

Robotic management of complicated ureteropelvic junction obstruction

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Received: 5 April 2009 / Accepted: 10 August 2009 / Published online: 27 August 2009
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Abstract

Purpose To assess the feasibility and outcomes of robotic pyeloplasty for complicated cases of ureteropelvic junction obstruction (UPJO).

Methods Complicated UPJO cases included patients with the following: concomitant multiple or calyceal stones, secondary UPJO (post-ureteroscopy, open or percutaneous surgery), malrotated kidney, horseshoe kidney, ectopic kidney, giant hydronephrosis, poorly functioning kidney (glomerular filtration rate <20 ml/min), non-redundant renal calyces (requiring nephroplication), ptosis of the kidney (requiring nephropexy), long stricture (>2 cm), age <5 or >60 years and duplex pelvis. All cases underwent dismembered robotic pyeloplasty. Data were collected for operative time, blood loss, stone clearance, analgesic usage and time to recovery. Follow-up was done with intravenous urography and dynamic renal scan.

Results A total of 29 cases underwent dismembered robotic pyeloplasty with an average operative time and blood loss of 130 min and 50 ml. Stone clearance could be achieved in 8 out of 10. The average follow-up period was 15 months with a symptomatic and objective success rate of 96.6% (28/29). No perioperative complications were noted.

Conclusions Robotic pyeloplasty for complicated cases of UPJO is feasible, safe and effective, and has a durable success rate.

Keywords Robotic pyeloplasty · Stones · Secondary ureteropelvic junction obstruction · Giant hydronephrosis · Horseshoe kidney · Nephroplication · Nephropexy

Introduction

Ureteropelvic junction obstruction (UPJO) is a common obstructive pathology of the upper urinary tract, frequently requiring surgical correction for various indications. While the open technique is practiced worldwide, laparoscopic and, now, robotic techniques are fast gaining popularity, due to the advantages of the minimally invasive surgery that these offer. Robotic technique scores over pure laparoscopy by enabling magnified 3D and stable vision, precise tremor-free movements and better maneuverability. Several studies of robotic pyeloplasty are now available suggesting good outcomes [1–3]. However, to our knowledge, there are very few reports in existing literature to assess the outcomes specifically in cases of UPJO with various complicating factors [4, 5]. Herein, we tried to evaluate the robotic technique for such cases having one or more associated factors, which may have a bearing on the immediate surgical outcome or long-term functional results.

Materials and methods

Robotic pyeloplasty is the standard of care at our center for the management of cases with UPJO from July 2006 onwards. We collected detailed perioperative and follow-up data of robotic pyeloplasty for cases associated with anatomical or functional variables, which could affect the perioperative morbidity or the long-term outcomes of reconstruction. These complicated UPJO cases were

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defined as the ones associated with one or more of the following factors: concomitant multiple (≥ 3) or calyceal stones, secondary UPJO (post-ureterorenoscopic, open or percutaneous nephroscopic surgery), malrotated kidney (more than 90°), horseshoe kidney, ectopic kidney (excluding lumbar ectopia), giant hydronephrosis, poorly functioning kidney (glomerular filtration rate, GFR < 20 ml/min), non-redundant renal calyces (requiring nephroplication), ptosis of the kidney (requiring nephropexy), long stricture (> 2 cm), age < 5 or > 60 years and duplex pelvis. Cases with a history of pyonephrosis and/or nephrostomy tube in situ were excluded. Pre-operative evaluation included a detailed history, clinical examination, urine analysis, culture, ultrasonography (USG), intravenous urography (IVU), radionuclide diuretic renal scan (RDS) and baseline GFR estimation in all cases. A contrast-enhanced CT scan was also obtained in few cases, where clinically indicated. An informed consent was obtained from all cases before the surgery.

