Introduction

The use of small bowel for ureteral substitution in patients with ureteral stenosis is already well known and established starting from the first experience in open surgery in 1959 (1). In the last years, with the advent of mini-invasive surgery preliminary experience were published both for laparoscopy and robotics: firstly “hybrid” procedures with open iliac reanastomosis (2), then, in 2014, fully with mini-invasive approach (3,4).

In all these series the ureter was completely substituted with ileum, performing cranial anastomosis between renal pelvis and ileal ureter, and caudal anastomosis between ileal ureter and bladder.

In this paper we present our robotic intracorporeal subtotal ureteral substitution preserving the distal part of the ureter with the aim to reduce the risk of vescico-ureteral reflux.

Materials and methods

Patient details

We report the case of a 65-year-old gentleman, with “functional” right single kidney with moderate chronic kidney diseases undergone radiotherapy for Burkitt Lymphoma in early 80’s. In the early 2000’s he underwent implantable penile prosthesis, with reservoir placed extraperitoneally on the right side. In September 2018, during follow up visits, right hydrenephrosis due to 2 cm lumbar ureteral stenosis was found.

Patients underwent robot-assisted right iliac ureterectomy and end-to-end anastomosis in October 2018. Post-operative course was uneventful, double J stent was
removed 4 weeks after surgery. Three months after surgery, follow up US revealed right hydronephrosis. CT showed 1 cm stenosis at the level of right ureter (Figure 1). The serum creatinine was 1.8 mL/dL. A right double J stent was placed.

Considering the previously radiotherapy with the subsequent damage of the ureteral tissue and the precociousness of the recidivism of the stenosis, the endoscopic treatment of the stenosis or the segmental urethrectomy with re-anastomosis were excluded.

Moreover, with the aim to avoid damaging the renal function of the single “functional” kidney, a total ureteral substitution, that is related with high risk of reflux, was excluded as well; therefore, a subtotal ureteral substitution was planned. The following surgical technique is explained by accompaniment video (Figure 2).

**First step: dissection of the lumbar ureter**

The patient was placed in modified flank position initially. Pneumoperitoneum was induced by placing a Veress needle. Camera port was placed on the pararectal line 3–4 cm above umbilicus, three operative robotic ports were positioned on the same (pararectal) line, 4 cm one from each other. The 12 mm assistant port was placed on the midline, just above the umbilicus and 5 mm ancillary was placed at level of xyfoid. A 30° laparoscope, side-down was used (Figure 3).

The colon was dissected medially, the gonadal and cava veins were identified. The ureter was identified, it was extremely adherent within the retroperitoneal tissue, due to fibrosis post radiotherapy. Ureterolysis was extremely challenging, nevertheless the ureter was isolated from uretero-pelvic junction (UPJ) to iliac vessels but it appeared stenotic and avascular in its two proximal thirds (Figure 4).

Due to poor quality of ureteral tissue and the length of stenosis that did not allowed an “end to end anastomosis” the small calibre of gonadal vein that did not allow a RUG technique (6) and inadequate length of appendix we were forced to choose an ileal-ureteral substitution.

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**Figure 1** Preoperative CT scan adn 3D reconstruction. (A) Three months after surgery the CT scan showed 1 cm stenosis at the level of right ureter; (B) 3D reconstruction simulates the location and length of the stenosis.

**Figure 2** The clinical case and our surgical technique steps by steps (5). Available online: http://www.asvide.com/
Second surgical step: dissection of distal ureter + bowel isolation and reestablishment of bowel continuity, uretero-ileal anastomosis.

It was necessary to undock the robot and place the patient in lithotomic position. Six Ports were placed in a fan, RARP like, shape (Figure 5).

The peritoneum was incised, the distal ureter was identified and dissected. This part of the ureter appears regular, well vascularized and without stenosis. In order to avoid vescico-uretral reflux and to avoid the handling of the prosthesis’ reservoir we opted to preserve the distal part of the ureter. A 20-cm ileal segment was measured and isolated approximately 20 cm proximal to the ileocecal valve using several Endo-GIA stapler loads (Covidien, Mansfield, USA). Continuity of the bowel was re-established performing a latero-lateral anastomosis by using Endo-GIA stapler again, as we previously described for robotic cystectomy (7). Then the anastomosis between ileal loop and distal ureter was performed with interrupted 4\0 monofilament stitches (Figure 6).

Third step: ileo-pyelic anastomosis

The daVinci system was undocked and the patient was placed again in flank position. Docking and ports were the same of the first step of the procedure. The ureter was sectioned at the level of UPJ. The posterior plate of ileo-pyelic anastomosis was performed with a running suture by using 4\0 monofilament suture. A double J stent was
placed in a retrograde fashion, finally the anterior plate of ileo-pyelic anastomosis was completed (Figure 7). Both anastomoses were checked by using flexible ureteroscopy.

The haemostasis was controlled, and a drain tube was placed in the periureteral space, moreover, prudentially, a nephrostomy tube was placed.

