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DOUBLE-J STENT INSERTION ACROSS VESICOURETERAL JUNCTION—IS IT A VALUABLE INITIAL APPROACH IN NEONATES AND INFANTS WITH SEVERE PRIMARY NONREFLUXING MEGAURETER?

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ABSTRACT

Objectives. To evaluate the role of double-J stent insertion in perinatally detected primary nonrefluxing megaureters as a method to temporize treatment in patients with impaired renal function or to prevent function loss in patients treated expectantly, but deemed at high risk of deterioration.

Methods. Two neonates and 8 infants with a ureter greater than 10 mm and an obstructive excretion pattern, including 3 cases with renal function less than 40%, were selected to undergo double-J stent insertion for a 6-month period. Patients underwent surgery if the ureter redilated and the excretion pattern was obstructive at reassessment 3 months after stent removal.

Results. Stents were placed at a median age of 3 months (range 1 to 6). Open insertion was necessary in 5 cases (50%). Seven patients (70%) developed stent-related complications (five breakthrough urinary infections) requiring early stent removal in 2 (20%). Five patients (50%) underwent surgery at a median age of 14 months (range 13 to 27), including the 3 patients with decreased renal function at presentation. None required ureteral tapering. None experienced any renal function loss with respect to the initial evaluation.

Conclusions. Double-J stent insertion across the vesicoureteral junction allows for effective internal drainage of primary nonrefluxing megaureters, but at the cost of a 70% morbidity rate and various technical drawbacks. Therefore, stenting should be considered on a case-by-case basis. The procedure seems valuable to temporize surgery in patients with decreased renal function. However, given the associated morbidity, it seems impractical for patients with preserved function selected in accordance with currently available prognostic indicators. UROLOGY **68:** 870–876, 2006. © 2006 Elsevier Inc.

About 80% of perinatally detected primary nonrefluxing megaureters (PNRMs) resolve spontaneously; hence, conservative management is generally considered a safe initial approach.[1,2] Initial management, however, can be a clinical dilemma when treating neonates and infants with a PNRM associated with impaired renal function. In these cases, diversion can be considered appropriate to postpone definitive treatment until after 1 year of age and/or allow accurate assessment of renal function before embarking on major bladder reconstruction.[3–5]

External urinary diversion is a well-established temporizing measure in children with urinary tract obstruction. However, both nephrostomy tubes and cutaneous ureterostomy have their limitations, and methods for internal drainage would be preferable.[3,4] Lee *et al.*[5] have recently suggested creation of a refluxing reimplantation as an internal diversion method according to the principle that surgery can be safely deferred if vesicoureteral junction (VUJ) obstruction is exchanged for the less harmful vesicoureteral reflux (VUR).[5] Double-J stent insertion across the VUJ is potentially a minimally invasive alternative to achieve temporary internal drainage of PNRMs.

In addition, we thought that this procedure, being reversible, could also serve in patients with PNRM with preserved function but deemed at high risk of deterioration. We hypothesized that the stent could be beneficial in three ways:

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by ensuring unimpaired flow across the VUJ while waiting for spontaneous maturation of the junction; by stretching the stenotic ureteral segment; and/or by decompressing the system and thus making subsequent assessment of the urinary excretion pattern reliable.

We report our experience with double-J stent insertion in neonates and infants with PNRMs and either impaired or preserved function.

MATERIAL AND METHODS

In the period 2000 to 2004, 2 neonates and 8 infants (6 boys and 4 girls) having an asymptomatic PNRM underwent double-J stent insertion across the VUJ at our institution. The PNRM was on the left side in 6 cases, the right in 3, and bilateral in 1, accounting for a total of 11 affected renoureteral units.

The criteria for stent insertion were either a differential renal function on the affected side of less than 40% (n = 3) or the presence of prognostic indicators suggesting a significant risk of renal function deterioration (n = 7), namely a diameter of the retrovesical ureter greater than 10 mm associated with a clearly obstructive excretion pattern.[6]

The evaluation before stent insertion included renal ultrasound scans, cycling micturating cystouretrography (MCUG), and 3-mercaptoacetylglycine scintigraphy with diuretic renography (n = 9) or diuretic intravenous urography (n = 1).

