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Controversial Cases in Endourology

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Section Editors

CASE PRESENTATION

A 36-YEAR-OLD WOMAN presents to the office with a 3-year history of right flank pain. She had an abdominal radiograph demonstrating a 1-cm stone over the right kidney (Fig. 1), and a subsequent intravenous urogram demonstrated that the stone was in the collecting system. She underwent shockwave lithotripsy without success and a subsequent percutaneous nephrolithotomy through a lower-pole access in which the stone was not seen despite rigid and flexible nephroscopy. She returns with a non-contrast CT scan (Fig. 2). She continues to have pain, and her abdominal radiograph remains unchanged. She is thin and otherwise healthy and insistent on eradication of this stone.

EXPERT OPINIONS

No. 1

The first thing I would do is to review the urogram and try to clarify where the stone lies. There are a couple of reasons the stone might not have been seen at the time of percutaneous nephroscopy. For example, the pelvocaliceal system may not have been examined completely. In general, the likelihood of seeing all of the pelvocaliceal system is a little less when the access tract is in the lower pole. In most cases, the lower pole is more anterior than the upper pole, a factor that can make manipulation of the flexible endoscope challenging. Sometimes, it is simply not possible to examine all the calices from a single access tract. It important to inject contrast medium and use fluoroscopy during nephroscopy to determine that all of the system has been examined.

However, the most likely reason that the stone was not seen is that it is in a caliceal diverticulum. In almost all circumstances, the neck of the diverticulum can be seen using a ureteroscopic approach.

If the stone proves to be in a calix or the the pelvis, I would offer the patient the option of a repeat SWL treatment, percutaneous nephrolithotomy, or ureteroscopy with holmium laser lithotripsy. If the stone is particularly hard (e.g., calcium oxalate), it may respond to another shockwave treatment. Optimally, the patient would be treated with a Dornier HM-3 or Siemans Lithostar with shock tube C, with the goal of delivering the maximum amount of energy possible.

If the stone is in a caliceal diverticulum, it is difficult, and sometimes impossible, to eradicate it using SWL alone. Fragment passage is made particularly difficult if the diverticulum is in a dependent position. Even if the stone fragments well, the pieces that result often do not pass to the outside because of the small lumen of the neck of the diverticulum.

Ureteroscopy is an option in this circumstance as well. The approach here would be to identify the opening to the diverticulum and pass a wire through it. Next, the neck of the diverticulum is balloon dilated to allow access to the stone for fragmentation with the holmium laser. Optimally, the stone fragments are washed or basketed out, and the lining of the diverticulum is fulgurated to obliterate the diverticulum and prevent future stone formation. This process is tedious and requires patience, but it can be effective. If the approach works, a percutaneous tube is not necessary. A double-J stent should be placed at the termination of the procedure.

I would use a combined percutaneous-retrograde approach. First, with the patient in the prone position, a flexible ureteroscope is guided up into the pelvocaliceal system. The opening to the diverticulum is identified and is opacified to confirm its position in relation to the stone. I then advance a 5-, 10-, or 15-mm Amplatz gooseneck Nitinol snare into the diverticulum to serve as a target for percutaneous access. This maneuver is very helpful when stones are not particularly opaque.

Percutaneous access is then obtained by placing the tip of the access needle in the snare. A guidewire is advanced though the snare via the needle. The snare is then snugged down on the wire, and the wire is pulled down the ureter, through the bladder, and out the urethra. Tract dilation can then be done in standard fashion using the urologist's dilator of choice.

On entry into the diverticulum, the stone can be fragmented using ultrasonic lithotripsy with subsequent removal of the pieces. I would then fulgurate the interior of the diverticulum with the intent of obliterating it. I would dilate the neck of the diverticulum and fulgurate it as well. A nephrostomy tube (e.g., 14F Cope loop) is placed in the renal pelvis. At a later date, an antegrade nephrostogram is done to ensure that the patient is stone free and that there is no obstruction of the ureter. The tube may then be removed.