**Results**

Operative time was 4 h, no intraoperative or postoperative complications were recorded. Estimated blood losses were 400 cc. The patients were discharged in 10 postoperative day.

At third month of follow-up the trans-nephrostomic enhanced computer-tomography showed a completely opacification of ileal ureter; indeed, the nephrostomy was removed (Figure 8). At mild-term of 6 months of follow-up serum creatinine was 1.9 mg/dL and the patient was asymptomatic.

**Conclusions**

The safety of robotics in ureteral surgery is already well known (8), also for ureteral reconstruction (9,10). However, adoption of minimal invasive techniques for ileal ureteric substitution has been slow and late, presumably because of the complexity of the procedure and the extent of the surgical field. Brandao et al. (3) were the first that report a case of completely intracorporeal robotic ileal ureter in a patient with multiple strictures. The first series of 7 patients who underwent to robotic intracorporeal ileal ureter with 3 months of follow-up was recently published by Ubrig et al. in 2018 (4) showing a complete functional restoration of the upper urinary tract and significant renal recovery.

Notwithstanding the technical and technological innovation, the experiences of robotic ureteral substitution reported in the Literature still remain anecdotal (Table 1).
Table 1: Summary of reported series for robot assisted ileal interposition

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Country</th>
<th>No patients</th>
<th>Technique</th>
<th>Months of follow-up</th>
<th>Length of ileum used (cm)</th>
<th>Method of bowel detubularisation</th>
<th>Operative time (h)</th>
<th>EBL (cc)</th>
<th>Major complication according to Calvien-Dindo</th>
<th>Hospitalization (days)</th>
<th>Creatinine at the end of follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brandao et al. Urology 2014 (3)</td>
<td>USA</td>
<td>1</td>
<td>Total ureteral substitution</td>
<td>24</td>
<td>20 cm</td>
<td>Stapler</td>
<td>7</td>
<td>50 cc</td>
<td>None</td>
<td>4</td>
<td>Stable respect to preoperative</td>
</tr>
<tr>
<td>Ubrig et al. Urology 2018 (4)</td>
<td>Germany</td>
<td>7</td>
<td>Total ureteral substitution</td>
<td>3</td>
<td>20 cm</td>
<td>Stapler</td>
<td>5.5</td>
<td>100 cc</td>
<td>1</td>
<td>5</td>
<td>Improvement of 9.3%</td>
</tr>
<tr>
<td>Wagner et al. JSLS 2008 (11)</td>
<td>USA</td>
<td>1</td>
<td>Total ureteral substitution</td>
<td>48</td>
<td>NA</td>
<td>Na</td>
<td>9</td>
<td>NA</td>
<td>None</td>
<td>8</td>
<td>None</td>
</tr>
<tr>
<td>Sim et al. Cerr European J Urol 2014 (12)</td>
<td>Germany</td>
<td>1</td>
<td>Total ureteral substitution</td>
<td>33</td>
<td>20 cm</td>
<td>Stapler</td>
<td>5</td>
<td>50 cc</td>
<td>None</td>
<td>8</td>
<td>Stable respect to preoperative</td>
</tr>
<tr>
<td>Chopra et al. J Endourology 2016 (13)</td>
<td>China</td>
<td>3</td>
<td>As ureteral length</td>
<td>6</td>
<td>11 cm</td>
<td>Stapler</td>
<td>4</td>
<td>230 cc</td>
<td>None</td>
<td>14</td>
<td>Decrease of 0.3 mg/dL</td>
</tr>
<tr>
<td>Zhong et al. Urology 2017 (14)</td>
<td>China</td>
<td>2</td>
<td>Total ureteral substitution with Boari Flap- Psoas Hitch</td>
<td>6</td>
<td>20 cm</td>
<td>Stapler</td>
<td>6.5</td>
<td>50 mL</td>
<td>None</td>
<td>14</td>
<td>NA</td>
</tr>
<tr>
<td>Kumar et al. Robot Surg 2019 (15)</td>
<td>India</td>
<td>1</td>
<td>Ileocalicostomy ureteral substitution</td>
<td>6</td>
<td>20 cm</td>
<td>Stapler</td>
<td>4.5</td>
<td>50 mL</td>
<td>None</td>
<td>8</td>
<td>NA</td>
</tr>
</tbody>
</table>

The novelty of our technique is represented by the fact that for the first time the distal tract of the ureter was maintained, and the caudal anastomosis was performed between the ureter preserved and the tabularised ileum. The rationale of this approach is that with the preservation of the distal part of the ureter the intradetrusorial portion of the ureter was maintained avoiding damaging the natural anti reflux mechanism.

In conclusion, notwithstanding the complexity of this technique, the sub-total ureteral substitution with ileum can be a safety and effective procedure, that can be performed in patient with long life expectancy whom required a preservation of homolateral renal function.

Acknowledgments

None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. Written informed consent was obtained from the patient for publication of this manuscript and any accompanying images.

References