On ultrasound scan, the cross-section diameter of the retrovesical ureter and anteroposterior diameter of the renal pelvis on a transverse plane were determined.

Diuretic tests were performed with an indwelling catheter. On diuretic renography, obstruction was defined as a half-life of the isotope greater than 20 minutes after diuretic injection (furosemide 1 mg/kg). On intravenous urography, it was defined as the persistence of contrast in the renal pelvis for longer than 20 minutes after diuretic administration, with diuretic being injected after complete emptying of the nondilated renoureteral unit.

Prophylactic antibiotics were administered to all the patients.

The ureteral stents used were 3F, 12-cm-long, polyurethane double-J stents without valves (Rusch International, Kernen, Germany). Such stents are provided with a guidewire and a 5F pusher and can be inserted transuretherally using a 10F cystoscope. The maximal period of stenting recommended by the manufacturer is 6 months.

Cystoscopic insertion was always attempted. If it failed, the stent was inserted by way of a minimal cystostomy, in which case dilation of the ureteral meatus was also done. Dilation was started with a lachrymal probe and continued with ureteral catheters up to 5F.

No effort was made to reach the renal pelvis with the stent.

During stenting, children were followed up with monthly urine tests and ultrasound scans. No dimercaptosuccinic acid scan was performed after urinary tract infection.

The stents were removed after 6 months, or earlier if clinically indicated. The removal was always done endoscopically. A complete reassessment was performed 3 months after stent removal.

Patients underwent ureteral reimplantation if, at reassessment, the differential function of the affected kidney was less than 40% or if an obstructed excretion pattern was found on diuretic testing associated with progressive redilation of the ureter.

Ureteral tapering was performed only if, after resection of the stenotic segment, the width of the collapsed ureter at intraoperative assessment was greater than 10 mm and/or the bladder was not wide enough to accommodate a submucosal tunnel five times longer than the ureteral width.

All patients who underwent surgery underwent follow-up MCUG 6 months after surgery. The patients who did not undergo surgery were followed up with periodic assessments. The median follow-up period after removal was 19 months (range 8 to 36).

RESULTS

The results are summarized in Figure 1. Before stent placement, the median ureteral diameter was 15 mm (range 11 to 19), and the median anteroposterior pelvic diameter was 36 mm (range 29 to 43). The excretion pattern was obstructive in all the patients, and 3 patients presented with a differential function of less than 40% (range 29% to 34%). The median patient age at stent insertion was 3 months (range 1 to 6).

Open insertion was required in 5 cases (50%), 1 bilateral case because of the impossibility to fit the cystoscope into the urethra (n = 2) or to pass the stent through the ureteral meatus (n = 3).

All ureters decreased in size during stenting, as shown by the ultrasound scans (Fig. 2).

Stent-related complications developed in 7 patients (70%), including breakthrough infections in 5, blockage due to intracorporeal knotting of the stent in 1, and chronic hematuria in 1. Breakthrough infections were febrile in 2 cases. Early stent removal was required in 2 cases (20%), 1 with a fungal renal infection unresponsive to medical treatment and 1 in the child with the blocked stent.

All the stents were successfully removed cystoscopically; four presented with encrustations localized to the tips.

At reassessment 3 months after stent removal, de novo VUR was detected in 3 of 10 patients. This, however, was no longer present on follow-up MCUG performed after an additional 6 months.

In the 3 patients with impaired function at presentation, ureteral dilation recurred and the excretion pattern was obstructive. The differential renal function persisted unchanged in all 3 patients at less than 40%.

Of the 7 patients with preserved function at presentation, the dilation did not recur in 5 (n = 3, Fig. 2) or was very mild (n = 2, 3 and 4 mm), and the excretion pattern became unobstructive. In the remaining 2, the ureter redilated (8 and 9 mm), and the excretion pattern was persistently obstructive. The differential renal function persisted unchanged at greater than 40% in all 7 patients.