All cases underwent dismembered robotic pyeloplasty through a transperitoneal approach. Three robotic ports were used: one 12 mm for camera arm and two 8 mm for instrument arms. One or two additional 5-mm ports were used for assistance. A lateral decubitus position reclining at 60° , with a bolster underneath the flank, was used for all except one case with pelvic ectopic kidney, for which a low lithotomy with a steep trendlenburg position was used. Continuous 5'0 polyglactin sutures were used for reconstruction. A 6F JJ stent was inserted over a glide wire in antegrade fashion, utilizing the dexterity of robotic instruments. Stones if present were retrieved and kept in a plastic bag for removal at the end of the procedure. A perinephric drain was kept in all cases along with an indwelling urethral catheter. Data were collected regarding operative time, blood loss, stone clearance, conversion, analgesic usage, time to recovery and hospital stay.

The stent was removed at 6 weeks. Symptomatic assessment was done at 3 months' interval by direct interview of the patient using the grading system: no relief, partial relief or complete relief of pain. The objective follow-up included IVU and RDS at 3 months after surgery. Subsequently, RDS was advised at 6-monthly intervals.

Results

As much as 29 cases were included in this study, the details of which are given in Table 1. Three cases had more than one complicating factors. These included cases with (1) poorly functioning kidney and giant hydronephrosis, (2) multiple secondary stones and malrotated kidney, and (3) nephroplication and giant hydronephrosis. Additionally, the case with ectopic kidney also had a single free floating

Table 1 Detailed breakup of associated complicating factors in cases that underwent robotic pyeloplasty for ureteropelvic junction obstruction

Complicating factor	Number of cases
Concomitant stones	10
Multiple (≥ 3)	4
Calyceal	6
Secondary UPJO	4
Post-ureterorenoscopy	1
Open surgery	2
Percutaneous nephroscopy	1
Malrotated kidney (more than 90°)	1
Horseshoe kidney	2
Ectopic kidney	1
Giant hydronephrosis	4
Poor renal function (GFR < 20 ml/min)	5
Non-redundant renal calyces (requiring nephroplication)	1
Ptosis of the kidney (requiring nephropexy)	1
Long stricture (> 2 cm)	0
Age < 5 or > 60 years	2
Duplex pelvis	1

secondary stone, though it was not considered as a separate complicating factor. The procedure in all the cases was performed robotically using the modified Anderson–Hyne's technique with reduction of pelvis as needed for the particular case. One case was converted to open procedure because of difficulty in identifying the ureter. The average operative time was 130 min (median 120, range 72–180 min) and the surgeon's console time was 100 min. The average blood loss was 50 ml with no case requiring blood transfusion.

Stone clearance could be achieved in eight cases out of ten, one each in the single and multiple calculi group. All stones were removed intact and the clearance documented on X-ray. Shock wave lithotripsy was prescribed in one case with residual calculus, after 3 months of surgery with subsequent complete clearance. The other case with residual calculus remains under surveillance, requiring no additional treatment. The recovery was fairly rapid in most cases, with the average time to start of oral feeds being 15 h. Urethral catheter and drain were removed on post-operative day 1 and 2, respectively, in all except two cases where they were electively kept for a longer duration considering their long suture line. The mean hospital stay was 2.7 (range 2–6) days. Analgesic requirement was 200 mg of diclofenac, on average. There were no cases of port site infection. No perioperative complications were noted. One case with baseline poor renal function showed persistent obstructive drainage pattern on RDS, subsequently requiring

nephrectomy at 7 months. All other cases had symptomatic relief and radiographic evidence of normal drainage on RDS at their last follow-up. The average follow-up duration was 15 (range 3–30) months.

