Update on Obstructive Urolithiasis in Small Ruminants

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Key Points

- Obstructive urolithiasis in small ruminants is a complex, multifactorial condition, whose management must be considered with respect to regional variation, husbandry differences, and individual variability.
- A thorough workup of these cases may allow practitioners to provide clients with a more accurate prognosis and information for surgical planning.
- There is no single best surgical option for the management of obstructive urolithiasis and the procedure choice must be made on an individual basis, considering factors such as intended use of the patient, financial commitment of the client, and the resources available to the surgical team.

Obstructive urolithiasis continues to be a perennial challenge for veterinary practitioners despite a recent increase in peer-reviewed literature on the topic. Like the disease process itself, the reasons for this are multifactorial, including regional variability, financial commitment of the owner, and husbandry factors that are influenced by the intended use of the animal.

Case Workup

The diagnosis of obstructive urolithiasis in small ruminant patients can often be made based on history and presenting complaint alone; however, a thorough physical exam, including digital rectal exam should never be foregone. Lack of urination and signs of colic are among the most frequently reported in confirmed cases of obstructive urolithiasis. The heart rate is often elevated, consistent with levels of dehydration and pain; however, severe hyperkalemia may result in a falsely decreased value. Pulsation of the pelvic urethra, palpable on digital rectal exam or palpation of the perineum ventral to the anus, are also supportive of obstructive urolithiasis.

Diagnostic imaging provides diagnostic, prognostic, and surgical planning information in the workup of these cases. For practitioners with radiography capabilities, two radiographic views are recommended to identify radiopaque stones: (1) a lateral view with legs extended caudally and (2) a lateral view with legs flexed cranially. Common locations to visualize uroliths radiographically include the urinary bladder, distal to the sigmoid flexure, sigmoid flexure, and distal to the pelvic urethra. Lack of uroliths visualized on radiographs does not definitively rule out their presence, however, as some uroliths, such as struvite, are susceptible to being overshadowed by soft tissue material or lack significant radiopacity due to being small. Ultrasound can be used to estimate urinary bladder size and visualize sediment or uroliths within the lumen of the urinary bladder or urethra, which should be evaluated in its entirety from the pelvis to the prepuce. In addition, the kidneys should be evaluated for evidence of hydronephrosis and the ureters for evidence of dilation, both of which are associated with decreased likelihood of a positive outcome. Lastly, ultrasound may assist in the identification of free abdominal fluid or subcutaneous fluid, consistent with rupture of the urinary bladder or urethra, respectively.

Laboratory analyses have both diagnostic and prognostic value as well. Common electrolyte derangements include hyponatremia, hypochloremia, hypophosphatemia, and either hypo- or hyperkalemia. Another common finding is azotemia, defined by elevated BUN, creatinine, or both. Packed cell volume and plasma proteins are often elevated as well.

Examination of the preputial orifice, exteriorization of the penis, and amputation of the urethral process (vermiform appendage) is cursory to every examination. Visual inspection of these often reveals the presence of crystals, uroliths, and/or blood. Sedation is often needed, particularly for exteriorization of the penis. Alpha-2 agonists should be avoided because they promote increased urine production. Favorable substitutes include benzodiazepines and opioids, such as a combination of midazolam (0.3 mg/kg IV) and butorphanol (0.1 mg/kg IV).

Medical Management

Medical management may be pursued if amputation of the urethral process is successful in reinstating urine flow in patients with partial urethral obstruction or in patients with complete obstruction where surgical management is not an option based on owner preferences (often a financial decision). Initial medical management of patients with partial urethral obstruction is aimed at relaxation of the urethra and general pain management, which can include acepromazine (0.05 mg/kg IV or SQ q4 hours), midazolam (0.2 mg/kg IV or SQ q4 hours), and morphine (0.1 mg/kg IV or IM q6 hours). The use of nonsteroidal anti-inflammatory drugs (NSAIDs) in azotemic patients should be avoided and many practitioners delay use until obstruction is resolved and fluid diuresis is initiated.