Five patients (50%), all with unilateral PNRM, underwent ureteral reimplantation at a median age of 14 months (range 13 to 27). These in-

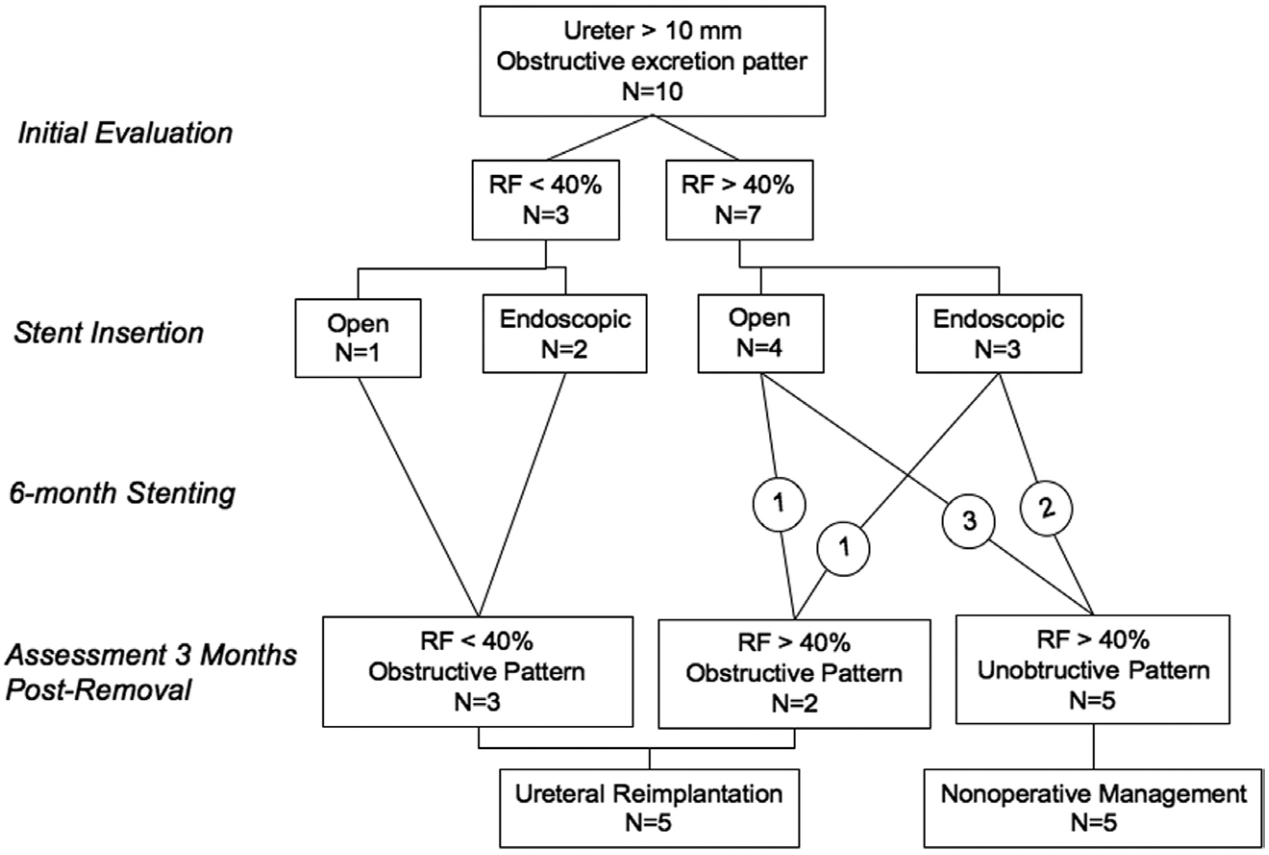

FIGURE 1. *Results of stent placement in 10 patients in present series. RF = renal function. Obstructive pattern defined by half-life greater than 20 minutes after diuretic injection (Lasix 1 mg/kg).*

cluded the 3 patients with decreased renal function at presentation and 2 with normal function. The latter underwent surgery because of recurrent ureteral dilation and the persistent obstructive excretion pattern after stent removal.

Two of the 5 patients requiring open stent placement underwent surgery; the previous open stent placement did not interfere with subsequent reimplantation. The latter was done according to Cohen in 3 patients and according to Politano in 2. None required ureteral tapering. All patients did well after surgery, and follow-up MCUG did not show any VUR.

