Buckshot colic: utilizing holmium:yag laser for ureteroscopic removal of a bullet fragment within the proximal ureter

Matthew Ziegelmann, MD, Alonso Carrasco, MD, John Knoedler, MD, Amy E. Krambeck, MD
Department of Urology, Mayo Clinic, Rochester, Minnesota, USA

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Buckshot colic is a rare phenomenon, presenting as firearm-induced urinary tract obstruction. We present a case of gunshot-induced ureteral obstruction in a 49-year-old male, treated endoscopically with the holmium:YAG (holmium) laser. CT revealed a 1 cm bullet fragment within the left proximal ureter. A percutaneous nephrolithotomy was performed utilizing the holmium laser to fragment the metal into basket-retrievable pieces. At 4 month follow up the patient is without evidence of stricture. To our knowledge, this is the first reported utilization of the holmium laser to treat "buckshot colic". Endoscopy with holmium laser appears a feasible and safe treatment option.

Key Words: buckshot colic, bullet, holmium laser, ureter, ureteroscopy

Introduction

"Buckshot colic" is a rare form of upper tract obstruction secondary to missile fragments within the urinary tract.[1] Associated objects include metallic shrapnel, shotgun pellets, and bullets, and treatment approaches include open or endoscopic approaches.[2] Due to the rarity of this phenomenon, literature regarding buckshot colic is limited to case-reports and small series.[2-4] We present buckshot colic managed with the holmium laser to fragment and remove metal shrapnel within the ureter.

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Address correspondence to Dr. Amy E. Krambeck, 200 First Street SW, Rochester, MN 55905 USA

Case report

A 48-year-old man presented to the emergency department with 24 hours of fever and left flank pain. His past medical history was significant for human immunodeficiency virus on antiretroviral therapy, as well as paraplegia secondary to an L1-spinal cord injury from an abdominal gunshot wound sustained 30 years prior. Notably, 2 months prior he was treated with ureteroscopic stone extraction for a non-obstructing atazanavir ureteral stone. At that time, a piece of metal encompassed by stone was identified within a mid-pole calyx. The metallic object, presumed to be shrapnel from his prior gunshot wound, was left in place as it appeared to be embedded within the calyx.

Laboratory evaluation revealed a marked leukocytosis and evidence of acute kidney injury with an elevated creatinine. A non-contrast CT scan of the abdomen and pelvis demonstrated a hyper-attenuated object within the

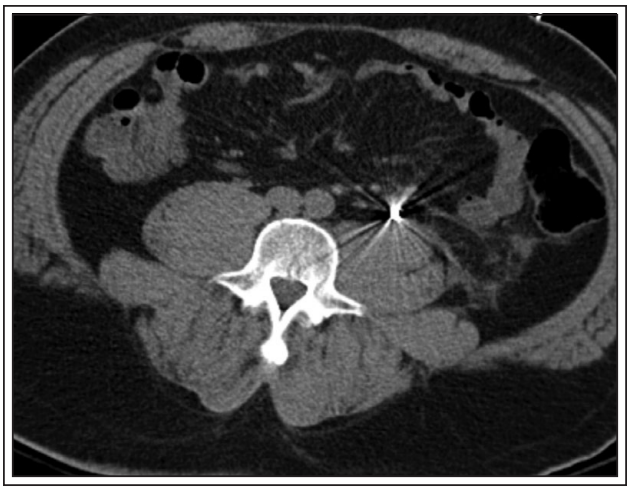

Figure 1. Non-contrast CT scan image of the metallic fragment within the left mid-ureter.

left mid-ureter, Figure 1. A percutaneous nephrostomy tube was placed for decompression, Figure 2. A subsequent DMSA scan showed differential renal function of 33% on the left and 67% on the right.

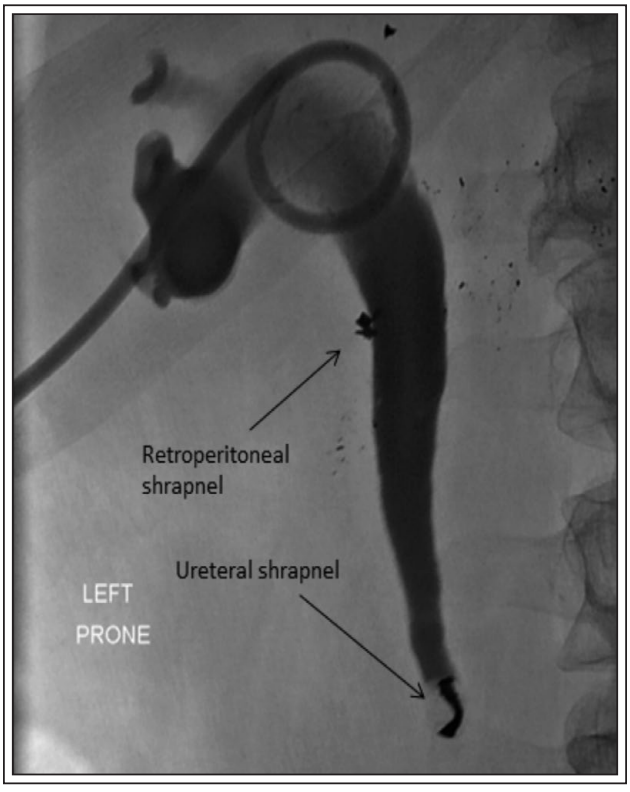

Figure 2. Nephrostogram after placement of an indwelling percutaneous nephrostomy tube showing complete upper tract obstruction secondary to an obstructing metallic fragment.

