Ureteropelvic Junction Obstruction: Contemporary Approaches to Several Case Scenarios

FROM THE GUEST EDITOR

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Ureteropelvic junction (UPJ) obstruction is a common condition managed by the pediatric urologist. Traditionally, the open pyeloplasty has been the surgical “gold standard” to treat primary UPJ obstruction in children. For more than a decade, several techniques have been developed to reduce the invasiveness of intervention. The minimally invasive open pyeloplasty was developed, which involves a 1-1.5 cm incision. The laparoscopic and then robotic-assisted pyeloplasty further reduced the invasiveness of the pyeloplasty. Endoscopic procedures have also been promoted especially for the secondary UPJ obstruction. The least invasive intervention is conservative management with the belief that urine flow impairment requires several other criteria to be met prior to surgical intervention.

These four contemporary approaches to the UPJ obstruction are discussed in this edition of Dialogues in Pediatric Urology. This edition is organized into five case scenarios of primary and secondary urine flow impairment followed by a discussion by Pierre Mouriquand for the conservative approach, Martin Koyle for the minimally invasive open pyeloplasty, Troels Jørgensen and Yazan Rawashdeh for the laparoscopic/robotic pyeloplasty, and Michael Ost and Steven Docimo for the endoscopic intervention. The goal of these cases is to present an exchange of ideas on the management of these commonly presenting patient scenarios.

FROM THE EDITOR

Anthony A. Caldamone, M.D.

This issue of the Dialogues in Pediatric Urology discusses a common condition from the standpoint of techniques in dealing with UPJ obstruction as well as the controversies in defining obstruction. On the one hand our technologies have become more and more sophisticated in being able to treat UPJ obstruction by a variety of techniques from open to laparoscopic/robotic to endoscopic, while we still struggle with the definition of obstruction especially in the asymptomatic patient. Life was so much easier when the patient with hydronephrosis presented with symptoms. The correlation was obvious and the intervention followed. More recently, we have had to ask different questions such as whether or not asymptomatic hydronephrosis is likely to progress to either symptoms or loss of renal function. These are much more challenging thoughts.

Dr. Palmer has put together an outstanding group of experts and presents a very well balanced approach to several case scenarios of ureteropelvic junction obstruction.
CASE 1
12 month-old male with a unilateral t½ of greater than 20 minutes and equal differential renal function on MAG-3 renal scintigraphy and normal parenchyma, anteroposterior (A-P) pelvis diameter of 2.5 cm and grade III hydrenephrosis on renal ultrasonography.

The same patient with deteriorating differential function from 50% to 30% of the ipsilateral kidney over the past year.

Conservative Approach

Conservative treatment implies 3 main conditions: 1) an asymptomatic child (no urinary tract infection; no pain); 2) a stable or improving pelvic dilatation on repeated ultrasound scans; and, 3) a stable or improving relative renal function on repeated isotope scans. If one of these 3 conditions fails then surgery is considered.

One issue is the choice of isotope in children with urine flow impairment (UFI). Nuclear medicine radiologists are very cautious in the interpretation of drainage curves which can be highly influenced by the degree of hydration of the child, the bladder fullness and the position of the child. They usually recommend to only rely on the change of relative renal function to suspect a significant UFI, i.e., to only rely on the first 2 minutes of the isotope study which mainly covers the vascular phase of the dynamic study. The question whether to use DMSA rather than MAG-3 should then be raised in case of suspected UFI.

If it is an antenatal ultrasound finding, I would organize a postnatal ultrasound at day 8-15 of life to confirm the pelvic dilatation (A-P diameter), check the calyces and the remainder of the urinary tract. If the ureter(s) is or has been visible on a previous scan or if the bladder looks abnormal (thick walled or enlarged) or if there is evidence of a ureterocele, then I would organize a cystography. If the A-P pelvic diameter is above 15 mm after birth, then I plan an isotope scan at 6 weeks of gestation. If this isotope scan is abnormal, I would organize cystography if this investigation has not already been performed.