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FIG. 1. Abdominal film showing 1-cm stone overlying right kidney.

No. 2

This patient has a 1-cm stone in the posterior portion of her right kidney, which is the probable cause of her right flank pain. I assume that she has not been having problems with urinary tract infection, as this was not mentioned in the clinical introduction. Shockwave lithotripsy was not successful, and a stone was not seen at the time of attempted percutaneous nephrolithotomy. The aforementioned findings suggest an associated collecting system abnormality such as a caliceal diverticulum.

The renal collecting system anatomy needs to be defined in this case. If the patient's renal function is normal, she should undergo intravenous urography, which should include posteroanterior, lateral, and oblique images with delayed films. If this study does not provide adequate anatomic information or the patient has renal insufficiency, retrograde pyelography using similar directional imaging should be undertaken.

If this stone is demonstrated to be in a caliceal diverticulum, I would recommend that percutaneous nephrolithotomy be undertaken by directly accessing the stone with subsequent fulguration of the cavity after stone removal. This procedure could probably be accomplished via an infracostal access if the needle was inserted into the cavity during deep inspiration. I would leave a tube in the diverticular cavity for about 1 week and would not attempt to insert it into the collecting system proper. The reported results with this technique are excellent: stone-free rates >90%, resolution of symptoms in >90% of patients, and correction of the underlying anatomic abnormality in almost 90% of individuals.[1-12]

A retrograde ureteroscopic approach is another option. The diverticular ostium is usually fairly easy to see and can be dilated with a 12F balloon. This dilation usually provides adequate access to the stone, allowing intracorporeal lithotripsy,

FIG. 2. Representative slice from non-contrast CT scan demonstrating 1-cm stone within right kidney.

the holmium laser being my tool of choice. The reported stone-free rates with this approach are approximately 60%.[13,14] Other treatment options for such cases include open or laparoscopic nephrolithotomy with ablation of the diverticular cavity. Ultrasonography can be used to help locate the stone. These more invasive techniques are rarely necessary, however.

If this stone were demonstrated to be in the collecting system proper, I would consider percutaneous nephrolithotomy by directly accessing the stone-containing calix, as this would give the patient the best chance of being stone free and limit the frustration that is associated with multiple treatment failures. Another option in this setting would be retrograde ureterorenoscopy and holmium laser lithotripsy.

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No. 3

The calculus seems to be lodged in the calix or caliceal diverticulum. The persistent symptom of right flank pain might be evoked by means of valve-like action of the stone itself and could be relieved only if stone removal was successful.

Such calculi are difficult to fragment with SWL and to visualize via a lower-pole nephroscopic approach. The best treatment is to make a direct approach to the stone by percutaneous nephrolithotripsy and fragment it using the Ho:YAG laser.

The success of percutaneous treatment is dependent mainly on making the best tract directly to the stone. It is easy to achieve direct puncture under ultrasound guidance. However, dilatation of the tract is very difficult in such a case with a small space around the stone. I prefer to use a long epidural needle rather than a standard long puncture needle. An epidural needle is stiffer than the standard one, and its tip is designed to control the direction of the guidewire. For dilatation of the tract, a metal antenna type of dilator is preferable, and the dilatation should be performed gently, keeping the stone feeling at the tip of the dilator all the time.

Once the stone can be observed, fragmentation is not so difficult unless one misses the target in the visual field. Gentle movement of the nephroscope is mandatory. For stone fragmentation, I recommend using the Ho:YAG laser because this stone looks very hard on CT scan, and elegant stone fragmentation is mandatory because of the very limited space around the stone.

It is unclear whether the narrow neck of the calix or caliceal diverticulum needs to be dilated after stone removal.

