Obstructive Urolithiasis in Goats

A Case Report

Kaitlin Marie Wilson
Mississippi State University
College of Veterinary Medicine
Class of 2018
Clinicopathologic Conference
Presented May 19th 2017

CPC Advisor: Gretchen Grissett, DVM, MS, DACVIM (LA)

Introduction:

Urolithiasis is a disease of calculi that form anywhere along urinary tract from the renal pelvis to urethral process. Calculi can be varied shapes, sizes, colors, amounts, and textures. In goats, the most common stone types are struvite and calcium phosphate with calcium carbonate, calcium oxalate, and silica being less common. Urolithiasis is one of the most important economical illnesses of male small ruminants – a life-threatening emergency, but preventable (7). Prognosis has traditionally been poor for life-long management, but a newer surgical option can extended the life expectancy of pet goats from weeks to a year or longer (17).

History and Presentation:

Billy, a seven-year-old mixed breed buck goat, presented to Mississippi State University College of Veterinary Medicine on the 11/26/16 with a 72-hour history straining to urinate. The owners, who loved their pet goat very much, reported Billy frequently had trouble urinating. It resolved each time after the referring veterinarian treated with penicillin for seven days. This time, Billy had not resolved as usual and presented to MSU-CVM. His diet included corn, apples, carrots, Bermuda grass hay, Purina goat chow, and a salt block. He was the only goat on the property, had no deworming or vaccination history, and was not used for breeding.

Billy presented lethargic, alert, and frequently postured to urinate with abundant straining. His heart and lungs ausculted normally, but was tachycardic (168 bpm), and weighed 91 pounds with a body condition score of five out of nine. A distended bladder was felt on abdominal palpation, but no subcutaneous edema was felt along the ventrum. When his penis was extended, his urethral process appeared grey and necrotic. The non-viable urethral process was manually removed and Billy immediately began to urinate normally. Based on his history

and physical exam, the diagnosis of obstructive urolithiasis was made. While this diagnosis is often confirmed with an abdominal ultrasound, it was not performed at this time.

Billy was prescribed flunixin meglumine (1.1 mg/kg IM Q24H for three days) and ammonium chloride (50 mg/kg PO, not to exceed 200 mg/kg, Q24H until urine pH 6-6.5) to acidify his urine and dissolve urinary calculi. The two most common stone types of small ruminants – struvite and calcium phosphate – form in alkaline urine. Acidifying his urine would dissolve present stone and help prevent future calculi from forming and help prevent a repeated obstruction. The urine pH was monitored at home using aquarium pH indicator strips and Billy stayed his ammonium chloride for two weeks. The importance of this treatment was stressed to the owners. Should Billy re-obstruct, the next treatment would be much more invasive. Owners were instructed to watch for signs of a repeat obstruction – posturing to urinate, straining, bleating, anorexia, and dribbling urine. They were also instructed to discontinue grain, increase roughage, and encourage water intake.

On 1/3/17, Billy presented to MSU-CVM again for a 24-hour history of straining to urinate. Grain had been removed from his diet, was still administered four grams of ammonium chloride mixed with sugar once daily, and there were no changes to his environment or care. Billy presented painful, but bright, alert, and responsive. Throughout the exam, he frequently strained to urinate. He was tachycardic (152 bpm), tachypneic (40 brpm), had a tense abdomen, and a thickened sigmoid flexure, and gritty debris was appreciated near his prepuce.

An abdominal ultrasound revealed a mildly dilated right renal pelvis, mildly dilated urethra, the bladder seemed intact and not substantially dilated, and no free fluid was present. Urine pH was eight and a complete blood count and serum chemistry with fibrin were performed. Pertinent results are the following: mild azotemia (BUN 25 with 9-21 mg/dl and

creatinine 2.99 with 0.90-1.90 mg/dl) and moderate moderate hypocalcemia (6.8 with 8.8-11.8 mg/dl). A urinary catheter was unsuccessfully passed. The sum of these findings led to a diagnosis of obstructive urolithiasis for the second time.

