Recent advances in surgical management of urolithiasis in sheep and goat

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The cases of urolithiasis in caprine and sheep presented for treatment for one year to University Teaching Veterinary Clinics were managed surgically. A brief history about the clinical cases, their clinical examination, kidney function tests and ultrasonography was studied. The cases were surgically managed by performing different surgical procedures viz, excision of urethral process, urethrotomy, perineal urethrotomy, tube cystotomy and cystorrhaphy and modified bladder marsupialisation as demanded by clinical situation. The postoperative management, survival rates and restoration of normal urination, rupture sites and return of normal kidney function tests of the cases has been discussed.

Key words: Urine, ultrasound, urethrotomy, bladder.

INTRODUCTION

Urolithiasis is the most widespread and economically important disease of ruminants. It is a problem in castrated males and second biggest cause of death behind respiratory disease, accounting for 18 to 38% of lamb deaths in winter (Bani et al., 2007; Vinodh Kumar et al., 2010). Nidus formation occurs when mucoproteins in the urine coalesce and precipitate with crystals in supersaturated urine (Belknap and Pugh, 2002). If calculi increase in number or size, obstruction of tract anywhere from urethral process to bladder may result in sheep and bucks (Khan et al., 2013) which can rapidly progress to bladder or urethral rupture, uremic crisis and death may occur (Kannan and Lawrence, 2010). Clinical manifestation of urolithiasis in Rams and Bucks are remarkably different than in bovine species. They may show partial or complete obstruction, and complete obstruction with ruptured urinary bladder and hence demand different surgical under diverse clinical situations. In sheep and goats ultrasonographic scanning may be useful for the diagnosis and prognosis of this disease (Makhdoomi and Gazi, 2012).

MATERIALS AND METHODS

The study was a completely randomized block design including Rams (n=17) and Bucks (n=12) presented for treatment of urolithiasis to University Teaching Veterinary Hospital, Kashmir for a period of one year. On admission, the animals were subjected to...
Table 1. Grouping of animals.

<table>
<thead>
<tr>
<th>Species</th>
<th>Group</th>
<th>Grading</th>
<th>PUN/Creatinine(mg/dl)</th>
<th>USG findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheep</td>
<td>A (n=9)</td>
<td>Low risk Group</td>
<td>Up to (100 g/dl) 2 mg/dl</td>
<td>Intact Urinary Bladder</td>
</tr>
<tr>
<td></td>
<td>B (n=8)</td>
<td>High risk Group</td>
<td>(above 100) above 2 mg/dl</td>
<td>Ruptured Urinary Bladder</td>
</tr>
<tr>
<td>Bucks</td>
<td>C (n=6)</td>
<td>Low risk Group</td>
<td>up to (100 mg/dl), 2 mg/dl</td>
<td>Intact Urinary Bladder</td>
</tr>
<tr>
<td></td>
<td>D (n=6)</td>
<td>High risk Group</td>
<td>(&gt; 100 mg/dl) 2 mg/dl</td>
<td>Ruptured Urinary Bladder</td>
</tr>
</tbody>
</table>

Table 2. Surgical Plan of High risk group Rams and Bucks.

<table>
<thead>
<tr>
<th>Surgical Plan</th>
<th>Rams</th>
<th>Bucks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tube cystotomy</td>
<td>(n=3)</td>
<td>(n=3)</td>
</tr>
<tr>
<td>Perineal urethrostomy (PU)</td>
<td>(n=3)</td>
<td>(n=2)</td>
</tr>
<tr>
<td>Modified Bladder marsupialization (MBM)</td>
<td>(n=2)</td>
<td>(n=1)</td>
</tr>
</tbody>
</table>

Plate 1. Tube cystotomy.

