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ROBOTIC ASSISTED LAPAROSCOPIC PYELOPLASTY IN CHILDREN

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ABSTRACT

Purpose: Historically, open pyeloplasty has been the gold standard of treatment for ureteropelvic junction obstruction in the pediatric age group. The prospect of using technology such as the robot in this age group has been a concern. Several nonurological robotic procedures have been performed in children. We undertook a retrospective study to evaluate the feasibility and outcomes of robotic assisted laparoscopic pyeloplasty in the pediatric population.

Materials and Methods: Seven patients 6 to 15 years old underwent robotic assisted laparoscopic pyeloplasty at our institution between June 2003 and November 2004. All patients underwent dismembered pyeloplasty (Anderson-Hynes). Variables analyzed included length of stay, estimated blood loss, operative time, anastomosis time and docked robotic time.

Results: Mean followup was 10.9 months (range 2 to 18). Mean length of stay was 1.2 days (range 1 to 3). Mean operative time was 184 minutes (range 165 to 204), with a mean robotic anastomosis time of 39.5 minutes (30 to 46). Mean estimated blood loss was 31.4 ml (range 10 to 50). Stent size varied from 3.8Fr to 6Fr. Six of the 7 patients have had followup studies demonstrating improved drainage, symptom resolution and no evidence of obstruction on diuretic renal scans or excretory urogram. The remaining patient is awaiting 3-month followup evaluation.

Conclusions: Robotic assisted pyeloplasty can be safely performed in the pediatric population. The precision in dissection, incision and suturing allows for comparable results to open pyeloplasty in this age group.

KEY WORDS: urologic surgical procedures, robotics, ureteral obstruction, hydronephrosis, pediatrics

Ureteropelvic junction obstruction (UPJO) is recognized as the most common cause of hydronephrosis in the newborn and young child. The acknowledged gold standard for management of UPJO is open pyeloplasty.[1,2] Open repair is associated with increased hospital stay, postoperative pain and potentially esthetically displeasing scarring. Since first being described in 1993, adult laparoscopic pyeloplasty has become increasingly popular for treatment of UPJO.[3–6] Robotic assisted surgery offers several advantages over traditional laparoscopy, including 3-dimensional visualization and 6 degrees of wrist movement. These specific robotic properties allow for easier dissection of the renal pelvis as well as precise trimming and reconstruction of the ureteropelvic junction (UPJ). To our knowledge there has been 1 case series of robotic assisted laparoscopic pyeloplasty reported in the literature.[7] We report our technique and outcomes of robotic assisted laparoscopic pyeloplasty in children.

MATERIALS AND METHODS

Seven pediatric patients underwent successful robotic assisted pyeloplasty for UPJO at our institution using the da Vinci® Surgical System between June 2003 and November 2004. The etiology of UPJO was abnormal insertion/stenotic UPJ in 4 patients, while 3 patients had an accessory lower pole crossing vessel causing obstruction. Variables analyzed included length of stay, estimated blood loss (EBL), operative time and robotic anastomosis time.

Preoperatively, patients were diagnosed with UPJO on the basis of presenting symptomatology and radiographic studies. All patients were evaluated preoperatively with excretory urography, ultrasound and/or diuretic renography. In select cases crossing vessels were established using computerized tomography or color Doppler ultrasonography.

Preoperative preparation and patient positioning. All patients underwent cystoscopy, retrograde pyelogram and placement of a 4Fr or 5Fr open-ended ureteral catheter just before pyeloplasty. The ureteral catheter was placed in the proximal ureter just distal to the UPJ to promote dilation of the renal pelvis, and facilitate identification and dissection of the renal pelvis. The patients were then positioned in 45-degree flank position for pyeloplasty. The ureteral and Foley catheters were prepared in the field to allow retrograde placement of a ureteral stent during the procedure.

Surgical technique. Pneumoperitoneum was achieved by standard transperitoneal Veress needle access. A standard 10 mm umbilical port was placed and the remaining 2, 8 mm robotic ports were placed under direct laparoscopic vision. The bedside surgeon trocar was placed subxiphoid in the midline (see figure). The abdomen was insufflated with CO_2 to 12 mm Hg and general laparoscopy was performed. A set of standard laparoscopic instruments are required in addition to the robotic instrumentation for the da Vinci robot.

Initially, the colon was taken down along the avascular line of Toldt. Once the ureter was identified and isolated the bowel was mobilized medially, exposing the renal hilum.

