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TOPIC PAPER

Analysis of complications from 600 retroperitoneoscopic procedures of the upper urinary tract during the last 10 years

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Abstract
Introduction The aim of this study is to review 10 years experience of retroperitoneoscopy procedures.
Methods A total of 600 patients treated between 1995 and 2007 by retroperitoneoscopy (nephrectomy, partial and total nephrectomy, adrenalectomy, pyeloplasty, renal cyst, calyceal diverticulectomy) were reviewed for per, peri and postoperative complications including patients in the learning curve.
Results The mean blood loss was 159 mL. Conversion to open surgery was required in 28 patients (4.6%) primarily due to technical problems during dissection (elective). There were 32 (5.3%) surgical complications, including bleeding or hematomas in 12 cases and 2 of them required reintervention, urinomas in 8 which were treated by installation of a ureteral drainage (JJ stent). Wound or deep abscesses happened in four, urinary fistula in one and pancreatic fistula in another. Evisceration (hernias) was seen in three patients. Intestinal injury occurred in two. The complication rate depended on the difficulty of the procedure and learning curve of the surgeon. A total of 28 patients (4.6%) presented medical postoperative complications (hyperthermias, deep venous thrombosis, pyelonephritis, pulmonary superinfections, pulmonary atelectasia and transient vascular ischemic accident). Mean postoperative hospital stay was 6.2 days (ranged from 2 to 20).
Conclusion Retroperitoneoscopy can be the technique of choice for accessing and carrying out all the surgery of the upper urinary tract respecting the principles of oncological surgery. After experience with 600 cases during the last 10 years the technique has become safe, simplified, reproducible and effective although not easy. Most complications are minor and easily managed.

Keywords Nephrectomy · Complications · Partial nephrectomy · Retroperitoneoscopy

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Introduction

Laparoscopy based on refinements in technology and instrumentation developed rather slowly and lately in urology and was adopted from gynecologists and general surgery, so initially it has been based on the transperitoneal approach. The clinical step forward was a transperitoneal laparoscopic nephrectomy performed by Clayman et al. [1]. On the other hand retroperitoneoscopic surgery has developed relatively quickly; although retroperitoneal minimally invasive surgery was first attempted by Wittmoser [2] for lumbar sympathectomy after blunt dissection with a telescope and pneumatic dissection with carbon dioxide and the first retroperitoneoscopic ureterolithotomy was performed by Wickham [3], the full scope of retroperitoneoscopy was realized only after 1990 once Gaur constructed a simple device consisting of a No. 7 surgical glove mounted on a red-rubber catheter and created the workspace of the retroperitoneal laparoscopy [4] by inflating the glove to 110 mmHg using a pneumatic pump and manometer. He successfully used this approach for multiple retroperitoneal procedures, including simple nephrectomy, renal biopsy, ureterolithotomy and pyelolithotomy [5–7].

So far, retroperitoneal laparoscopy, also known as retroperitoneoscopy or lumboscopy, has been described by numerous centers for a variety of procedures, including pelvic lymph node dissection [8, 9], ureterolithotomy [10, 11] and a variety of renal procedures [12–14].

Initial reports described as disadvantages of the retroperitoneal laparoscopic approach due to the increased operative duration, poor visualization secondary to inadequate insufflation of the retroperitoneum, and considerable experience and training needed [15]. The goal of this study is to present complications of this technique based on large experience of 600 cases of the retroperitoneal laparoscopy.

Materials and methods

The procedural details were analyzed retrospectively in 600 patients (age 17–88 years) who underwent retroperitoneoscopic surgery for urological disease at our department from 1995 to 2007. Using this technique, 15 different procedures were performed (Table 1). Three senior urologists performed all procedures.

