World J Urol
DOI 10.1007/s00345-015-1602-8

ORIGINAL ARTICLE

Minilaparoscopy in urology: initial results after 32 cases

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Received: 20 January 2015 / Accepted: 20 May 2015

Abstract
Purpose The use of minilaparoscopic instruments has gained interest in recent years, permitting a less invasive treatment for many surgical procedures. Its application in urological surgeries has not been established yet.
Methods Between November 2012 and December 2014, 32 patients underwent minilaparoscopic surgeries, using 3.5-mm instruments. The procedures performed included pyeloplasties (16 cases), radical nephrectomies (2), simple nephrectomies (4), renal cyst decortication (5), ureterolithotomy (2) ureteral reimplantation (2) and partial ureterectomy (1).
Results All the procedures were performed minilaparoscopically, except for one simple nephrectomy and one renal cyst decortication that were converted to a standard laparoscopic approach, due to intensive perioperative bleeding. One pyeloplasty had to be reoperated for a urinary fistula repair. All the patients had good-to-excellent cosmetic outcomes, except for one patient who developed keloids at her scars. Functional results were comparable to the ones described in the literature.
Conclusion Minilaparoscopy is a feasible option for patients and physicians searching for a even less invasive procedure compared with the laparoscopic approach, with better cosmetic and the same functional and oncologic outcomes.

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Keywords Minilaparoscopy · Urology · Renal · Ureteral · Surgery

Introduction

Since the first reported nephrectomy [1], laparoscopic surgery has gained space between urologists and nowadays became well established as the standard of care for the majority of urological operations, demonstrating reduced postoperative pain, lower blood loss and shorter hospitalization time when compared to open surgery [2].

Nevertheless, despite the reduction in abdominal wall injury, laparoscopic surgery still causes postoperative pain and carries a risk of bleeding, infection and hernia formation at the sites of instrument insertion. Some patients even complain of cosmetic issues after a couple of weeks following the procedure, due to the scars from portal placement [3].

In an attempt to reduce even more the morbidity of conventional laparoscopy and to improve cosmetic results, procedures such as laparoendoscopic single-site surgery (LESS), which uses the insertion of the instruments through one site, usually the umbilical scar, and natural orifice transluminal endoscopic surgery (NOTES), based on the introduction of the instruments through a natural orifice, for example the vagina, were developed [3, 4].

Both techniques, although feasible, demand a long learning curve and require adaptation of the surgical team to different conditions, such as lack of triangulation and small working space for LESS, and require the use of expensive and unusual instruments for NOTES [5].

Minilaparoscopy is an option to perform the same procedures using the standard instruments, but miniaturized (2–4 mm wide). This decreases pain and abdominal trauma,

Published online: 28 May 2015

Fig. 1 Position of the trocarts in a right sided nephrectomy

leading to a lower risk of hernia formation, bleeding, and avoids the necessity of a new learning curve, since the basic principles of laparoscopic surgery are maintained [6].

We report our initial experience performing kidney and ureteral procedures using 3-mm instruments in 32 patients.

Materials and methods

Between November 2012 and December 2014, 32 patients underwent minilaparoscopic renal and ureteral surgeries using 3-mm instruments. The procedures included pyeloplasties, radical and simple nephrectomies, ureterolithotomies, renal cyst decortications, ureteral reimplants and ureteroplasty.

All the cases were accessed transperitoneally, using a 10-mm 30° laparoscope installed at the umbilicus (the umbilical scar is a natural incision that disappears after the surgery) [7]. Two 3-mm ports were installed, both on the hemiclavicular line, one 2 cm below the 12th rib and one at the level of the umbilicus, for dissection and mobilization of the targetted organs (Fig. 1).

In the cases when a large specimen removal was required, such as simple or radical nephrectomies, we used an additional 10-mm port between the pubic symphysis and the iliac bone to apply clips and remove the organ. Patients with a previous Pfannenstiel incision had their specimens removed through this incision.

Pyeloplasties were performed dismembered using the Anderson–Hines technique in all patients, except for one case, in which we performed a Y-V plasty.

On the left side, a transmesocolic approach, with direct access to the ureteropelvic junction (UPJ), was executed. The obstructed area was resected followed by a ureteropelvic anastomosis with two running sutures. The sutures were placed in the abdominal cavity through the umbilical port and removed through the 3-mm port at the end of the surgery after the needles were straightened with the needle holder. The double-J catheter was positioned in an antegrade fashion by using a venous access sheath instead of an additional port. After the posterior ureteropelvic anastomosis was performed, the guide wire was placed in the ureter, and then the access sheath was removed and the double-J inserted transcutaneously. The same was done on the right side, except for the access, that required medial colon mobilization, executed with a monopolar cautery for exposal of the UPJ. At the end of the procedure, the resected UPJ was removed through the 10-mm umbilical port, and a small suction drain was placed through the 3-mm trocart for urine leak monitoring.