complete pre-operative evaluation and pre-surgical intervention. Preoperatively supportive and therapy fluid, injections meloxicame, atropine sulphate, urinary alkilizer, litholytic drug and antibiotics at recommended dosage regimen was given to animals with severe dehydration and/or uraemia to stabilize and prepare for surgery. Ultrasonographic examination Ultrasonography of urinary conducts in ventrodorsal approach was done using a real time, B mode ultrasound scanner (Logiscan 128) equipped with linear array 5 to 7 MHz probe on day zero, day 3<sup>rd</sup> on removal of catheter or on the day of normal urine flow restoration. Based on, Kidney function Tests viz, Plasma urea nitrogen (PUN) and creatinine** and Ultrasonography, The grouping of Animals was done as under as shown in (Table 1). Besides grading rams and Bucks as low risk group and high risk groups, their surgical plan largely depended upon status of the urinary tract e.g. Partial obstruction, complete obstruction intact bladder and ruptured bladder. The animals of high risk group both Rams and bucks were subjected to the procedures designated as under in (Table 2).

In animals with partial obstruction penis was exteriorize by desleeving the penile sheath and washed with 2% povidone, urethral process was excised, the urethra catheterized and flushed with heparinised normal saline. Animals with complete obstruction with ruptured Urethra were subjected to Tube cystotomy (Plate 1). Rams and Bucks of high risk group were remedicated using Triflupromazine @ 0.05mg/kg intravenously and were subjected to anterior epidural anaesthesia using 2 % and 10 ml Lignocaine, in right lateral recumbency using left caudal paramedian approach at a site 3 inch lateral and parallel to the penile urethra. About 3 inch long skin incision was made; muscles and peritoneum were incised to reach the abdomen.

The free blood stained urine along with occasional calculi were drained out in instalments. The bladder was exteriorized and a tear in the bladder identified and the site of rupture was recorded. The polyvinyl catheter (PVC) 2 mm outer diameter was guided antegrade (Normograde) from the bladder trigone into the proximal urethra. Sterile saline was flushed via catheter to dislodge uroliths from the proximal urethra back into the bladder for removal. The urethra was exposed through perineum (ischial urethrostomy). The retrograde flushing was performed. One end of the PVC catheter was placed in bladder and the other end directed through pelvic and ischial urethra to the penile urethra, free end was anchored with a stay suture at the prepuce. The tear in the bladder was sutured with continuous Lambert pattern using Vicryl. The muscles and peritoneum were closed in conventional manner. The skin was
sutured by cross mattress sutures using silk. The catheter and stay suture at preputial orifice was removed once the normal flow of urine established.

For perineal urethrostomy: a midline incision was given below anus, with Sharp and blunt dissection, the penis was located (Plate 2). Dorsal aspect of urethra was incised and PVC of 3mm outer diameter was placed, the free end of catheter was anchored with skin. As Kidney function tests touched near normal, tube cystotomy was done. Three animals’ two rams and one buck were grossly areflexic; with diffused urine scald and gross congestion of urethral process were subjected to minimal invasive MBM. The bladder was located by ultrasonography. A two and half inch incision was made in supra pubic region two inches anterior to the scrotal attachment. The muscles three inches diameter were removed in circular fashion. The bladder and its tear was located approximated to muscle incision and sutured using vicryl no 2 to margin of the circular incision with continuous sutures. One more layer of continuous suture was given between serous surface of urinary bladder with the skin in linear fashion and surplus part of the urinary bladder was excised out. The contents of the bladder were drained out and flushed with the heparinised normal saline. The animals were monitored clinically at 24 hrs, days 8 and 16 and at the time of removal of catheter or as kidney function tests returned normal. The wounds were examined for complications if any. The catheter was checked for leakage and patency. Re-invasive surgery if needed was done and the patient discharged under a post-operative advisory note.

