Cutaneous Pyeloureteral Stent for Laparoscopic (Robot)-Assisted Pyeloplasty

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Abstract

Background and Purpose: In select centers, laparoscopic (robot)-assisted pyeloplasty has emerged as a viable approach for the treatment of ureteropelvic junction obstruction (UPJO). Stent placement for urinary diversion is a common postoperative practice with several potential techniques and respective challenges. Robot-assisted diversion techniques such as indwelling Double-J or nephroureteral stents require either additional anesthesia or costs or they carry bleeding risks. Herein we describe an alternative postpyeloplasty cutaneous pyeloureteral (CPU) stenting technique that minimizes these challenges and achieves effective urinary diversion.

Introduction

THE TECHNIQUE USED to achieve urinary diversion after dismembered pyeloplasty is debatable. Multiple diversion options include Double J stent placement (antegrade or retrograde), or nephroureteral transanastomotic, transvesical, and/or transpelvic stent placement.^{1–5} Traditionally, cystoscopic insertion and subsequent removal of the stent has been standard of care and modifications, including dangling wires for removal without repeat anesthesia, have been described cystoscopically and percutaneously.

Nevertheless, the techniques available present inherent technical challenges independent of the surgical approach (robotic or open). The requirement of urethral instrumentation, additional anesthesia, and corresponding increases in cost for the indwelling Double J stent render this stent undesirable. Parenchymal traversal presents the risk of intraoperative or postoperative bleeding with the nephroureteral stent. As described by Son and colleagues,⁵ transpelvic stenting into the proximal ureter successfully avoids repeat anesthesia or bleeding risks; however, it has only been described for an open pyeloplasty cohort.

Here, we describe our technique of a cutaneous pyeloureteral (CPU) stent used post laparoscopic (robot)-assisted pyeloplasty via the modification of a Salle stent that achieves effective urinary diversion while avoiding cystoscopic manipulation, preventing additional anesthetic administration, and reducing overall health care costs. A supplementary video demonstrating this technique is available at www.liebertpub.com/end

Technique

Patient preparation

All patients underwent robot-assisted pyeloplasty after a confirmed diagnosis of ureteropelvic junction obstruction (UPJO) based on ultrasound and nuclear medicine renal scan with furosemide imaging.

Patient positioning

All pressure points should be well padded. The patient is brought to the edge of the bed with 15° flexion, and a beanbag is placed underneath the patient. The patient is well secured to the table at the level of the nipple and iliac crest.

During the procedure, the flank is left exposed to allow access for stent placement during the procedure, both for maneuvering and for securing once the stent is placed.

Port placement

The robot-assisted procedure is standardized to use the following four ports: a 12-mm camera port at the level of the umbilicus, midline 8-mm robotic port above the camera port, another 8-mm robotic port 4–6 cm away from the umbilicus along the line drawn from umbilicus to anterior iliac spine, and a 5-mm assistant port in the midline at the suprapubic level (Fig. 1). The ports are placed under vision and are directed into the camera port to avoid injury to intra-abdominal structures from the trocar tip; we call this the “trocar-in-port” technique.

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FIG. 1. Port placement.

Stent placement

Once the redundant pelvis is excised and the ureter is spatulated, an apical stitch is placed with 5-0/6-0 PDS suture. After the completion of the posterior anastomosis, a Salle nephroureteral stent (Cook Medical Inc., Bloomington, IN) is prepared so that it can be used as a CPU stent with minimal modifications. Both the proximal and distal end of the stent are cut: Distal, as required, and proximal, as it is manufactured with a preplaced needle that precludes placement of a guidewire during intraoperative placement. The distal ureteral end is measured so it traverses the anastomosis and into the upper ureter yet not traversing through the ureterovesical junction (Fig. 2). The stent is cut obliquely at this point; the guidewire is advanced through the stent and secured externally with a small hemostat.

After making a skin indentation and visually inspecting the point of entry of the stent, a 14-gauge $\times$ 3.25 in BD AngiocathTM peripheral venous catheter (Fig. 3a) is advanced under vision in a percutaneous fashion to ensure a straight entry into the renal pelvis. The angiocath is further advanced

to puncture the anterior renal pelvis (Fig. 3b) or, in older children, a small puncture is made with the Potts scissor, as this angiocath would not reach the pelvis through a thick abdominal wall.