Billy underwent an emergency tube cystostomy under general anesthesia. During surgery, his bladder was extremely difficult to observe. It was adhered via fibrosis to the colon, multiple loops of small intestine, and the omentum. The bladder itself was irregularly shaped, thickened, and had multiple areas of invaginated pockets. It was speculated the bladder pathology was secondary to a prior bladder rupture. Many calculi were removed from the bladder. They were all tan, but varied in size and shape from fine granules to several millimeters in diameter. Suction was used to aide in stone removal. A urinary catheter was unsuccessfully passed normograde through the urethra. He recovered well after surgery and the stones were submitted to Minnesota Urolith Center at the University of Minnesota College of Veterinary Medicine.

Post-operatively, Billy was placed on isotonic intravenous fluids for three and a half days (50ml/kg/day). To monitor the azotemia, a serum creatinine was checked once daily for four days. Over that time, his creatinine slowly decreased from 3.52 to 1.49 mg/dl (reference range 0.90-1.90 mg/dl). His tube was monitored for constant dripping with no complications during hospitalization. Ammonium chloride (50mg/kg PO for 2 days then 100mg/kg PO Q24H for 5 days) was administered to acidify his urine and dissolve the stone(s) in his urethra. His urine pH was checked Q24H to ensure proper dosage and over eight days, the pH slowly decreased from eight to six. Other medications included procaine penicillin G (44,000 IU/kg SQ Q12H for 6 days), ceftiofur hydrochloride (1.1mg/kg SQ Q24H for 7 days), flunixin meglumine (1.1mg/kg IV Q24H for 3 days), and an 8-way clostridial vaccine (SQ once). Because Billy received ceftiofur hydrochloride for seven days (not approved for use in goats or for durations longer than

five days), from that point forward, he was barred from ever entering the human food supply. After eight days, Billy was sent home with an e-collar and prescribed ammonium chloride (100mg/kg PO 24H until recheck) and ceftiofur hydrochloride (1.1 mg/kg SQ Q24H for 7 days). The owners were instructed, again, to monitor Billy's urine pH, only feed forages, and offer mineral block supplementation.

Billy returned on 1/17/17 for a recheck and tube removal. He had no issues at home and continuously dripped urine through the tube over the prior two weeks. He was reported to still be taking 4 grams of ammonium chloride with no issues, but his urine pH measured at eight. Billy presented bright, alert, and responsive with no significant physical exam findings. On 1/18/17, his tube was clamped for a voluntary urination challenge. To ensure that his bladder didn't distend too far, his bladder size was checked via ultrasound several times a day. Soon after, he urinated without difficulty and was monitored for 48 hours. During his hospitalization, he was administered ammonium chloride (100 mg/kg PO Q24H) and his urine pH slowly decreased over four days from eight to six. Other medications included ceftiofur hydrochloride (1.1 mg/kg SQ Q24H for two days) and ceftiofur crystalline free acid (6.6 mg/kg SQ once on 1/20/17).

Billy's tube was removed after 48 hours and he was sent home with the instruction to continue ammonium chloride (100mg/kg PO Q24H for 14 days). It was stressed to the owners that continuing this medication would help prevent Billy from a repeat blockage. It was carefully explained that due to the state of his bladder being adhered to intestines and body wall, he would never be able to have a bladder marsupialization. The only viable surgical option that remained was a perineal urethrostomy, which is considered a salvage procedure with poor long term prognoses. Again, the owners were instructed to only give Billy Bermuda grass hay, forages, a mineral block, and he may not have grain or alfalfa.

