Outcome Analysis and Cost Comparison Between Externalized Pyeloureteral and Standard Stents in 470 Consecutive Open Pyeloplasties

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Purpose: Despite the widespread use of ureteral stents for pyeloplasty by pediatric urologists there is ongoing controversy regarding the most advantageous type of transanastomotic drainage. We compared patients who underwent placement of an externalized pyeloureteral Salle intraoperative pyeloplasty stent (Cook Urological, Spencer, Indiana) to those who had a standard Double-J® ureteral stent placed to assess the benefits, drawbacks and costs of each modality during open pyeloplasty.

Materials and Methods: Our study sample comprised 470 age matched children who underwent primary open pyeloplasty in an 11-year period. A total of 242 patients (51.5%) underwent Double-J ureteral stent insertion and 228 (48.5%) underwent placement of a Salle intraoperative pyeloplasty stent at surgery. Operative time, hospital stay, overall complication and success rates, type of complications and hospital costs were compared between the 2 groups.

Results: Median age was 18 months and median followup was 39 months. Mean hospital stay was 3.0 and 3.1 days in children with a Double-J ureteral and a Salle intraoperative pyeloplasty stent, respectively ($p = 0.7$). The overall complication rate was 9.9% (24 of 242 patients) for the Double-J ureteral stent vs 8.3% (19 of 228) for the Salle intraoperative pyeloplasty stent ($p = 0.6$). Complications in patients with a Double-J ureteral stent consisted of urinoma in 3, return visits due to bladder spasms in 7 or catheter obstruction in 6 and readmission due to pyelonephritis in 5. Complications in children with a Salle intraoperative pyeloplasty stent involved urinoma in 1, prolonged drainage through the Penrose drain in 5 and readmission due to pyelonephritis in 1. Recurrent ureteropelvic junction obstruction developed in 12 cases per group. The success rate was 95.0% (230 of 242 cases) and 94.7% (216 of 228) for the Double-J ureteral and the Salle intraoperative pyeloplasty stent, respectively ($p = 0.2$). Hospital charges, including the surgical procedure, postoperative hospitalization and cystoscopy or a clinical visit for catheter removal, in patients with a Double-J ureteral and a Salle intraoperative pyeloplasty stent were $9,825 and $9,260, respectively.

Conclusions: The 2 ureteral stents are equivalent in regard to overall complication and success rates after pyeloplasty. However, Salle intraoperative pyeloplasty stent insertion was associated with a Canadian $565 cost decrease per patient and most importantly the preclusion of a second general anesthesia for catheter removal.

Key Words: kidney; stents; complications; ureter; anastomosis, surgical

Standard Anderson-Hynes dismembered pyeloplasty has been used for more than 60 years and it remains the surgical treatment of choice for UPJO. The technique includes insertion of a nephrostomy tube with or without a transanastomotic stent,[1] or simply nonstented repair.[2,3] At many centers, including ours, there has been a tendency to stent the pyeloureteral anastomosis.[4]

When performing stented pyeloplasty, several methods of drainage can be used.[1,5–10] The most common choice has been insertion of a DJUS, which can be retrieved by cystoscopy 6 to 8 weeks later.[11–13] An alternative option entails insertion of an externalized DJUS, which allows catheter removal on an outpatient basis.[7,10,14] Although the 2 types of transanastomotic drainage for pyeloplasty have been widely used by pediatric urologists, there is ongoing controversy regarding the most advantageous type of stent. The internal DJUS has the disadvantage of requiring a second anesthesia for catheter removal in children. This situation is particularly important in an era when outcome analysis and particularly the costs of care are evaluated carefully.

Therefore, to evaluate the benefits and drawbacks of each stent for open pyeloplasty as well as the associated costs we compared patients who underwent placement of a SIPS externalized pyeloureteral stent and those with standard DJUS insertion.

MATERIALS AND METHODS

We compared the costs of 2 types of ureteral stent commonly used for pediatric pyeloplasty using decision tree model and 1-way sensitivity analysis.

Study received institutional review board approval.

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Study Sample, and Inclusion and Exclusion Criteria

The records of 522 consecutive children who underwent primary open pyeloplasty between 1995 and 2005 at a single institution were reviewed. A total of 37 patients who underwent nonstented repair and 15 with bilateral UPJO were excluded from study. As a result, our study sample comprised 470 children, including 242 (51.5%) with a DJUS and 228 (48.5%) with a SIPS inserted at pyeloplasty. The type of ureteral stent introduced varied according to surgeon preference, surgical access (dorsal lumbotomy vs flank incision) and anatomy of the distal ureter. Of the 202 patients who underwent dorsal lumbotomy 138 received a DJUS, likely due to limited exposure of the renal parenchyma. In 20 patients younger than 18 months with a narrow ureterovesical junction a SIPS was used because the DJUS distal end could not be negotiated into the bladder.

