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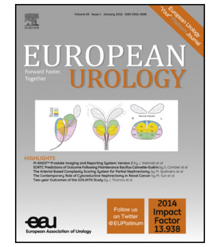

European Association of Urology

Surgery in Motion

Robot-assisted Surgery for Benign Ureteral Strictures: Experience and Outcomes from Four Tertiary Care Institutions

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Abstract

Background: Minimally invasive treatment of benign ureteral strictures is still challenging because of its technical complexity. In this context, robot-assisted surgery may overcome the limits of the laparoscopic approach.
Objective: To evaluate outcomes for robotic ureteral repair in a multi-institutional cohort of patients treated for ureteropelvic junction obstruction and ureteral stricture (US) at four tertiary referral centres.
Design, setting, and participants: This retrospective study reports data for 183 patients treated with standard robot-assisted pyeloplasty (PYP) and robotic uretero-ureterostomy (UUY) at four high-volume centres from January 2006 to September 2014.
Surgical procedure: Robotic PYP and robot-assisted UUY were performed according to previously reported surgical techniques.
Outcome measurements and statistical analysis: Preoperative, intraoperative, and postoperative variables and outcomes were assessed. A descriptive statistical analysis was performed.
Results and limitations: No robot-assisted UUY cases required surgical conversion, while 2.8% of PYP cases were not completed robotically. The median operative time was 120 and 150 min for robot-assisted PYP and robot-assisted UUY, respectively. No intraoperative complications were reported. The overall complication rate for all procedures was 11% ($n = 20$) and complications were mostly of low grade. The high-grade complication rate was 2.2% ($n = 4$). At median follow-up of 24 mo, the overall success rate was >90% for both procedures. The study limitations include its retrospective nature and the heterogeneity of the study population.
Conclusions: Robotic surgery for benign US is safe and effective, with limited risk of high-grade complications and good intermediate-term results.
Patient summary: In this study we review the use of robotic surgery at four different tertiary care centres in the treatment of patients affected by benign ureteral strictures. Our results demonstrate that robotic surgery is a safe alternative to the standard open approach in the treatment of ureteral strictures.

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1. Introduction

The worldwide spread of robotic surgical technology such as the da Vinci system (Intuitive Surgical, Sunnyvale, CA, USA) has changed the way urologists approach minimally invasive complex reconstructive procedures in the last 10 yr. As an example, robot-assisted radical prostatectomy has improved surgeon vision and facilitated difficult steps such as nerve-sparing dissection and urethral anastomosis [1].

Besides radical prostatectomy, robotic technology has been adopted for the treatment of several other urologic conditions such as ureteral stricture (US). Although the laparoscopic approach in this field has been described, its widespread adoption has been limited by technical issues. Open surgery is still the most frequent approach for these complex reconstructions [2]. However, robot-assisted surgery represents a feasible and less challenging minimally invasive alternative to open surgery. The main advantages of the Da Vinci system are greater dexterity for intracorporeal suturing and better three-dimensional visualization of the surgical field. Therefore, this technology may help surgeons to overcome the traditional limits of laparoscopic surgery and may be safely adopted for benign ureteral conditions such as ureteropelvic junction obstruction (UPJO) and US.

Here we describe a multi-institutional cohort of patients who underwent robot-assisted ureteral repair for benign US at four tertiary care centres, and evaluate the feasibility and outcomes for this approach.

2. Materials and methods

2.1. *Study population*

After institutional review board approval in each centre, data for 183 patients treated for UPJO and US from January 2006 to September 2014 at four high volume institutions (Humanitas Hospital, Milan, Italy; Ospedale San Raffaele, Milan, Italy; OLV Clinic, Aalst, Belgium; S. Luigi Gonzaga Hospital, Orbassano, Italy) were collected.

Inclusion criteria for the study are all the patients with a UPJO or US, including cases of either primary or recurrent obstruction, treated with a "simple" ureteral anastomosis. Patients who had recent pyelonephritis or urinary tract infection were excluded. Preoperative clinical assessment of patients with UPJO included clinical evaluation of symptoms, mercaptoacetyltriglycine (MAG)-3 diuretic renal scans, and computed tomography (CT) urography. The preoperative work-up for patients affected by US included CT urography. Patients were selected for surgery according to the presence of symptoms and/or evidence of obstruction on diagnostic imaging.

