Laparoscopic cystectomy: indications and limitations.

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Summary.- OBJECTIVES: To describe the technique and preliminary results of the laparoscopic cystectomy as well as to review current indications and limitations of a novel surgical approach for a classical operation.

METHODS: A careful description of the key points of the technique of laparoscopic cystectomy and creation of an ileal conduit is provided. Operative and immediate complications of this operation in a preliminary series of 11 patients are described.

RESULTS: Laparoscopic cystectomy is proven feasible with a mean operative time of 7.3 hours and minimal blood loss (median 330 cc). Transfusion was required in two patients and the rate of major complications is in this series for 18%. Minor complications account for 27% of the series. Mean hospital stay was 7 days.

CONCLUSIONS: Laparoscopic cystectomy can be performed safely although a high level of skill is needed. The precise role of the technique has yet to be described and for the moment being, and till oncological results will be confirmed remains under evaluation.

Keywords: Laparoscopic cystectomy. Feasibility. Preliminary results.

Resumen.- OBJETIVOS: Describir la técnica de cistectomía laparoscópica y los resultados preliminares así como revisar las indicaciones actuales y limitaciones de este nuevo abordaje quirúrgico para una operación clásica.

MÉTODOS: Se suministra una descripción cuidadosa de los puntos clave de la técnica de cistectomía laparoscópica con creación de un conducto ileal. Se describen las complicaciones intraoperatorias y postoperatorias precoce de la operación en un serie preliminar de 11 pacientes.

RESULTADOS: Se demuestra que la cistectomía laparoscópica es viable con un tiempo medio de operación de 7,3 horas y unas pérdidas sanguíneas mínimas (mediana 330 cc). Dos pacientes necesitaron transfusión y la incidencia de complicaciones graves en la serie fue del 18%. Las complicaciones leves ascienden al 27% de la serie. La estancia media fue de 7 días.

CONCLUSIONES: La cistectomía laparoscópica puede ser realizada con seguridad aunque requiere un alto nivel de habilidad. El papel preciso de la técnica está todavía por describir y de momento, hasta que los resultados oncológicos sean confirmados, permanece bajo evaluación.

Palabras clave: Cistectomía laparoscópica. Viabilidad. Resultados preliminares.
INTRODUCTION

Advancements in laparoscopic techniques have recently revolutionized the surgical approach to a variety of urological disorders. Ablative and reconstructive procedures are being routinely performed in many institutions (1). The concept of performing major urological operations with minimal surgical trauma has driven urologists to a new operative perspective. Certainly, a minimally invasive approach to cystectomy represents a good example of this new surgical philosophy.

Laparoscopic cystectomy has been performed for both benign and malignant conditions in recent years (2). Increased experience with laparoscopic pelvic anatomy has been central to this development. However, laparoscopic urinary tract reconstruction following cystectomy is still technically challenging.

Till recently, the reconstructive part of the laparoscopic cystectomy procedure has been performed extracorporeally through a mini-laparotomy incision. Laparoscopic urinary diversion, performed completely intracorporeally, has only recently been reported (2). Herein, we review the experimental and clinical studies that served as basis for the development of this operation. The authors' experience and technique are outlined. Also, we evaluate the current indications for this procedure, its feasibility, oncologic adequacy, advantages and limitations of the method, and its future perspectives.

HISTORICAL BACKGROUND

Laparoscopic simple cystectomy was initially reported by Parra and colleagues in 1992 (Table I) (3).
A benign, retained bladder of a 27 year-old woman suffering from recurrent symptomatic pyocystis after prior supravesical urinary diversion was excised laparoscopically. Surgical time was 130 minutes, blood loss was 115 ml and hospital stay was 5 days. Kozminski and Partamian initially reported a laparoscopic-assisted ileal conduit, wherein the ileal loop exclusion, restoration of bowel continuity, and ileo-ureteral anastomoses were all performed extracorporeally through a mini-laparotomy incision (4). Sanchez de Badajoz and colleagues also reported a laparoscopic cystectomy with extracorporeal creation of an ileal conduit in a woman with malignant disease of the bladder (5). Based on the increasing acceptance of laparoscopic-assisted transvaginal hysterectomy, Puppo and colleagues described their initial experience with laparoscopic-assisted transvaginal radical cystectomy in 5 female patients with muscle-invasive bladder cancer (6). Urinary diversion consisted of bilateral cutaneous ureterostomy in one case and an extracorporeally-constructed ileal conduit through an extension of a stoma-site incision in the remaining 4 patients. Operative time range was 6-8 hours, including the pelvic lymphadenectomy performed in 3 of the 5 patients. Denewer and colleagues presented their experience in the management of 10 patients with T2-T3b bilharzial squamous and transitional cell bladder cancer who underwent laparoscopic radical cystectomy (7). Construction of a continent pouch was performed open surgically through a limited abdominal incision.