On 2/13/17, Billy presented again to MSU-CVM for a three-day history of straining to urinate, dribbling urine, anorexia, lethargy, and swollen scrotum. The owners followed through with the ammonium chloride as instructed (confirmed with a urine pH of between five and six) and there had been no other changes to his care, environment, or diet. He continuously postured to urinate and was tense on abdominal palpation. Both testicles were difficult to move within the scrotum. The left testicle was severely atrophied and the right testicle and sigmoid flexure were severely swollen and slightly painful.

An abdominal ultrasound revealed a distended bladder (8cm x 8cm) containing a moderate amount of calculi varying in shapes and sizes. Urethral calculi were seen in several places along the urethra and no free fluid was present in the abdomen or subcutaneously. Finally, there were multifocal areas of calcification bilaterally in both testicles and a 1cm wide abscess was present in the base of the right testicle. Urinary catheterization was unsuccessful. Again, for the third time, Billy was diagnosed with obstructive urolithiasis.

Pathophysiology/Anatomical Considerations:

Diet imbalance is the main cause of urinary calculi. Grain has an increased amount of phosphate, which causes an increased amount of phosphate to be excreted by the kidneys into the urine (1). In addition, goats fed high-grain diets do not produce as much saliva as forage-fed goats. The phosphate that would normally be secreted into the saliva is secreted by the kidneys into the urine. This high amount of phosphate precipitates in the urine and forms struvite and calcium phosphate stones (15). Legumes and alfalfa are high in calcium which results in hypercalciuria and the formation of calcium carbonate stones. Finally, grasses high in silica (mostly in the western US) form silica calculi. When the animal is dehydrated and the urine becomes concentrated, the silica easily bind to urinary mucoproteins and form stones (18).

Vitamin A deficiency can also cause bladder epithelial cell sloughing, which serves as a nidus for any kind of stone formation. Overall, dehydration causes a more concentrated urine, allowing for precipitation of debris and allows stones to form (11).

Urinary pH is also important in stone formation. Alkaline urine allows struvite (pH 7.2-8.4), calcium phosphate (pH 6.5-7.5), and calcium carbonate stones to form. Calcium oxalate stones form in acidic urine and pH has no effect on the formation of silica calculi. (13)

The reason why males are more prone to obstructive urolithiasis is due to anatomy. Female goats do form stones, but they are readily flushed through their shorter, wider urethras (16). Male goats have long, narrow urethras that turn twice (proximal and distal sigmoid flexures) as well as a urethral process at the end of their penis. Calculi most commonly get lodged at the urethral process with the distal sigmoid flexure the second most common site – both the narrowest portion of the urethra (18). In addition, males that are castrated early have smaller diameter urethras due to a lack of testosterone, causing wethers to have higher rates of blockage than bucks (13).

Diagnosis:

Diagnosis is typically made based solely on history and physical exam. Owners frequently report anorexia, strainuria (“parked out” or hunched), vocalization, standing out from the herd, bruxism, signs of colic, depression, and dribbling urine. Owners may also report that their signs suddenly resolved, but have progressively come back. This would happen in the case of a ruptured bladder. Upon physical exam, patients are dull, tachypneic, tachycardic, pyrexic, tense on abdominal palpation, may have gritty debris around preputial hair, and may have subcutaneous edema around the sigmoid flexure and ventral abdomen in cases of urethral rupture. (6, 12)

To ensure an intact bladder, an abdominal palpation and ultrasound would be an ideal first step. A bladder measuring 8-10 cm in diameter is considered diagnostic for a blocked urethra. Before continuing with diagnostics and treatments, the kidneys should also be checked for signs of hydronephrosis. Patients with signs of hydronephrosis have a severely decreased prognosis (6). If free fluid is present on abdominal ultrasound, perform an abdominocentesis and compare the fluid creatinine to peripheral blood creatinine. If the ratio is 2:1 or greater, the abdominal fluid is urine and a uroabdomen secondary to ruptured bladder is confirmed (12). Abdominal radiographs may also be performed. Keep in mind that only calcium oxalate and calcium carbonate stones are radiopaque. Struvite, silica, and calcium phosphate stones are radiolucent (7).