The instruments and technique of retroperitoneoscopy have been previously described [16–19]. In the beginning, the patient is positioned decubitus and general anesthesia is induced as well as placement of a nasogastric or orogastric tube and a Foley urinary catheter. Then the patient is placed in standard full flank, lateral decubitus (lumbotomy) position. The anatomic access site for retroperitoneoscopy is the space between the 12th ribs superiorly, the iliac crest inferiorly, the lateral border of the paraspinal muscles posterolaterally, and the lateral peritoneal reflection anteromedially.

Table 1 Type of surgical procedure

	n
Radical nephrectomy	170
Simple nephrectomy	114
Adrenalectomy	112
Partial nephrectomy	70
Pyeloplasty PUJ syndrome	58
Nephroureterectomy	28
Cyst marsipalization	21
Diverticulectomy	9
Miscellaneous	
Lymph node biopsy	7
Pyelotomy	4
Retrocaval ureter	2
Retroperitoneal fibrosis biopsy	2
Retroperitoneal lymphadenectomy	1
Ureterectomy	1
Ureterotomy	1
Total	600

A minimal (1.5 cm) lumbotomy cutaneous incision is performed 1 cm subcostally and in parallel with the 12th rib, on the lateral border of the paraspinal muscles that projects roughly onto the posterior axillary line. The surgeon pierces the muscles and fascias with a Kelly clamp all the way to the retroperitoneal posterior pararenal space with impunity. At this point, there is no significant vessel involving risk of vascular wound and to our knowledge no vascular wound has been described during the creation of the retroperitoneal workspace [20]. This tunnel is dilated until an index finger can be inserted to push the peritoneum forward, thus creating a retroperitoneal cavity. This space is located between the fascia transversalis and the fascia of Gerota. Care must be taken to digitally dissect in an anterior plane and in a 180° angle so as not to traumatize the paraspinal muscles.

The 2nd trocar (12 mm) is placed (under digital control), 2 cm above the iliac crest and 2 cm anteriorly to level of the 1st trocar in order to allow good mobility of the instruments. The 3rd trocar (12 mm) is placed (under digital control), at the same level with the 2nd trocar but 4 cm anteriorly (roughly at the medial auxiliary line). This port is reserved for the 0° optics handled by the first assistant. Then a 5–12 mm (1st) trocar with foam grip is introduced through the initial lumbotomy incision and the incision is closed with two stitches. Through this trocar the surgeon interchangeably uses the monopolar scissors, the bipolar grasping forceps, suction device, needle holder and various large-caliber instruments, including a 12-mm EndoGIA stapler, a 10-mm right-angle dissector, clip appliers, and retrieval bag.

Insufflation is begun at 12 mm Hg and the camera is introduced through the 2nd port. Using the fenestrated grasper ± the bipolar the surgeon frees the anterior abdominal wall from the peritoneum or fatty tissue in order to introduce the next 1–2 secondary ports under laparoscopic control at the anterior auxiliary line across the 2nd or 3rd port. These trocars are used by the second assistant for aspiration and various graspers during the operation.

Hereafter the laparoscope is introduced through the 3rd trocar.

The renal fascia is opened longitudinally for exposure of the psoas muscle, representing the most important anatomical landmark of retroperitoneoscopy. Further anatomical landmarks are the ureter, spermatic/ovarian vein the vena cava and lower pole of the kidney.

In retroperitoneoscopic nephrectomy key point is the access to the renal vessels, their dissection and ligation of the artery with hemo-locks and stapling of the vein with Endo GIA and finally detaching the kidney.

In all ablative procedures, specimens were delivered intact after enlarging the primary port site or, for large

specimens by an iliac incision of 5–6 cm usually with the EndoCatch system. Insertion and extraction of the organ retrieval bag are accomplished via the primary lumbotomy incision.

For partial nephrectomy the renal vessels are identified and isolated/clamped using vessel loops and the kidney is mobilized to allow exposure of the lesion. A laparoscopic ultrasound probe may be used to determine the line of incision and depth of tumor involvement. Bleeding vessels are sealed or ligated, renal calyces are sutured and the renal capsule is then closed.