Recently, our group at the Cleveland Clinic reported the initial two cases of laparoscopic radical cystectomy with ileal conduit, performed exclusively by intracorporeal techniques (8). Prior to embarking upon this clinical experience, we determined the feasibility of the procedure in a survival porcine study (9). The operation was performed in 10 animals, which were followed for 1-3 months. Isolation of the ileal loop, restoration of intestinal continuity and bilateral uretero-ileal anastomosis were successfully and reproducibly performed completely intracorporeally.

**SURGICAL TECHNIQUE**

With the patient in the supine lithotomy position, a six-port approach is employed (Fig. 1), as previously described (8). A 10 mm 0° laparoscope is utilized. Slight Trendelenberg decline avoids interposition of small bowel in the operative field. The posterior parietal peritoneum is incised horizontally over the rectovesical pouch, with the incision extending on either side up to the common iliac artery (Fig. 2). The vas deferens are identified and divided. The seminal vesicles are maintained attached to the bladder specimen, without their individual mobilization, as performed during a laparoscopic radical prostatectomy. Denonvillier's fascia is incised and the plane between the rectum and bladder is developed bluntly towards the prostatic apex. Both ureters are widely mobilized from the bladder to the pelvic brim, which allows precise definition of the posterior and lateral vascular pedicles.
of the bladder. These are controlled by serial applications of the Endo-GIA stapler (U.S. Surgical, Norwalk, CT) (Fig. 3). The bladder is distended via the Foley catheter with 200 cc of 2% formaline solution and the peritoneotomy is carried anteriorly in an inverted-V manner, lateral to the medial umbilical ligaments. It is then extended towards the umbilicus, where the urachus is transected. The anterior surface of the bladder is completely mobilized and the retropubic space of Retzius is developed. The bladder is deflated. Endopelvic fascia is incised bilaterally, the puboprostatic ligaments are divided and the dorsal vein complex is controlled, either by suture ligation or an Endo-GIA stapler. The urethra is transected distally to the prostatic apex, the rectourethralis muscle is incised and the remaining attachments are released to free the en bloc radical cystoprostatectomy specimen, which is entrapped in an Endocatch II bag (U.S. Surgical, Norwalk, CT). Bilateral pelvic lymphadenectomy is completed.

A 15 cm segment of ileum, located 15 cm proximal to the ileocecal valve, is isolated based on a broad, well-vascularized mesenteric pedicle with the use of the Endo-GIA stapler. Side-to-side ileo-ileal stapled anastomosis is performed intracorporeally by 2 sequential firings of the Endo-GIA stapler to restore intestinal continuity. The left ureter is retroperitoneally transposed to the right side of the abdominal cavity through a small opening in the sigmoid mesocolon. The distal end of the ileal loop is exteriorized through the pre-selected port-site in the right rectus muscle using conventional techniques. With the ileostomy occupying the port-site opening, pneumoperitoneum is reestablished and bilateral ileo-ureteral anastomoses are performed sequentially, using completely...
intracorporeal techniques (Fig. 4). At the selected site of anastomosis, a small ileotomy is created and precise mucosa-to-mucosa ileo-ureteral anastomosis is fashioned over a 7-Fr, 90 cm single-J ileo-ureteral stent. A 4-0 Vicryl suture on a RB-1 needle is employed, and laparoscopic free-hand suturing and intracorporeal knot-tying techniques are used exclusively. Two 10 mm Jackson-Pratt drains are inserted through different port-sites, and a Foley catheter is indwelled per urethra as a pelvic drain. The entrapped specimen is extracted intact through a small circumbilical extension of the umbilical port-site, and laparoscopic exit performed.

