SURGICAL TECHNIQUE

Laparoscopic ureteral replacement by Boari flap: Multi-institutional experience in 30 cases

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Abstract

Introduction: The Boari flap is an excellent technique for replacement of distal ureteral injuries. There are few reports with the use of laparoscopic surgery, especially with long term results. Our goal is to present the results of a multi-institutional study of 30 cases.

Materials and methods: We analyzed 30 patients treated between December 2001 and January 2009 who underwent a laparoscopic intracorporeal Boari flap, in three Latin American centers. In all cases the same surgical technique was employed. The database was recorded prospectively and analyzed retrospectively.

Results: The mean age was 43.2 years (range 9–71 years). Most were women (22 of 30) with a slight predominance of left-side lesions (17 of 30). The most common cause of ureteral injury was hysterectomy in 14 patients (46.6%) and endoscopic ureterolithotomy in 9 patients (30%). The mean length of ureteral resection was 7 cm (5–20 cm). The average operative time was 161.16 min (90–280 min). The average estimated blood loss was 123 mL (0–500 mL), and hospital stay was 4.86 days (2–10 days). There were no intraoperative complications or conversion to open surgery. Postoperative complications occurred in 5 patients (16.6%), Clavien 1 in 2 patients (6.6%) and Clavien 3 in three patients (10%). The success rate was 96.6% (29 patients) with a mean follow up of 32 months (5–60 months).

Conclusions: Laparoscopic Boari flap in our hands had good short and long term results.

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PALABRAS CLAVE
Uréter; Lesión del uréter; Laparoscopia; Boari; Reemplazo ureteral

Reemplazo ureteral con colgajo de Boari laparoscópico: experiencia multi-institucional en 30 casos

Resumen
Introducción: El colgajo vesical tipo Boari es una excelente técnica para el reemplazo de lesiones del uréter distal. Existen pocas comunicaciones con el uso de la vía laparoscópica, sobre todo con resultados a largo plazo. Nuestro objetivo es presentar los resultados de un estudio multi-institucional en 30 casos.
Material y método: Se analizan 30 pacientes tratados entre diciembre de 2001 y enero de 2009, en quienes se realizó un colgajo de Boari laparoscópico intracorpóreo en 3 centros latinoamericanos. En todos los casos se empleó la misma técnica quirúrgica. La base de datos fue registrada de forma prospectiva y analizada retrospectivamente.
Resultados: La edad media fue de 43,2 años (rango de 9 a 71 años). La mayoría fueron mujeres (22 de 30) con un ligero predominio del lado izquierdo (17 de 30). Las causas más frecuentes de lesión ureteral fue la histerectomía en 14 pacientes (46,6%) y la ureterolithotomía endoscópica en 9 pacientes (30%). La longitud ureteral media resecada fue de 7 cm (5 a 20 cm). El tiempo medio operatorio fue de 161,16 min (90 a 280 min). El sangrado intraoperatorio estimado promedio fue de 123 ml (0 a 500 ml) y la estancia hospitalaria de 4,86 días (2 a 10 días). No hubo complicaciones intraoperatorias ni conversión a cirugía abierta. Ocurrieron complicaciones postoperatorias en 5 pacientes (16,6%), Clavien 1 en 2 pacientes (6,6%) y Clavien 3 en 3 pacientes (10%). La tasa de éxito de la cirugía fue del 96,6% (29 pacientes), con un tiempo medio de seguimiento de 32 meses (5 a 60 meses).
Conclusiones: Nuestros resultados con la técnica de colgajo de Boari laparoscópico confirman los buenos resultados de esta técnica a corto y largo plazo.
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Introduction
The major basic principles of ureteral surgery that underpin the choice of the restoration technique of distal ureteral injuries are a delicate mobilization of ureter and tension-free anastomosis in order to avoid anastomosis failure and prevent ischemic complications. Since Casati and Boari, over 100 years ago, described for first time bladder flap technique to repair large ureteral defects, its use continues to be a good surgical alternative. In 2001, Fergany et al. described for first time laparoscopic Boari flap technique in animals. In the same year, Fukita et al. published their results with the laparoscopic Boari flap in three patients. These successful outcomes were published in subsequent years. Our goal is to present the early and long-term results of a multi-institutional study of 30 patients operated with the same technique.

Materials and methods
The series consists of 30 patients operated between December 2001 and January 2009. Authors previously described the technique employed. A prospective database was established for this study. Demographical, intra- and postoperative data were analyzed retrospectively as well as long-term results. Complications were defined according to Clavien classification. Long-term follow-up was carried out with intravenous urography, computed tomography and Mag-3 renal scintigraphy.

