A New Spin on the Entrapped Ureteral Calculus*

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ABSTRACT

We describe ureteroscopic lithotripsy using a revolving 1.5F tipless basket. After passing a laser fiber alongside the basket and performing lithotripsy, one uses a rotary wheel at the base of the basket handle to spin the stone to a different area for further fragmentation. This allows complete stone fragmentation, in contrast to traditional laser baskets, which bore a hole through the center of the stone. Irrigation flow testing demonstrated significant advantages with the 1.5F basket with or without a laser fiber alongside the basket compared with traditional baskets.

INTRODUCTION

FLEXIBLE URETEROSCOPY has progressed over the last 10 years from simple diagnostic procedures to complex interventions, mainly because of a dramatic growth in fiberoptic technology, ureteroscope design, and surgical technique and improvements in accessory instrumentation. Despite these advances, an entrapped calculus in a stone basket that is too large to withdraw or release continues to be a difficult complication for the endourologist, especially if the stone is within the ureter. Solutions described in the past include holmium laser fracturing of the basket wire,[1] extracorporeal shockwave lithotripsy of the entrapped basket and stone,[2] or laser lithotripsy and irrigation using an iris valve through two working channels of a rigid ureteroscope.[3] We describe our experience with the Halo™ (Sacred Heart Medical, Minnetonka, MN), a new spinning Nitinol tipless basket that allows laser fragmentation of stones through one working channel of a flexible ureteroscope. Because it is the first 1.5F basket described, we also compare the irrigant-flow rate associated with this basket with those associated with other commercially available baskets, with and without a 200-μm holmium-laser fiber, through a standard 3.6F ureteroscopic working channel. The equipment is listed in Table 1.

TECHNIQUE

Access to the calculus

After placement of a safety guidewire under fluoroscopic and cystoscopic guidance, the calculus is approached with either a semirigid ureteroscope (distal calculi) or flexible ureteroscope (middle- and proximal-ureteral or intrarenal calculi) using a ureteral access sheath in a manner similar to that previously described.[4] Once the sheath is appropriately positioned, two Sure Seal® devices (Applied Medical, Rancho Santa Margarita, CA) are placed in the working channel of the ureteroscope in order to have enough ports for the laser fiber, the basket, and irrigation.

Spinning basket technique

After entrapment of a caliceal or ureteral stone and encountering resistance when the stone is withdrawn down the ureter, a 200-μm laser fiber is passed alongside the basket, and the red laser-aiming beam is placed on the engaged stone. After fragmentation, the basket is rotated to another area for lithotripsy until the stone has been fragmented sufficiently for removal through the sheath. If the basket wire is fractured, the operator

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*Video of this technique can be found online at www.liebertpub.com\end.

TABLE 1. EQUIPMENT FOR SPINNING-BASKET LITHOTRIPSY

Semirigid and/or flexible ureteroscope
Ureteral access sheath (if flexible ureteroscopy is anticipated)
Two Sure Seal® adapters (Applied Medical, Rancho Santa Margarita, CA)
Halo™ 1.5F Basket (Sacred Heart Medical, Minnetonka, MN)
200- or 272-μm holmium laser fiber

should confirm that all basket pieces have been removed from the urinary tract by examining the basket postprocedure.

ROLE IN UROLOGIC PRACTICE

Several strategies have been described to remove an entrapped basket containing a stone. Most urologists first disassemble the basket handle, remove the basket sheath, and reinsert the ureteroscope alongside the inner basket filament in order to perform lithotripsy adjacent to the basket. Unfortunately, disassembly of a basket in this manner is time consuming and usually renders the basket nonfunctional, necessitating additional accessories and increasing the cost of the procedure. If the stone cannot be fragmented after disassembly, most then consider using the holmium laser to fracture the basket wire for release.[1] Fractured tipless baskets tend to close easily, whereas fractured tipped baskets tend to break and close with a protruding end.[1] In either case, care should be taken to remove the basket under direct vision to avoid ureteral injury.

If neither of the above is successful, less-attractive alternatives exist. Extracorporeal shockwave lithotripsy of both a basket and a stone has been described,[2] This may not be a good option if the stone is resistant to SWL or if the lithotripter is not available. Use of laser lithotripsy and irrigation through two working channels of a rigid ureteroscope can be considered, but this alternative is limited primarily to the distal ureter.[3] Open or laparoscopic ureterolithotomy with basket removal is one of the last choices when endoscopic options fail.

The unique handle of the 1.5F Halo basket (allowing stone rotation and lithotripsy) and the basket's small size (facilitating adequate irrigant flow) make it an attractive alternative to other commercially available baskets. We compared the lithotripsy ability of the 1.5F Halo basket (via the spinning technique) and a 3F Cook Laser Flatwire Basket in an *in-vitro* beaker test and in a ureteral model. For each test, a 6-mm stone was entrapped in each basket. Fragmentation of the entrapped stone was successful in both models using the Halo basket. In the ureteral model, the Halo basket was fractured during laser firing but could be released and withdrawn easily. With the Cook basket, we noted that a core was drilled through the center of the stone, yet the stone did not fragment sufficiently to release and extract the fragments. More importantly, once the laser fiber had drilled through the stone, the fiber extended beyond the stone, out of sight of the operator, posing a risk of ureteral injury. We also evaluated irrigant flow rates through the 3.6F working channel of an Olympus URF-P3 endoscope for several commercially available baskets with and without a 200-μm holmium-laser fiber. The laser fiber was passed through the Cook 3F basket and alongside the Halo 1.5F and Microvasive Zerotip 1.9F baskets. Baskets larger than 2.0F do not allow simultaneous passage of a laser fiber.