I would then repeat the ultrasound scan at 3 months, 6 months and 12 months of age. Should the repeated ultrasound scan show an increased A-P diameter, then I would repeat the isotope scan. Beyond the first year of life, I would repeat the ultrasound scan once a year until the age of 3. Any worsening of the dilatation should lead to a repeated isotope study.

Very few patients with an A-P diameter under 15-20 mm have a pyeloplasty. One third between 20 and 30 mm; half between 30 and 40 mm; 2/3 between 40 and 50 mm and all above 50 mm receive surgery (H. Dhillon and P.G. Ransley).

If the child is symptomatic (UTI, pain), and/or if the ultrasonographic dilatation increases by more than 5 mm A-P diameter, and/or if the relative renal function on the isotope scan decreases by more than 5%, then a surgical procedure is considered. In case #1, I would perform a pyeloplasty considering that the relative function has dropped by 20%. I would consider this case as a significant UFI (i.e. “obstruction”).

Minimally Invasive Open Pyeloplasty

In the first scenario of equal function, I would offer a conservative approach and observe. However with the reduction in renal function in children this age, I offer a mini- incision off the tip of the 12th rib. I do discuss laparoscopic and robotic options as well, but do not strongly “push” these options unless the child is older. The patient is placed in a flank position and a 1-1.5 cm incision is generally made off the tip of the 12th rib. The muscles are split and peritoneum mobilized medially. This is the key point as at this time we use a series of baby Deavers to assure exposure. Gerota’s is opened and the dilated renal pelvis is grasped with stay sutures. If the UPJ is not easily seen at first or if the pelvis is tensely distended, I insert a 21-gauge needle and aspirate urine as I continue placing stay sutures. In this age group, almost without fail, the UPJ can be mobilized to the skin level. No further retraction is necessary, as a standard dismembered pyeloplasty can be performed extracorporeally.

What is key operatively when using a small incision is to assure that there are no crossing vessels, a less likely occurrence in this age group. In the situation of a normal contralateral kidney, with compliant parents, I offer the alternatives of a silastic ¼-inch Penrose brought out through the incision (removed 7-10 days postoperatively), a ureteral stent as noted above or a nephrostent such as a Salle intraoperative pyeloplasty stent (Cook Medical) or kidney internal splint/stent (KISS) catheter (Cook Medical). These are removed 2-3 weeks postoperatively. I only administer perioperative antibiotics and have never regretted this. We have a 95% success rate using minimally invasive open technique. Most infants leave the hospital in <24 hours with minimal need for anything stronger than non-steroidal anti-inflammatory drugs (NSAIDs) and Tylenol.

In regards to preoperative retrograde pyelograms, for a while I did not perform them, but then regretted this as there was more distal obstruction below the UPJ than I expected. Since then I have routinely performed a retrograde pyelogram. If the family has agreed to a ureteral stent, then it is placed at that time, even if it doesn’t pass the UPJ, as I leave a string distally that exits the urethra at this age. This avoids the cost and potential risks (unlikely) of a second anesthetic.

Laparoscopic/Robotic Pyeloplasty

Assuming that this young patient were to undergo a form of percutaneous endoscopic surgical procedure, his current age would be the limiting factor. Therefore, the retroperitoneoscopic approach, be it laparoscopic or robotically assisted, would most likely not be applicable due to the constraints of lack of working space. In our experience the age limit for retroperitoneoscopic robotic-assisted pyeloplasty is about 1.7 years.1 Even use of 5 mm instruments does not entirely overcome this limitation as these newer instruments are limited by a >10 mm distance from the distal articulating joint and the instrument tip. The approach to be recommended would therefore be transperitoneal robotic-assisted or laparoscopic. Retroperitoneoscopic laparoscopic approach has, however, been reported from several centers in infants below the age of one and can be attempted where the required experience is at hand.2,3

We do not routinely perform retrograde pyelograms, and only reserve this investigation to cases where preoperative imaging is equivocal as when a dilated ureter is seen potentially indicating megaureter or