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No. 4

First, I would go back to basics. We need to do (or review if the study was previously done) a careful retrograde pyelogram to make sure where this stone is exactly. We also must assess whether the calix the stone is in is partially or completely excluded from the collecting system. Despite the urogram showing the stone to be in the collecting system, it is possible that the infundibulum of the calix is so narrow that it was inadvertently missed on flexible intrarenal endoscopy at the time the percutaneous procedure was carried out.

Plain renal tomography may also be helpful in some cases to delineate exactly the location of the stone. Careful mapping of the stone location is essential to the creation of a successful plan of attack that will solve the patient's problem. I would then explain in detail to the patient the situation and the likelihood of success with any of a number of options. However, SWL or repeat indirect access nephroscopy are both likely to fail a second time if tried again. Direct access percutaneous therapy is the option most likely to achieve success.

The best solution for a stone problem of this type is a direct percutaneous access to the stone and into the affected region in the kidney. This may entail a mid-kidney or an upper-pole access. These routes will often be above the 12^{th}, 11^{th}, or even the 10^{th} rib. However, I have rarely found it necessary to go higher than the 11^{th} rib to access a renal stone. Although these high accesses carry a slightly greater risk of complications such as pneumothorax, the probability of success is much higher than with an approach via a lower-pole access.

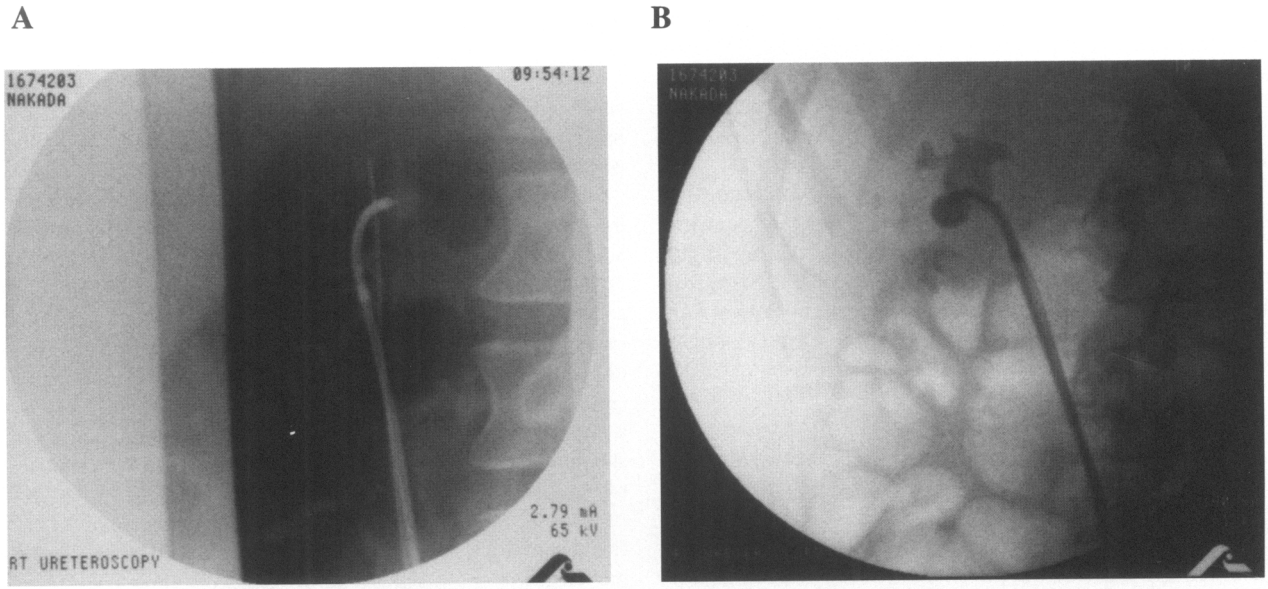

FIG. 3. Fluoroscopic images obtained during flexible ureteroscopy. (**A**) Ureteroscope deflected onto stone. (**B**) Flexible ureteroscope inside excluded diverticulum after laser incision.

