From laparoscopic training on an animal model to retroperitoneoscopic or coelioscopic adrenal and renal surgery in human

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Abstract. So far, laparoscopic approaches to kidney and adrenal have been limited because of their retroperitoneal location. We here report eight renal and adrenal endoscopic procedures performed in seven patients: two adrenalectomies for hyperaldosteronism, one adrenalectomy for isolated metastasis from an adenocarcinoma of the lung; two nephrectomies for end-stage infected hydronephrosis, two partial nephrectomies for small circumscribed lesions of the kidney, and one endoscopic resection for pain relief of a voluminous cyst at the kidney. The approach was retroperitoneal in two cases and retroperitoneal in five cases using the retropneumoperitoneum insufflation technique. One patient was operated by a combined approach using the retro- and transperitoneal routes. All procedures were successfully completed endoscopically. The retroperitoneoscopic approach of the kidney is safe and does not interfere with the peritoneal organs. Its working space is tenuous, but allows a direct access on the kidney with good exposure of its pedicle. For adrenal surgery, the retroperitoneoscopic dissection is more difficult, because movements of instruments are often impaired by the closeness of the costal margin and the iliac crest. However, in case of difficulties we found it very convenient to switch from a retroperitoneal endoscopic approach to a combined coelioscopic and retroperitoneoscopic operation. Far from excluding each other, both approaches are complementary, particularly for difficult situations (i.e., previous peritoneal or retroperitoneal surgery).

Key words: Laparoscopy — Retroperitoneum — Adrenalectomy — Endocrine disorders — Nephrectomy

Recently, laparoscopic surgery has been used for the removal of renal and adrenal lesions [2-4]. We here describe our experience with the laparoscopic and/or retroperitoneoscopic approaches for renal and adrenal surgery in seven patients. The feasibility of the retroperitoneal approach using a retropneumoperitoneum was initially assessed and the technical aspects were developed on an experimental model (farm pig). The development of this new approach in the laboratory setting was also accompanied by a strict assessment of safety, general efficacy, potential need, and benefits before application in selected clinical practice.

Materials and methods

Animal experiment

Farmer pigs weighing 25-30 kg were used in this study according to the rules for animal studies at the University of Louvain School of Medicine. Anesthesia was induced with propofol (Diprivan). After endotracheal intubation, maintenance of anesthesia was achieved with halothane. The pigs were placed in lateral position [1, 5]. A Veress needle was introduced in the lumbar triangle between the 14th rib and the lumbar muscular mass. The retroperitoneal space was insufflated with CO₂ at a rate of 1 l per min up to a pressure of 15 mmHg, and under coelioscopic control. The retroperitoneal space was easily widened by blunt dissection with the optic in order to separate the peritoneal layer from the fat tissues of the retroperitoneal space. Two other retroperitoneal 10-mm trocars were respectively introduced below the costal margin and above the iliac crest under direct vision. Dissection of the kidney and/or the adrenal could be initiated once the three ports were placed forming an equilateral triangle. The pigs were sacrificed at the end of the experiment. A total of 16 right or left consecutive retroperitoneoscopic renal and adrenal procedures were successfully carried out in ten pigs.

Clinical application in humans

After good expertise was gained with retroperitoneoscopic surgery thanks to this convenient animal model, we decided to propose this
The patient formed a hemorrhagic Fig. 1. Cross section through the abdomen of the patient placed in right lateral position, with the Veress needle introduced under ultrasonographic control until its tip lies just behind the posterior plane of the lower pole of the left kidney. Inset: favorite external sites of trocar placement.

approach to seven patients who could directly gain advantages from this minimally invasive retroperitoneoscopic approach. Specific informed consent for the planned procedure was obtained.