Follow-up included an abdominal ultrasound, urinalysis, and a urine culture after 1 mo, as well as CT urography and a MAG-3 diuretic renal scan after 6 mo for patients affected by UPJO obstruction and US. Abdominal ultrasound was repeated at 12 mo and annually thereafter. Follow-up visits were at 1, 3, 6, and 12 mo, and annually thereafter, with clinical evaluation of symptom relief at each visit.

The study hypothesis was that robotic surgery is a feasible, safe, and effective minimally-invasive strategy for treatment of UPJO and US. The criteria for success for patients treated for UPJO and US were resolution of symptoms, no radiologic evidence of obstruction on CT urography, and no functional evidence of obstruction on MAG-3 renal scans.

2.2. *Surgical techniques*

In this multi-institutional study, patients were treated using one of three different robotic surgical techniques according to the site of the ureteral disease. Patients affected by UPJO underwent robot-assisted pyeloplasty. Patients affected by proximal US (starting from the ureteral pelvic junction to the external iliac vessels) underwent robot-assisted uretero-ureterostomy. Patients affected by distal US (starting from the external iliac vessels to the intramural segment of the ureter) underwent robot-assisted ureteral reimplantation.

Surgical techniques for robot-assisted pyeloplasty and robot-assisted uretero-ureterostomy have previously been described [3,4]. For robot-assisted ureteral reimplantation, the patient is positioned in the dorsal lithotomy and Trendelenburg position (20°) and the robot is brought into position between the patient's legs. An orogastric tube is placed before gaining access to the intraperitoneal space to decompress the stomach. Traditional open access is used to gain access to the intraperitoneal space. Port placement is illustrated in Fig. 1, with two 8-mm robotic trocars in a triangular arrangement in relation to the 12-mm robotic camera port at the umbilicus. Additional 5-mm and 12-mm assistant ports are positioned ipsilateral to the defect.

After port positioning, the colon is swept aside and its peritoneal reflections are transected at the line of Toldt to access the retroperitoneal cavity ipsilateral to the US site. At this point, the stenotic portion of the ureter is usually identified as a bulge in the ureteral wall. However, in some cases a ureteroscope may also used in this surgical step to identify the stenotic area, as first described by Glinianski et al [5]. Dissection of the ureter should be performed carefully to avoid disruption of the arterial blood supply. Transection of the affected portion of the ureter is completed using robotic scissors. Spatulation of the ureter is then performed. At this point, careful dissection of the bladder is completed to allow adequate mobilisation of the bladder on its pedicle. Further mobilisation can be achieved by freeing the bladder superiorly from the peritoneum. Periodic filling and voiding of the bladder through a Foley catheter are performed to determine whether sufficient mobilisation had been achieved to reach the transected ureter. This is important to obtain a tension-free anastomosis. For transperitoneal extravesical ureteral reimplantation, the bladder is directly incised at the site of the new ureteral orifice, which should be medial to the tendon to allow for a ureteral path that is as straight as possible. The bladder mucosa is then reached and two marker stitches are placed before incision to simplify the subsequent anastomosis. A small incision is made in the upper part of the isolated mucosa to access the bladder. Two running sutures with a 3-0 Vicryl SH needle are then used to complete the vesicoureteral

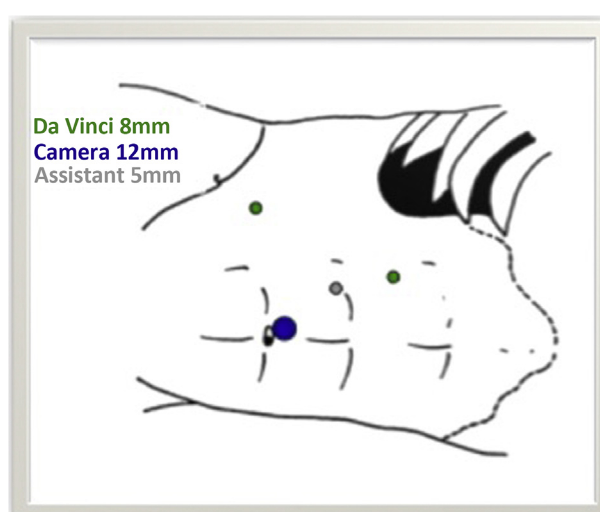

Fig. 1 – Port placement.

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