Five patients (50%), one with bilateral PNRM, did not undergo ureteral reimplantation. Three of these had undergone open stent placement. After a median follow-up after removal of 24 months (range 11 to 36), all were asymptomatic. The retrovesical ureter was not visible in 3 cases, including the bilateral case, and was 3 and 5 mm in the remaining 2. The anteroposterior diameter of the renal pelvis was less than 20 mm in three renoureteral units and between 20 and 30 mm in the other three. All patients presented with a differential renal function of the affected kidney greater than 40% and an unobstructed urinary excretion pattern on diuretic renography.

COMMENT

We described our experience with double-J stent insertion across the VUJ as an initial approach in asymptomatic neonates and infants with PNRM. This represents the second report on this approach previously described in 2 symptomatic infants.[7]

The procedure proved to be an effective method of achieving internal drainage of PNRMs, because all megaureters decreased during stenting. Moreover, none of the 5 patients undergoing reimplantation required ureteral tailoring, although ureteral tapering is generally considered necessary in most reimplanted megaureters.[1,6,8] Double-J stenting, however, also proved to be associated with a concerning 70% morbidity rate and several technical drawbacks such as the need for two anesthesia sessions in all patients and for open insertion in one half the cases. Improvements could probably be achieved by appropriate technical refinements. Progressively smaller operative cystoscopes are becoming available, potentially reducing the need for open insertion in patients with a small caliber urethra; stents provided with valves could minimize the risk of infections.[9] Also,