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vesicoureteral reflux. As for operative technique, in principle this does not differ from the technique described for the open Anderson-Hynes dismembered pyeloplasty. Making sure not to oversew a crossing vessel especially when using the retroperitoneal approach, or where that might have been indicated on preoperative imaging. At completion, we would stent the system using an exteriorized blue stent, which has the advantage of being removed without the need for anesthesia 1 week postoperatively. An overnight percutaneous drainage tube would rarely be considered and only in the presence of significant incongruence between the thickness of the ureteric and pelvic walls. The long-term outcome is comparable to that of the open approach and does not seem to differ between laparoscopic and robotic-assisted procedures.4

Endoscopic Treatment

In the child with rapid deterioration of renal function in the setting of a primary UPJ obstruction, prompt reconstruction is indicated. Although a percutaneous endopyelotomy (antegrade approach) can be performed in the pediatric population for a primary UPJ obstruction with reasonable success (89%), it is not the primary treatment modality of choice in a toddler of this age.1 This child would be best served with a laparoscopic pyeloplasty. A retrograde pyelogram is always indicated if an endoscopic approach is considered. If an obstructing segment greater than 1.5 cm is present or there is any element of worsening renal function, an endoscopic repair is contraindicated. This child is also too young (< 4 years old) to expect a solid outcome with any endoscopic approach. If undertaken, however, percutaneous access with a mini-perc set (11-French sheath) would be used and a laser endopyelotomy through a pediatric cystoscope would be performed.2 An 8F nephrostomy tube would be left overnight and a 6F ureteral stent would be left in vivo for six weeks. A retrograde ureteroscopic laser endopyelotomy could also be performed though a 6F flexible ureteroscope, but not at the expense of having to dilate healthy ureter to get to the area of stenosis.

Stoller and colleagues were the first to utilize a retrograde endoscopic approach (Acucise Device, Applied Urology) to treat a primary UPJ obstruction in the pediatric population.3 In a small comparative study, they later concluded that retrograde endopyelotomy could successfully correct a secondary UPJ obstruction following an open pyeloplasty.4 This observation was first reported by Kavoussi et al.5 Success rates as high as 88% have been observed when utilizing a percutaneous antegrade approach with electrosurgical incision.6 Figenshau et al, for example, utilized this approach and reported a 62% success rate in eight children (ages 6-17) with a primary UPJ obstruction. A 100% (8/8) success rate, however, was achieved when treating secondary UPJ obstruction in the age range of 3 months to 12 years.7

Conservative Approach

A plateaued drainage curve on a MAG-3 scan does not necessarily imply “obstruction”. To illustrate this, I would give the example of a bath and a sink (Figure 1). They both have the same drainage system. None of them is obstructed although the bath takes much longer to empty than the sink.

CASE 2

3 year-old female with an ipsilateral t½ of greater than 20 minutes and stable 30% differential renal function on MAG-3 renal scintigraphy six months after open pyeloplasty. The child has persistent ipsilateral grade III hydronephrosis on renal ultrasonography.

If the child is well and the ultrasound and isotope scans are stable. I would organize another ultrasonogram 1 year later and if the situation remains stable, another one 3 years later and at puberty.

Minimally Invasive Open Pyeloplasty

The age to surgically correct this condition really depends on who did the prior operation and what incision was used. If it were my own complication, I would use the same mini-incision as before through the old scar. Even in this age group, as noted in the publication above, the incisions tended to be small. To me the patient comes first, and I have no qualms about enlarging the incision if I need to. If this were an older patient or an unusually obese child, I would consider a robotic approach and certainly offer this to the family.

I tend to use belts and suspenders more in reoperative cases. My preference is to avoid unnecessary anesthetics if I can, so I lean to a nephroureteral stent rather than
Penrose, or stent or nephrostomy alone. In all these cases, especially if I wasn’t the original surgeon, I would do a retrograde pyelogram to assess the anatomy. My hope is that a percutaneous nephrostomy hasn’t been necessary, as there can be more local skill. This would often lead to a larger incision. Likewise the UPJ may be scarred in and be less mobile, and hence an operation at skin level would be more difficult without a more generous incision. Like any operation: exposure, exposure, exposure!!! I have only used the mini-incision in 2 re-do cases, 1 of my own and 1 referred in. They went well, but clearly this is not a satisfactory experience that allows me to recommend it. Re-do cases can be bears, and you have to be ready for the worst case scenario.