Next, since the most common location of obstruction is the urethral process, rump the patient and fully extend the penis (18). Diazepam (0.1mg/kg IV) may be required. If this is the location of the blockage, tissue will be red or grey and removal should establish urine flow. Gentle urethral catheterization may be attempted. However, it is frequently unsuccessful since the catheter or stone may get stuck in the urethral diverticulum instead of passing into the bladder. Traumatic urethral tears are a risk, but using a soft, curve-tipped catheter lowers the danger of tears (2). These are also the reasons why contrast radiography is not frequently utilized (6). (12)

While the above diagnostics are enough to diagnose obstructive urolithiasis, complete blood count and serum chemistry would reveal hyponatremia, hypochloremia, hyperkalemia, azotemia, hemoconcentration, and metabolic acidosis (12). In addition, urinalysis would reveal crystaluria, pyuria, hematuria, and proteinuria (6).

Treatment and Management:

It's important to note that due to the increased BUN, the meat will be condemned at slaughter if owners choose euthanasia. They need to understand that to prevent this, treatment is required until the BUN is back to normal limits (5). Overall, the idea of treatment is establishing urine flow. The main treatments are urethral process amputation, tube cystostomy, bladder marsupialization, and perineal urethrostomy. Each treatment has a good short term prognosis, but long term prognosis is fair in most cases (18).

For urethral process amputation, diazapam may be required in order fully exteriorize the penis (18). Never use alpha-2 agonists for sedation as they increase urine production – not ideal in a urinary obstruction case (13). If there is a persistent frenulum, full exteriorization is often difficult and sometimes impossible. A scalpel is used to amputate the process at the base near the glans penis. In terms of prognosis, patency is temporary. Goats may re-obstruct as soon as a few hours later. One study found that only four of 14 goats remain unobstructed for one year (18). Even if there are no calculi present, breeding is not affected by the removal of the process so amputation may help prevent another emergency in the event of repeated obstruction (12).

A tube cystostomy is used to divert urine flow while urethral stones dissolve and urethral tissues heal. A 20-22 french Foley catheter is passed through the body wall, into the bladder, the balloon is inflated, and the external tube is sutured on the ventral abdomen. The urethra is flushed normograde to clear the obstruction and ammonium chloride is used post-operatively to help dissolve stones. An Elizabethan collar is required post-operatively to keep the patient from pulling on the tube. The tube remains in place until the patient drips urine through their prepuce, an average of 11 days (2). Then, the tube is clamped for 48-72 hours and the patient is observed for voluntary urination. After that, the tube may be removed. Short term prognosis is good with

success rates up to 90% (4). Unfortunately, over half of patients require a second tube cystostomy due to repeated obstruction (17). (18)

With bladder marsupialization, the bladder is sutured open along the ventral abdomen, allowing for free-flow of urine. This treatment is very effective in the short term (10). However, the risk of infection is very high. One study found that 100% of marsupialized goats at necropsy had chronic supperative cystitis, urine scald, and bacterial cystitis (9).

A perineal urethrostomy (PU) must not be used in a breeding buck and is considered a salvage procedure. In this surgery, the penis is transected on midline ventral to the anus and the urethra is sutured open to allow for urine flow out a stoma. The short-term prognosis is good, but more than half of cases will stricture at their surgical site within eight months and re-obstruct (17). To combat this, the surgeon may consider performing this surgery as far distal as possible to allow for repeated surgeries (2). (18).