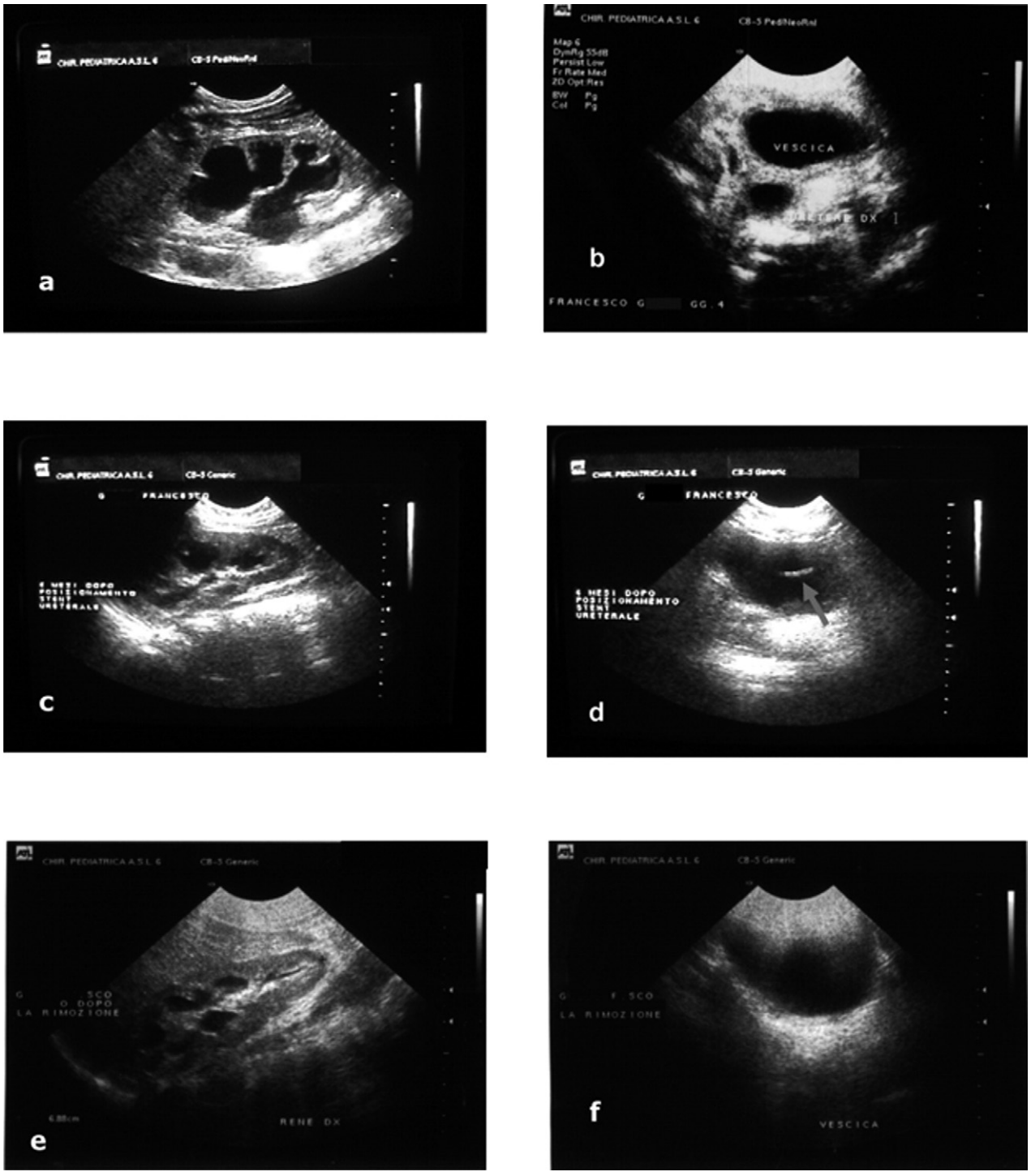

FIGURE 2. *Modifications in hydronephrosis (a,c,e) and ureteral dilation (b,d,f) on ultrasound scans in patients with resolution. At presentation, (a) severe dilation of renal pelvis visible, associated with (b) right ureter having cross-section diameter greater than 10 mm. After 6 months of stenting, (c) hydronephrosis had improved and (d) ureter completely decompressed. Stent visible within bladder (gray arrow). Finally, 3 months after stent removal, (e) only mild residual hydronephrosis persisted, with (f) recurrent ureteral dilation no longer evident.*

magnetic retrieval of the stent could allow eliminating one anesthesia session.[10] Nevertheless, drawbacks and complications make the cost/benefit ratio of the procedure questionable, and the selection criteria for stenting become critical. We performed VUJ stenting in two different subsets of patients, in 3 patients already committed to surgery at presentation because of decreased renal function and in 7 with preserved function but deemed at high risk of deterioration.

In the former group, we sought to temporize

definitive treatment using the procedure. The need to temporize bladder surgery before 1 year of age because of the fear of jeopardizing bladder behavior has been greatly questioned in recent years.[11,12] Temporization, however, can still be required in selected patients presenting with urinary infections unresponsive to medical treatment, or in those with significant renal impairment, to allow accurate assessment of renal function and evaluate the potential for recovery before embarking on major bladder reconstruction. Temporization has classically been achieved by external urinary diversion by way of nephrostomy tubes or cutaneous ureterostomy.[3,4] Both methods, however, are cumbersome, prone to complications, difficult to handle, and not well accepted by parents. Internal drainage is theoretically a better option. One method to achieve internal drainage in megaureters is endoscopic incision of the narrowed ureteral segment.[13] Lee *et al.*[5] have recently attempted creation of a refluxing ureteral reimplantation as a temporizing measure in 3 infants with a severe PNRM and significant function deterioration. Both procedures work by exchanging VUJ obstruction for the less harmful VUR and unavoidably commit the child to secondary bladder reconstruction. Moreover, 1 of the patients in the series by Lee *et al.*[5] ended up undergoing nephrectomy; therefore, in this patient, a refluxing stump was left behind, which could have been avoided with a stent.

Double-J stent insertion across the VUJ allows, at least in hortotopic PNRMs, the establishment of reversible internal drainage in a minimally invasive manner. A possible disadvantage could be that, with the currently available devices, stenting cannot be prolonged beyond 6 months unless the stent is changed. However, we postponed surgery in our patients for an additional 3 months after stent removal, reaching a median age at surgery of 14 months. This did not cause function loss or result in the need for ureteral tapering at reimplantation in any of our patients. The effect of the stent on the VUJ seemed to persist for a period after removal, as suggested by the appearance of transitory reflux in 3 patients.