In cases dealing with the renal pelvis or ureter the first step of the operation is to place a ureteral probe first via cystoscopy. Then the pelvis or ureter is opened with scissors, after which stones are extracted and removed with an endobag, or a pyeloplasty is performed. The pelvis is sutured at the end of the operation with running sutures.

In the majority of cases a Redon 8Ch drainage tube was left in place via the 4th port. For our survey we studied the operational time, the amount of bleeding, the rate of transfusions, the conversion rate, the morbidity, the surgical and medical complications, as well as the duration of hospitalization. All operations were classified according to their difficulty as easy, slightly difficult, fairly difficult, difficult, very and extremely difficult. The classification was based on the European scoring system for laparoscopic operations in urology proposed by Guillonneau and Abbou [21].

Results

Patients' characteristics (age, weight, height, sex ratio and American Society Anaesthesiology score) are presented in Tables 1 and 2. Mean age was 52.8 years, mean weight was 71 kg, average height 168 cm, the female to male ratio was 0.91 and the average ASA score was 1.84. The indications for retroperitoneoscopy were as follows: 170 radical nephrectomies for cancer; 114 simple nephrectomies for destroyed kidneys or renal multicystic disease; 112 adrenalectomies; 70 partial nephrectomies generally for tumors; 58 pyeloplasties for ureteropelvic junction syndrome; 28 nephroureterectomies for TCC of the upper urinary tract; 21 ablations of for symptomatic renal cysts; 22 relapse-ureterectomies; 9 calyceal diverticulectomies responsible generally for urinary infections or lumbar pain; 8 lymph node biopsies for suspicious isolated adenopathies or generally in a context of testicular tumors; 4 pyelotomies; 4 surgeries of the ureter (including 2 retrocaval ureters); 2 biopsies for suspected retroperitoneal fibrosis. Hereafter procedures like lymph node biopsies or lymphadenectomies, pyelotomies, ureterectomy or ureterotomy and surgery for retrocaval ureter are referred under the general term of "miscellaneous" (Table 1).

Table 2 Patient characteristics

	Mean age (years)	Mean weight (kg)	Mean height (cm)	F/M ratio	Mean ASA score
Radical nephrectomy	60.8	68.4	165.5	0.58	1.87
Simple nephrectomy	46.0	69.0	161.8	1.07	1.88
Adrenalectomy	52.0	65.6	165.6	1.44	1.96
Partial nephrectomy	55.7	70.3	169.4	0.60	1.75
Pyeloplasty UPJ syndrome	39.2	62.3	168.3	1	1.58
Nephroureterectomy	59.4	73.4	171.8	0.81	1.80
Cyst marsupalization	55.5	68.5	167.8	1.1	1.91
Diverticulectomy	37.9	62	165.6	8	1.5
Miscellaneous	49.8	74.2	168.6	0.38	1.66
Total	52.7	71.2	168.1	0.91	1.84

Operating time and transfusion, complication and reintervention rates depended on the difficulty of the procedure. Mean operating time ranged from 66 to 192 min for cyst marsupalization and nephroureterectomy, respectively (Table 3). The absolute range of operating time was 30 (cyst marsupalization) to over 400 min (for the longest interventions which were the partial nephrectomies and the surgeries of uncrossing the retro caval ureters). The mean blood loss was 159 mL (0–3,700) although it was quite variable regarding each operation from 26 mL for cyst marsupalization to 391 mL for the most hemorrhagic surgery the partial nephrectomy. The most abundant bleedings occurred at the time of vascular traumas during radical nephrectomies and the relapse-ureterectomies. The percentage of perioperatively transfused patients ranged from 12.8% for partial nephrectomy or 7% for nephroureterectomy to 0% for pyeloplasties and cystectomies (Table 3).