After 2 weeks of culture specific antibiotics, the patient underwent a left percutaneous nephrolithotomy and antegrade ureteroscopy through the existing nephrostomy tube tract. No foreign bodies were identified within the renal calyces. In the mid-ureter a metallic object with circumferentially attached stone was identified. Using the flexible nephroscope and a 200 µm holmium laser fiber, the stone was fragmented under direct visualization at settings of 0.8 Joules (J) and 8 Hertz (Hz). The stone was removed and a sample was sent for culture, which was negative, as well as analysis, which revealed atazanavir as the primary constituent. The object was clearly visible after all stone was removed, Figure 3. A nitinol basket was used to grasp the object, and an attempt was made at removing the metal intact. However, this met with significant resistance. Therefore, the holmium laser fiber was re-inserted and used to fragment the metal into small pieces under excellent direct visualization. The basket was then used to remove the small fragments. Next, flexible ureteroscopy was performed to evaluate the ureter in its entirety down to the level of the urinary bladder. There was no evidence of residual stone or metallic fragments, and the urothelium was intact. An intraoperative nephrostogram revealed ureteral patency without extravasation. A nephroureteral stent was left in place, and subsequently removed 4 weeks later.

A MAG-3 lasix renal scan was performed at 6 weeks post stent removal which demonstrated stable differential renal function without evidence of obstruction. He continues to follow closely for renal function monitoring. At 4 months postoperative, he was without evidence of ureteral obstruction.

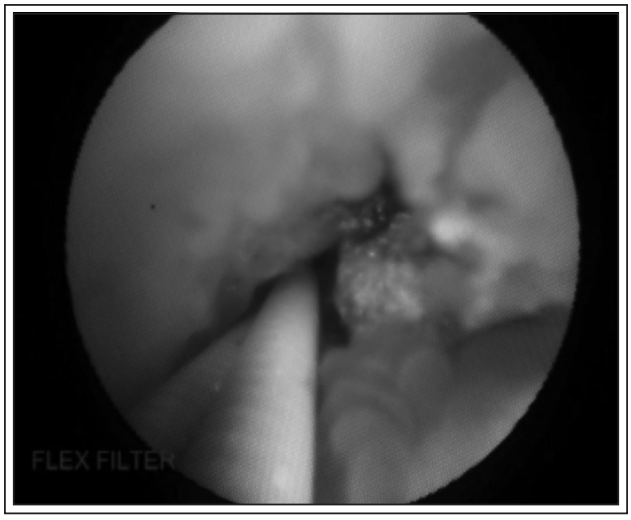

Figure 3. Nephroscopic view of the metallic fragment within the mid-ureter.

Discussion

We present an original report of holmium laser bullet fragmentation for the treatment of buckshot colic. Shrapnel, small or large caliber bullets, and shotgun pellets can be lodged directly into the collecting system, or slowly erode over time from the renal parenchyma or surroundings soft tissues.[3,4] Patients may present within several hours after the sustained injury or as far out as months, years, or even decades later.[2] Although variable, latency periods often differ based on the type of injury. In their review of the literature, Fildes and colleagues found a median latency time of 11 years for shrapnel injury. In contrast, bullet-related injuries often present earlier, with a median time to presentation of 1 month, and the majority of patients with shotgun injury present within the first several weeks.[2]

Treatment options for buckshot colic include observation with spontaneous passage, endoscopic removal via an antegrade or retrograde approach, and open surgical removal.[2-4] Given the large size and heterogenous shape of fragments from shrapnel or bullet-related injuries, patients are more likely to require surgical intervention as compared to those patients with shotgun-injuries.[4]

In our patient, the gunshot wound was sustained 30 years prior. We hypothesize that a bullet fragment within the renal parenchyma eroded into the collecting system over time. The history of recent ureteral stone most likely contributed to upper tract dilation and distal movement of the fragment.

We utilized the 200 µm holmium laser fiber to fragment the metallic object from an antegrade endoscopic approach. We routinely utilize the 200 µm fiber during antegrade stone procedures due to its flexibility through the nephroscope while still delivering maximal power. Despite several reports of endoscopic management, we found no reports of holmium laser for the treatment of buckshot colic. However, the use of the holmium laser to fracture an impacted wire-basket in order to disengage the device from a large ureteral stone has been reported by multiple authors.[5,6] In an interesting experiment, Bedke and colleagues exposed a number of objects to fragmentation by the holmium laser within a physiologic saline solution. Wood, steel, copper, and graphite were all successfully fragmented.[7]

The holmium laser works predominantly via a photothermal effect, creating a vapor bubble with resultant collapse.[8] Therefore, an important consideration is the risk of injury to surrounding tissues. However, the literature regarding thermal dissipation in vivo is limited. Wyatt and Hammontree performed ex-vivo testing of holmium laser fragmentation of several foreign bodies including a hairpin, pen, pencil, and glass stirring rod. During fragmentation no significant increase in the temperature of the object or the surrounding water was observed, suggesting that irrigation fluid results in rapid dissipation of heat, thus preventing thermal damage to surrounding tissues.[9] More recently, Molina and colleagues found that continuous saline irrigation was associated with a significantly lower ureteral temperature during holmium laser treatment of ureteral stones.[10] In our patient, continuous room temperature saline irrigation was utilized, and there was no evidence of ureteral injury. However, given the risk of thermal spread, further study to evaluate direct heat conductance through materials other than stone, such as metal, is warranted.

In conclusion, buckshot colic is a rare clinical entity that presents with renal colic secondary to urinary tract obstruction from a foreign body associated with firearm-induced injury. Although more study is warranted, endoscopic management of urinary tract foreign with holmium laser appears to be a feasible treatment option in the appropriately selected patient.

Disclosures

Amy E. Krambeck, MD serves as a DSMB member for HistoSonics Inc.
No other competing financial interests exist regarding this study or its authors. □

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