In regards to the indications for ureterocalycostomy, I would not consider this through a mini-incision in the majority of cases. The ideal case is one with a scarred intrarenal pelvis and thin lower pole parenchyma. I would be very hesitant to use this operation with normal parenchyma, and in such a case would ask myself why the first operation was done. In this case above, I would doubt that the parenchyma would be normal and more likely would be thin.

**Laparoscopic/Robotic Pyeloplasty**

For this 3 year old patient who “is to undergo a redo procedure” both laparoscopy and robotic-assisted surgery can be considered. Notwithstanding, most centers including the authors’ would proceed with open redo pyeloplasty in such a case. However, with increasing laparoscopic experience and especially with the introduction of robotics, reports of successful laparoscopic and robot assisted transperitoneal redo’s have been appearing in the literature.5-7

Surgically, the procedure is commenced by a transperitoneal approach. Adhesions are taken down by sharp and blunt dissection revealing the UPJ. The stenotic segment is resected, the ureter spatulated and anastomosis performed in the usual manner after transposing any crossing vessels that may have been overseen at the primary procedure. The system is stented in an antegrade fashion with a JJ-stent which is kept for 6 weeks. Percutaneous drainage is usually not necessary. Overall, success rate for laparoscopic/robotic redo pyeloplasty lies in the vicinity of 80 – 90%.5,7 We are unaware of any comparative studies between laparoscopic and robot assisted redo surgeries.

**Endoscopic Treatment**

This 3 year old female has a pyeloplasty failure or what we term a secondary UPJ obstruction. In this instance, endoscopic repair should always be the first line of therapy, provided the length of re-stenosis on a retrograde pyelogram is less than 1.5 cm. An endoscopic approach is the least invasive treatment that will not preclude or worsen outcomes should it fail and/or additional treatments are required.

In a pre-school aged child either a retrograde (ureteroscopic) or antegrade (percutaneous) approach can be utilized. Indeed, the earliest success with a pediatric retrograde endopyelotomy was in correcting a secondary UPJ obstruction by using ureteral dilators. The Acucise Device has been used as well, but it is not routinely used nowadays. More commonly, a retrograde ureteroscopic approach will be used as it is the least invasive. A 200-um holmium laser is used to perform the endopyelotomy in the posterior-lateral position. A 6F stent is left in vivo for six weeks. Balloon dilation is avoided owing to its 66% success rate.10

If a percutaneous approach with a mini-perc set (11F sheath) is utilized, a laser endopyelotomy through a 9.5F offset pediatric cystoscope is performed. Alternatively, a 9F infant resectoscope with a crescent stricture blade, as the working element, can be used to “cold knife” the stricture. An 8F nephrostomy tube would be left overnight and a 6F stent would be left in vivo for six weeks. Tapered endopyelotomy stents (i.e,14/7F and 12/6F) are too large to be placed, let alone tolerated, in a child.

In older series, outstanding success rates (88-100%) were reported after endoscopically treating a secondary UPJ obstruction regardless of the approach: retrograde (ureteroscopic) or antegrade (percutaneous). Patient age less than 4 years and a narrowed ureteral segment greater than 10 mm were predictors of a poor outcome in a recent series that reported a 39% success rate when either retrograde ureteroscopic laser or balloon dilation was used.15

**CASE 3**

6 year-old male with a unilateral t½ of greater than 20 minutes and a 40% differential renal function on MAG-3 renal scintigraphy and ipsilateral grade IV hydronephrosis on renal ultrasonography. Consider the options if this child has a horseshoe kidney compared to these results secondary to a renal crossing vessel.
In regards to use of drains in these types of cases, if I ended up intraperitoneal in the case of a horseshoe, I do not leave drains. In this age group I do not like leaving a ureteral stent that crosses the ureteral orifice into the bladder and thus lean to a nephroureteral stent. In the patient with just a crossing vessel where peritoneal violation is less likely, then at this age I prefer a Penrose to the nephrostent, but again, the age for me pushes my decision to avoid an indwelling internalized stent.