In patients with resolved or partial obstruction, urine acidification can be used for urolith dissolution. Ammonium chloride (100-200 mg/kg PO) is given initially and the dose must be titrated based on urine pH due to variable individual response. Check urine pH 4-6 hours after oral administration using a urinalysis reagent strip of pH paper strip; urine pH should be below 6.5, with a goal range of 5.5-6.5. It may be necessary to increase the oral dose of ammonium chloride to 450 mg/kg PO q24 hours. It should be noted that calcium carbonate uroliths are unlikely to dissolve by urinary acidification.

Patients with complete obstruction without a surgical option may be provided medical management with either cystocentesis or an indwelling, percutaneously placed catheter can be utilized. A Bonanno™ suprapubic bladder drainage catheter provides an indwelling method of cystocentesis for approximately 24-48 hours. Under sedation, the patient is placed in right or left lateral recumbency. The skin (a 6cm x 6cm area) overlying the bladder, identified ultrasonographically, is clipped and aseptically prepared. It is recommended to anesthetize the skin at the intended insertion site with a small volume of local anesthetic and create a small stab incision using a #15 scalpel blade to ease catheter placement. Using ultrasound guidance and aseptic technique, the catheter and stylet are placed through the skin incision and advanced into the lumen of the bladder; once confirmed in the bladder by urine flow, the catheter is advanced off the stylet. The pigtail shape of the catheter tip helps to maintain itself within the lumen of the bladder. The catheter is secured with 2-0 nonabsorbable, monofilament suture on a straight needle. A one-way valve may be used, or one created by taping in place the cut finger of an examination glove. Common complications include dislodgement from the bladder and kinking or obstruction of the catheter, however, perforation of cecum with the catheter has been reported, thus necessitating ultrasound guided placement. This catheter should also be considered when referral is elected, as it may reduce the risk of bladder or urethral rupture, particularly if the surgical facility is far away.

Cystocentesis with Walpole's solution may also be pursued if previously attempted therapies have failed. Either through the Bonanno™ catheter or routine cystocentesis, urine is withdrawn from the bladder and replaced with 50 mL of Walpole's solution. The pH of the urine is tested after equilibrating for 2 minutes; the process of removing urine and replacing with Walpole's solution should be performed until pH reaches 4-5. The cystocentesis needle is left in place for the entirety of the procedure so the use of an extension set is recommended. Risks of this procedure include leakage of the solution into the abdomen or subcutaneous tissue through either bladder or urethral rupture, respectively. Therefore, this procedure should only be pursued if euthanasia is the only alternative option. In animals with evidence of stranguria or abdominal pain and those that have not produced a stream of urine within 12 hours after treatment should be reevaluated and humane euthanasia considered.

Surgical Management

The tube cystostomy, first described in 1995, continues to be one of the most common ways of surgically managing obstructive urolithiasis. Recent literature reports improved outcome when combined with urethrotomy for urolith removal; however, it should be noted that the predominant urolith type in these studies is calcium carbonate, which may affect the improved prognosis (see following section for more information). It should be noted that of all surgical procedures reported for obstructive urolithiasis, the tube cystostomy is the only option that has the potential to regain urethral patency, and thus is the only option for breeding males. Perineal urethrostomy (PU), though less technically challenging, is typically considered a salvage procedure as stricture of the perineal stoma within 1-2 years of surgery is common. A modification of the traditional PU was reported in 2013, called the modified proximal perineal urethrostomy (MPPU). Briefly, the penile body is approached on midline, with the incision beginning about 2-3cm distal to the anus and the retractor penis muscle is transected. The penis is transected just proximal to the proximal bend of the sigmoid flexure and proximal and distal segments are oversewn as needed to control hemorrhage. Proximal penile attachments to the level of the pelvic brim are transected to allow the penile body to be elevated dorsally; ensure all ventral attachments of the penis are transected. Incise the distal 2cm of the urethra longitudinally and incorporate the spatulated urethra into the closure; the urethral mucosa is apposed to the skin on either side.