Discussion

Ureteropelvic junction obstruction is a common congenital anomaly of the upper urinary tract, frequently requiring surgical correction for various indications. Open pyeloplasty is the most practiced approach with proven and consistent results in most cases. Robot-assisted laparoscopic technique is now fast gaining popularity and may become the new standard of care in the near future for managing UPJO [2, 6]. We started our robotic program in July 2006 with the acquisition of da Vinci S surgical system. One of the senior surgeons had prior experience with the robotic technology, while the rest of the surgical team was new to it when the robotic program was started. Presently, there are few reports in literature dealing with robotic pyeloplasty in complicated cases of UPJO. Atug et al. have shown good outcomes for concomitant stone removal and robotic pyeloplasty [5]. Similarly good outcomes were recently reported for robotic repair of secondary UPJO [4]. Successful attempts have also been made with the use of robotic technique for pyeloplasty in horseshoe kidney, ureterocalicostomy and nephropexy [7–9]. We have earlier reported our experience of robotic pyeloplasty using the transmesocolic approach for left-sided UPJO [10].

The presence of stones complicates UPJO by inducing infection/inflammation, which may render the tissues edematous and friable. It may make dissection more cumbersome, increase blood loss and cause difficulty in sutures to hold onto tissues. Incomplete clearance at the time of surgery also requires auxiliary procedures for ensuring complete clearance. In this study, we included only cases with multiple calculi or a stone fixedly located in a peripheral calyx, excluding those with small free floating stones in the renal pelvis, since such stones may not hamper the outcomes as much.

Outcomes of repair of UPJO resulting secondarily after a previous surgery are directly influenced by the degree of fibrosis, ischemia and the length of stricture. The obstruction in these cases is a true anatomical stricture with intramural fibrosis, unlike primary UPJO. The degree of extramural fibrosis depends on the invasiveness of the previous surgery and may itself have a significant negative influence on long-term success. Repair in cases of malrotated kidney, horseshoe kidney or ectopic kidney is similarly affected by difficult exposure, non-dependent ureteral opening, longer stricture length and anomalous crossing vessels [11]. Giant hydronephrosis with draining volume of

more than 1 l also impedes the efficacy of repair, because of the need of significant reduction of pelvis with its longer suture line [12, 13]. The associated higher chances of urinary leak may increase the perianastomotic fibrosis during healing. Identification and isolation of ureter may also be difficult in these cases, due to distorted anatomy. In this series, one such case required conversion to open due to this reason. Blood loss may be more due to the wide dissection area. Poor renal function may reduce the flow of urine across the anastomosis and affect long-term patency rate [14]. Non-redundant hydronephrotic lower pole and ptosis of the kidney may similarly result in poor drainage [12]. Long stricture length is another risk factor. It needs a longer gap to be bridged, thereby increasing the tension on the anastomosis and compromising the results. Duplex pelvis presents a tricky situation, where pyeloplasty for one part may induce stricture of the other, depending on the proximity of the two parts of the pelvis [15]. Extremes of age present a surgical challenge [16, 17]. The healing capacity of the elderly may present a barrier to rapid healing, and healing may be associated with more fibrosis. Thus, all of the above factors were included in this study. Crossing vessels were not considered as a complicating factor, since we did not believe that it could hamper long-term functional outcomes [18]. Patients with a history of pyonephrosis and/or nephrostomy in situ were also excluded. These cases are commonly associated with dense perinephric and peripelvic adhesions. In our early experience, we preferred to perform the open approach for such cases. However, with increasing experience, the procedure can also be performed robotically.

Though this is a retrospective analysis, it represents the first such attempt to specifically focus on the perioperative and long-term functional outcomes of robotic repair of ureteropelvic junction obstruction in the presence of various complicating factors. Our efficacy rate of 96.6% in complicated cases of UPJO has shown that the robotic technique may be successfully applied in these cases with all its associated advantages of minimally invasive surgery. The need is to diligently follow the basic surgical principles of proper exposure, gentle tissue handling and watertight anastomosis with minimized tension or ischemia. Adequate reduction of pelvis and maximizing the drainage with procedures, such as nephropexy or nephroplication wherever required, are additional helpful maneuvers. We have shown that all of these steps can be adequately and successfully applied with the help of the robotic interface.

Conclusions

Robotic pyeloplasty is safe and feasible for complicated cases of UPJO. It has shown good operative and functional

outcomes in our hands with minimal perioperative morbidity.

Conflict of interest statement None.

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