**Laparoscopic/Robotic Pyeloplasty**

Laparoscopic and robot assisted surgical management of UPJ obstruction in the first case of a horseshoe kidney, which presents certain anatomical challenges, are best addressed by the transperitoneal route. This access gives a better overview and allows orientation in relation to fixed anatomic landmarks and thus undoubtedly facilitates the procedure. Again a few reports have described pyeloplasty in the horseshoe kidney using the retroperitoneal approach. In the case of an aberrant vessel, a special caveat has to be raised when contemplating retroperitoneoscopic surgery. As the crossing vessel lies anterior to the pelvis this might be missed on retroperitoneoscopy, which dictates a posterior access to the renal hilum. It is therefore imperative to completely dissect the lower pole of the kidney to ensure absence of crossing vessels.

In regards to the laparoscopic vascular hitch procedure, the authors have no experience with this procedure, but we have been following the published series with interest in wait of long term results before we consider taking up the procedure at our institute. Current data seem to suggest that this method is efficacious in a select group of older patients who meet certain criteria indicating the absence of a concomitant intrinsic obstruction and in whom preoperative imaging verifies the presence of an offending crossing vessel.

**CASE 4**

5 year-old male with a 7 mm lower pole renal calculus and severe hydronephrosis with normal parenchyma on CT scan. The differential function is presumed equal on CT scan with intravenous contrast.

**Conservative Approach**

I do not believe that a CT scan can “confirm” UPJ obstruction; it can only show dilatation. In this particular case, it is interesting to have more information on the urine flow and I would recommend an Uro-MRI to better visualize the UPJ and see if this 7 mm stone can transit through it. If the child is asymptomatic (no UTI, no pain), in a first step, I would “give the child a chance” and see if the stone can migrate alone. If the child becomes symptomatic or if the stone grows, I would consider surgery.

**Minimally Invasive Open Pyeloplasty**

I would not approach this case using a completely open surgical technique as I would insert a ureteral stent at the time of ESWL. Lower pole stones, we know do not pass as well as those in other locations, even if well pulverized. My mentor Ben Gittes was a strong advocate of the posterior lumbotomy approach for almost all stones in adults and he taught us to use rigid and flexible nephrosopes for them. In my institutions, I have not treated stone patients. I could get off the hook and say I would refer it to Tom Lendvay in our shop. However, if I was forced to be the treating urologist, and preliminary ESWL is not an option, I would approach it no differently than I did in the first case, and use a flexible scope and attempt to retrieve the stone with flexible graspers.

**Endoscopic Treatment**

Endoscopic management of a primary UPJ obstruction in a horseshoe kidney is uncommon. An approximate 75% success rate has been reported in adults when a percutaneous, “cold knife” technique was used. Similar success rates for percutaneous endopyelotomy in the setting of a crossing vessel have also been shown, but not if there is significant concomitant hydronephrosis (35%). The literature is lacking in regard to these special anatomical circumstances managed endoscopically in children. In this regard, “success rates” can not be quoted on any significant reported evidence.

If undertaken, endoscopic procedures in these special circumstances aim at avoiding vascular injury. Pre-operative imaging with a CT-angiogram or MRI should be considered to elucidate vascular anatomy. In the instance of a horseshoe kidney, the endopyelotomy should be directed anteromedially. If a crossing vessel is of concern, the endoscopic incision should be directed laterally, minimizing a posterior component. With regards to obtaining access in an antegrade endopyelotomy, the angle of puncture is shifted from the posterior-lateral vector (30 degrees) to a more perpendicular 90 degree axis. Otherwise, the endoscopic approaches would not differ from those discussed in cases #1 and #2. Most commonly, a retrograde ureteroscopic approach will be used as it is the least invasive. A 200 um holmium laser is used to perform the endopyelotomy in the posterior-lateral position. A 6F stent is left in vivo for six weeks. Balloon dilation is avoided owing to its 66% success rate.

If a percutaneous approach with a mini-perc set (11F sheath) is utilized, a laser endopyelotomy through a 9.5F offset pediatric cystoscope is performed. Alternatively, a 9 Fr infant resectoscope with a crescent stricture blade as the working element can be used to “cold knife” the stricture. An 8F nephrostomy tube would be left overnight and a 6F stent would be left in vivo for six weeks.