Robot assisted Anderson-Hynes pyeloplasty was the preferred approach for children with a large renal pelvis or high ureteral insertion, or for children with crossing vessels at the UPJO. A stay suture was placed on the ureter just distal to the anticipated future area of spatulation. A second suture was placed above the level of obstruction in the renal pelvis, which allowed traction and maintenance of orientation. Be-

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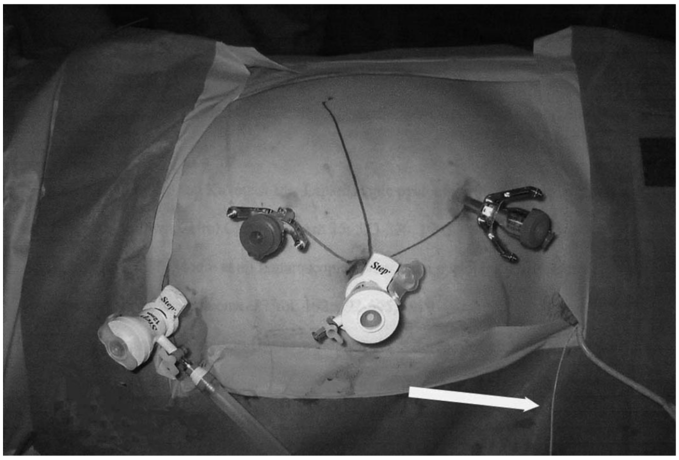

Trocar placement for left robotic pyeloplasty. Arrow indicates Foley and open-ended urethral catheters.

fore excision of the UPJ area extensive pyelolysis was performed. The UPJO was then transected, the ureter was spatulated and any redundant renal pelvis was excised.

The renal pelvis was closed first, if a reduction of the pelvis was performed. The posterior anastomosis was then completed using 4-zero polyglactin sutures on an RB-1™ needle. The bedside surgeon placed a 3.8Fr to 6Fr ureteral stent in a retrograde fashion over a guidewire passed through the open-ended catheter that was placed preoperatively. The pyeloplasty was then completed using running 4-zero polyglactin sutures for the anterior anastomosis. The UPJ was allowed to drop back into the renal bed, and the proximal ureter and pelvis were inspected to ensure no kinking before desufflating the abdominal cavity. In those patients with a crossing vessel we ensured that the anastomosis was adequately distal to the crossing vessel. Meticulous pyelolysis was performed using the da Vinci robot to ensure that the anastomosis was away from the crossing vessels.

A closed surgical drain (such as a Jackson-Pratt) was placed through one of the trocar sites after completing the pyeloplasty. The fascia and skin then were closed with absorbable sutures in standard fashion at each laparoscopic port site.

All except 1 patient was discharged the next morning. The parents removed the Foley catheter on postoperative day 2. If the drain output did not increase after the Foley catheter was removed, the drain was pulled. The double pigtail stent was left indwelling for approximately 6 weeks. At 3-month followup objective assessment of the repair was performed with diuretic renography or excretory urogram by the primary urologist.

RESULTS

Seven patients 6 to 15 years old underwent robotic pyeloplasty at our institution between June 2003 and November 2004 (see table). Mean followup was 10.9 months (range 2 to 18). The procedure was performed with the da Vinci system in all cases without conversion to open surgery. Mean hospital stay was 1.2 days (range 1 to 3). There were no perioperative complications, and recovery was uncomplicated in all patients.

One patient remained hospitalized for 3 days because of prolonged drainage through the Jackson-Pratt (JP) drain. Computerized tomography showed an overly distended bladder, despite a draining Foley catheter. The bladder was incompletely emptying, and this was likely the cause of the high output from the JP drain. The 10Fr Foley catheter was changed to 12Fr and the output from the JP drain ceased.

Mean operative time, including setting up the robot, was 184 minutes (range 165 to 204). Mean robotic anastomosis time was 39.5 minutes (range 30 to 46). No intraoperative complications or open conversions occurred. EBL was 31.4 ml (range 10 to 50). The stent was 3.8Fr to 6Fr, depending on the size of the patient. The stent was removed after approximately 6 weeks.

Six of the 7 patients have had followup studies revealing improved drainage, symptom resolution and no evidence of obstruction on diuretic renal scans or excretory urogram. The remaining patient is awaiting 3-month followup evaluation. No patient required additional procedures postoperatively.

DISCUSSION

The introduction of laparoscopy and robot assisted techniques has allowed for minimally invasive reconstructive surgery that mirrors open surgical procedures. These techniques offer substantial benefits to patients by decreasing morbidity, accelerating postoperative recovery, causing less pain and improving cosmetic outcome.

