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Comparative evaluation of the resolution of hydronephrosis in children who underwent open and robotic-assisted laparoscopic pyeloplasty

Joao A. Barbosa [a,b], Alexander Kowal [a], Bulent Onal [a], Eder Gouveia [a,b], Michele Walters [a], Justin Newcomer [a], Jeanne Chow [a], Hiep T. Nguyen [a,*]

[a] *Department of Urology, Hunnewell-353, Children's Hospital Boston, 300 Longwood Avenue, Boston, MA 02115, USA*
[b] *University of Sao Paulo School of Medicine, Department of Urology, Av. Dr Arnaldo, 455, Sao Paulo, SP, CEP 01246-903, Brazil*

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Abstract *Objectives:* To assess long-term postoperative ultrasonographic outcomes of robotic-assisted laparoscopic pyeloplasty (RALP) and of conventional open pyeloplasty (COP) in pediatric patients with ureteropelvic junction obstruction.
Methods: Retrospective review of 312 patients who underwent RALP or COP in a single institution. Preoperative and postoperative ultrasounds were used to determine the grade of hydronephrosis. Postoperative assessment included 3 ultrasounds at 0—6, 6—12 and >12 months intervals. Patients were matched by age, etiology of obstruction, grade of preoperative hydronephrosis and gender for case-matched analysis.
Results: We identified 212 pyeloplasties that met inclusion criteria, being 58 RALP and 154 COP. Groups were different in age, gender and etiology, but similar in severity of hydronephrosis and follow-up time. At the end of follow-up, complete resolution and success rates were 62% and 74% in RALP and 45% and 70% in COP, respectively. Matching included 105 patients. Complete resolution was higher in RALP ($p = 0.004$), while median time before improvement was lower (12.3 months RALP vs 29.9 months COP). There was no difference in success rate at the end of follow-up between the groups.
Conclusion: RALP shows satisfactory long-term outcomes, comparable to COP. In our cohort, patients who underwent robotic pyeloplasty showed faster resolution of hydronephrosis on ultrasound.

Abbreviations: RALP, robotic-assisted laparoscopic pyeloplasty; COP, conventional open pyeloplasty.

* Corresponding author. Tel.: +1 617 355 3341; fax: +1 617 730 0474.
E-mail addresses: Joaoarthur.barbosa@childrens.harvard.edu (J.A. Barbosa), Alexander.kowal@childrens.harvard.edu (A. Kowal), Bulent.onal.@childrens.harvard.edu (B. Onal), edergouveia@yahoo.com.br (E. Gouveia), Michele.walters@childrens.harvard.edu (M. Walters), Justin.newcomer@childrens.harvard.edu (J. Newcomer), Jeanne.chow@childrens.harvard.edu (J. Chow), Hiep.nguyen@childrens.harvard.edu (H.T. Nguyen).

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Introduction

The gold standard treatment for ureteropelvic junction obstruction (UPJO) is conventional open pyeloplasty (COP). Prior studies of COP have demonstrated success rates exceeding 90% [1]. There is significant morbidity and extended recovery associated with a large flank incision, prompting an interest in minimally invasive procedures [2]. Laparoscopic pyeloplasty (LP) was proposed as an alternative to COP in 1993 by Schuessler et al., with subsequent comparable success rates to COP [3]. However, because of the high technical demands of the procedure with its associated long learning curve [4,5], conventional LP has not gained popularity as the preferred treatment option in children. More recently, robotic-assisted laparoscopic pyeloplasty (RALP) has become increasingly popular. With instruments that allows for 7 degrees of freedom of movement, motion scaling and tremor reduction, and a stereoscopic three-dimensional display that allows depth perception and magnification [6,7], RALP has demonstrated a shorter learning curve with urologists. Within a short time, RALP has become an accepted alternative to COP.