Conversion of the retroperitoneoscopic procedure to open surgery was required in 28 patients (4.6%) primarily due to technical problems during dissection (anatomy of the patient, adhesion of the tumor). Thirteen patients (2.1%) were converted due to technical impossibility (Table 4). Thus, six radical nephrectomies could not be carried out: three due to difficulties at the time of the extraction of the specimen and another three due to vascular modification and risks. Six partial nephrectomies were converted because of the position of the tumor and one nephroureterectomy due to complex anatomy and renal trauma. Five patients (0.8%) had adhesions in the retroperitoneum, sometimes due to previous surgery, making the retroperitoneoscopy impossible: one ureteropelvic junction syndrome which had already undergone an Acusize procedure, one partial nephrectomy which had already undergone a ureteral surgery, a radical nephrectomy and one simple nephrectomy which had secondary adhesions at the presence of infection due to lithiases. Five were emergency

Table 3 Perioperative details

Type of surgical procedure	Duration of operations	Blood loss	Perioperatively transfused patients	Conversion rate	Surgical complications	Medical complications	Duration hospital stay
	Mean (min)	Mean (mL)	Total (%)	Total (%)	Total (%)	Total (%)	Mean (days)
Radical nephrectomy	147	170	11 (6.4)	13 (7.6)	9 (5.3)	10 (5.8)	6.0
Simple nephrectomy	114	104	4 (3.5)	2 (1.7)	3 (2.6)	6 (5.2)	4.6
Adrenalectomy	117	153	4 (3.5)	3 (2.6)	3 (2.6)	5 (4.4)	5.3
Partial nephrectomy	179	391	9 (12.8)	8 (11.4)	10 (14.2)	4 (5.7)	8.5
Pyeloplasty UPJ syndrome	162	3	0	1 (1.7)	4 (6.8)	2 (3.4)	6.4
Nephroureterectomy	192	172	2 (7.1)	1 (3.5)	1 (3.5)	0	8.5
Cyst marsupalization	66	26	1 (4.7)	0	1 (4.7)	0	4.7
Diverticul-ectomy	84	17	0	0	1 (11.1)	1 (11.1)	6.4
Miscellaneous	129	66	0	0	0	0	8.1
Total	138	159	31 (5.1)	28 (4.6)	32 (5.3)	28 (4.6)	6.2

Table 4 Aetiology of Conversion to open procedures

	Adhesions	Hemorrhage	Obesity	Technical difficulties	Combination	Total (%)
Radical nephrectomy	1	2	1	6	3	13 (7.6)
Simple nephrectomy	2	0	0	0	0	2 (1.7)
Adrenalectomy	0	2	1	0	0	3 (2.6)
Partial nephrectomy	1	1	0	6	0	8 (11.4)
Pyeloplasty	1	0	0	0	0	1 (1.7)
Nephroureterectomy	0	0	0	1	0	1 (3.5)
Cyst marsupalization	0	0	0	0	0	0
Diverticulectomy	0	0	0	0	0	0
Miscellaneous	0	0	0	0	0	0
Total (%)	5 (0.8)	5 (0.8)	2 (0.3)	13 (2.1)	3 (0.5)	28 (4.6)

explorations to control hemorrhage (0.8%) from the renal pedicle, aorta or vena cava: two radical nephrectomies, two adrenalectomies and one partial nephrectomy, at the time of the dissection and the clamping of the pedicle. Two lumboscopies (0.3%) were converted because of the serious obesity of the patients (remarkable modification of the anatomical landmarks and unfeasibility of mobilization of the trocars). Finally three cases were converted because of combinations of the above reasons.