Surgical technique
Patients were placed in lithotomy position with 20° Trendelenburg tilt. Pneumoperitoneum was created with Veress needle (umbilical level) and maintained at 15 mmHg. Disposition of trocars is as follows; 12 mm umbilical trocar for the 30° optical, 12 mm trocar placed in the left iliac fossa port-site and 5 mm trocar was placed in right iliac fossa port-site. Occasionally, for the surgical assistant, a pararectus paraumbilical trocar is placed (Fig. 1). Colon is mobilized and ureter is identified at the level of the crossing of iliac vessels. The dissection proceeds distally and proximally until the normal ureter is identified. On distal position, Hem-O-Lok clip is placed and the section of the ureter is carried out in healthy tissue. Bladder is visualized by filling with 250 ml saline and its upper limit is visualized properly and the total dissection of Retzius space is performed without sectioning bladder pedicles. Anterior bladder flap is created: base is
directed toward the ureter and the distal end toward the contralateral edge of the bladder. As result, a rhomboid flap with wide base is obtained (Fig. 2). Rhomboid flap allows sufficient length to reach the ureter in a tension-free manner, even above of the iliac vessels. The spatulation ankle is anastomosed to bladder flap with interrupted Monocryl 4-0 sutures (up to anterolateral edges by both sides) (Fig. 3). Then, bladder catheter is removed and the sheath of 18Fr cystoscope is placed. Once cystoscope sheath is placed, hydrophilic guide and after 6Fr double-J catheter are advanced through the sheath. Bladder closure is performed using running Monocryl 3-0 suture. In the level of ureter, anastomosis to anterior side is carried out with interrupted Monocryl 4-0 suture (Fig. 4). A trick for performing good Boari tube is to use a small piece of Nelaton-catheter (14 or 16Fr) guiding the running suture of the flap. A watertight seal is verified by filling the bladder with 200 ml of sterile saline. A counteropening drainage type Jackson-Pratt is placed.

![Figure 2](image2.jpg)

**Figure 2** Boari flap dissection with rhomboidal shape and wide base.

![Figure 4](image4.jpg)

**Figure 4** Final result, in which tubular Boari flap and right ureter anastomosed can be seen.

### Results

Preoperative data are summarized in Table 1. Mean age was 43.2 years (range 9–71 years). Most of patients were women (22 of 30 patients). 56.6% of patients showed slight predominance of left side (range 17 of 30 patients). Hysterectomy was the most frequent cause of ureteral injuries (46.6%; 14 patients), followed by endoscopic ureterolithotomy in 9 patients (30%; 9 patients) (Table 2). The average length of resected ureter was 7 cm (range 5–20 cm). Mean operative time was 161.16 min (range 90–280 min). Estimated intraoperative bleeding was 123 mL (range 0–500 mL) and the mean hospital stay was 4.86 days (range 2–10 days). There were neither intraoperative complications nor conversion to open surgery. In 5 patients (16.6%), postoperative complications have been described. According to

<table>
<thead>
<tr>
<th>Variable</th>
<th>Result</th>
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<tbody>
<tr>
<td>Mean age (range)</td>
<td>43.2 years (9–71 years)</td>
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<tr>
<td>Female/male ratio</td>
<td>2.75/1</td>
</tr>
<tr>
<td>Side</td>
<td>Left 17 (56.6%)</td>
</tr>
<tr>
<td></td>
<td>Right 13 (43.4%)</td>
</tr>
<tr>
<td>Mean operative time (range)</td>
<td>161.16 min (90–280 min)</td>
</tr>
<tr>
<td>Previous surgery</td>
<td>Gynecological: 16</td>
</tr>
<tr>
<td></td>
<td>Radical hysterectomy 14</td>
</tr>
<tr>
<td></td>
<td>Oophorectomy 1</td>
</tr>
<tr>
<td></td>
<td>Ureteral endometriosis 1</td>
</tr>
<tr>
<td></td>
<td>Urological: 14</td>
</tr>
<tr>
<td></td>
<td>Endoscopic ureterolithotomy 9</td>
</tr>
<tr>
<td></td>
<td>Ureteral reimplantation 2</td>
</tr>
<tr>
<td></td>
<td>Partial cystectomy 1</td>
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<tr>
<td></td>
<td>Bladder TUR 1</td>
</tr>
</tbody>
</table>

TUR: transurethral resection.
Clavien classification, 2 patients were grade 1 (6.6%) and 3 patients were grade 3 (10%). In our study, Clavien grade 1 corresponds to adynamic ileus that were resolved with medical treatment and urinary infiltration being necessary to maintain bladder catheter for a longer time. Grade 3 complications corresponding to both uroperitoneum and hemoperitoneum (each complication occurred in a different patient) were resolved by laparoscopic surgery. The third grade 3 complication was found in a patient who underwent a more extensive resection and developed a bladder flap strictures that was resolved by laparoscopic ileal ureter. The successful rate of surgery was 96.6% (29 patients). The average follow-up time was 32 months (range 5–60 months) (Figs. 5 and 6).

