital dissection of the posterior pararenal space permits palpation of psoas major and the posterior aspect of the kidney, as well as beginning lateral detachment of the renal compartment with the assurance that one is in the correct cleavage plane. The digital approach behind the posterior axillary line avoids damaging the peritoneum, the reflection of which is always located more anteriorly [7].

Several techniques have been described to detach the posterior pararenal space, the principal ones being digital dissection and balloon dissection [3, 10, 11, 15, 20]. Balloon dissection, introduced by Gaur [11], is widely used, but it does not appreciate the medial limit for detachment between the parietal fascia and the posterior layer of the renal fascia, the fusion of which can occur at various levels between quadratus lumborum and psoas major [16, 17, 19]. Moreover, poor placement of the balloon can lead to rupture or tissue damage [11, 20].

Outside the kidney, the lateroconal fascia separates the posterior and anterior pararenal spaces and thus protects the retroperitoneal digestive organs (duodenum, pancreas and colon). During insufflation of the posterior pararenal space, the lateroconal fascia is condensed and insinuates itself into the space between the kidney posteriorly and the colon anteriorly [15]. In radical nephrectomy this fascia has to be collapsed in order to approach the anterior pararenal space, but owing to its thinness there is considerable risk of entering the peritoneal cavity, especially in the abdominal midline where the plane of dissection is the least apparent [24]. Meticulous dissection of the peritoneum is required to remain within the anterior pararenal space, however it may be preferable to enter the perirenal space to avoid laceration of the digestive tract.

A key safety measure is to avoid dissecting the area of the retroperitoneal vessels until psoas major has been accurately identified. During initial digital dissection its palpation provides the medial limit of blunt dissection. After introduction of different trocars psoas major must be visualized as laterally it limits the area of the retroperitoneal vessels. On the left the renal pedicle can be approached by opening Gerota's fascia anterior to psoas major. On the right the inferior vena cava is usually readily identified at the medial edge of psoas major progressive upward dissection enables the successful identification of the gonadal v., renal pedicle and the suprarenal v.

Description of the renal pedicle in lumboscopy

The principal risk during laparoscopic surgery is venous laceration [26]. Cussenot et al [9] have emphasized the need to identify specific anatomic landmarks for laparoscopic surgery in the male pelvis because of the modified axis of vision.

During lumboscopy the inferior approach to the renal pedicle, together with the ventral and cranial mobilization of the kidney, considerably modifies the presentation of the renal pedicle. On both sides the renal v. and its branches are the first to be approached during dissection of the pedicle. On the left side the complex embryology of the renal vv. explains the frequency of anastomoses with parietal and digestive vv., being the origin of most of the difficulties encountered [5, 21, 22, 25, 27]. In particular, the reno-hemi-azygo-lumbar trunk is a frequent cause of confusion owing to its variability and unusual approach [21, 22]. Gillot et al [13] studied the course of the branches of the left renal v. and found evidence of a common trunk that could unite, to a variable extent, with the medial branch of the hemiaygos v., an intra-psoic v., a gonadic v. and a posterior renal v. in 56% of cases [13]. Baniel [3] noted the presence of a reno-hemi-azygo-lumbar trunk in 43% of patients with testicular cancer and lumbar-aortic lymph nodes. The camera approaches the renal pedicle in the axilla of the reno-hemi-azygo-lumbar trunk, consequently, the latter may be confused with the distal part of the renal v. Prior identification of psoas major, toward which runs the reno-hemi-azygo-lumbar trunk, makes it possible to avoid this interpretation.

Variations of the renal aa. are rare and usually concern their level of origin and course [6]. Video-assisted surgery provides magnification of the field of vision permitting detection of the arteries by their pulsations. In addition, the initial entry point of the finger, which corresponds to the L1-L2 level, is an approximation of the normal localization of the renal pedicle.

Conclusion

A lumboscopic approach of the retroperitoneum modifies the anatomy of the renal pedicle and changes the expected anatomical relationships. Identification of psoas major is the crucial first step before dissection of the retroperitoneal vessels. On the left the distal portion of the renal v. can be confused with a bulky reno-hemi-azygo-lumbar trunk. On the right identification of the vena cava on the medial aspect of psoas major facilitates successive identification, from below upwards, of the gonadal, renal and suprarenal vv. all located in the same plane.

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