Generally, it is easy to coil a wire (i.e., Glidewire) in an occluded calix and create a direct access to the stone via standard percutaneous puncture techniques. If the infundibulum is indeed occluded, it may be necessary to perform an endoscopic infundibuloplasty via the direct access. This can include balloon dilation or incision of the affected stenotic area. A percutaneous tube and antegrade ureteral catheter or stent should be left in place as needed.

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Editor's Note

We thank Dr. Ono for inviting Dr. Hirao of Nara Medical University to comment on this case. As judged by the responses from our experts, the endourologic management of caliceal diverticular stones remains technically complex. In any patient who has failed multiple treatments for a solitary renal stone, the urologist should suspect that an unrecognized anatomic abnormality is present.

The treatment plan was to perform retrograde ureteroscopic access and laser lithotripsy of the stone in either a calix or a caliceal diverticulum. It was my belief from the layered appearance of the stone on the preoperative CT scan that it was

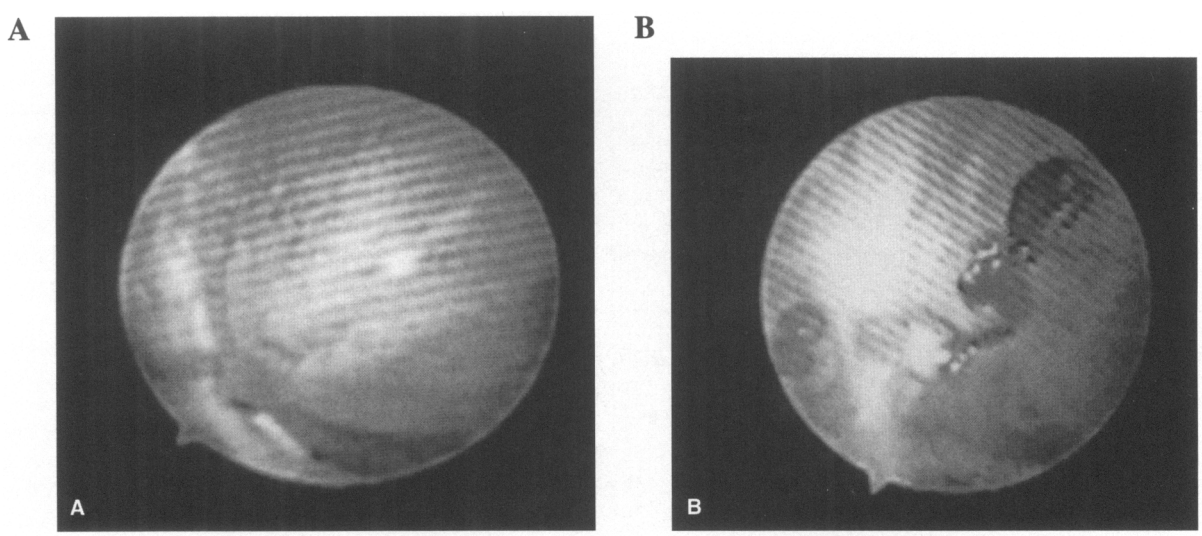

FIG. 4. Endoscopic views during surgery. (**A**) Papilla corresponding to stone location on fluoroscopic images. (**B**) Inside of excluded diverticulum with few remaining stone fragments, which were subsequently removed.

in a caliceal diverticulum. If ureteroscopy was unsuccessful, percutaneous therapy was planned in that same session.

Intraoperatively, we found that when the tip of the flexible ureteroscope was pointed at the stone fluoroscopically, the same papilla was in view (Figs. 3A and 4A). No diverticular neck or opening was seen throughout the collecting system despite an exhaustive search. We elected to incise the papilla using the holmium laser and found an excluded calix full of stone fragments (Figs. 3B and 4B). The fragments were irrigated and removed, and the incision was enlarged to allow ample drainage of this now "included" diverticulum. The patient's symptoms resolved immediately postoperatively.