In cases of ureterolithotomy, the ureter was accessed in the same way as described for nephrectomy. Stones were removed in one piece through the umbilical port, and the ureteral defect was closed using a running suture after a double-J stent placed in the same way as described for pyeloplasties, since both cases were proximal large stones.

Renal cyst decortication was indicated only when the patients complained of lumbar pain associated with radiological confirmation of obstruction of the collecting system. On the left side, the cyst was approached through an incision of the mesocolon facilitating a quick access to the area to be resected. On the right side, the colon was mobilized medially with explosion of the cyst. A large area of the cystic wall was resected, and the liquid was aspirated. At the end, a suture at the bottom of the cystic cavity was placed, filling the region with the omentum or the perirenal fat, to permit a definitive treatment minimizing the risk of neoformation.

Radical and simple nephrectomies were performed using the same trocart placement, added to an extra 12-mm port at the iliac fossa, to apply clips for control of the renal hilum and at the end of the procedure, for specimen removal.

For the access of the pelvis to perform ureteral reimplantation and ureterectomy, the patients were positioned in the supine position with one 10-mm trocart at the umbilical incision for the laparoscope placement and two extra 3-mm ports on each iliac fossa for instrumentation. In the case of segmentar ureterectomy, an end-to-end anastomosis was performed followed by a retrograde double-J stenting with a cystoscope.

Both ureteral reimplants were performed by reproducing the extra vesical technique, and a double-J stent was also placed after dividing the distal ureter in a retrograde fashion. Before performing a ureterobladder anastomosis, through a venous access sheath (or a Seldinger needle) similarly as we described for pyeloplasties, a guide wire was inserted into the distal ureter and placed into the kidney.

Table 1 Summary of our experience with minilaparoscopic urological experience

Procedure	Number of cases
Pyeloplasty	16
Radical nephrectomy	2
Simple nephrectomy	4
Ureterolithotomy	2
Cyst decortication	5
Ureteral reimplant	2
Ureterectomy	1
Total	32
Characteristics	
Operative time	Range 35–120 min (depending on the procedure)
Blood loss	Range 50–400 ml (depending on the procedure)
Conversion to standard laparoscopy	1 Nephrectomy—inflammation 1 Renal cyst—bleeding
Addition of standard instruments	6 Nephrectomies (clip applier)
	1 Renal cyst deroofing (conversion to laparoscopic approach)
Hospital discharge	1.5–6 days

The access sheath was removed, and the stent was installed transcutaneously.

To evaluate postoperative pain, all the patients selected for minilaparoscopic treatment were kept under nonsteroid anti-inflammatory drugs regularly on postoperative day one, and on demand, after patient's solicitation, after.

Two to 3 months after the surgeries, all the patients were questioned about their satisfaction related to the port-site scars. For this evaluation, they were questioned if they were very satisfied, satisfied, indifferent or unsatisfied with their scars and which ones had a worse or better cosmetic result (10 or 3 mm).

All the patients signed an informed consent and were aware that if any sign of technical difficulty were detected during the surgery, the team would choose either to convert the minilaparoscopic approach to a standard laparoscopic surgery or even to an open procedure.

Results

The initial goal in all cases was to perform a minilaparoscopic surgery, and all the patients were successfully treated minilaparoscopically, except for two cases (one simple nephrectomy and one renal cyst decortication associated with a lower calix stone) that required conversion to standard laparoscopy. All the results are summarized in Table 1.

Pain evaluation showed an excellent result. After day two, only one patient submitted to a pyeloplasty required opioids, and the rest of the patients were either discharged from the hospital or required no pain medication during the rest of their hospital stay.

The postoperative results are listed below, divided by each procedure.

Pyeloplasty

All the cases were performed successfully despite of the side affects and the presence or absence of a crossing vessel. All patients were discharged from the hospital 36 h after the procedure, except for one case, that required reoperation for a urinary fistula repair, diagnosed by CT scan and reoperated after 15 days. The double-J was removed on postoperative day 30th.

At a follow-up ranging between 4 and 24 months, all the patients treated showed a patent UPJ with improvement in their renal function on scintigraphy evaluation, except for one case with a previous DMSA of 16 %, and had a very large hydronephrosis. After 4 months, a venous pyelogram showed delay on contrast elimination, without obstruction.

Nephrectomy

All the nephrectomies were performed without conversion to open procedures (Figs. 1, 2, 3). One out of the six cases was converted to standard laparoscopy in which intense inflammation was found in the peri-renal tissue, requiring the use of more robust instruments for traction and dissection of the organ. With the use of these instruments and the harmonic scalp for dissection and coagulation, the kidney was successfully removed. There were no differences between radical and simple nephrectomies in terms of operative time, bleeding and hospital discharge (Table 1).