Prognosis

The prognosis for affected animals is generally considered to be guarded to moderate, due to complications associated with the acute management of the condition as well as the risk of reoccurrence. There is, however, significant variability in published survival data. Studies reporting on the success of the tube cystostomy procedure range from 48% nonsurvival to 100% survival to discharge. In the study reporting 100% survival to discharge, the patients primarily had calcium carbonate stones and the tube cystostomy procedure was combined with urethrotomy overlying urethral obstructions. Factors associated with nonsurvival may include advanced clinical disease at the time of presentation, moderate to severe lethargy at the time of presentation, obesity, evidence of uroperitoneum, abnormal PCV (increased or decreased), severe azotemia, and increased CK. Stone type may affect prognosis as well, however, sufficient data to identify a relationship is lacking at this time.

Urolith Composition

Recent improvements in mineral analysis techniques have allowed for differentiation between struvite and amorphous magnesium calcium phosphate (AMCP), both of which were formerly classified as struvite. AMCP/struvite combination is now being recognized as the most common urolith type, whereas pure struvite is considered rare. These uroliths more frequently appear as sand or grit rather than distinct stones. Calcium carbonate continues to be another commonly recognized urolith which has the classically described “gold BB” distinct spherical features. Silicate stones, though rare, are more common in animals housed in sandy soils of western North America, including the United States and Canada.

Prevention

Due to wide variability in management, intended use of the animal, regionality, individual susceptibility, and more, we are not likely to have a single prevention strategy that will be effective for all cases of urolithiasis. Thus, prevention strategies must be tailored uniquely to target the risk factors present.

Delaying castration until after the age of 4-6 months may result in maturation of a wider urethral diameter, which allows for the passage of larger formed uroliths. However, separation of animals by sex may be necessary, as they may reach sexual maturity by that time.

Struvite and AMCP uroliths have been more strongly correlated with animals under one year of age and those receiving concentrates in the ration. Excess phosphorus in the diet is a significant predisposing factor, and in one study, urinary calculi was inducible with a Ca:P ratio of less than 1:1.5. Therefore, it is recommended that the dietary Ca:P ratio of animals in this risk-based group be maintained at 2 to 3:1. Exceeding this ratio may, however, predispose to calcium-containing uroliths. Animals over one year of age and those receiving legumes in the diet are predisposed to calcium carbonate uroliths as well. Therefore, it is recommended that the dietary Ca:P ratio of animals in this risk-based group be maintained at 2:1 by excluding legumes, particularly alfalfa, from the diet.

Urinary acidification, discussed previously as a treatment for obstructive urolithiasis, may also be utilized for the prevention of struvite/AMCP urolith formation. Urinary acidification for the prevention of urolith formation should be done in a pulsatile nature, such as for 1 week once every 4 weeks, as renal adaptation to acidification and a subsequent increase in urinary pH does occur. As discussed in the Medical Management section, the dose must be titrated, up to 450 mg/kg PO q24 hours, to achieve urine pH below 6.5 (range: 5.5-6.5) when measured 4-6 hours after administration. This approach works well for small herds and control at the individual level, however, for herd level prevention, it may be necessary to work with a nutritionist to evaluate the dietary cation anion difference (DCAD) and employ strategies to reduce to 0 mEq/kg of feed using chloride salts.

Urine dilution of stones has been advocated and can be facilitated by both ensuring abundant accessibility to fresh, clean, palatable water sources. In addition, forages, as opposed to concentrates, promote water intake, and should be encouraged.

More research on this topic is needed, however, it appears that there is individual susceptibility to urolith formation and stone composition may be a familial trait.

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