SIPS Characteristics and Insertion Technique

Our local practice has incorporated a commercially available, externalized DJUS, also known as SIPS. This stent consists of a double coiled, multiperforated catheter that extends from kidney to bladder, similar to a standard DJUS. A slight modification adds a long, straight, nonperforated arm to 1 end (the extended externalized part) (fig. 1). A 4Fr SIPS was used in all patients.

The technique to introduce a SIPS is similar to that of other nephroureteral stents. Briefly, this stent is inserted after half of the pyeloureteral anastomosis is completed, allowing positioning of the catheter under direct vision. In most cases the distal part of the SIPS is positioned in the mid ureter after cutting its distal coiled end. The proximal end (extended arm) is made of a semirigid malleable material that facilitates its passage through the renal parenchyma, usually the lower kidney calix. It is important to secure the catheter to the renal capsule with a 5-zero chromic stitch, thus minimizing the risk of stent displacement and exteriorization of the holes.

After the pelvic-ureteral anastomosis is completed the external part of the catheter is exteriorized through a contralateral stab wound and fixed to the skin with a 4-zero polypropylene suture. The external part of the stent is connected to a urine bag for the first 24 to 36 hours after the operation. Subsequently the distal end of the stent is clamped. If the Penrose drain site remains dry, the patient is sent home the following day with a Tegaderm™ dressing covering the catheter.

After 7 to 10 days the stent is easily removed in the outpatient clinic with no need for sedation or anesthesia (fig. 2). If abdominal pain or prolonged leakage (greater than 7 days) around the Penrose drain occurs after clamping, the stent is kept open with drainage into a collecting bag or a double diaper. An antegrade nephrostogram can be performed at any time to study the distal anatomy and the patency of the anastomosis. Furthermore, this access can be used to advance a DJUS antegrade under fluoroscopic guidance if necessary. In contrast to children who undergo DJUS insertion at pyeloplasty, patients who undergo SIPS placement do not need a Foley catheter placed in the bladder.

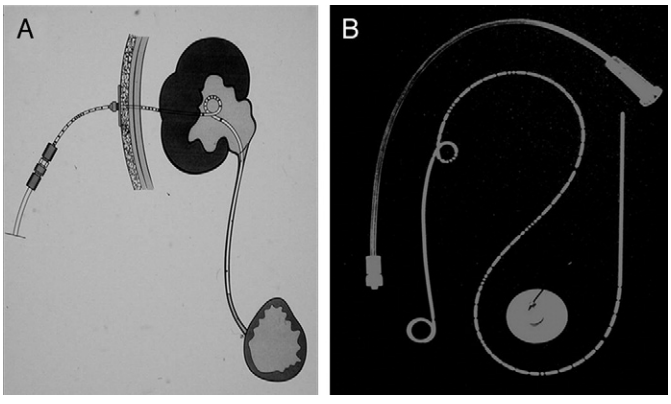

FIG. 1. *A*, distal end of SIPS is cut and positioned in mid ureter. *B*, SIPS and urine bag adaptor.

Variables

The variables recorded in our study were operative time, hospital stay, overall complication and success rates, type of complications and incurred hospital costs. Operative time included retrograde pyelography and anesthesia times. Complications consisted of urinoma, prolonged Penrose site drainage, return visits to the emergency department due to bladder spasms, stent migration or displacement, pyelonephritis and recurrent UPJO. Success after pyeloplasty was defined as no clinical and radiological evidence of obstruction, as determined by ultrasound or diuretic renography at the latest clinical appointment and a lack of symptoms. Variable analysis was done by comparing children who underwent DJUS insertion vs those who underwent SIPS placement. Statistical analysis was performed using SPSS® 15.0. Pearson's chi-square test was used for comparative analysis with $p < 0.05$ considered statistically significant.

Cost Analysis

Financial analysis was based on cost rather than on charges since the former better reflects the economic impact of treatment (inserting a specific type of ureteral stent) and it is less likely to be widely different among institutions. The cost variables included the type of stent (DJUS or SIPS), operating room time in 30-minute intervals, surgical and anesthetic fees for pyeloplasty and stent removal, postoperative admission to the hospital, outpatient admission for DJUS removal and clinical visits. Pyeloplasty costs involved the costs of surgeon and anesthesia professional fees, operating room time, hospital stay, analgesics, postoperative visits and instruments used. Physician professional fees were derived from the Schedule of benefits of the Ministry of Health and Long-Term Care in Canada.[15] Operating room costs, including anesthesia professional fees, depended on operating room time. At our institution operating room costs are based on 30-minute increments ($400 per 30 minutes of operating room time) and they were provided by the hospital administration. All costs were determined as of January 2008 (table 1). Costs are presented in Canadian dollars.

Decision Analysis Model

Decision analyses models were devised to estimate and compare the costs incurred by each stent using TreeAge Pro Healthcare Module software (www.TreeAge.com). The primary outcome parameter for the model was the resolution of obstruction on ultrasound or diuretic nuclear scintigraphy. Base case analysis involved a child with unilateral primary