PERCUTANEOUS VACUUM VESICOLITHOTOMY UNDER DIRECT VISION: A NEW TECHNIQUE

JOHN G. VAN SAVAGE, ANTOINE E. KHOURY,* GORDON A. McLORIE AND BERNARD M. CHURCHILL†

From the Division of Urology, Department of Surgery, Hospital for Sick Children, University of Toronto, Toronto, Ontario, Canada

ABSTRACT

Purpose: The number of vesical calculi is increasing as the number of patients with intestino-cystoplasty increases. We describe our technique for easily removing vesical calculi in children via anatraumatic percutaneous endoscopic approach.

Materials and Methods: The procedure involves percutaneous suprapubic puncture and direct visualization of the calculi via cystoscopy through the urethra or via a second suprapubic puncture when the bladder neck is closed. The stones are vacuumed up at a time with suction tubing through the suprapubic working sheath in a controlled manner with no urethral trauma. Ten patients 3 to 16 years old (mean age 8) with vesicolithiasis underwent percutaneous vacuum vesicolithotomy under direct vision in 1993 to 1995.

Results: Two to 12 bladder calculi were extracted (mean 7). All calculi less than 1 cm. were removed by this procedure. All bladder calculi between 1 and 1.5 cm. were also removed but they required simultaneous electrohydraulic lithotripsy. There were no complications at a mean 1-year followup. Mean hospitalization was less than 24 hours (range 0 to 3 days).

Conclusions: Percutaneous vacuum vesicolithotomy is highly successful, easy to perform and safe for extracting vesical calculi. Since the procedure is done through a percutaneous sheath, it is particularly suited to the individual with an absent, small caliber, sensitive or surgically reconstructed urethra.

KEY WORDS: bladder, calculus, endoscopy

The rate of vesicolithiasis after augmentation intestino-cystoplasty approaches 50%, and it may not decrease with time.1 As the number of patients with intestinocystoplasty increases, so will the number of vesical calculi requiring treatment. Bladder calculi may be managed by monotherapy orcombination therapy with extracorporeal or intracorporeal lithotripsy, endoscopic extraction via a retrograde or antegrade approach, or open vesicolithotomy.2-8 The child with a surgically reconstructed or small caliber urethra or a closed bladder neck and Mitrofanoff appendicovesicoscopy has fewer options due to limited access to the bladder lumen or neobladder reservoir for endoscopic extraction of bladder calculi. We describe our experience with percutaneous vacuum vesicolithotomy in children with limited or no urethral access.

PATIENTS AND METHODS

Between August 1993 and April 1995, 7 boys and 3 girls 3 to 16 years old (mean age 8) with limited or no urethral access to the bladder were diagnosed with vesicolithiasis. No patient had a urethra large enough for atraumatic extraction of stones or lithotripsy stone fragments. A third of the patients with intestinocystoplasty performed at our institution have stones. The primary diagnoses were myelomeningocele in 6 patients, bladder extrophy in 2, and posterior urethral valves and prostatic-vesical rhabdomyosarcoma in 1 each. Seven patients had undergone ileocystoplasty and 6 had undergone a Mitrofanoff appendicovesicoscopy with the bladder neck closed in 4. Patients had been between 2 and 12 calculi (mean of 7). All patients had bacteriuria involving 1 or more of Klebsiella pneumoniae or oxytoca (5), Escherichia coli (3), Enterobacter cloacae (2), group D streptococcus (2), and Proteus mirabilis, Bacteroides fragilis, Peptostreptococcus and Enterococcus species (1 each).

The procedure is done with the patient under general endotracheal anesthesia, and a preoperative dose of intravenous antibiotics is given. When the patient has a ventriculoperitoneal shunt, the fluoroscope is used to localize it to protect it from puncture. The bladder is filled until it is easily palpable by good intravenous fluid hydration through a suprapubic cystostomy with a 22 gauge spinal needle, or via an 8F catheter introduced through the Mitrofanoff conduit or native urethra when available. The bladder is then tapped with a 22 gauge spinal needle to confirm urine. In patients who previously underwent augmentation intestinocystoplasty the bowel segment of the augmented bladder plate is tapped, although it is often difficult to be certain which segment the needle traverses. A 14 gauge intravenous needle is then introduced through the same stab wound followed by a 0.038-inch guide wire through this needle. The Amplatz system is then used to dilate the tract from the 11F stiffener up to the size of the largest stone multiplied by 3. For example, an 8 mm. stone requires at least a 24F sheath. Dilatation of the sheath tract through the rectus abdominis sheath and bladder is performed to a predetermined depth to prevent injuring the posterior wall of the bladder. The sheath is cut to size to allow a wider excursion in the bladder.

 Stones are then directly visualized through an 8F cystoscope in the urethra or through a second suprapubic puncture. Suction tubing is used for aspirating stones and mucus through the sheath, while observing the process through a second suprapubic puncture or the urethra (see figure). The procedure is done under direct vision, and so there is no chance of mucosal injury. It is easy to see the stones, and the suction tubing may be advanced toward the stone with the
warm saline irrigation off, so that the stone does not continuously evade the endoscopist. When the suction tubing is positioned above the stone, the suction tubing is unclamped for a fraction of a second for a small stone, which will be vacuumed up through the tubing into a trap, or completely unclamped for a larger stone, for which continuous suction is needed to retrieve the stone through the Amplatz sheath. No grasping forceps are used, and so stones are not broken into pieces or dropped while being extracted. There is limited or no urethral trauma since stones are retrieved through the percutaneous sheath, and the urethra (when used) only serves as a conduit for a small caliber cystoscope into the bladder.