Surgical technique

The patient is placed in lateral position. A Veress needle is introduced under ultrasonographic control in the lumbar triangle (between the 12th rib and the iliac crest on the posterior axillary line) and advanced under continuous sonographic control until its tip lies just behind the posterior plane of the lower pole of the kidney. At this level the needle is assumed to reside well within the perirenal fat inside Gerota’s fascia. The retroperitoneal space is then insufflated with CO₂ at a rate of 1 L per min with a preset pressure limit of 12 mmHg. After instillation of 1.5 L of CO₂ the Veress needle is replaced by a 10-mm disposable trocar. A coaxial laparoscope 10 mm in diameter is inserted through this initial trocar. The retroperitoneal space already created by the retroperitoneoperitoneum is easily widened by blunt dissection with the optic. Once a bloodless dissection of the loose perirenal fat has been obtained—separating the peritoneal layer from the fat tissues of the retroperitoneal space—two or three other trocars can be introduced under direct vision (Fig. 1).

Dissection of the kidney is started by identification of the ureter that is cut between two ligatures or clips. The proximal ureter is pulled upward so as to facilitate the exposure of the renal pedicle. The posterior aspect of the renal pedicle is dissected first and the renal artery is ligated or secured with titanium clips. After ligation of the vein and liberation from all remaining adhesions, the kidney is extracted by a short lombotomy.

For adrenalectomy the procedure is basically the same. The adrenal is identified at the internal side of the upper pole of the kidney. Careful mobilization of the upper pole of the adrenal is performed and each inferior phrenic arterial branches is clipped in order to obtain a bloodless dissection of the upper portion of the adrenal. Once this has been done the dissection can be completed by liberation of the lower portion and clipping of the main vessels in the vicinity of the renal vein (for left adrenal) or the inferior vena cava (for right adrenal). The adrenal is extracted in a self-sealing bag through one of the trocars.

For partial nephrectomy, parenchymal incision circumscribing widely the lesion to be removed is performed with the monopolar electrocautery. Completion of hemostasis is achieved by using the laparoscopic 5-mm argon beam coagulator probe.

Results

From September 1993 to November 1994, we performed endoscopically three adrenalectomies and five renal operations in seven patients. There were one female and six males with a mean age of 53 years (range 33–73). Of the three adrenalectomies performed, one was of the right (hyperaldosteronism) and two of the left gland (one for hyperaldosteronism and one for isolated metastasis of an adenocarcinoma of the right lung operated 4 years before). Of the five left renal operations, two were nephrectomies for end-stage infected hydronephrosis; two were partial nephrectomies for well-circumscribed lesions in the lower pole of the kidney (small hypernephroma) in high-risk very debilitated patients; and one was resection for pain relief of a voluminous cyst (200 mL) at the kidney upper pole associated with a partial nephrectomy for a small tumor of the lower pole.

All renal operations were completed by a retroperitoneoscopic approach. One left adrenalectomy for hyperaldosteronism was deliberately performed by a laparoscopic approach. A 46-year-old woman presenting also primary hyperaldosteronism had a 3-cm right adrenal adenoma. Despite the fact that she had undergone right nephrectomy 10 years before, we were able to perform easily a retropneumoperitoneum and an almost complete retroperitoneoscopic dissection of the right adrenal. However, the upper pole of the kidney was entangled by adhesions related to the previous nephrectomy. During dissection of those adhesions the peritoneal layer was slightly tearred, allowing CO₂ to escape from the retroperitoneal space to the peritoneal cavity with the peritoneal layer falling on the endoscope. The operation was nevertheless pursued through a laparoscopic approach. In fact, the laparoscopic portion of this operation was easy to complete, because the retropneumoperitoneum and the retroperitoneoscopic dissection had already created a large retroperitoneal working space, rendering the exposure of the inferior vena cava and of the right adrenal simple and rapid. Furthermore, the flank approach in the lateral decubitus position was convenient and resulted in less dissection than a laparoscopic anterior approach [4].

Subjectively, the laparoscopic and retroperitoneoscopic approaches create less postoperative pain. Patients were able to ambulate the day after surgery and to return home on the 3rd or 4th postoperative day; the other advantage was the better cosmetic result.

