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Infant robotic pyeloplasty: Comparison with an open cohort

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Abstract *Objective:* To present our experience with infant pyeloplasty, comparing outcomes between robotic-assisted laparoscopic pyeloplasty (RALP) and open pyeloplasty (OP).

Materials and methods: A retrospective review was performed of all children <1 year of age who underwent unilateral dismembered pyeloplasty at a single pediatric institution since January 2007. Patients with standard laparoscopic pyeloplasty were excluded. Patient demographics, intraoperative details, narcotic usage, and complications were reviewed.

Results: A total of 70 infants (51 boys and 19 girls) were identified, with nine RALP and 61 OP performed. Median age was 9.2 months (range, 3.7–11.9 months) for RALP and 4.1 months (range, 1.0–11.6 months) for OP ($p = 0.005$). Median weight was 8 kg (range, 5.8–10.9 kg) for RALP and 7 kg (range, 4–14 kg) for OP ($p = 0.163$). Median operative time was 115 min (range, 95–205 min) for RALP and 166 min (range, 79–300 min) for OP ($p = 0.028$). Median hospital stay was 1 day (range, 1–2 days) for RALP and 3 days (range, 1–7 days) for OP ($p < 0.001$). Median postoperative narcotic use of morphine equivalent was <0.01 mg/kg/day (range, 0–0.1 mg/kg/day) for RALP and 0.05 mg/kg/day (range, 0–2.2 mg/kg/day) for OP ($p < 0.001$). Median follow-up was 10 months (range, 7.2–17.8 months) for RALP and 43.6 months (3.4–73.8 months) for OP ($p < 0.001$). The success rate was 100% for RALP and 98% for OP.

Conclusions: Infant RALP was observed to be feasible and efficacious with shorter operative time, hospital stay, and narcotic utilization than OP.

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Introduction

Originally described by Anderson and Hynes [1], open pyeloplasty (OP) has long been the gold standard for management of ureteropelvic junction obstruction (UPJO). Previous studies have reported success rates to be as high as 90% in patients undergoing OP [2,3]. Shorter recovery times, decreased pain management, and the potential for improved cosmesis have been realized with the evolution of minimally invasive surgery (MIS), including laparoscopic pyeloplasty (LP). Since the first reports of LP in adults [4] and infants [5], minimally invasive techniques have gained increased acceptance for the treatment of UPJO. However, laparoscopic suturing is technically challenging, time-consuming, and has the potential for a long learning curve [6,7]. These challenges have potentially limited its widespread application for pediatric urological reconstructive surgery. Technological advances, including robotics, have helped to mitigate the limitations of standard laparoscopic surgery [8].

Pediatric robotic assisted laparoscopic pyeloplasty (RALP) has been associated with shorter hospital stays and decreased narcotic requirements at the expense of longer operative times in early reports [9,10]. Studies have consistently demonstrated RALP to have comparable success to OP in children. However, there is a paucity of reports that aim to assess peri and postoperative outcomes of RALP in the infant population, in large part owing to concerns about reduced working space in smaller patients. We present the first report comparing RALP and OP in the infant population.

Materials and methods

Study population

Using institutional review board-approved methods a retrospective review was performed to include all children aged <1 year of age at time of surgery who underwent primary unilateral dismembered pyeloplasty at a single pediatric institution since January 2007. Patients managed with standard LP or those undergoing repeat pyeloplasty were excluded. The robotic surgery program was started at our institution in February 2009, and we began offering infant RALP in October 2011. Data were collected on age, weight, gender, operative time, length of hospital stay, analgesics, complications, and length of follow-up period. Operative time was defined as skin incision to closure. Surgical indications included Society for Fetal Urology grade 3–4 hydronephrosis with an abnormal well-tempered diuretic renogram and/or clinical problems including urinary tract infection (UTI) and pain.

Data analysis

Data were analyzed with non-parametric statistics. We utilized Wilcoxon and Mann–Whitney *U*-tests for continuous variables and Fisher's exact and Chi square tests for categorical variables. Statistical calculations were performed with PASW Statistics GradPack (version 20.0; SPSS, Chicago, IL, USA). Statistical significance was set at $p < 0.05$.

Study objective

This study was designed with the objective of assessing outcomes, including the feasibility, safety, efficacy, and potential advantages of RALP compared to OP in the infant population.

Surgical technique for RALP

All cases were performed with a transperitoneal approach. Patients were placed in flank position. One 8.5-mm camera trocar and two 8-mm trocars were placed under direct vision. All but one RALP was performed using the hidden incision endoscopic surgery (HIdES) technique for trocar placement [11]. Conventional trocar placement was utilized in one patient. Assistant ports were not utilized. The retroperitoneum was exposed by reflecting the ipsilateral colon. The renal pelvis, UPJ, and ureter were mobilized. Gonadal vessels were preserved. A percutaneous Prolene suture was placed into the renal pelvis to provide traction and exposure. An incision was made into the renal pelvis above the UPJ. The obstructed segment was used as a handle for manipulation and eventually excised. The ureter was spatulated to achieve a widely patent anastomosis. The anastomoses were performed with a modified double-armed running 5-0 or 6-0 polydioxanone. Tying two sutures together created the double-armed suture, leaving a suture length of 4–8 cm from the knot to each needle. The sutures were brought into the abdomen by holding the tails of the knot with a standard laparoscopic instrument through a working trocar. An indwelling ureteral stent was placed antegrade, percutaneously through an angiocatheter, during the anastomosis, when technically feasible.

Diet was advanced as tolerated. Ureteral stents were typically removed 4–6 weeks postoperatively. Routine postoperative imaging included renal ultrasounds. Success was defined as stable or improved hydronephrosis on renal ultrasound or clinical improvement of preoperative symptoms. At our institution, a diuretic renogram is not routinely obtained after every pyeloplasty and is performed when clinically indicated. Complications were assessed according to the Clavien classification system [12].

Perioperative analgesia

Patients received local anesthesia at trocar sites for RALP and at the incision for OP when a regional block was not utilized. A regional block was utilized after shared decision-making with the family, surgeon, and anesthesiologist. The surgical pain management service primarily addressed postoperative analgesia for patients with regional blocks until it was discontinued. Narcotic use was converted to morphine sulfate equivalents.

Results

During the study period, 70 infants (9 RALP and 61 OP) were identified. The first infant RALP was performed in October 2011. A single surgeon performed all robotic procedures. Demographic data are presented in Table 1. There was no

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