There were 32 (5.3%) surgical complications, including bleeding or hematomas in 12 cases and 2 of them required reintervention, urinomas in 8 which were treated by installation of a ureteral drainage (JJ stent). Wound or deep abscesses happened in four (2 deep abscesses had to be drained by surgical way), urinary fistula in one and pancreatic fistula in another which was treated openly. Evisceration (hernias) was seen in three patients. Intestinal injury occurred in two which had to undergo a temporary colostomy after probably secondary colon wound during monopolar coagulation on the peritoneum. One of our radical nephrectomy patients deceased during resuscitation following the hemorrhagic collapse after an urgent conversion for intra-operational trauma of the renal pedicle (Table 5). Peritoneal tears occurred infrequently but never affecting the surgical proceeding.

The complication rate depended on the difficulty of the procedure and learning curve of the surgeon. In 1% of cases surgical reintervention was necessary from 8 h (acute hemorrhage) to 6 weeks (pancreatic fistula) after surgery. Patients who had minor inner trauma required less opiates such as renal cyst resection compared to nephrectomy.

A total of 28 patients (4.6%) presented medical postoperative complications: 10 unexplained hyperthermias, 7 deep venous thrombosis, 2 pyelonephritis after cure of ureteropelvic junction syndrome, 2 pulmonary infections, 1 phlebitis, 1 pulmonary atelectasia and 1 transient vascular ischemic accident with paraparesis, a wound infection and a cardiac arrhythmia (Table 6). The majority of these complications occurred in carcinological context.

Table 5 Surgical complications by procedure

	Radical nephrectomy	Simple nephrectomy	Adrenal-ectomy	Partial nephrectomy	Pyeloplasty	Nephro-ureterectomy	Cyst marsupalization	Diverti-culectomy	Miscellaneous	Total (%)
Wound or deep abscess	2	1	1	0	0	0	0	0	0	4
Bleeding-hematoma	3	2	2	3	2	0	0	0	0	12
Evisceration	2	0	0	1	0	0	0	0	0	3
Intestinal injury	0	0	0	1	0	1	0	0	0	2
Death	1	0	0	0	0	0	0	0	0	1
Pancreatic fistula	1	0	0	0	0	0	0	0	0	1
Urinary fistula	0	0	0	1	0	0	0	0	0	1
Urinoma	0	0	0	4	2	0	1	1	0	8
Total	9 (5.3)	3 (2.6)	3 (2.7)	10 (14.3)	4 (6.9)	1 (3.5)	1 (4.7)	1 (11.1)	0	32 (5.3)

Table 6 Medical complications by procedure

	Radical nephrectomy	Nephrectomy	Adrena-lectomy	Partial Nephrectomy	Pyelo-plasty	Nephro-ureterectomy	Cyst marsupalisation	Diverticu-lectomy	Miscellaneous	Total (%)
Hypertension	1	0	0	0	0	0	0	0	0	1
Atelectasia	1	0	0	0	0	0	0	0	0	1
Digestive hemorrhage	0	0	0	1	0	0	0	0	0	1
Hyperthermia	3	1	4	1	0	0	0	1	0	10
Pulmonary infection	1	0	1	0	0	0	0	0	0	2
Para paresis	0	0	0	1	0	0	0	0	0	1
Phlebitis	0	0	0	1	0	0	0	0	0	1
Wound infection	1	0	0	0	0	0	0	0	0	1
Pyelonephritis	0	0	0	0	2	0	0	0	0	2
Venous Thrombosis	3	4	0	0	0	0	0	0	0	7
Arrhythmias	0	1	0	0	0	0	0	0	0	1
Total	10 (5.9)	6 (5.2)	5 (4.4)	4 (5.7)	2 (3.4)	0	0	1 (11.1)	0	28 (4.7)

Mean postoperative hospital stay (Table 3) was 6.2 days (ranged from 2 to 20). Patients who required prolonged hospitalization were due to complication management. Most of the procedures were of moderate or significant difficulty, with only a few exceptions of simple procedures, e.g. cyst de-roofing, lymph node biopsy, pyelotomy and ureterolithotomy. According to European scoring system for laparoscopic operations in urology criteria, 36 procedures were classified as easy or slightly difficult, 322 fairly difficult or difficult and 242 very difficult.