The average flow rates without a laser fiber were significantly higher with the Halo basket than with the Cook basket (15.1 v 0.6 mL/min; $P = 0.001$) and the Zerotip (9.3 mL/min; $P \leq 0.001$). The average flow rates with a laser fiber were significantly higher with the Halo than the Cook basket (8.5 v 0.4 mL/min; $P \leq 0.001$) and the Zerotip (5.2 mL/min; $P \leq 0.001$) (Fig. 1).

In summary, the technique described using a novel 1.5F spinning stone basket gives the endourologist another option when faced with a challenging stone in a tight ureter.

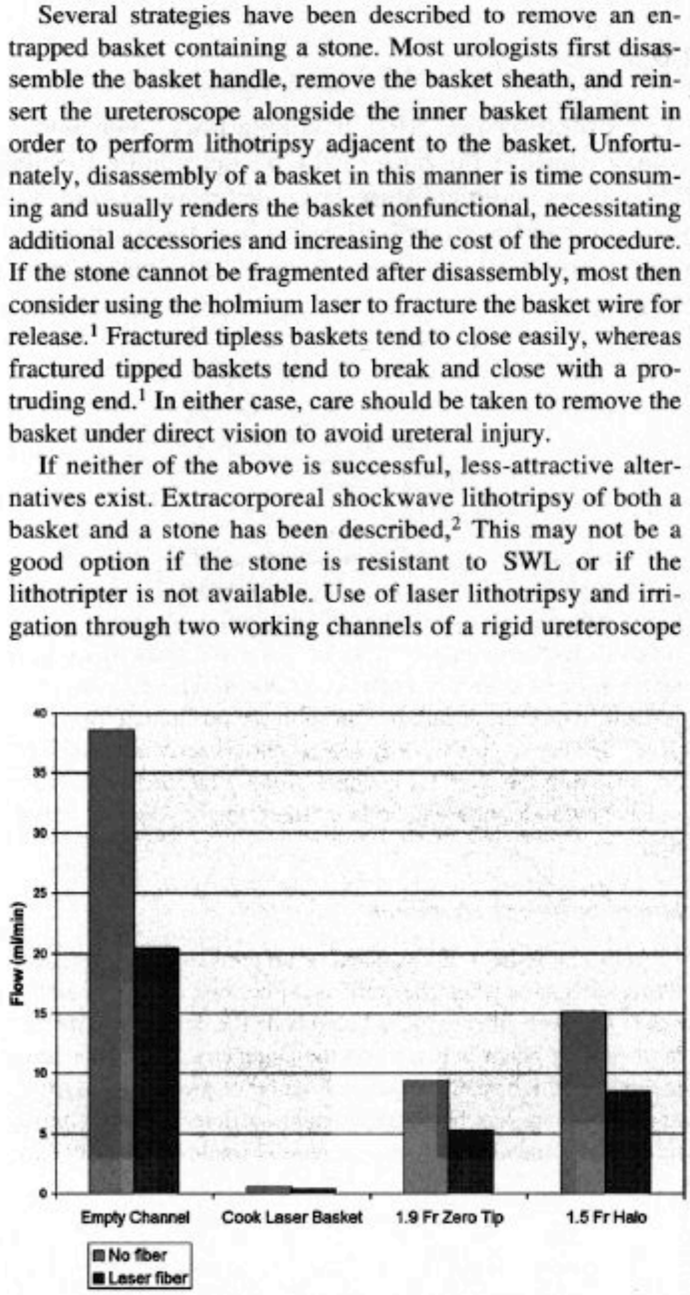

FIG. 1. Irrigant-flow rates through flexible ureteroscope (Olympus URF-P3) with and without stone basket, 200-μm laser fiber, or both.

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EDITORIAL COMMENT

Having an entrapped basketed stone during ureteroscopic stone manipulation is anxiety provoking for even the most experienced endourologist. A variety of techniques have been described to extricate stones entrapped within a basket; however, avoidance remains the best practice.

The authors describe a new technique using a "spinning" Nitinol basket to facilitate removal of entrapped basketed stones. Their technique employs a 1.5F basket with rotating capabilities. *In-vitro* experiments demonstrate that the small basket optimizes irrigation, and the spinning feature improves lithotripsy efficiency.

I had an opportunity to implement their technique and found it to be very effective. The ability to rotate the stone facilitated precise application of the laser tip on the basketed stone. The basket also can be manipulated forward and backward to enhance exposure of the stone to the laser beam. This technique would be challenging without the availability of a capable assistant. Care is required handling both the 1.5F basket and the 200-μm laser fiber, which are prone to damage. I expect that basket rotation mandates that stones be freely floating and not impacted. A more intriguing application of their technique may be to basket stones intentionally to prevent their retropulsion during intracorporeal lithotripsy.

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