We also attempted double-J stent insertion in patients with preserved renal function but deemed at high risk of deterioration. In keeping with the findings of Liu *et al.*,[6] the predictors of function deterioration were a retrovesical ureter greater than 10 mm and a severely obstructive excretion pattern on diuretic testing.[6] The major problem in patients with massive hydronephrosis is that the dilation dramatically increases the compliance of the system.[14] This, in turn, can cause the isotope to quickly dilute within the system after diuretic injection, mimicking an obstructive excretion pattern even in the absence of true VUJ obstruction.[15] In this scenario, therefore, the clinician cannot rely on the presence of an obstructive excretion curve to select patients for surgery and is, instead, forced to wait for renal function deterioration. We hypothesized that stenting could be beneficial in these patients in three ways: First, by ensuring unimpaired urinary drainage while waiting for spontaneous maturation of the VUJ. Second, the stent would widen by stretching (in combination with dilation in the patients undergoing open placement) the stenotic distal ureter. Finally, stenting would decompress the system, and thus restore the conditions of normal excretion physiology and allow reliable assessment of the excretion pattern. None of our patients developed any renal damage while stented. Also, at reassessment 3 months after removal, we observed two different response patterns to stenting. In 5 patients, the dilation did not recur and the excretion pattern became unobstructive, and in the other 2, the ureter redilated and the excretion pattern persisted as obstructive. The latter was the same behavior of the PNRMs in the patients with decreased renal function. In the absence of a control group, it was not possible to use our data to draw any definitive conclusion on the effect of the stent on the VUJ. In the 5 patients with resolution, the improvement could have been a result of the natural history of the disease. For the 2 patients with recurrence, it remains unproved that any renal function loss would have occurred with observational management. Consistent with the rationale of our approach, however, it seemed unethical to continue conservative treatment for the latter 2 patients.

Nevertheless, the major concern with this approach is not the incomplete evidence of its effectiveness, but rather the associated morbidity. Prerequisite to determining the role of double-J stenting, if any, in the treatment of neonates and infants with PNRMs and preserved function is the presence of strict criteria to select patients with a risk of renal function deterioration that would outweigh the morbidity of stenting. Overwhelming evidence has suggested that conservative management is a safe initial option for almost all patients with PNRMs and preserved function. Even in those with the features suggested by Liu *et al.*,[6] conservative management would have been harmless in as much as 75%. Our review of published reports, however, failed to identify better selection criteria. Of the prognostic indicators investigated in addition to those we used, patient gender and the laterality of the PNRM failed to show any prognostic value.[2] In contrast, the degree of associated hydronephrosis proved to be a good predictor of the time to reso-

lution of the megaureter, but not of the risk of function deterioration.[2]

CONCLUSIONS

Double-J stent insertion across the VUJ allows effective internal drainage of PNRMs. Moreover, none of the stented PNRMs needing reimplantation required tapering. The procedure, however, is associated with a 70% morbidity rate and several technical drawbacks, including the need for two anesthesia session in all the patients and for open stent insertion in one half of cases. Therefore, the cost/benefit ratio should be evaluated on a case-by-case basis. It seems that double-J stenting can be considered one of the options when temporization is required in selected patients with hortotopic PNRM and decreased renal function. Using currently available prognostic indicators, none of the patients with PNRM and preserved function seemed to be at risk of deterioration that would have outweighed the morbidity of the procedure.