RESULTS

To date, 11 patients have undergone this procedure at our institution, as outlined in Table II. All patients had organ-confined bladder cancer without CT scan evidence of extravesical involvement. Mean operative time was 7.3 hours (6.5-11.5 hours) and median blood loss was 330 cc (200-1200 cc). Transfusion was required in two patients. Median hospital stay was 7 days (4-30 days). All procedures were completed successfully, without any open conversion. There were 2 major (18%) and 3 minor (27%) complications: major – bowel obstruction (1) and bowel perforation (1). This latter patient developed complications from severe aspiration pneumonia, leading to delayed mortality; minor – adductor spasm (2) and sub-acute bowel obstruction resolving spontaneously (1). Pathologic staging ranged from pT2bN0M0 to T4 (prostate involvement) N1M0 disease. Three patients had lymphatic micrometastasis (mean 6.3 nodes/patient; range 2-13). Surgical margins of the bladder specimen were negative for cancer in all 11 patients.

CURRENT INDICATIONS FOR LAPAROSCOPIC CYSTECTOMY

The increased experience with laparoscopic surgery and progressive familiarity of the urologist with pelvic laparoscopic procedures, notably lymph node dissection, bladder neck suspension, and, most importantly, laparoscopic radical prostatectomy, have naturally led to laparoscopic cystectomy. Basically, laparoscopic cystectomy can be performed for various benign conditions such as pyocystis or an intractably contracted bladder with a non-functional outlet. Laparoscopic radical cystectomy is indicated in patients with organ-confined muscle-invasive bladder cancer or recurrent multifocal carcinoma in situ which has failed intra-vesical chemotherapy. Contra-indications include prior pelvic radiotherapy, multiple previous abdominal operations, active bladder or upper tract infection, coagulopathy, and extra-vesical involvement by the bladder cancer. The feasibility of laparoscopic cystectomy has been demonstrated consistently (3-8). Our early experience suggests that all essential ablative and reconstructive maneuvers necessary during a radical cystectomy and ileal conduit urinary diversion can be duplicated laparoscopically with precision. More importantly, established oncologic principles are maintained, as evidenced by the negative surgical margins for cancer in all our patients. Although only
long-term follow-up of these patients will define the role of laparoscopy in bladder cancer management, the early oncologic adequacy is encouraging.

The laparoscopic technique must be adjusted to the reconstructive needs of the individual patient. A mini-laparotomy or exteriorization of bowel and ureters through a port-site extension have been largely employed in experimental models (10) and in the clinical setting (3-7, 11). Van Savage et al. recommended the use of a laparoscopic-assisted approach for Mitrofanoff appendicovesicostomy as continent urinary diversion for obese patients, when bowel mobilization is done laparoscopically and the continent diversion can be accomplished through a low Pfannenstiel incision, with improved postoperative cosmesis to this specific patient population (12). Clearly, our prior experience with major laparoscopic reconstructive procedures, such as

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**TABLE II: LAPAROSCOPIC RADICAL CYSTECTOMY WITH ILEAL CONDUIT FOR BLADDER CANCER IN 11 PATIENTS: CLEVELAND CLINIC EXPERIENCE**

<table>
<thead>
<tr>
<th>Intraoperative Endpoints</th>
<th></th>
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<tbody>
<tr>
<td>Mean operative time (hours)</td>
<td>7.3</td>
<td>(6.5 – 11 h)</td>
</tr>
<tr>
<td>Mean blood loss (cc)</td>
<td>330</td>
<td>(200 – 1200 cc)</td>
</tr>
<tr>
<td>Blood transfusion</td>
<td>2 patients</td>
<td></td>
</tr>
<tr>
<td>Conversion to open surgery</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Mean specimen weight (gm)</td>
<td>246</td>
<td>(90 – 400 gm)</td>
</tr>
<tr>
<td>Lymph node removal (mean nodes/patient)</td>
<td>6.3</td>
<td>(2 – 13)</td>
</tr>
<tr>
<td>Pathologic staging</td>
<td>T2bN0M0 – T4N1M0</td>
<td></td>
</tr>
<tr>
<td>Surgical margins</td>
<td>Negative in all cases</td>
<td></td>
</tr>
<tr>
<td>Mean hospital stay (days)</td>
<td>7</td>
<td>(4 – 30 days)</td>
</tr>
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</table>