Stones larger than 10 mm. require electrohydraulic lithotripsy, since the largest Amplatz sheath is 30F. Fragments smaller than the inner diameter of the tubing may be collected in a trap, while larger fragments drop off the suction tubing when it is relieved from suction. When all stones are removed after a count of those present on a preoperative roentgenogram of the kidneys, ureters and bladder, a catheter is placed for straight drainage for 2 days in a native bladder and 5 days in an augmented bladder. This catheter is placed through the urethra when the bladder neck is open or through the Mitrofanoff conduit when the bladder neck is closed. When all stones have not been removed, a large cystoscope is used to inspect the bladder through the Amplatz sheath. When residual stones are suspected, fluoroscopy or anteroposterior and lateral films may be obtained for localization.

RESULTS

Calculi ranged from 3 to 15 mm. (mean 7) and lithotomy was complete in all patients. Percutaneous electrohydraulic lithotripsy through the Amplatz sheath was done for 10 to 15 mm. vesical calculi in 3 patients. Stones larger than 15 mm. were generally managed with open cystolithotomy. There were no complications. In particular, there was no trauma to the urethra or prolonged leakage through the suprapubic puncture site. Operative time ranged from 15 to 90 minutes. Mean hospitalization was less than 1 day (range 0 to 3).

Vesical calculus composition was calcium apatite (4 patients), struvite (3), brushite (2), and/or calcium oxalate or octacalcium phosphate (1 each). Mean followup was 1 year. Suprapubic puncture sites healed with diminutive scars. Two children required additional percutaneous vesicolithotomy for recurrent vesicolithiasis after 1 year. Patients with intestino-cystoplasty are followed with abdominal roentgenograms or sonography of the bladder every 6 months to ensure that no stones are forming. Thus, it is easy to notice stones when they are less than 1.5 cm. and amenable to our minimally invasive procedure.

DISCUSSION

Percutaneous vacuum vesicolithotomy provides a minimally invasive means of extracting vesical calculi. It is ideally suited for patients with small caliber or absent urethras. Since there is minimal trauma to the urethra, it would also be useful in patients with sensitive or reconstructed urethras. We do not perform operative rigid endoscopy through the Mitrofanoff conduit, since the caliber is small, the angle into the bladder may not be optimal and the conduit or flap valve mechanism could be easily damaged. A small flexible cystoscope may be used through the Mitrofanoff conduit. The Mitrofanoff conduit also serves as a useful catheterizable channel for the drainage of irrigant fluid when smaller stones are retrieved with flexible grasping forceps through the sheath introduced by a single suprapubic puncture.

The advantage of our vacuum technique over other techniques is its simplicity. The suction catheter is placed on top of a stone in the bladder under direct vision and wall suction is then applied only to the stone. The problems of dropping or breaking the stone during retrieval are not encountered, as with the flexible grasping forceps. Furthermore, suction tubing may be bent in any direction to facilitate direct aspiration of the stone. Also, the urethra is not damaged by pulling a rough or large stone through it, and only a small cystoscope is needed in the urethra to visualize the stone. Another advantage of the procedure is that stones are visualized directly, vacuumed out with minimal trauma to the bladder or urethral mucosa and are not chased across the bladder.

The advantage of the procedure over lithotripsy is apparent in patients who lack a normal or large caliber urethra through which to void or irrigate out small fragments. These small fragments retained in the bladder could serve as a nidus for further stone formation. This is particularly true in patients with augmentation intestino-cystoplasty, whose bladders often have numerous irregularities that may not drain well with the small caliber catheters used to drain and
irrigate the bladder. Since we routinely introduce a 24 to 30F percutaneous sheath, irrigating out the calculus fragments and mucus from the bladder is simple and quick with a large volume and good flow of irrigant fluid.

The advantages of percutaneous vacuum vesicolithotomy over open vesicolithotomy are decreased operative time and reduced convalescence. Operating times of less than 1 hour and hospital stays averaging 1 day are significantly better, particularly in a patient population with larger than average medical and surgical histories. Because the urologist has considerable skill in endoscopic and percutaneous procedures, the learning curve is also favorable. A potential disadvantage of the procedure is extraperitoneal fluid extravasation and lowering of the core body temperature in the small patient, particularly since the saline irrigant fluid flows at a high rate during the procedure. With our followup protocol with frequent bladder imaging in patients with a known predisposition to vesicolithiasis, we hope to eliminate the need for open cystolithotomy with its attendant greater morbidity.

CONCLUSIONS

Percutaneous vacuum vesicolithotomy is a useful tool in the pediatric and adult urologist armamentarium to remove vesical calculi from patients with an absent, small caliber, sensitive or surgically reconstructed urethra. It is highly successful, simple to perform and engenders low morbidity.

REFERENCES