Percutaneous tube cystostomy and vesicular irrigation for treatment of obstructive urolithiasis in a goat

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- Perineal urethrostomy is a common treatment for obstructive urolithiasis in small ruminants but prohibits subsequent breeding and, therefore, is not suitable for breeding animals.
- Cystotomy with surgical placement of a temporary cystostomy tube may also be used for treatment of obstructive urolithiasis but may be prohibitively expensive for some owners.
- Percutaneous tube cystostomy and irrigation of the bladder with a chemical solution may be a viable, less-expensive treatment for male goats with obstructive urolithiasis.

RUMINANTS

A 3-month-old 20-kg (44-lb) sexually intact male Boer goat was admitted to the Oklahoma State University Veterinary Teaching Hospital with a history of stranguria of 4 days' duration. The goat was from a pen of 50 weaned kids (20 male, 30 female). Four male herd mates of similar age had died during the preceding month. All of these animals had been seen straining to urinate for variable periods prior to death. No female kids were affected. The animals were fed a commercial goat pellet and grass hay ad libitum.

Results of physical examination were unremarkable, other than dribbling of urine from the prepuce. Vocalization and straining were observed when the goat attempted to urinate. Dry chemical analysis[a] of the urine revealed hematuria (3+), alkaluria (pH, 8.5), and proteinuria (100 mg/dl). No abnormalities were detected during palpation of the sigmoid flexure and ventral aspect of the abdomen. The goat was restrained in a sitting position, 3 ml of a 2% lidocaine solution was infused into the preputial orifice to desensitize the prepuce and glans penis, and an assistant percutaneously directed the sigmoid flexure craniad while the preputial skin was retracted caudad, exposing the preputial mucosa. The distal tip of the urethral process was examined and grasped with a gauze sponge. The prepuce was lightly adhered to the urethral process and glans penis and was freed with gentle caudad traction of the prepuce. The urethral process was purple and contained numerous small calculi. Xylocaine jelly (2%) was applied topically, and the urethral process was removed obliquely with scissors. Catheterization of the terminal portion of the urethra with a 3.5-F catheter[b] revealed impaction of the glans urethra with multiple 0.5- to 1-mm-diameter uroliths. Gentle hydropulsion removed some of the uroliths, but the catheter could not be advanced beyond 2 cm. The tissue overlying the terminal 3 cm of the urethral groove on the glans penis was discolored (gray-green). Urine was observed exiting the penis through a perforation in the penile epithelium at the most proximal extent of the discolored area. Ultrasonographic examination of the caudoventral and right ventrolateral portions of the abdomen in transverse and sagittal planes revealed multiple acoustic shadows lacking reverberation artifact and originating from the most dependent portion of the bladder. These shadows were consistently seen in all scans that included the midventral portion of the bladder and were interpreted to represent mineralized material. The bladder's maximal transverse diameter was 6 cm. The right and left kidneys were evaluated ultrasonographically, and no acoustic shadows were observed in either renal pelvis. Hydronephrosis was not detected. During ultrasonography, a small stream of urine was voided with less straining than prior to catheterization.

The prognosis for a return to breeding soundness was estimated to be poor because of the necrosis and perforation of the epithelium overlying the urethral groove. Initial treatment options discussed with the owner included perineal urethrostomy for salvage or cystotomy with urethral hydropulsion coupled with cystostomy tube placement if urethral patency could not be achieved. The owner did not want to pursue treatment unless the animal's breeding potential could be maintained. The cost estimate for management via cystotomy exceeded the economic constraints of the owner. Because the goat was able to expel urine and the bladder was of moderate size, the owner requested that conservative management be pursued with further attempts at catheterization and hydropulsion the following morning.

Ammonium chloride (100 mg/kg [45.5 mg/lb], PO, q 12 h) was administered to acidify the urine. Serum creatinine concentration was high (3.9 mg/dl; reference range, 0.6 to 1.4 mg/dl), but Hct and total protein concentration were within reference limits. The azotemia was assumed to be postrenal in origin, given the clinical diagnosis and lack of ultrasonographic evidence of hydronephrosis, but IV fluid therapy to correct the azotemia was considered hazardous without establishment of a more definitive means for urine egress. It was anticipated that improvement in the goat's ability to urinate coupled with voluntary water intake would result in partial or complete resolution of the azotemia. The goat was observed to pass small amounts of urine frequently throughout the evening.