A newer surgery, a modified proximal perineal urethrostomy (MPPU), is modeled after feline surgery. For a MPPU, the incision is made very proximal – just ventral to the anus. Just like with feline patients, care is taken to fully transect the ischiocavernosus muscles bilaterally to decrease tension, avoid stricture, and prevent repeated obstruction. Besides those modifications, the MPPU is identical to its classic counterpart. In one study, 100% of patients that presented for follow-up were stricture-free at 12 months post-operative – the best long-term prognosis of any treatment discussed. The main concern is intra- and post-operative hemorrhage, which can be combatted with careful dissection and a pressure bandage placed for 24-36 hours post-operatively. (17)

Post-operative treatment is identical in all surgeries. Antibiotic use is based on urinary culture or if an infection is suspected. To combat post-obstructive diuresis and post-renal

azotemia, patients should be on IV isotonic fluids for 24-48 hours. Creatinine can be measured daily until within a normal range. Pain management is paramount, but patients should not be administered NSAIDs until they are administered appropriate fluid therapy. Morphine (0.1 mg/kg IV Q6H) may be used until then. Flunixin meglumine (1.1 mg/kg IV Q24H) may be used until the IV catheter is pulled. This may be followed by meloxicam (1 mg/kg PO Q24H for three days, then Q48H for 5-7 days) (5).

Ammonium chloride (start at 50 mg/kg PO Q24H, no more than 200 mg/kg PO Q24H), a urine acidifier, is a crucial part of after-care to dissolve struvite and calcium phosphate calculi, which form in alkaline urine (6). Ammonium chloride is broken down by the liver and converted into hydrogen ions and urea. Hydrogen reduces the body's pH by combining with bicarbonate. This results in a decrease in both blood and urine pH. Due to the formation of urea, patients risk liver disease and metabolic acidosis by being on ammonium chloride for prolonged periods of time (14). In addition, the kidneys can eventually compensate for the ammonium chloride, rendering the treatment ineffective (6). It's important to remember that ammonium chloride will have no effect on calcium oxalate, silica, or calcium phosphate stones (13). The goal is to get the urine pH down to between 6 and 6.5 and it may be monitored at home using pH indicator strips. The dose may be increased by 50 mg/kg PO Q24H until the goal pH is achieved. If a patient becomes refractory, pulse dosing may be implemented. (3)

In cases where urethral catheterization is successful, Walpole's Solution (sodium acetate, glacial acetate, and water) may also be used to acidify the bladder to a pH of 4.5 and dissolve struvite stones. However, percutaneous access to the bladder can also be effective in stone dissolution. (8)

For prevention of urolithiasis, avoid a high-grain diet, alfalfa, legumes, silica-heavy pastures, and dehydration. Instead, offer a small amount of high-quality grain that has a calcium-phosphorous ratio 2:1 and plenty of hay and forages. In addition, encourage adequate hydration by adding salt to the diet (4-5% total dry matter intake) or offering electrolyte water (3). In addition, consider castrating bucks when they are older.

Case Outcome:

On 2/13/17, Billy underwent an emergency modified proximal perineal urethrostomy under general anesthesia. It was intended that he undergo a castration and scrotal ablation, but he sustained moderate blood loss and was experiencing severe hypotension under anesthesia. Post-operatively, a compression bandage was applied and Billy was placed on isotonic IV fluids (50 ml/kg/day) for 38 hours. No complications occurred during hospitalization. Medications administered during his stay include morphine (5mg SQ Q6H for 3 days), flunixin meglumine (1.1 mg/kg IV Q24H for 2 days), procaine penicillin G (44,000 IU/kg IM Q24H for 5 days), and meloxicam (1mg/kg PO Q24H for 3 days, then 0.5mg/kg PO Q48H). Billy was discharged after seven days and prescribed meloxicam (0.5 mg/kg PO Q48H for 5 days) and his owners were instructed, again, to avoid grain, alfalfa, to watch for signs of obstruction.

Billy was supposed to have a castration and scrotal ablation two-three weeks after discharge as an out-patient procedure. To date, Billy has not yet been back to MSU-CVM. As of May 16th, 2017, Billy was doing well at home! His owners reported no concerns or issues and Billy is urinating normally.