My training was to always confirm the presence of a stone the day of surgery and the absence of the stone after a presumed successful procedure in the operating room before the patient is closed. We now have ultrasonography to use in the operating room, which surely is a nice adjunct; however, intraoperative fluoroscopic images or true plain films if necessary, are still part of my regimen. Sometimes you find another stone that had never been suspected, but this is highly unlikely with modern imaging. Remember I trained in the Dark Ages more than a quarter century ago.

**Laparoscopic/Robotic Pyeloplasty**

In case of significant renal pelvic dilatation and caliectasis on CT indicating a real need for pyeloplasty, we would go for retroperitoneoscopic access using the robot. The UPJ is dismembered giving insight into the pelvicaliceal system. If the stone is visible and accessible it can easily be removed using the robotic instruments. Alternatively, we have on several occasions introduced a flexible cystoscope/ureteroscope through an accessory port, and used that to explore the pelvicaliceal system and extract stones using a Dormia basket. If the dilatation on the other hand is minimal, and could be attributed to infection or the stone, then we believe that proper management would

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entail endoscopic retrograde intrarenal surgery with inspection of the UPJ and laser disintegration of the stone.

Again, the system would be stented for 1 week with an exteriorized blue stent in the first scenario and for 6 weeks with a JJ-stent in the latter. No drains would routinely be left. No differences in patient outcomes are expected using either laparoscopic or robotic-assisted techniques.

Endoscopic Treatment

If this case is to be managed endoscopically, an initial retrograde pyelogram is needed to clarify the length of the UPJ obstruction and the lower-pole infundibular angle to the UPJ. Assuming the stenotic segment is less than 1.5 cm, a simultaneous endoscopic treatment of the stone and UPJ obstruction is feasible. Flexible ureteroscopy and laser lithotripsy with or without stone basketing achieves outstanding stone free rates (88-100%) in children.21

Although maximal deflection of a flexible ureteroscope in children is often accomplished, a lower-pole infundibular angle greater than 270 degrees to the UPJ in this scenario, with or without infundibular stenosis, might limit a ureteroscopic approach (Figure 2). In this instance, a simultaneous percutaneous nephrolithotomy and endopyelotomy, in that order, should be performed. Percutaneous access should be through a mid or upper pole calyx. The technique and drainage with regards to the endopyelotomy in this case would not differ from those described in cases #1-3. The 7-mm lower pole stone can be basketed with a zero degree nitinol tipless basket or fragmented using a holmium:YAG laser.

If a ureteroscopic approach is anatomically feasible, a 9.5F ureteral access sheath should be used to minimize intra-renal pressure while working. The access sheath may also be used to dilate through the UPJ obstruction and exclude it from extravasation while ureteroscopic lithotripsy with stone basketing is performed first. Once the stone has been addressed, a laser endopyelotomy may be performed using the technique and drainage described in previous cases.

Figure 2: (A) A 7 year-old boy with two separate 7-9 mm stones within a lower pole calices (white arrow). A ureteroscopic approach was attempted, but a lower pole infundibular-UPJ angle > 270 degrees (black arrow) limited ureteroscopic access and visibility. (B) A percutaneous nephrolithotomy was subsequently performed, clearing all stones in one operation.

CASE 5

4 year-old female with a grade 3 vesicoureteral reflux (VUR) of a single collecting system (grade III hydronephrosis on ultrasonography) and ipsilateral t½ of greater than 20 minutes and equal differential renal function on MAG-3 renal scintigraphy. The child has recurrent breakthrough urinary tract infections (UTIs).

Conservative Approach

The central issue behind these answers is the definition of “urinary obstruction”. To date, Steve Koff’s approach published more than 20 years ago remains valid. Any UFI which causes a progressive reduction of renal function on repeated assessments is a significant UFI (i.e., an “obstruction”). Beside the usual morphological and functional investigations, it is likely that the hemodynamic approach measuring the ipsilateral reduction of renal blood flow (and the contralateral renal blood flow increases) and the metabolic approach assessing the biochemical urine content will help to define the concept of “obstruction”.