Discussion

Progresses in laparoscopic techniques, instrumenta-
tion, and video technology have allowed surgeons to perform removal of solid intraabdominal organs. De-
Despite some impressive recent reports [2–4], laparoscopic approaches of kidney and adrenal have been relatively limited, because of the retroperitoneal location of these organs. Since 1992, we have developed an animal model for routine laparoscopic training of attending surgeons and residents in order to reduce the inevitable morbidity related to the learning curve of endoscopic surgery. The fact that the anesthesiologic aspects of this model can easily be managed by surgeons allows good flexibility for training and experimentation. Several intraperitoneal operations were routinely performed on this model (cholecystectomy, fundoplication, splenectomy, intestinal resection, nephrectomy). In the meantime we also gained expertise with the retroperitoneal approach for renal and adrenal video surgery [1, 5].

As with other laparoscopic procedures we thought it important to assess the safety and efficacy of this retroperitoneoscopic approach in an appropriate animal model prior to clinical application. This is the reason why—at the beginning of our experience—we applied this approach only in selected patients. One patient had undergone left colonic surgery 2 years before for adenocarcinoma (Dukes’ B stage). A laparoscopic approach would have been made difficult by the previous peritoneal dissection, precisely in the area in front of the left kidney harboring a 2-cm-diameter lesion. For another patient, the retroperitoneoscopic approach for a lesion in his left adrenal allowed us to avoid left lobotomy after previous right thoracotomy.

The advantages of the retroperitoneoscopic approach are its safety and the fact that there is no interference with the peritoneal organs. The retroperitoneal approach using direct CO₂ insufflation is very convenient because the dissection of the retroperitoneal layers and the identification of the Gerota’s fascia are rather simple. The working space, despite being restricted, obtained by this approach allows direct access on the kidney with good exposure of its pedicle. If necessary dissection can be extended down to the pelvic ureter and up to the diaphragm. The “insufflation” technique to create a retroperitoneal working space is bloodless, atraumatic, and probably safer than the “balloon” technique, which is a relatively blind approach at least during the initial steps of the procedure.

The main disadvantages or the retroperitoneoscopic approach are: the restricted working space; the limitation of the number of trocars; the “knitting effect” related to the closeness of trocars; and the rapid loss of the retroperitoneal working space in case of laceration of the peritoneal layer or while using suction device. Consequently dissection has to be meticulous, because the ability to control bleeding could be extremely difficult, or even impossible, if suction is used causing the loss of retropneumoperitoneum. So far we have found the retroperitoneoscopic dissection of the adrenal gland to be rather difficult, because movements of endoscopic instruments are often impaired by the proximity of the costal margin. However, failure to remove one adrenal by the retroperitoneoscopic route gave us the opportunity to switch from a complete retroperitoneal endoscopic operation to a combined retroperitoneal and transperitoneal endoscopic operation. In this case the retroperitoneal approach was the first—useful—step of a coelioscopic adrenalectomy.

We consider the retroperitoneoscopic approach to be inappropriate for complete cancer staging and for curative oncological surgery. However, this procedure could be particularly indicated for the surgical management of asymptomatic adrenal lesions like solitary metastasis and “incidentalomas.” Assessment of this retroperitoneoscopic approach through analysis of the outcome of the procedure in clinical practice should be developed from a background of each surgeon’s clinical experience to determine if this new approach is of value to patients. So far we have found this emerging surgical retroperitoneoscopic technique to be appropriate in carefully selected cases, when applied by surgeons with abdominal and urological experience and credentials.

In conclusion, the retroperitoneoscopic dissection of the kidney in a patient placed in the lateral decubitus position is convenient and safe. This approach is less convenient for adrenal gland. However, we have been impressed by the ease of the laparoscopic dissection of the adrenal or the kidney when a retroperitoneal working space has been initially developed by a retropneumoperitoneum and retroperitoneoscopic dissection. Far from excluding each other, both approaches—laparoscopic and retroperitoneoscopic—are complementary, particularly for difficult situations, i.e., patients having previously undergone retroperitoneal or peritoneal surgery.

References