In February, the stone analysis came back as 100% silica. However, an interesting note was attached to the report. Minnesota Urolith Center states at the bottom of the page that Billy's stones do "not match infrared spectral references for any urinary minerals in our reference

library…a portion of the sample was sent at our expense to Louis C. Herring and Company, Orlando, FL. They were also unable to identify the composition…". Billy remains to be an interesting case. Hopefully, with the help of his MPPU, he will live a long, happy life as a very loved pet goat.

References:

1) Abba, Y. et al. "Clinical Management of Dietary Induced Urolithiasis Associated With Balanoposthitis In a Boer Goat". *Open Veterinary Journal* 5.1 (2015): 30-33. Print.

2) Anderson, David. "Urolithiasis in Ruminants". *American College of Veterinary Internal Medicine Forum*. VIN, 2014. Print.

3) Byers, Stacey. "Urolithiasis In Small Ruminants". *Wild West Veterinary Conference*. VIN, 2014. Print.

4) Ewoldt JM, Anderson DE, Miesner MD, *et al*. Short- and long-term outcome and factors predicting survival following surgical tube cystostomy for treatment of obstructive urolithiasis in small ruminants. *Vet Surg*. 2006;35:417–422.

5) Gill, Marjorie. "Small Ruminant Medicine and Surgery". *American Board of Veterinary Practitioners Symposium*. VIN, 2011. Print.

6) Grissett, Gretchen. "Urinary Disease of Small Ruminants". 2017. Presentation.

7) Haskell, Scott. *Blackwell's Five-Minute Veterinary Consult*. 1st ed. Oxford: Wiley-Blackwell, 2009. Print.

8) Janke, Jared J. et al. "Use Of Walpole's Solution For Treatment Of Goats With Urolithiasis: 25 Cases (2001–2006)". *Journal of the American Veterinary Medical Association* 234.2 (2009): 249-252. Web.

9) May, KA. et al. "Experimental Evaluation Of Urinary Bladder Marsupialization In Male Goats". *Veterinary Surgery* 31.3 (2002): 251-258. Web. 30 Apr. 2017.

10) May, KA *et al.* "Urinary bladder marsupialization for treatment of obstructive urolithiasis in male goats." *Vet Surg*. 1998;27:583–588.

11) McGavin, M. Donald, and James F Zachary. *Pathologic Basis of Veterinary Disease*. 4th ed.

St Louis, Mo.: Mosby Elsevier, 2007. Print.

12) Miesner, Matt. "Diagnosing Urolithiasis in Small Ruminant Colic Cases". *Livestock* 19.3 (2014): 176-179. Web.

13) Miesner, Matt, and Meredyth Jones "Urolithiasis in Small Ruminants". *Central Veterinary Conference*. dvm360, 2009. Print.

14) Plumb, Donald C. *Plumb's Veterinary Drug Handbook*. 7th ed. Oxford: Wiley-Blackwell, 2011. Print.

15) Sullivan, K. et al. "Impact of Two Types Of Complete Pelleted, Wild Ungulate Feeds And Two Pelleted Feed to Hay Ratios on The Development Of Urolithogenic Compounds In Meat Goats as a Model for Giraffes". *Journal of Animal Physiology and Animal Nutrition* 97.3 (2012): 566-576. Web. 24 Apr. 2017.

16) Tamilmahan, P. et al. "Tube Cystostomy for Management of Obstructive Urolithiasis in Ruminants". *Veterinary World* 7.4 (2014): 234-239. Web.

17) Tobias, Karen, and Sarel van Amstel. "Modified Proximal Perineal Urethrostomy Technique for Treatment of Urethral Stricture in Goats". *Veterinary Surgery* 42.4 (2013): 455–462. Print.

18) Van Metre, David. "Urolithiasis in Small Ruminants: Surgical And Dietary Management". *American Association of Small Ruminant Practitioners*. Boulder: Colorado State University, 2004. Print.