Rapid, Economical Treatment of Large Impacted Calculi in the Proximal Ureter With Ballistic Ureteral Lithotripsy and Occlusive, Percutaneous Balloon Catheter: The High Pressure Irrigation Technique

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Purpose: We describe our innovative technique for the treatment of large calculi (greater than 1.5 cm) of the proximal ureter.
Materials and Methods: Between 2003 and 2005 we positioned an 8Ch pyelostomy in 25 patients diagnosed with impacted calculi of the proximal ureter greater than 1.5 cm on ultrasound, direct x-ray of the abdomen, and/or computerized tomography and subsequent retrograde pyelography. After 30 days all patients underwent combined treatment in the Valdivia supine position, including positioning a 0.035-inch guidewire through the pyelostomy into the ureter up to above the calculus, pyelostomy removal and insertion onto the guide of a 7Ch balloon occlusion catheter, which was inflated in the ureter immediately above the calculus. Ureteral lithotripsy was done with an 8.5 to 11.5Ch ureteroscope (Wolf, Dudley, Massachusetts) with a 6Ch operating channel and a Calcusplit® ballistic probe, alternating high antegrade pressure by the balloon catheter and retrograde pressure using the ureteroscope, as required. After lithotripsy and fragment dislocation the ureteroscope was retracted with rapid flow antegrade irrigation. At the end of the procedure after antegrade contrast medium followup the balloon catheter was retracted as far as the pelvis as a nephrostomy. We analyzed operative time, the number of postoperative recovery days, the incidence of complications during and after surgery, and the stone-free rate immediately, after 5 days and after 1 month.
Results: Average calculus size was 1.7 cm. Ten patients presented with multiple ureteral bending upon diagnosis, which was no longer found at surgery with a consequent lack of difficult ureteroscope feeding. Significant edema downstream of the calculus was present in all cases. High pressure irrigation, a rigid ballistic probe and retrieving forceps enabled the dislocation of even larger fragments from the original calculous site in all cases. Antegrade high pressure irrigation after lithotripsy enabled the complete clearance of calcareous fragments as far as the bladder without the need for ancillary maneuvers. We observed no cases of calcareous fragment push-back. No retroperitoneal extravasation, or pyelolymphatic or pyelovenous backflow was observed. Average procedure time was 33 minutes. The renal-ureteral stone-free rate was 100% at the end of the procedure and all calcareous fragments were in the bladder. We did not observe any ureteral lesions. In no case was there onset of fever. Average postoperative hospitalization was 2 days. Followup with contrast material after 5 days showed a renal-ureteral stone-free rate of 100% and a bladder stone-free rate of 84%. The nephrostomy was removed at an average of 5.5 days.
Conclusions: Compared to the techniques described in the medical literature our method appears to have certain advantages, including a mini-invasive approach to the renal pelvis compared to that of percutaneous nephrolithotomy with protection of the renal parenchyma from high pressure, rigid ureteroscope use, which provides a high level of maneuverability and low operating costs, ballistic probe use, which provides lower costs and higher speeds than the laser, and balloon catheter use, which removes the risk of push-back and enables push-down of the fragments without any further ancillary maneuvers. The balloon catheter also enables contrast medium followup and immediate postoperative drainage. The speed of the procedure and the ability to adjust antegrade or retrograde flow with variable pressure and direction make this technique highly suitable for the complete resolution of large, impacted calculi of the proximal ureter.

Key Words: ureter, ureteral calculi, ureteroscopy, lithotripsy, kidney

Calculi of the proximal ureter that are less than 1 cm should initially be treated with SWL. However, well established, optimal treatment for proximal ureteral calculi of larger dimensions does not exist. Moreover, it is well known that impacted calculi are much less responsive to SWL and for this reason URS is the front line therapy for this type of calculus.[1]

A widely accepted definition of impaction is the impossibility of passing a guidewire or catheter beyond the calculus at the first attempt.[2] However, such a definition appears incomplete since such failure could be attributable to a delay in calculous treatment. Thus, impacted calculi may be further defined as calculi that cause ureteral obstruction and remain in the same position at least 2 months.[3]

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Considering the ever growing number of urologists who use URS as front line therapy for impacted calculi of the proximal ureter, an instrument able to safely prevent migration of the calcareous formations would be extremely useful in the ureteroscopic field. In fact, the proximal migration of fragments during URS is a considerably widespread problem that depends on irrigation flow pressure, the energy source used for endoscopic lithotripsy, the site and degree of calculus impaction, and lastly on the degree of proximal ureter dilatation.[4] Some studies cite migration rates of proximal calculi of 48% when pneumatic lithotripsy is performed and, even with laser lithotripsy, the failure rate of the method for proximal ureteral calculi can be up to 25%.[5]

We describe a personal and innovative technique that foresees dual access (percutaneous with an occlusion balloon catheter and ureteral with a semirigid ureteroscope and ballistic lithotriptor) for calculi with a diameter of greater than 1.5 cm that are impacted in the proximal ureter.