Next, the preloaded stent with guidewire is advanced via the cannula of the angiocath, and with the help of the robotic needle driver the stent is directed into the ureter (Fig. 3c). Once the coil is placed in the renal pelvis the stent is stabilized, the guidewire is withdrawn, and remainder of the anastomosis is completed (Fig. 3d, e).

Finally, at the end of the procedure the intracorporeal portion of the stent is withdrawn perpendicular to the skin under direct vision, and the external stent is secured to the skin (Fig. 3f). With the single intrapelvic coil, it may be beneficial to have some intraperitoneal redundancy for respiratory movements to prevent any inadvertent dislodgement of the stent. Unlike the transpelvic stent described by Son and associates in an open series,⁵ we do not secure the stent to the renal pelvis. In our practice we remove the stent in 7 days; thus, a stent fixation to the renal pelvis may hinder stent removal. In patients with an intrarenal pelvis, there is not much redundant renal pelvis, and thus the stent is brought out at the superior edge of the renal pelvis.

Stent management

The stent is secured with nylon stitch and taped well to the skin at two different points. In infants and non-toilet-trained children, our practice is to drain the stent in double diapers. In toilet-trained children, the stent is attached to an external urine bag. In smaller children, managing the stent in double diapers is technically easier than the drainage bag. On postoperative day 1 the stent is capped via tying a knot in the stent. If the patient remains asymptomatic with no worsening pain, nausea, vomiting, or fever then the patient is discharged home with the stent capped.

Stent removal

On postoperative days 7–10 the stent is removed percutaneously in an outpatient clinic. We do not perform an antegrade study before stent removal.

Equipment

- Custom modification (see Fig. 2) of Salle Intraoperative Pyeloplasty Stent Set and drainage bag with connector (Cook Medical Inc. Bloomington, IN)
- 14-gauge $\times$ 3.25 in BD AngiocathTM peripheral venous catheter
- Drain fixation stitch 3-0 nylon
- Steristrips and tegaderm

Role in Urologic Practice

Urinary stents after Anderson-Hynes pyeloplasty is controversial. Multiple different modalities have been described with inherent risks and benefits. Various techniques are used; these include standard cystoscopic insertion and removal of indwelling Double J stents, nephrostomy tube placement, and percutaneous stent kits.

Removal of indwelling Double J stents requires additional anesthesia and increases overall costs. To ameliorate this problem, modifications such as dangling wires have been

FIG. 2. Cutaneous pyeloureteral (CPU) stent.

FIG. 3. Robot-assisted placement of the cutaneous pyeloureteral (CPU) stent. (a) Initial puncture with angiocatheter. (b) Puncture of the anterior wall of renal pelvis with the angiocatheter. (c) Guiding the ureteral stent over the guidewire. (d and e) The pelvic coil is placed in the renal pelvis. (f) The stent is secured externally at the level of the skin.

described; Yucel and associates used a dangling string on the stent as a retrievable method to recover the stents at a mean of 10.3 days with no dislodgement during their laparoscopic pyeloplasty.⁶ Though the author reports no dislodgement, in adult female patients with temporary ureteral stents we have noticed dislodgement secondary to bladder spasms (clinically witnessed though not reported). It also seems it may be more challenging to maintain the string placement without dislodgement in the pediatric population due to diaper changes and potential fecal contamination of the string as a source of retrograde infection.

Austin and colleagues reported their experience of using nephrostomy tubes in 137 open pyeloplasty repairs with a complication rate of 2.9% and mean hospitalization of 4.4 days. The average duration of the tube was 8 (2–30 days).¹ Various nephroureteral stents, such as a feeding tube,² kidney internal splint/stent catheter⁷ and a pyeloplasty catheter with a renodrain introducer,³ have been used. These stents can be associated with a potential risk of perirenal hematoma, muscle pain, and chronic loin pain.³ These potential risks are magnified in minimally invasive techniques, where sudden bleeding during renal cortex traversal is more difficult to stop,

in comparison to open pyeloplasty, where bleeding can be controlled with direct pressure.