Laparoscopic Anderson-Hynes pyeloplasty for UPJO is an established and effective minimally invasive procedure in adults. Success rates are comparable to open surgery.[8,9] There have been successful reports of laparoscopic pyeloplasty performed in children.[10,11] Janetschek et al discounted laparoscopic dismembered pyeloplasty as being too difficult to master to become an acceptable procedure.[12] Their report and studies at other centers demonstrating exceedingly long operative times have discouraged attempts to perform this procedure laparoscopically in children. The major difficulty of laparoscopic pyeloplasty is intracorporeal suturing, which prolongs operative times.[4,8]

On the other hand robotics has several advantages in complex laparoscopic reconstructive procedures such as pyeloplasty. Using the da Vinci robotic system, all steps of traditional Anderson-Hynes dismembered pyeloplasty can be performed.[4,6] The advantages of the da Vinci robot include tremor control, 1:5 motion scaling, 6 degrees of freedom within 1 cm of the tip of the end effector, true 3-dimensional vision, simplified suturing and improved operative technique. Clinical experience with da Vinci assisted laparoscopic pyeloplasty in adults has been reported.[13,14] Recently, Gettman et al reported shorter overall operative and anasto-

Perioperative characteristics

Pt No.—Age—Sex	Surgery Date	Side	Crossing Vessel	Op Time (mins)	Robot Docked Time (mins)	Anastomosis Time (mins)	Hospital Stay (days)	EBL (ml)	Stent Size (Fr)
1 — 14 — F	06/25/2003	Lt	No	180	142	38	1	20	6 × 22
2 — 15 — F	07/25/2003	Rt	No	165	144	41	1	50	6 × 24
3 — 13 — M	09/02/2003	Lt	Yes	170	106	30	1	10	6 × 24
4 — 6 — M	12/08/2003	Lt	No	175	121	42	3	50	3.8 × 22
5 — 15 — M	05/03/2004	Rt	Yes	195	123	35	1	25	6 × 24
6 — 8 — M	07/28/2004	Lt	No	204	127	46	1	15	4.8 × 22
7 — 13 — M*	11/19/2004	Rt	Yes	200	160	45	1	50	6 × 24

* Patient has not yet received followup evaluation.

motic times with da Vinci robotic pyeloplasty in adults.[15] Bentas et al also reported their initial experience with da Vinci assisted laparoscopic Anderson-Hynes pyeloplasty.[16] Among the cohort of 11 adult patients they reported a mean operative time of 197 minutes, with no intraoperative complications, no open conversions, minimal blood loss and a 100% success rate at 1-year followup.

Our operative time (mean 184 minutes) was similar to the only known published series of robotic assisted pyeloplasty in children. Olsen and Jorgensen reported a median operative time of 173 minutes in robotic pyeloplasty using the retroperitoneal approach.[7] Also, El-Ghoneimi et al reported a mean operative time of 228 minutes with laparoscopic nonrobotic pediatric pyeloplasty.[17] Our anastomosis time (39.5 minutes) was shorter than the published series. Gettman et al reported a 62.4-minute anastomosis time with adult laparoscopic pyeloplasty,[13] while Yohannes and Burjonrappa reported a mean time of 45 minutes.[18] In another study Gettman et al compared laparoscopic and robotic pyeloplasty in adults, reporting mean anastomosis times of 70 minutes using the da Vinci robotic system and 120 minutes with laparoscopic pyeloplasty.[15]

In our study 7 children underwent Anderson-Hynes dismembered pyeloplasty with a mean followup of 10.9 months. Today the general consensus regarding the followup regimen after pyeloplasty is a diuretic scan performed 3 months postoperatively.[19] Recently, Psooy et al reported that after an unobstructed postoperative diuretic renogram recurrence of UPJO is unlikely and does not justify long-term followup, and, thus, discontinuation of followup can be safely considered at this time.[20] In our study diuretic renography and/or excretory urography at approximately 3 months showed unobstructed drainage in 6 patients. The remaining patient is awaiting followup study. In the beginning we were concerned about the movements of the robotic instrument arms, especially in small children, due to the lack of tactile feedback. However, in practice this concern is easily overcome after adequate training and use of the da Vinci robot in the adult population. Therefore, experience in the use of the da Vinci robot in adult patients is recommended.

Robot assisted laparoscopic pyeloplasty may be a feasible and attractive alternative to open surgery in children. While it undoubtedly requires a high level of skill and understanding of the ergonomics of robot assisted laparoscopic surgery, this approach may nevertheless be mastered and the procedures performed in relatively the same length of time as conventional open surgery. Our experience so far suggests that robot assisted Anderson-Hynes pyeloplasty in the pediatric age group provides acceptable overall operative times and anastomosis times, with no intraoperative complications or open conversions, and with favorable objective and subjective outcomes to date.

CONCLUSIONS

Robotic pyeloplasty, a well established procedure for the management of UPJO in the adult population, can be safely used in children. Precision in dissection, incision and suturing can be mastered, and robotic pyeloplasty may indeed compete with open pyeloplasty in the pediatric patient.

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