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By the morning of day 2, urine output had decreased and bladder size had increased to 9 cm. Further attempts to catheterize the distal portion of the urethra were unsuccessful because of multiple small uroliths in the urethra. The owner was contacted, and a treatment protocol consisting of percutaneous tube cystostomy and vesicular irrigation with a chemolysis solution was accepted.

An IV catheter was placed in the left jugular vein and lactated Ringer's solution (2 ml/kg/h [0.9 ml/lb/h]) was administered. Analgesia was obtained by lumbosacral epidural administration of 2 ml of 2% lidocaine, and the goat was placed in right lateral recumbency with the left hind limb retracted caudodorsally. The bladder was located ultrasonographically in the left prepubic region; no viscera were observed between the abdominal wall and the bladder. Hair in this region was clipped, and the site was aseptically prepared. Under ultrasound guidance, a 12-F sleeved trocar[c] was thrust into the lumen of the distended bladder. The trocar was removed, allowing urine to flow freely from the sleeve, and a 10-F silicone Foley catheter[d] was placed through the sleeve into the lumen of the bladder. The balloon of the catheter was inflated with 10 ml of sterile saline (0.9% NaCl) solution. The sleeve was removed from the abdomen, and the catheter was withdrawn until the balloon was pulled against the left ventral aspect of the abdominal wall. The catheter and sleeve were sutured to the ventral abdominal wall with a Chinese finger cuff ligature of size-1 nylon. Ultrasonography was used to confirm that the catheter balloon was located in the lumen of the bladder, and the catheter was attached to a continuous suction unit[e] with a vacuum pressure of approximately 20 cm H_2O. Approximately 750 ml of urine was initially withdrawn from the bladder. Treatment with ceftiofur hydrochloride (4.4 mg/kg [2 mg/lb], IM, q 24 h) was instituted and continued throughout the time the cystostomy tube was in place. Fluids were administered IV at a rate of 100 ml/kg/d for the next 24 hours. Urine pH was monitored daily.

On day 3, the goat's appetite and attitude had improved markedly. Abdominal ultrasonography revealed no evidence of uroabdomen. The urinary bladder was empty, and the bulb of the Foley catheter was readily imaged. Serum creatinine concentration was 1.5 mg/dl; therefore, IV fluid therapy was decreased to a rate of 75 ml/kg/d (34 ml/lb/d). Urine pH was 7 on day 3 and 6 by day 4 and ranged from 6 to 6.5 throughout the remainder of the hospitalization period. Urine was evacuated from the bladder with the closed suction system for 4 days, after which a tubular plastic sheath[f] was attached to the end of the catheter to act as a 1-way valve to prevent pneumobladder and ascending infection. On day 5, serum creatinine concentration was within reference limits, and IV fluid therapy was discontinued. On day 6, bladder irrigation was instituted to dissolve any uroliths remaining in the bladder. Thirty milliliters of a solution of hemiacidrin[g] was infused into the bladder, and the catheter was occluded. Thirty minutes later, the catheter was allowed to drain. This procedure was repeated 4 times daily for 3 days. Serum creatinine, phosphorus, and magnesium concentrations were measured on days 6, 7, and 8 and remained within reference limits. No clinical evidence of irritation or discomfort was observed during or after irrigation with hemiacidrin.

Ultrasonographic examination of the bladder on day 9 did not reveal any acoustic shadows in the bladder lumen; therefore, bladder irrigation was discontinued. On day 10, examination of the glans penis revealed that necrotic tissue overlying the urethral groove had sloughed. Catheterization of the urethra was possible to the level of the urethral recess. The cystostomy tube was occluded to allow urination, and a normal stream of urine was observed within 4 hours. The cystostomy tube was removed on day 12. Small amounts of urine were observed to drip from the tract of the cystostomy tube for the next 6 hours, but no urine accumulated in the subcutaneous tissues around the tract. Abdominal ultrasonography on day 14 revealed an intact, small bladder (< 5 cm in diameter), with no acoustic shadowing within the bladder and no evidence of peritoneal fluid accumulation.