Discussion

Most open urological surgery is extraperitoneal; since the pioneering work by Clayman et al. [1], laparoscopic urological surgery has developed rapidly and now includes a wide range of procedures. At the beginning of their experience, urologists used the transperitoneal approach to reach the upper urinary tract. The transperitoneal route was then preferred because it is easier to perform and allows the surgeon to work in the wider and more familiar peritoneal chamber [22].

The retroperitoneal laparoscopy or retroperitoneoscopy or lumboscopy is a recent way of approaching the retroperitoneum. Today this technique is well standardized and reported in almost all the relevant articles for retroperitoneal space. As a result of the current advances in retroperitoneoscopy, our group is able to do both approaches but prefers a retroperitoneal approach; it confers no benefit in visualization, access or dissection of the kidney or adrenals. The advantages in retroperitoneoscopy [15, 23–26] are the direct approach to the retroperitoneum despite the difficulties associated with the smaller operating chamber. By avoiding the peritoneal cavity the risk of visceral and vascular injury may be reduced. Retroperitoneal organs and certain landmarks can be visualized directly. Intestinal retraction is made easier as the peritoneal envelope surrounds the intestines and individual bowel loops need not be retracted. Postoperative adhesions and peritonitis if there is spillage of infected renal contents are minimized. Moreover, lumboscopy meets all the criteria of open renal surgery, according to which all urologic interventions are performed via the retroperitoneal route without transgressing the abdominal cavity.

Limitations of the retroperitoneal approach include the possible obliteration of this potential space by previous surgical procedures or inflammatory processes. A more common problem is that excessive fat may obscure the retroperitoneal anatomy. Landmarks in the retroperitoneum are relatively few compared with the peritoneal cavity. In addition, the limited skin area available may make port placement more difficult. Improper placement may result in colonic injury, as the peritoneal reflection is relatively fixed. By contrast, only three patients in our series of laparoscopic nephrectomies had to be converted to open surgery because of the size of the kidney [27].

Gaur was the first to develop the retroperitoneal laparoscopy and to carry out a nephrectomy [4, 5]. We do not use balloon distension to create the workspace. Since we standardized our technique the single digital dissection proved to be sufficient for adequate exposure of the retroperitoneal space. Thus, we could reduce our operating time by 5–15 min, which was usually required for balloon dissection [28]. Additionally, in our practice severe adhesions, such as those after previous renal surgeries can be lysed sufficiently by endoscopic incision. The peritoneum is separated from the abdominal wall by the index finger of the surgeon introduced through the subcostal incision. The first 2 trocars are placed under digital control. The wide longitudinal incision of the renal fascia performed at the beginning of the procedure helps to enlarge the working space. An important factor is optimal exposure of the entire surgical field before starting dissection at the renal hilum.

It has been demonstrated in our and other series worldwide that all the surgery of the upper urinary tract can be carried out by retroperitoneal laparoscopy: simple nephrectomies [29], radical nephrectomies [17, 30], partial nephrectomies [18], adrenalectomies[19], lymphadenectomies, renal cyst ablation, diverticulectomies, pyelolithotomy, ureterolysis, ureterolithotomy and retrocaval ureters. We prefer retroperitoneoscopic access for all of these indications.

Recent studies confirm that the operative duration, blood loss and complications for laparoscopic nephrectomies decrease with the experience of the surgeon. A total of 5% of our patients were transfused of which two-thirds after a radical or partial nephrectomy. The blood losses are notably decreased perioperatively compared to the open surgery [31].

Conversion to open surgery (in 28 of our cases) does not necessarily indicate a complication. We mainly converted the lumboscopy to open surgery only when there were complex anatomical situations or gross obesity which did not allow proper dissection, or patients presenting with perinephric adhesions, due to infectious side effects, or previous surgery in the area. Indeed, these fibrous adhesions obstruct the creation of the workspace and complicate this approach. The retroperitoneal laparoscopy makes it technically possible to extract bulky masses. In our study, only 2.1% of the patients had to be converted because of technical difficulties related to a too bulky mass or a mass adhering to the vascular pedicles (Table 4).