I believe the VUR is purely incidental and probably related to a dysfunctional bladder. If the isotope scan is normal, this reflux will resolve with growth and bladder training. I would challenge the diagnosis of UPJ obstruction. Is it a genuine UPJ anomaly (i.e., significant UFI) or is this abnormal junction secondary to VUR? In other words, is it a descending flow impairment (i.e., pyelo-ureteric flow impairment) or is it an ascending flow impairment (i.e., uretero-pyelic flow impairment)? If febrile UTIs persist after adequate bladder training (plus or minus antibiotic prophylaxis), I would consider a pyeloplasty.

Minimally Invasive Open Pyeloplasty

This is a fun case and I have had experience with such a case. Obstruction always trumps reflux as the more important surgical consideration. If we get into the whole reflux controversy, then we may as well make this a multi-part Dialogues in Pediatric Urology. So in this case, I would perform a retrograde pyelogram and do a subureteric injection of dextranomer/hyaluronic acid (Deflux; Oceana Therapeutics, Inc.) since with grade III VUR, I would find it hard to justify coincidental reimplantation. With the pyeloplasty, a nephroureteric tube would be essential and even though unlikely to be of benefit, I would perform an antegrade study, just to make sure that some untoward process had not occurred below.

I have been in cases with Dr. Hendren when I was training, where we did perform top and bottom operations at the same sitting. However, I worry about obstruction and tend to be aggressive surgically about VUR in the rarest of instances. In case #5 with equal differential function, I would offer Deflux because it is in my opinion minimally invasive, the child is already under anesthesia, I am performing cysto-
toscopy anyway, and at this age, based on my own success rate with injection, would offer the family no further VCUGs if they were trustworthy and had a good primary care provider, reserving this study only for further febrile infections. If VUR was still present, that is my injection had failed, then because of the recurrent febrile UTI, I would perform a mini-incision extravesical reimplant.

**Laparoscopic/Robotic Pyeloplasty**

Management of concomitant UPJ obstruction and ipsilateral VUR poses certain challenges. The introduction of endoscopic management by use of dextranomer/hyaluronic acid allows simultaneous one stage management and is the preferred treatment option as single stage reimplantation and pyeloplasty theoretically compromises the blood supply of the ureter. Concomitant reimplantation and pyeloplasty has, however, been reported without adverse outcome.

In a staged procedure, pyeloplasty should always be the primary procedure as treating VUR first will invariably lead to deterioration of UPJ obstruction. In case of high grade reflux, it may be beneficial to protect the UPJ anastomosis postoperatively by use of bladder drainage for 5 days postoperatively and the system should be stented with an exteriorized blue stent for 3–4 weeks.

**Endoscopic Treatment**

The concomitant presence of both grade III VUR and a UPJ obstruction in this 4 year old female certainly alters the order and timing of endoscopic treatments. Primarily treating the VUR with a subureteric injection (Deflux) may actually worsen the proximal ureteropelvic obstruction. Above all, it is known that VUR may disappear following repair of a UPJO. These facts give us strong reason to treat the UPJ obstruction first and treat the VUR (if needed) at a second staged procedure. Furthermore, ureteroscopically manipulating a ureteral orifice immediately after a Deflux injection will likely ruin a subureteric treatment, although such risk has not been proven.

If the criteria for endoscopic treatment of the UPJ obstruction are met, a ureteroscopic or percutaneous approach as discussed in the previous cases may be used first. Following removal of the stent, periureteral orifice edema will persist for some time altering the anatomy of the ureteral orifice; a STING/HIT procedure should not be done until at least 6 weeks after stent removal. Another option is to maintain this girl on prophylactic antibiotics and repeat a VCUG in 1 year. If she has a breakthrough UTI on prophylaxis or her VUR persists at the 1 year mark, a subureteric injection to treat her VUR is indicated. Endoscopic treatment of VUR with Deflux has been shown to have an approximate overall 75–85% success rates with a single injection. Stratified by grade, treatment of grade III VUR should yield a 73% success rate.

### REFERENCES


### Minimally Invasive Open Pyeloplasty


### Laparoscopic/Robotic Pyeloplasty


### Endoscopic Treatment


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