Prior comparisons between COP and RALP in pediatric patients have focused on and demonstrated that COP has shorter operative times and decreased cost, while RALP results in shorter length of hospital stay, decreased narcotic requirements and improved cosmetic results [8,9]. In addition, these studies have consistently demonstrated that RALP has comparable outcomes to those of COP, with low rates of failure and reoperation. However, many of these studies have failed to evaluate another important clinical outcome: the rate of hydronephrosis resolution following pyeloplasty. Of those that do, the definition of imaging success is varied and often unspecified, with some studies requiring nothing more than stable findings [4,9,10]. Consequently, there has been a lack of assessment of the postoperative course of RALP using clear anatomic parameters over time. Since most clinicians will primarily follow the patients postoperatively with ultrasonography (US) (unless they develop symptoms such as pain and infection), evaluation of this clinical outcome would be of value to help guide clinicians as to timing of follow-up imaging and when to be concerned if there is persistent hydronephrosis in follow-up. The purpose of this study was thus to assess and to compare the resolution of hydronephrosis following RALP and COP by examining preoperative and postoperative US imaging, and describing the degree of anatomic change in the postoperative course of pyeloplasty.

Materials and methods

Institutional review board approval was obtained prior to a retrospective review of patient charts and ultrasound images. A search of a single tertiary care referral institution's urology database yielded 312 pediatric subjects who underwent either COP or RALP between January 2001 and January 2008. The indications for pyeloplasty at this institution are symptomatic disease, progressing hydronephrosis with prolonged renal drainage time, and decreasing renal function below 40%. The choice of treatment was at the discretion of the urologist and the patient's family. Patients who lacked preoperative or postoperative US evaluation, had shorter than 1-year follow-up, had a prior history of pyeloplasty, or had stents or nephrostomy tubes in place during imaging were excluded. Patients with concomitant complex urological comorbidities including transplanted kidney, vesicoureteral reflux, posterior urethral valves, ureterocele/ectopic ureter, and primary megaureter were also excluded. UPJO in a duplex collecting system was not excluded. All patients underwent a dismembered pyeloplasty without pelvic reduction; the COP was performed through a retroperitoneal approach, while RALP was transperitoneal. The same pyeloplasty technique was performed regardless of whether an intrinsic or extrinsic obstruction was identified. All patients who underwent RALP had a stent placed during surgery; however, not all patients undergoing COP did so.

Official reports of the latest preoperative and postoperative US performed in our hospital were reviewed. The common descriptors of the extent of hydronephrosis in the kidney in question were recorded and tabulated on a scale of 0–5 for each exam: none/normal = 0; minimal/slight/mild/minor = 1; mild to moderate = 2; moderate = 3; moderate to severe = 4; and severe/marked/massive/large = 5. Such descriptions were obtained after the evaluation of an experienced radiologist and the review of an experienced pediatric urologist, and based upon pelvic measurement and calyceal dilatation. The preoperative US score was then subtracted from the postoperative score for both groups of patients. The difference between the two scores represented the extent of improvement or worsening of hydronephrosis following the treatment. Postoperative outcome was divided into three categories: complete resolution, improving hydronephrosis and stable/worsening hydronephrosis. Complete resolution was defined as a postoperative score of 0 or 1 (absent or mild hydronephrosis), while improvement was defined as a reduction of at least 2 grades in hydronephrosis after surgery to avoid a bias from intra- and inter-observer variability of US. Success was accepted as complete resolution and improvement together. The first US date at which hydronephrosis became undetectable was accepted as the time of complete resolution.

In order to overcome the demographic differences between the two groups, a case-matched analysis was performed. Matching was performed randomly and hierarchically by etiology of obstruction, age, grade of preoperative hydronephrosis and gender. More detailed postoperative assessment of hydronephrosis for these patients was obtained, including three ultrasounds at time intervals of 0–6 months, 6–12 months and longer than 12 months. An ultrasound performed at least 2 months after pyeloplasty or ureteral stent removal was accepted as the first postoperative ultrasound. Patients who showed no radiologic improvement of hydronephrosis on US had renal drainage evaluated by mercaptoacetyltriglycine renograms (MAG-3) at the discretion of the attending physician. The interval from the date of surgery until the date of last ultrasound examination, regardless of diagnosis date, was accepted as the length of follow-up.