**Complications**

Minor (n=3; 27%)

- Sub-acute bowel obstruction: 1
- Adductor spasm: 2

Major (n=2; 18%)

- Bowel obstruction: 1
- Bowel perforation/Delayed mortality due to aspiration pneumonia complications: 1

* Ten cases performed completely intracorporeally with laparoscopic stapling and free-hand suturing techniques. One patient underwent Indiana Pouch construction extracorporeally through an extended port-site incision, with bilateral ureteral anastomoses performed intracorporeally.

¶ 8 males underwent to radical cystoprostatectomy
3 females underwent to anterior pelvic exenteration
ileal ureter (13), laparoscopic enterocystoplasty (14), and radical prostatectomy (now approaching 60 patients), all performed completely intracorporeally, has significantly facilitated our approach to the laparoscopic radical cystectomy and ileal conduit technique.

**LAPAROSCOPIC CYSTECTOMY: POTENTIAL ADVANTAGES AND LIMITATIONS**

The laparoscopic technique offers excellent visualization and minimal surgical trauma during simple or radical cystectomy (Table III). However, some limitations need to remain in mind while considering its clinical applications. These procedures require considerable laparoscopic dexterity to be performed effectively. According to the urologist's previous laparoscopic experience, the learning curve can vary significantly. Operative times are currently longer in the laparoscopic group than in its open counterpart. This increases operating room costs and prolongs anesthesia time. Nevertheless, the decreased morbidity, reduced wound-related complications, and less postoperative pain observed in laparoscopic cases may translate into a shorter hospital stay, faster recovery and rapid return to normal activities. Moreover, surgical time is significantly reduced with experience, as evidenced by our series, wherein the surgical time decreased from 11.5 hours in the first patient to the 7 hours range currently. Also, in our experience blood loss is decreased considerably (approximately 150-250 cc currently), minimizing or potentially eliminating the need for blood transfusions. The use of the laparoscopic Endo-GIA stapler for control of the vascular pedicles of the bladder is a critical adjunct in this regard. The efficacy of stapler in decreasing blood loss and shortening operative time has been documented during open radical cystectomy as well (15). Despite the lengthy surgical times, we were encouraged in our experience by the precision with which reconstructive steps such as uretero-ileal anastomoses and restoration of bowel transit could be achieved laparoscopically. These parameters will be addressed objectively in the near future by comparison of a larger laparoscopic series to contemporary open surgery controls, as has been done with other laparoscopic ablative procedures.

A current limitation of the laparoscopic radical cystectomy relates to the ability to accurately perform a nerve-sparing procedure. Laparoscopic urologists are rapidly evolving in this regard. The experience with preservation of the neuro-vascular bundles during laparoscopic radical prostatectomy (16), allied to the excellent visualization of pelvic structures and decreased blood loss during laparoscopic surgery, will probably allow its incorporation into the laparoscopic cystectomy technique in the near future. At this writing, the laparoscopic technique should be limited to organ-confined disease, wherein extra-vesical extension has been reasonably excluded by abdominal CT scans and bimanual examination under anesthesia.

Concerns regarding port-site metastasis and intra-peritoneal tumor seeding during laparoscopic lymph node removal in patients with transitional cell carcinoma of the bladder are justifiable, and preventive measures like entrapment of even small lymph node specimens in an Endocatch Bag and its careful laparoscopic manipulation are essential (6). These risks will only be determined (or excluded) in a longer follow-up of a larger series.