**Table 2** Operative data.

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<table>
<thead>
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<tbody>
<tr>
<td>Mean estimated blood loss</td>
<td>123 mL (0–500 mL)</td>
</tr>
<tr>
<td>(range)</td>
<td></td>
</tr>
<tr>
<td>Mean hospital stay (range)</td>
<td>4.86 days (2–10 days)</td>
</tr>
<tr>
<td>Mean follow-up time (range)</td>
<td>32 months (5–60 months)</td>
</tr>
<tr>
<td>Postoperative complications rate</td>
<td>16.6% (5 patients)</td>
</tr>
<tr>
<td></td>
<td>- Clavien 1: 2 patients (6.6%)</td>
</tr>
<tr>
<td></td>
<td>- Clavien 3: 3 patients (10%)</td>
</tr>
<tr>
<td>Mean ureteral length resected (range)</td>
<td>7 cm (5–20 cm)</td>
</tr>
</tbody>
</table>

**Figure 5** Intravenous urography showing a right hydroureteronephrosis due to extensive thermal damage of the ureter at the level of the iliac vessels.

**Discussion**

Tension-free anastomosis is a critical success factor in ureteral anastomosis because it avoids ischemia and secondary strictures. Several techniques are available depending on the size of the ureter injury: direct ureteroneocystostomy, vesicopsoas-hitch, Boari bladder flap, intestinal segment interposition or even renal auto-transplantation. As consequence of low incidence rates of ureteral diseases requiring Boari bladder flap, the papers reporting data about effectiveness of its laparoscopic approach are scarce, and most of them are referred to general results of ureteral reimplantations. Recently, Seideman et al. have published their experience in 45 laparoscopic reimplantations, 21 of which were carried out according Boari-flap technique. This is the largest series currently published in which the authors reported an overall success rate of 96% with a mean follow-up of 25.5 months (range 1–76 months). Conversion to open surgery was not reported. Complication rate was of 15.5% (7 of 45 patients). Two patients had recurrent strictures that required surgery. Of them, 1 with a ureteral stricture shorter than 1 cm was successfully treated with endoscopic ureterotomy. Similar to our study, the other patient with stricture secondary to retroperitoneal fibrosis required intestinal segment interposition. 21 patients who underwent laparoscopic Boari flap were grouped in two categories: first stage group and second stage group (9 vs 12 procedures respectively). The differences of the results of both groups were analyzed, and the mean intraoperative bleeding of second stage group was statistically lower (p = 0.04).

In only one publication laparoscopic Boari-flap technique has been compared with the open surgery. In this paper, the authors compared ten patients who underwent laparoscopic vesicopsoas-hitch with (6 patients) or without Boari-flap (4 patients) versus ten patients treated by open ureteroneocystostomy for similar ureteral pathologies. Although in laparoscopic series operative time was longer (228 min vs 187 min), laparoscopic approach provides better results regarding: mean estimated intraoperative bleeding (370 mL vs. 610 mL), analgesic requirement, mean days to
oral intake (1.5 days vs. 2.9 days), mean convalescence time (2.3 weeks vs 4.2 weeks) and, especially mean hospital stay (9.2 days vs 19.1 days). Even more, success rate in laparoscopic series was 100% whilst in open series it was 80%. Intra- or postoperative complications were not reported in laparoscopic series; however in open series major complications (i.e. urinary extravasation and anastomotic stricture) were reported.

Nowadays laparoscopic surgery has gradually been displaced in different surgical procedures by da Vinci robot-assisted surgery (Intuitive Surgical, Inc., Sunnyvale, CA, USA. States.) with its advantages in terms of 3-D vision and articulated arms. Thus, several studies performing robotic Boari-flap technique have demonstrated excellent short-term results.14-16

Our findings in a series of 30 patients (in our opinion the largest series published to date) who underwent laparoscopic Boari-flap confirm the good short and long term results.

Conflict of interests

Octavio A. Castillo is surgical proctor for Intuitive Surgical.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.juro.2012.11.020.

References