Those conversions undertaken as an emergency are usually secondary to a major complication such as bleeding. With experience, the vascular traumas which occur at the time of the dissection of the renal pedicle can be managed by endoscopy. The urgent conversion rate in our study is 0.833%; it is related primarily with the radical nephrectomies and often results from difficulties of dissection related to the presence of loco-regional adenopathies. To avoid these complications, it is imperative that there is minimal handling or probing of the region of the renal hilum. Rassweiller et al. [12] announced a total conversion rate of 7.5% including 3% for perioperative hemorrhages. Desai et al. [32] reported an experience of 404 retroperitoneoscopies and a conversion rate due hemorrhage of 1.7%. In his series of 274 urologic operations of the upper urinary tract and Thiel et al. [33] reported a hemorrhagic accident rate of 1.7% mentioning that only 0.3% were converted.

The vascular wounds are generally venous because of their brittleness. They relate to the renal vein, the vena cava and, sometimes, the avulsion of the genital vein. Four cases out of five could be treated by endoscopy by clamping and suturing of the bleeding area with blood losses going from 0.5 to 1, 2 L. Bleeding from gonadal vessels and their retroperitoneal branch vessels occurred towards the end of the procedure during blunt dissection of the kidney and ureter. Fahlenkamp et al. [24], in a multi-institutional review of 2,407 laparoscopic procedures, reported an incidence of 1.7% for vascular injuries; the incidence was 2.2% in a review of 36 laparoscopy centers in the USA [15].

In retroperitoneoscopy, it is rare to traumatize a vessel at the time of the insertion of the trocars. Indeed, there are not important vessels being along the specific area of abdominal wall and the digitally guided insertion protects the large abdominal vessels [34]. Three of our patients (0.5%) presented a digestive tract trauma: one pancreatic fistula and two intestinal wounds. The digestive tract wounds during retroperitoneal surgery seem to be attributed to the use of monopolar coagulation and the diffusion of heat energy at the time of the cleavage of the kidney and the peritoneum near the intestine and the pancreas. Theoretically, the rate of wounds of intraperitoneal organs by laparoscopic transperitoneal approach is higher. Of 20 digestive wounds, Fahlenkamp et al. [24] indexes 15 during the transperitoneal approach. It generally results from the handling of the digestive tract and the lysis of the adhesions in the event of postsurgical fibrosis. By the transperitoneal approach, Parsons et al. [35], mentions a rate of 2.13% and Vallancien et al. [36] 1.2% for 206 operations of the upper urinary tract. In his series comparing 50

nephrectomies for cancer carried out by transperitoneal laparoscopy with 52 nephrectomies for cancer carried out by retroperitoneal laparoscopy, Desai et al. [32] counts four wounds transperitoneally against none retroperitoneally. Bishoff et al. [37], in a series of 915 laparoscopies, however, found only 0.2% of digestive tract perforations half of them resulted from electrocoagulation. He insists on the difficulty of such a diagnosis in the postoperative period; the digestive wound presents with diarrhea, ileus, leukopenia and especially with a persistent pain on the site of trocar nearest to the wound.

There has been one death (0.1%) following a hemorrhagic shock among patients having undergone a radical nephrectomy. This rate of deaths is not higher than in the transperitoneal laparoscopic and open series.

