

Urinary Diversion during and after Pediatric Pyeloplasty: A Population Based Analysis of More than 2,000 Patients

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Abbreviations and Acronyms

FPSC = Faculty Practice Solutions Center

NT = nephrostomy tube

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Purpose: We evaluated the use and efficacy of intraoperative urinary diversion with ureteral stent or nephrostomy tube during pyeloplasty in children.

Materials and Methods: The Faculty Practice Solutions Center® national billing database was queried to identify all pediatric pyeloplasties performed from 2009 to 2012. Patient variables, surgical approach, use of intraoperative stent/nephrostomy tube and return for postoperative stent/nephrostomy tube or second pyeloplasty were obtained.

Results: A total of 2,435 children underwent open (1,792) or laparoscopic/robotic (643) pyeloplasty, with intraoperative urinary diversion rates of 45% and 83%, respectively. Comparing patients with and without an intraoperative stent/nephrostomy tube, 5.6% and 7.4%, respectively, returned to the hospital for urinary diversion. Multivariable analysis revealed no association with surgical approach, but higher surgeon volume ($p < 0.01$) and use of an intraoperative stent/nephrostomy tube ($p < 0.01$) were associated with decreased odds of requiring postoperative urinary diversion. Second pyeloplasty rate was 3.8% and was not associated with surgical approach or use of intraoperative stent/nephrostomy tube.

Conclusions: Intraoperative stent/nephrostomy tube use and increased surgeon volume were each independently associated with a significant but small decrease in risk of postoperative stent/nephrostomy tube placement. Use of an intraoperative stent/nephrostomy tube was not associated with rate of second (redo ipsilateral or contralateral metachronous) pyeloplasty.

Key Words: outcome assessment (health care), stents, ureter, ureteral obstruction, urinary diversion

SINCE the initial description of Anderson-Hynes pyeloplasty as a stentless procedure in 1949,¹ there has been ongoing debate regarding the use of upper urinary tract diversion during pyeloplasty.² Current options that have been demonstrated as safe and effective include trans-anastomotic externalized stents, internal stents/nephrostomy tubes and

stentless open or laparoscopic/robotic approaches,²⁻¹¹ with a lack of clear evidence of efficacy of intraoperative urinary diversion.

Regardless of surgical approach or urinary diversion, the Anderson-Hynes pyeloplasty is a well established procedure with low overall complication rates ranging from 3% to 15% and approximately a 95% success

rate in relieving obstruction.^{2,4,12,13} It is estimated that intraoperative stenting rates have decreased in recent years, potentially due partly to higher costs and longer hospitalization, requirement of a second anesthetic for internal stent removal and increased risk of urinary tract infection.^{2,6} There are numerous single institution analyses of stent efficacy with conflicting results biased by surgeon or institutional practice patterns. A formal multi-institution population based analysis of stent use and risk of secondary procedures is lacking in the literature.

Given the potential lack of cost-effectiveness and indeterminate use of intraoperative ureteral stent/NT during pediatric pyeloplasty,¹² we sought to determine the use of intraoperative ureteral stent/NT, and to analyze patient and surgeon characteristics associated with outcomes. We hypothesized that there would be a higher rate of postoperative urinary diversion and second pyeloplasty procedures in those individuals who did not undergo stent placement during pyeloplasty, although the absolute difference would be less than 5%.

MATERIALS AND METHODS

The Faculty Practice Solutions Center is a national database developed by the University Health System Consortium and the Association of American Medical Colleges to collect benchmarking data regarding clinical, operational and financial performance of academic clinical practices throughout the United States. Coding data collected include hospital, deidentified provider and patient demographic information, and CPT and ICD-9 codes with service site, date and payer category. FPSC is unique for its large scale of data capture, including more than 90 participating institutions and 60,000 physicians, and for its role in tracking billing information.

The FPSC database was queried to identify all individuals younger than 18 years who underwent pyeloplasty (CPT 50400, 50405 or 50544) between January 1, 2009 and June 30, 2012, with secondary procedures analyzed through December 31, 2012. All individuals undergoing urinary diversion during the initial pyeloplasty procedure (stented cohort) were defined based on intraoperative coding for stent or nephrostomy tube placement (52332, 50605, 50392 or 50393) and/or a stent removal code (52310 or 52315) on a date after primary pyeloplasty and before any stent/NT placement or second pyeloplasty.

All individuals were further identified by surgical approach, either open (50400, 50405) or laparoscopic/robotic (50544 or robotic identifier S2900). Since use of a robotic identifier was rare (84 of 643 laparoscopic cases) and did not allow for reliable differentiation between a laparoscopic vs robotic approach, these cases were placed in a single cohort for analysis. All demographic characteristics available were queried. Outcome variables assessed included postoperative stent/NT placement and/or second pyeloplasty.

The association between baseline characteristics and outcomes of postoperative stent/NT placement and second pyeloplasty was analyzed using a mixed effects logistic regression model including random effects for surgeon and hospital. The model also included an interaction effect between patient age and surgery type, allowing for a differential effect of age depending on whether the patient underwent open or laparoscopic surgery. Analyses were conducted using lme4, version 0.999999-2 in the statistical software environment R, version 3.0.0 (R Project for Statistical Computing, Vienna, Austria).¹⁴

Time to postoperative stent/NT placement was compared between patients with and without an intraoperative stent using a mixed effects Cox proportional hazards model including random effects for surgeon and hospital. This analysis evaluated patient gender, use of intraoperative stent/NT, surgeon and hospital volume, geographic region, insurance status, patient age and surgical approach. Patients who had not undergone postoperative stenting as of December 31, 2012 were censored at this date.

RESULTS

Population Characteristics

There were 2,435 children identified who underwent open (1,792) or laparoscopic (643) pyeloplasty between January 1, 2009 and June 30, 2012, with secondary procedures analyzed through December 31, 2012. Median followup was 27.3 months (range 6.1 to 47.8) from date of pyeloplasty until conclusion of secondary procedure analysis. Overall rate of intraoperative stenting was 55%, and stenting was more commonly used in those who underwent a laparoscopic/robotic approach (83%) compared to an open approach (45%). Table 1 outlines patient demographics, surgeon and hospital volume, surgical approach and outcomes for intraoperatively stented, unstented and all pyeloplasties combined. Race distribution, insurance status and gender were comparable between the stented and unstented cohorts but there were significant differences in age, surgeon and hospital volume, and followup time ($p < 0.001$).

Median age was 0.9 years (range 0 to 18.2) in patients undergoing open pyeloplasty vs 8.7 years (0.1 to 18.2) in those undergoing a laparoscopic/robotic approach. As a consequence, the median age of the stented cohort was greater, at 4.1 years (range 0 to 18.2), vs 1.0 year (0 to 18.2) in the unstented cohort ($p < 0.001$). Unstented status was associated with higher volume hospitals (18.6 vs 12.3 pyeloplasties yearly, $p < 0.001$) and higher volume surgeons (8.3 vs 5.7 pyeloplasties yearly, $p < 0.001$). Part A of the figure shows time to removal of intraoperatively placed ureteral stents, with the majority removed at 20 to 60 days postoperatively. Removal time of intraoperative NTs

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