The goat was discharged from the hospital on day 15 with instructions to continue ammonium chloride treatment for 30 days. The prognosis for breeding soundness was considered to be guarded to poor given the extent of penile epithelial necrosis. The owner was contacted via telephone 6 and 12 months after discharge and reported that the buck was of normal size and had not had any problem with urination since discharge from the hospital. The owner was instructed to have a breeding soundness examination with close inspection of the distal penis performed prior to sale or use for breeding.

Postmortem examination of 1 of the affected herd mates revealed that it had died of obstructive urolithiasis. Uroliths from the herd mate were determined to be 95% calcium phosphate (apatite) and 5% magnesium ammonium phosphate (struvite) by optical crystallography.[h] It was assumed that uroliths in the treated goat were similar. The client was instructed to change the concentrate ration of the herd mates, provide free-choice salt, ensure that drinking water was clean and palatable, and pursue nutritional consultation.

Obstructive urolithiasis is a common disorder of male small ruminants, and affected animals may be examined because of urinary tract obstruction or rupture. Proper management of this condition depends on the value and purpose of the animal and on the location and duration of the obstruction. Many small ruminants with this condition are managed by perineal urethrostomy with subsequent slaughter. Perineal urethrostomy destroys the reproductive capacity of breeding males and is, therefore, inappropriate for valuable rams and bucks. Also, urethral obstruction reportedly recurs in 58 to 78% of sheep and goats following perineal urethrostomy, often within several months after surgery.[1,2] Recurrent obstruction may be a result of urethral stricture secondary to urethral trauma or additional calculi, as sheep and goats with urolithiasis often have multiple calculi in the bladder that are not removed during urethrostomy.[1,3] The poor long-term prognosis associated with perineal urethrostomy has led many authors to recommend cystotomy for man-

agement of small ruminants with obstructive urolithiasis.[1,4,5] If normograde and retrograde hydropulsion are unsuccessful in relieving the obstruction, a tube cystostomy can be performed to allow for urinary diversion while inflammation around the obstructing urolith in the urethra subsides.[6-8] After 5 to 7 days of urinary diversion, repeated temporary occlusion of the cystostomy tube allows for urine to accumulate and expel the urolith. Use of this technique obviates the need for invasive urethral surgery and avoids the complications associated with it, such as stricture and dehiscence. This technique appears to result in a better long-term prognosis than urethrostomy but is prohibitively expensive for many clients.

Human patients with pelvic trauma frequently require urinary diversion via suprapubic bladder catheterization.[9] Several types of catheters have been used for this purpose, some of which are designed for percutaneous placement. Given appropriate insertion technique, monitoring, and maintenance, these catheters are associated with minimal morbidity in human patients and have been used for up to 6 weeks.[10] Percutaneous cystostomy catheters have been used in small ruminants as temporary means of urinary diversion prior to corrective surgery.[5]

Potential complications of percutaneous cystostomy tube placement include bladder rupture, trauma to adjacent viscera or vasculature, catheter dislodgement, and uroabdomen. Ultrasonographic guidance facilitates correct placement and allows for determination of the minimum and maximum insertion depth prior to placement. The technique should be reserved for instances when the bladder can be located adjacent to the body wall with no interposed viscera. The authors recommend use of a balloon-tipped catheter to minimize the risk of catheter dislodgement; the catheter balloon should be filled with fluid, rather than air, so that it will be less deformable. Commercially available over-the-needle percutaneous cystostomy catheters are available, but the authors do not have direct experience with their use.

If uroliths could be dissolved medically in a timely manner, small ruminants with obstructive urolithiasis might be effectively managed with percutaneous tube cystostomy, obviating the expense, risks, and time required for cystotomy. However, limited information is available on medical dissolution of uroliths in small ruminants. Various authors allude to successful use of dietary management and daily infusion of an acidic solution through a surgically placed cystostomy catheter for dissolution of urinary calculi.[7,8] The most common types of uroliths in small ruminants fed grain-based diets are magnesium ammonium phosphate and calcium phosphate.[8,11]