As robotic techniques are rapidly assimilated as treatment for pediatric and infant UPJO, a robust, minimally invasive technique for stent insertion is required. Noh and associates described their technique of antegrade stent insertion during robotic pyeloplasty.⁸ A disadvantage to this method is the need for subsequent cystoscopy and anesthesia for removal, increasing both anesthetic risks and overall costs.

Son and colleagues have described the use of an open-ended ureteral catheter as a transpelvic anastomotic stent in their open pyeloplasty cohort (2004–2007). The technique is similar to our CPU stent technique, as both present a percutaneous catheter through the renal pelvis and into the proximal ureter. In our CPU technique, however, we favor the use of the above described modified Salle stent over the 5F/6F feeding tubes, and we do not use a securing stitch on the renal pelvis as it may complicate removal.⁵ To date, we have not observed any procedural complications or any urine leakage from the puncture site in the renal pelvis after stent removal. No patient was reported to have any urinary tract infection. We did experience two cases of dislodgement. One stent was

caught in surgical drapes during the immediate perioperative setting that required cystoscopy and stent placement for a persistent urinary leak from the renal pelvis anastomosis. In another patient, the stent extruded spontaneously on post-operative day 7; ultrasound showed no perirenal extravasation and no exacerbation of hydronephrosis. Preoperatively, an extensive discussion is undertaken with the family regarding the placement and care of the external stent, and thus far there has been no hesitation or opposition toward the current practice.

Discussion

The CPU stent technique was designed to provide effective urinary drainage, prevent secondary anesthesia, prevent bleeding risks, and be cost-effective. The last 22 consecutive patients of 78 robot-assisted pyeloplasties had CPU stent placement as described. The average age in the cohort was 8.6 years (7 weeks–21 years). Stent insertion has taken between 5 and 10 minutes of operating room time. In our experience, the stent does not cause any additional pain, avoids bladder spasms and hematuria, and is easily managed once secured well with clear transparent dressing. One potential risk is the possibility of urine leakage from the puncture site in the renal pelvis; thus far none of the treated patients have presented with a clinically symptomatic urine leak.

Baskin and colleagues compared three methods of no stent, internal stent, and external stent after pyeloplasty to assess the success rates, complications, patient discomfort, and costs involved. Their decision tree cost analysis concludes that external and no stents are superior to internal stents in both cost and quality adjusted life-years.⁹ In this vein, our technique avoids a visit to the operating room for cystoscopy with its additional cost, urethral instrumentation, and anesthesia. Braga and colleagues,¹⁰ in their experience of 470 patients treated either by external pyeloureteral or standard indwelling stents in open pyeloplasties, showed a cost difference of \$565 in favor of external stents. The authors state this equaled an annual savings of \$28,150 for at least 50 cases. We believe an analogous cost savings is expected with the CPU stent technique. We have elected to continue this practice in all patients undergoing robotic assisted laparoscopic pyeloplasty.

Future Direction

We currently lack an ideal stent for both infants and large pediatric patients, and puncturing the pelvis with Potts scissors for older children is not ideal, thus obviating a need for refinement and redesigning based on this principle. The two cases of stent extrusion also demonstrate a notable drawback; this is likely secondary to the rigidity of the stent and inadequate coils in the stent. A custom-made stent for this purpose is needed, as the available Salle stent is not designed for this purpose and thus has limitations.

Overall, the presented CPU stent technique achieves effective urinary diversion after laparoscopic (robot)-assisted pyeloplasty, is technically simple to place, prevents the need for additional anesthesia, and minimizes bleeding risks for

the pediatric population in our limited experience. Further studies with larger sample sizes, longer follow-up times, and randomization of treatment for patients undergoing this procedure will help secure the role of CPU stenting in the perioperative care of patients undergoing laparoscopic (robot)-assisted pyeloplasty.

Disclosure Statement

No competing financial interests exist.

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Abbreviations Used

CPU = cutaneous pyeloureteral
 UPJO = ureteropelvic junction obstruction