Fig. 2 Arterial control in a left nephrectomy

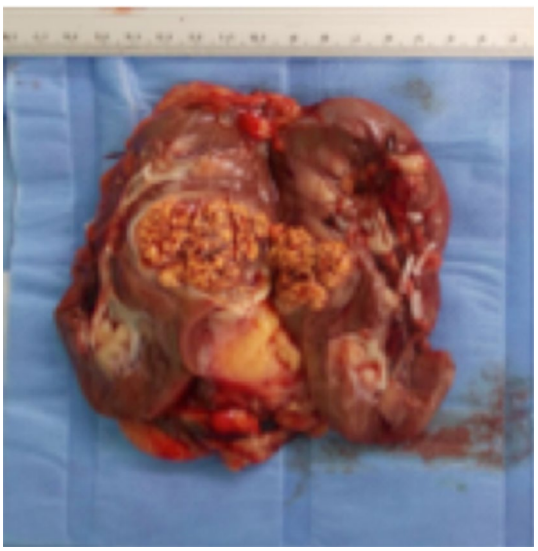

Fig. 3 Specimen of a left radical nephrectomy

Renal cyst decortication

All cases were completed successfully, and the patients improved their pain symptoms. Radiological evaluation of these patients showed no neoformation of cystic areas in a follow-up of 6, 10, 12, 24 and 28 months (Fig. 4).

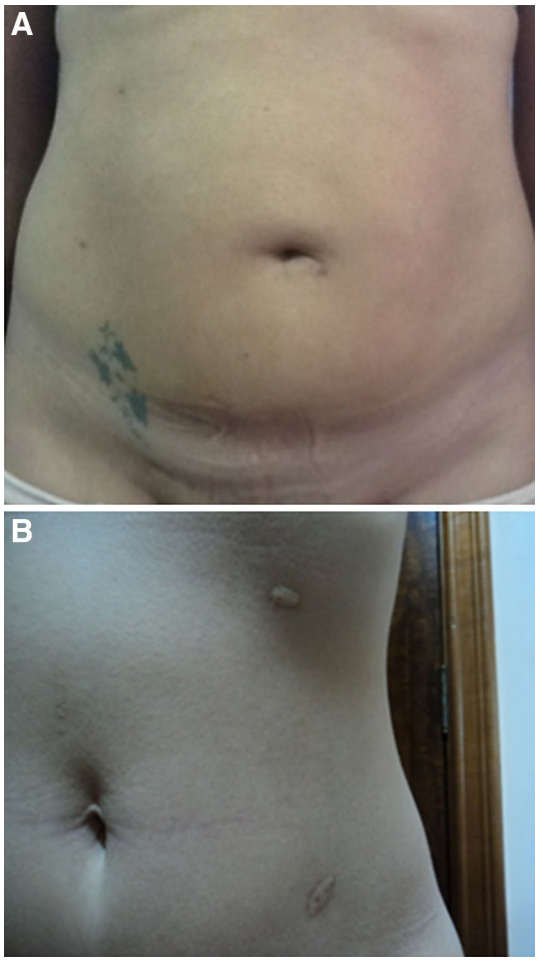

Fig. 4 **a** Minilaparoscopic nephrectomy after 60 days **b** Laparoscopic standard pyeloplasty

One patient with a right-sided large inferior pole cyst associated with a lower calix stone had her procedure converted to a standard laparoscopic approach due to bleeding from the parenchyma adjacent to the cystic wall. The bleeding was controlled with clips, and we could finish the procedure as described above.

Ureterolithotomy was executed in two large proximal ureteral stones for patients who did not have access to endourological procedures at their institution. In both cases, the stones were removed in one piece and the patients showed no obstruction on their postoperative radiological evaluation.

All the ureteral cases were operated due to ureteral strictures after endoscopic manipulation for distal ureteral stones. In two cases, we reimplanted the ureter, and in another case, showing an ureteral stricture at the level of the left iliac vessels, a segmental area of the ureter was resected followed by an end-to-end ureteral anastomosis and retrograde double-J stenting.

All the ureteral approaches were performed minilaparoscopically, and the functional result was excellent, with no obstruction and improvement in the renal function in all cases.

Cosmesis

At a median follow-up of 2.5 months, all the patients were very satisfied with the umbilical scar, except for one that developed keloids in all ports.

With relation to the additional ports, the three patients who underwent pelvic surgeries were very satisfied with all of them, and among the patients who underwent kidney surgeries, all the women were very satisfied, except for the one mentioned before, and another one who was unsatisfied with one of her port-site scars, the one where the postoperative suction drain was installed that showed a small hypertrophy.

The three men operated underwent pyeloplasties, and all of them said that they were indifferent to the aspect of their scars.