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UPCOMING CASE PRESENTATION

A 48-year old man presents with a 2-month history of left flank pain. He underwent stent placement at an outside institution for acute obstruction, which verified the presence of a horseshoe kidney and ureteropelvic junction configuration. Follow-up spiral CT angiography reveals a left-sided 1-cm renal pelvic stone and no anterior crossing vessels (Fig. 5). A diuretic renal scan reveals good function bilaterally and significant obstruction, with a half-time clearance of 26 minutes with the stent removed. The patient is otherwise healthy, with no history of stone disease or urologic surgery. He works as a carpenter, and he is interested in a minimally invasive solution.

READERS' RESPONSES

Questions for our readers:

1. How would *you* proceed and why?
2. What are the *best* alternatives?

Please return responses:

- Mail:
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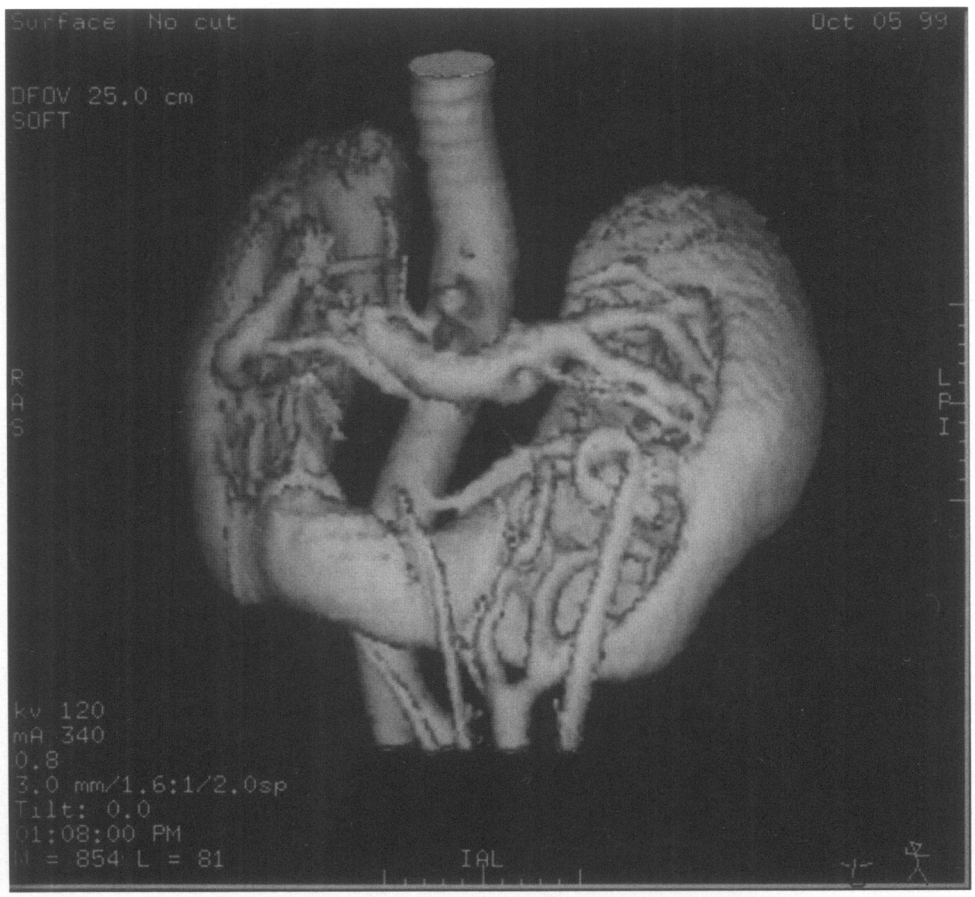

FIG. 5. Spiral CT angiography with three-dimensional reconstruction demonstrating horseshoe kidney, left ureteral stent, and no anterior crossing vessels. Stone is not seen clearly in this image but is present.