Hemiacidrin is an acidic gluconocitrate solution with magnesium carbonate that is used for dissolution of magnesium ammonium phosphate and calcium phosphate uroliths in humans.[12] Label instructions for chemolysis of cystoliths with hemiacidrin describe instillation of 30 ml of undiluted solution into the bladder for 30 to 60 minutes 4 to 6 times a day. Experimental incubation of human uroliths in half-strength hemiacidrin for 5 days resulted in complete dissolution of 11 of 15 stones that contained calcium phosphate alone or with magnesium ammonium phosphate or calcium oxalate.[13] Uroliths with > 10% calcium oxalate did not dissolve readily. In 1 study,[14] hemiacidrin irrigation through a percutaneous nephrostomy tube caused complete dissolution of struvite nephroliths in 68% of human patients and partial dissolution in 86%. Infusion times ranged from 2 to 30 days, but nephroliths in humans are likely substantially larger than cystoliths typically found in small ruminants. In small ruminants, cystostomy catheters remained in place an average of 14 days in 15 animals treated by tube cystostomy.[6] Thus, cystolith dissolution with hemiacidrin may be achievable in a time period similar in duration to current treatment protocols.

Complications associated with urologic irrigation with hemiacidrin include hypermagnesemia, hyperphosphatemia, and mucosal ulceration or edema.[12,15] Hemiacidrin is reported to be less irritating to the urothelium than other acids of similar pH.[16] Inclusion of magnesium ions in the formulation is speculated to mitigate the irritation caused by the solution. Contraindications to hemiacidrin infusion include urinary extravasation and urinary tract infection. Hemiacidrin irrigation was delayed for 5 days following cystostomy tube placement in the goat described in the present report to allow time for adhesion formation around the cystostomy tube so as to decrease the risk of irrigant leakage. Serum electrolyte and creatinine concentrations were monitored during the period of infusion, but no clinically important changes were detected. Clinical evidence of discomfort following hemiacidrin infusion was not observed.

Results of ultrasonographic evaluation of the bladder in animals suspected to have urolithiasis must be interpreted with caution, as a variety of artifacts can generate acoustic shadows similar to those seen with mineralized densities. Artifactual acoustic shadows could arise from gas-filled intestine adjacent to the bladder. Also, an edge artifact originating from the border of a rounded structure can occur. Acoustic shadows associated with uroliths are expected to be in the dependent portion of the bladder, to not be associated with reverberation artifact, to be detectable repeatedly over time, and to be identifiable in various scan planes. Further, shadows originating from mineralized densities tend to be rather anechoic, while those coming from gas tend to be more hyperechoic.[17]

Extrusion of the glans penis for examination in immature small ruminants can be difficult owing to the normal attachment of the prepuce to the glans penis. Loss of this attachment is mediated by testosterone and is usually complete by the onset of puberty. This separation may be delayed or not occur in animals castrated at an early age.[18] Penile extrusion is facilitated by sedating the animal and positioning it with lumbosacral flexion and by topical or epidural administration of a local anesthetic. Care must be taken during restraint and positioning of animals with urethral obstruction so as not to cause bladder rupture secondary to forceful abdominal compression.

The urethral process is commonly amputated therapeutically and sometimes prophylactically in small

ruminant breeding males. It is generally believed that its removal does not interfere with fertility, but conflicting statements can be found.[18,19] We have been unable to identify any published reports on the effects of urethral process amputation on fertility.

The specified method of management in the goat described in the present report resulted in resolution of the obstruction and apparent dissolution of cystoliths without untoward short- or long-term effects. The efficacy and cost-effectiveness of this approach warrant further investigation. In vitro examinations of the effects of hemiacidrin on small ruminant calculi of various size and composition are needed. The effects of hemiacidrin on the urothelium of small ruminants should also be examined.

[a]Multistix, Bayer Corp, Elkhart, Ind.
[b]Tom Cat catheter, Kendall, Mansfield, Mass.
[c]Trocar-point cystostomy catheter set, Cook Urologic, Spencer, Ind.
[d]Cook Veterinary Products, Bloomington, Ind.
[e]Argyle Sentinel Seal chest drainage unit, Tyco Healthcare, Mansfield, Mass.
[f]CT-90750-12, Carter-Wallace Inc, New York, NY.
[g]Renacidin, Guardian Laboratories, Hauppauge, NY.
[h]Urolithiasis Laboratory, Houston, Tex.

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