MATERIALS AND METHODS

From January 2003 to April 2005 we observed 25 patients with impacted calculi of the proximal ureter with a diameter of greater than 1.5 cm. After x-rays of the abdomen and renal ultrasound ascending pyelography and attempted ureteral catheterization were done on an outpatient basis. After ascertaining the impossibility of progressing with the small catheter a nephrostomy was positioned with an 8Ch caliber tube with descending pyelography and sampling for selective urine culture. After approximately 20 days creatinine clearance was determined. Endoscopic treatment was then performed at about day 30 after normal hospital admission.

TECHNIQUE

The patient was placed in the Valdivia position and spinal anesthesia was given with sedation. Through a nephrostomy a 7Ch occlusion catheter with a balloon inflated to 1 cc with contrast medium, diluted 50%, was positioned right above the calculus using a 0.035-inch Terumo® guidewire. The balloon was moved up the ureter until it was upstream of the calculus (fig. 1).

Endoscopic ureteral lithotripsy was then performed using a Wolf 8.5 to 11.5Ch ureteroscope with a 6Ch operating channel and a Calcusplit ballistic probe 5Ch in diameter after positioning a safety guide probe right below the calculus (the one used to position the balloon catheter was reused). Ureteroscopic lithotripsy was performed, as required alternating retrograde hydraulic pressure, which was exerted through the operating channel of the ureteroscope, with antegrade pressure using the balloon catheter with a manually operated syringe, which exerted high pressure where needed (fig. 2). Every time that a certain pressure was exerted through 1 path the opposite path was left open, that is for high antegrade pressure the ureteroscope operating channel was open and for high retrograde pressure the balloon catheter channel was open. Thus, ballistic lithotripsy of the calcareous formation into coarse fragments was performed. Fragment dislocation was facilitated by the high pressure of antegrade or retrograde irrigation and by the same rigid ballistic probe or retrieving forceps. When possible, after the calculus was dislocated lithotripsy of large fragments was done in the ureter at a slightly more proximal position than the site of the impacted calculus, just below the balloon.

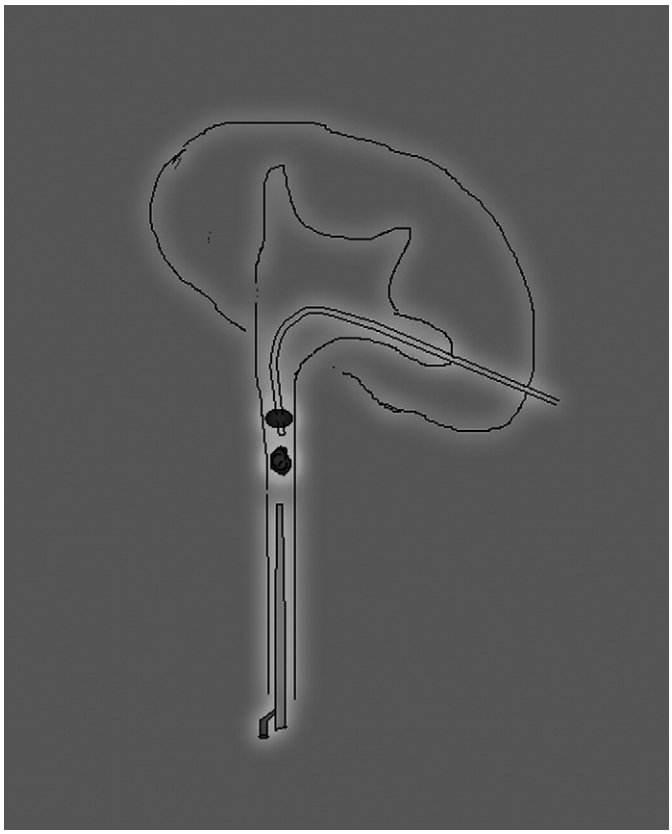

FIG. 1

After lithotripsy was completed the ureteroscope was progressively retracted with the operating channel open but without the irrigation flow. At the same time considerable hydraulic pressure was exerted through the occlusion catheter. In this way the calciferous fragments were pushed down into the bladder (fig. 3). At the end of the method imaging with contrast material was performed through the balloon catheter to confirm ureteral stone-free status. If necessary, further ureteroscopy was performed.

Lastly, the balloon was deflated and the balloon catheter tip was retracted as far as the pelvis for pyelostomic drainage. The balloon catheter was removed 5 days after inspection using antegrade imaging with contrast medium.

RESULTS

Average patient age was 44 years. Seven patients were women and 18 were men. Average calculus size was 1.7 mm. Symptoms reported at diagnosis were persistent pain in the side in 5 cases, acute renal colic in 10 and uroseptic fever in 3. Seven patients had no symptoms at diagnosis. In all cases there was severe hydronephrosis. In 12 cases pyelostomy urine culture yielded positive results. During ascending pyelography before positioning the pyelostomy significant ureteral kinking was found in 10 cases (40%) downstream of the calculus.

URS was performed in all cases without dilation. Access to the calculus proved optimal due in part to the resolution of ureteral kinking in 8 of the 10 cases in which it was