Discussion

Minilaparoscopic surgery is an old concept of surgery that utilizes miniaturized instruments for the accomplishment of conventional laparoscopic procedures [6]. Nevertheless, this way to operate patients was not applied in adult urologic surgery until recent years. The main reason for the lack of its use is the fact that urologic laparoscopic surgery requires traction and mobilization of large organs, demanding the use of robust instruments and strong energy devices such as harmonic scalps and clip appliers. In the beginning, minilaparoscopic instruments were problematic due to poor vision, loose grasping, defective irrigation or suction, and decreased durability [7].

With the development of these devices, a second generation of minilaparoscopic instruments has addressed the former drawbacks, and currently, a wide range of instruments has been added in the armamentarium of urologic surgeons, such as graspers, dissectors, needle holders and suction–irrigation devices. This, added to a better training of the surgeons, has increased the applicability of minilaparoscopic surgery, and it gained force in some urological conditions, especially for those patients seeking for better cosmesis [8].

The main advance of minilaparoscopic surgery is the reduction in abdominal trauma, consequently causing less postoperative pain and better cosmesis, since 3-mm incisions generate minimal scarring. An additional advantage of this technology is that there is no need for a learning curve, since it maintains the principals of triangulation resembling standard laparoscopic surgery. Our pyeloplasty results are comparable to the ones described to the standard laparoscopic technique series and other minilaparoscopic series, which makes us believe that this technique should be offered to patients seeking for a less invasive procedure and especially with a better cosmetic outcome than the laparoscopic approach [7, 9].

Until more robust data on LESS and NOTES outcomes are available, both techniques should be performed by experienced surgeons in an experimental setting [10]. Nevertheless, the above-mentioned techniques, despite being still under evaluation, already have a significant impact on the laparoscopic community. Their introduction established that the perioperative morbidity of laparoscopy can and should be reduced and that cosmetic outcome matters for both patients and surgeon. In other words, the rising interest of the urological community for both LESS and NOTES shows that we are evolving to an even less invasive treatment in urological surgery [11, 12]. With the availability of refined minilaparoscopic instruments and following the trend of further improving laparoscopic morbidity, minilaparoscopy has recently gained significant popularity.

The ideal indication for minilaparoscopic surgeries are the procedures that do not require specimen extraction, or the ones in which the specimen to be removed from the abdominal cavity fits the 10-mm trocart used for the laparoscope introduction. This includes a resected UPJ, a cyst wall, a stone, a product of a partial nephrectomy or even a small morselized kidney [13, 14]. As we could see in our series, the majority of cases were reconstructive surgeries, performed with initial results similar to those described in other series [7].

Performing a total nephrectomy using only 3-mm instruments has been one of our thoughts, but since we do not have hemostatic clips to control the hilar vessels, we would have to ligate each blood vessel with a suture line, which would take a very long time and put the patient's physical integrity at risk. An example of this situation occured in one patient who underwent a cyst decortication and had her surgery converted to a standard laparoscopic approach due to the necessity of use of hemostatic clips to stop the bleeding.

Donor and simple nephrectomies were performed in women with a previous Pfannenstiel incision without an extra scar formation, and ureteral procedures were performed also with results comparable to standard techniques [15, 16]. Vaginal extraction has also been described for specimen retrieval by several authors [17–20], and it could be used in this cases. In our series, all the patients who underwent total nephrectomies have had a previous Pfannenstiel incision for birth delivery, a very common procedure in our country; for this reason, we have not tried the vaginal extraction of the specimens.

Another application for minilaparoscopic instruments would be the association of those instruments with the standard laparoscopic instruments, or even for LESS and NOTES [3, 5].

Future prospects of this technology could be microlaparoscopy and robotic-assisted minilaparoscopy. Technological advancements made possible to further miniaturize laparoscopic instruments to <2 mm introducing microlaparoscopy as a new field in minimally invasive approaches to surgery, with promising results in the diagnostic evaluation of the pelvis already reported [21–23]. In addition, novel minirobotic instruments are under development and are expected to combine the reductive invasiveness of minilaparoscopy with the well-documented benefits of robotic assistance in the future [24].

Conclusion

Following the transition from open to laparoscopic surgery, minilaparoscopy presents a step forward toward even less invasive procedures. Further series with more patients comparing this approach to standard laparoscopy with an longer follow-up are still required to stablish this technique as standard of care for certain specific conditions.

Patients and surgeons seeking for better cosmetic outcome should take under consideration this approach, specially those with non-inflammatory conditions with no need for large specimen removal.

Minilaparoscopic approach should not be the goal for urologists, but a tool to an even less invasive treatment in urology than those that are already established in the literature, since it can be associated with other standard approaches.

Conflict of interest The authors have nothing to disclosure.

Ethical standard This project has been submitted to our institutions' ethics committee and approved according to 1964 Declaration of Helsinki and its later amendments.

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