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**TABLE III: POTENTIAL ADVANTAGES AND LIMITATIONS OF LAPAROSCOPIC CYSTECTOMY**

<table>
<thead>
<tr>
<th>Advantages</th>
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<tbody>
<tr>
<td>Decreased surgical morbidity</td>
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<tr>
<td>Outstanding visualization of pelvic structures</td>
</tr>
<tr>
<td>Decreased blood loss</td>
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<tr>
<td>Reduced postoperative ileus</td>
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<tr>
<td>Shorter hospital stay</td>
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<td>Improved cosmesis</td>
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<table>
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<tr>
<th>Limitations</th>
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<tbody>
<tr>
<td>Significant learning curve</td>
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<tr>
<td>Increased operative time with financial costs</td>
</tr>
<tr>
<td>Nerve-sparing procedure (?)</td>
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<tr>
<td>Unknown risk of port-site metastases</td>
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LAPAROSCOPIC CONTINENT URINARY DIVERSION

Laparoscopic radical cystectomy and urinary diversion, performed completely intracorporeally, probably represents the epitome of urologic minimally invasive surgery from a surgical planning and technical execution standpoint. To our knowledge, our group has recently performed the first case of laparoscopic radical cystectomy with ileal orthotopic neobladder (Studer) in a female patient, with the entire procedure being performed completely intracorporeally with purely laparoscopic techniques. The neobladder was constructed intracorporeally with free-hand laparoscopic suturing from 55 cm of detubularized ileum. Total surgical time was 8.2 hours, blood loss was 150 cc, and hospital stay was 5 days. Additionally, we have performed laparoscopic radical cystectomy and continent catheterizable Indiana Pouch diversion in another patient, wherein the Indiana Pouch was created extracorporeally through a 2 cm cephalad extension of the umbilical port-site incision. The constructed pouch was returned to the abdomen, and bilateral uretero-cecal anastomoses were performed intracorporeally.

FUTURE PERSPECTIVES

Open cystectomy remains a major surgical procedure in urology, associated with significant morbidity and prolonged hospitalization. Radical cystoprostatectomy with ileal conduit urinary diversion is the most commonly selected treatment for localized muscle-invasive bladder cancer worldwide. Laparoscopic simple and radical cystectomy seem to provide similar effectiveness compared to its open counterparts, while significantly reducing morbidity and surgical trauma. As experience with advanced laparoscopic reconstructive procedures increases, laparoscopic cystectomy will be progressively incorporated into the minimally invasive urologic armamentarium.

A 2 – 3 cm extension of a port-site for bowel exteriorization is a reasonable option to perform the required reconstructive procedure in combination with laparoscopic radical cystectomy. However, we believe that performing the entire operation intracorporeally may further reduce morbidity by minimizing bowel manipulation and paralytic ileus, while maintaining precision and effectiveness. After reporting the initial experience with completely intracorporeal ileal conduit following laparoscopic radical cystectomy, our group has studied in the laboratory the feasibility of more complex reconstructive procedures performed exclusively intracorporeally. Two survival porcine studies have been successfully completed: the first one involving a chronic animal model of laparoscopic orthotopic ileal neobladder (17), the second, a study applying laparoscopically the principles of combined gastroileal segments for both bladder augmentation and orthotopic gastroileal neobladder (18). The encouraging results of these complex experimental models and the refinements achieved therein with free-hand laparoscopic suturing techniques have been central to the successful clinical performance of a continent (Indiana Pouch) or orthotopic neobladder (Studer) by intracorporeal techniques by our group.

The precise role of laparoscopic radical cystectomy in the management of invasive bladder cancer has yet to be defined. Based on our early experience we believe that, with further technical refinement, laparoscopic radical cystoprostatectomy with ileal conduit diversion may become a viable, minimally invasive treatment option for the selected patient with localized muscle-invasive bladder cancer (8). Due to its reduced morbidity and faster recovery, laparoscopic radical cystectomy may have the potential to further benefit selected candidates to adjuvant chemotherapy protocols. Clinical application of advanced forms of laparoscopic urinary diversion, such as continent and orthotopic reservoirs, will further expand the laparoscopic armamentarium in urologic surgery.

REFERENCES AND RECOMMENDED READING (*of special interest, **of outstanding interest)