We consider a tear at the peritoneum as a minor complication and if it does occur, the problem can be managed using a variety of techniques. An intravenous cannula can be inserted into the peritoneum to vent the CO_2. This helps to increase the retroperitoneal space by reducing the intraperitoneal pressure. Another option is to widen the tear intentionally to equalize the pressure on the two sides. These techniques are usually sufficient to overcome the problem

Other surgical complications are very rare, since only three patients (0.5%) presented a hernia on the scar of a 12 mm trocar opening. The retroperitoneal laparoscopy decreases morbidity related to the large incisions of lumbotomy (often by extracting the specimen through a small incision in the iliac fossa). Elashry et al. [38] reported incisional hernia in 5 of 29 patients (17%) after transperitoneal laparoscopic nephrectomy. The specimens were removed intact via a transverse lower abdominal muscle-cutting incision. In all the present patients the specimen was removed intact, either by enlarging the primary port site or by a small 5 cm iliac incision. Retroperitoneal access provides protection against hernia formation and intact specimen retrieval is safe with this approach, especially when the wound is closed in layers.

As McDougall and Clayman indicated [39], our experience with retroperitoneal laparoscopic nephrectomy resulted in a greater decrease in postoperative morbidity compared to transperitoneal laparoscopic nephrectomy and open surgery.

A total of 4.6% of the patients presented medical postoperative complications generally related to the level that Clavien et al. [40] classifies IIa. Kadji et al. [31] found a similar rate of complications (4.5%) in a series of radical nephrectomies. Urinomas are frequent complications, although not the most severe. They are primarily urinary fistulas treated simply by ureteral drainage. In the event of partial nephrectomy, the location of a potential caliceal wound must be detected by the flow of a dye instilled by the ureteral catheter intraoperatively. This kind of trauma must be sutured. After pyelography, the ureteral catheter is replaced by double J stent left in place for 1 month [18]. A liquid collection in the retroperitoneum is spontaneously controlled by the limited workspace and natural tamponade thus caused. It is an advantage of the retroperitoneal approach [34]. The thoracic complications are summarized to two pulmonary infections and one atelectasia. The retroperitoneal laparoscopic approach technically makes it possible to remove large masses even if the workspace is limited. Nevertheless, in the event of bulky tumors and/or of lymphadenopathies solidifying the pedicle, the interest of another way initially can be discussed. In our experience, a large renal tumor T3 required a conversion and presented a local relapse and hepatic metastases. Two operated patients with nephroureterectomies pT3G3 presented local relapses. Higher dimensions would increase the risk of capsular invasion and loco-regional relapses. Nevertheless, the laparoscopic results are comparable with those of the conventional surgery [41].

In theory, the retroperitoneal laparoscopy, while remaining apart from the peritoneum, allows a faster approach to the retroperitoneal organs and prevents completely the risk of fibrous adhesion formation intraperitoneally and thus of later occlusions. In addition, the scapular pain of the pneumoperitoneum is less frequent retroperitoneoscopy so the postoperative period of pain is decreased [34]. Nevertheless, in their comparative series, Desai et al. [32] did not find significant differences in terms of hospital stay and consumption of analgesics between the two approaches.

During the last 5 years of our study there is a steep decline in complication and reintervention rates. The performing surgeons became more experienced in retroperitoneoscopy and most of the technical problems, could be managed endoscopically. The technique was standardized and the anatomical access and dissection techniques could be taught. Consequently the individual learning curve is significantly shorter for the trainees.

Conclusion

In conclusion, at the beginning of the third millennium, it is possible to state that retroperitoneoscopy can be the technique of choice for accessing and carrying out all the surgery of the upper urinary tract. Surgeons who want to perform renal laparoscopic surgery should know how to do both approaches (retroperitoneal and transperitoneal) because some patients will require retroperitoneal approach for instance if they had previous major intraperitoneal surgeries, or if it is a urinary upper tract tumor.

Retroperitoneoscopy respects the principles of the oncological surgery. After experience with 600 cases during the

last 10 years the technique has become safe, simplified, reproducible and effective although not easy. This approach is interesting in the event of previous history of abdominal surgery because it makes it possible to avoid risky and tiresome lysis of the adhesions. Most complications are minor and easily managed.

Conflict of interest statement There is no conflict of interest.

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