REFERENCES

1. Keating MA, Escala J, Snyder HMcC, *et al:* Changing concepts in management of primary obstructive megaureter. J Urol **142:** 636–640, 1989.
2. McLellan DL, Retik AB, Bauer SB, *et al:* Rate and predictors of spontaneous resolution of prenatally diagnosed primary nonrefuxing megaureter. J Urol **168:** 2177–2180, 2002.
3. Mor Y, Ramon J, Raviv G, *et al:* Low loop cutaneous ureterostomy and subsequent reconstruction: 20 years of experience J Urol **147:** 1595–1597, 1992.
4. MacGregor PS, Kay R, and Straffon RA: Cutaneous ureterostomy in children: long-term followup. J Urol **134:** 518–520, 1985.
5. Lee SD, Akbal C, and Kaefer M: Refluxing ureteral reimplant as temporary treatment of obstructive megaureter in neonate and infant. J Urol **173:** 1357–1360, 2005.
6. Liu HY, Dhillon HK, Yeung CK, *et al:* Clinical outcome and management of prenatally diagnosed primary megaureters. J Urol **152:** 614–617, 1994.
7. Shenoy MU, and Rance CH: Is there a place for the insertion of a JJ stent as a temporizing procedure for symptomatic partial congenital vesico-ureteric obstruction in infancy? BJU Int **84:** 524–525, 1999.
8. Greenfield SP, Griswold JJ, and Wan J: Ureteral reimplantation in infants. J Urol **150:** 1460–1462, 1993.
9. Friederich U, Vetter R, Jorgensen TM, *et al:* Experimental and clinical experience with new pyeloureteral stents in pediatric urology. J Endourol **11:** 431–439, 1997.
10. Mykulak DJ, Herskowitz M, and Glassberg KI: Use of magnetic internal ureteral stents in pediatric urology: retrieval without routine requirement for cystoscopy and general anesthesia. J Urol **152:** 976–977, 1994.
11. Upadhayay J, Shekarriz B, Fleming P, *et al:* Uretheral reimplantation in infancy: evaluation of long-term voiding function. J Urol **162:** 1209–1212, 1999.
12. De Kort L, Klijn AJ, Uiterwaal CSPM, *et al:* Ureteral reimplantation in infants and children: effect on bladder function. J Urol **167:** 285–287, 2002.
13. Bapat S, Bapat M, and Kirpekar D: Endoureterotomy for congenital primary obstructive megaureter: preliminary report. J Endourol **14:** 263–267, 2000.
14. Ireton RC, Parker RM, and Hayden P: Diuretic renography in evaluating dilated upper urinary tract in children. Urology **29:** 178–184, 1987.
15. Koff SA, Binkowitz L, Coley B, *et al:* Renal pelvis volume during diuresis in children with hydronephrosis: implication for diagnosing obstruction with diuretic renography. J Urol **174:** 303–307, 2005.

EDITORIAL COMMENT

Routine use of prenatal ultrasound scans results in an increased frequency of urologists evaluating asymptomatic infants with hydroureteronephrosis. Management alternatives include observation with serial ultrasound scans and/or nuclear renal scans, cutaneous ureterostomy, ureteral reimplantation, and ureteral stenting. Although ureteral stenting is a common technique for bypassing ureteral obstruction in older patients, reports of its use in the setting of a primary obstructive megaureter (POM) are limited.[1]

The authors describe placement of a double-J stent in 10 children with asymptomatic POMs. They are to be congratulated on a critical review of their results. They noted a complication rate of 70% with this technique, including breakthrough infections in 50%. In addition, 5 patients (50%) required open insertion of the stent. In 2 of these patients, the 10F cystoscope was too large for the urethra. The use of a smaller scope might have resulted in a lower rate of open insertions. Three months after removal of the ureteral stent, all patients underwent repeat renal scan. The indications for ureteral reimplantation in 5 patients consisted of a differential renal function of less than 40% or an obstructed excretion pattern associated with progressive redilation of the ureter.

From the authors' results, it remains difficult to determine in which patients ureteral stenting should be used. Seven patients had relative renal function greater than 40% and many would have continued to follow-up these patients without immediate intervention. The 3 patients with relative function less than 40% underwent subsequent ureteral reimplantation. The authors noted that no patient required a tapered ureteral reimplant; however, whether this resulted from stent placement or was simply a consequence of the natural history of megaureters to improve with time could not be determined from this study.[2] If proven with additional studies, the ability of stenting to decrease the need for tapered ureteral reimplantation could ultimately decrease the complications of persistent reflux or obstruction associated with these reimplants.[3]

Given the high complication rate and the need for multiple operations, the authors' conclusion that the use of ureteral stenting should be limited to very select patients seems valid. One potential setting for this technique may be its use in equivocal cases in which renal function significantly improves after stent insertion and then worsens after stent removal, confirming obstruction and the need for definitive surgical intervention. This may occur in the setting of bilateral POMs or a solitary kidney with a POM. However, the potential to decrease the need for ureteral tapering must be evaluated further and weighed against the same potential with other forms of POM management.

REFERENCES

1. Shenoy MU, and Rance CH: Is there a place for the insertion of a JJ stent as a temporizing procedure for symptomatic partial congenital vesico-ureteric obstruction in infancy? BJU Int **84:** 524–525, 1999.
2. Keating MA, Escala J, Snyder HM III, *et al:* Changing concepts in management of primary obstructive megaureter. J Urol **142:** 636–640, 1989.