RESULTS

Anamnesis revealed that animals, whether sheep or bucks were fed rations in pre-ruminant stage. The ration offered included rice bran, rice straw or commercial feeds either alone or in combination. 40% caprine and ovine kids had received previous treatment which included diuretic injections. The rest others had been given steroids, pain killers or tranquilizers. Survival rate post surgery in different animals with urolithiasis is presented in (Table 3). The hours of presentation varied much in animals and were presented for treatment at different intervals between 50.75 ± 4.20 to 88.90 ± 15.50 hrs (Rams) and 45.20 ± 4.60 to 55.10 ± 5.60 hrs (bucks) after the onset of first clinical signs. The severity of the case increased with the duration of obstruction as clinically marked by increase in PUN and creatinine levels in the animals of all the groups. The normal restoration of the urine flow was 9.20 ± 1.89, 11.42 ± 3.17, 9.08±2.20 and 11.66±2.84 days in groups A, B, C and group D, respectively (Table 3). The overall survival percentage was 97.50%

Amongst the animals of Group A presented 3 (37.5%) animals with ruptured bladder, representing the sites dorsal margin, body of bladder and Vertex in 1 animal each. The animals of Group B revealed 4 (66.66%) with the sites as trigone and rughae in 2 animals each. The animals of Group C showed 4 (66.66%) ruptures with the sites as urethral opening 2, dorsal body 1, and vertex...
Table 4. Percentages of ruptured/ intact bladders in different species of animals during urolithiasis.

<table>
<thead>
<tr>
<th>S/No</th>
<th>Species</th>
<th>Number of animals urolithiasis</th>
<th>Number of intact bladders</th>
<th>Number of ruptured bladders</th>
<th>Percentage of ruptured bladder</th>
<th>Percentage of intact bladders</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ovine</td>
<td>17</td>
<td>9</td>
<td>8</td>
<td>47.05</td>
<td>52.94</td>
</tr>
<tr>
<td>2</td>
<td>Caprine</td>
<td>12</td>
<td>6</td>
<td>6</td>
<td>50.00</td>
<td>50.00</td>
</tr>
</tbody>
</table>

Plate 3. Showing rupture of urethra and oedema of entire umbilical region.

1. The animals of Group D showed 5 (83.33%) ruptures with the sites as dorsal margin 2, neck 2, and vertex 1 (Table 4).

Ultrasound details preoperatively

Sonography in bucks showed moderate to severe seepage of urine into the pelvic cavity, Uroperitoneum, as evident by the hypoechoic image. The urethra was ruptured in one sheep and goat with severe urethritis and subcutaneous urine accumulation (Plate 3). The concretions and calculi were located in sigmoid flexure, ischial urethra, pelvic urethra and the perineal urethra. Whole of the tract was occupied with the tiny sandy grits, obstructing the entire course of urethra including urethral process. The animals presented beyond 72 hrs of obstruction (Group C) animal’s depicted ruptured urinary bladder with the urine accumulated in the peritoneal cavity by ultrasonography. In Group D animals ultrasonography revealed moderate to severe seepage of urine into the pelvic cavity and the loops of intestine loaded with concentrate material (Plate 4).

Operative observations

The observations recorded by ultrasonography were compared and confirmed during operative procedures and the accuracy of preoperative observations that is, intact bladders, ruptured bladders, seepage and tissue damages were 100% in all the species of animals under study. In the animals of Group A the patterns of rupture observed were elongated L-shaped in all the 3 animals. In the animals of Group B the patterns of rupture observed were massive linear through cut in 2 animals, elongated L-shaped in rest 2 animals. In the animals of Group C the patterns of rupture observed were multiple nicks shaped in 2 animals, curvilinear in the other 2 animals. In the animals of Group D the patterns of rupture observed were multiple trabeculae type in 2, multiple nicks in 2, shaped in 2 animals, linear in 1 animal, respectively.

Surgical treatments were the only solution to save the animals. The choice of the appropriate surgical technique depended on the value and future use of the animal, location of the obstruction, and the respective integrity of the urethra and bladder. The surgical techniques revealed that amputation of the urethral process was simple, inexpensive and quick technique. After desleeving glans penis the urethral process was excised with scissors at its base. It had good short-term results. This procedure resolved obstruction in two-thirds of the treated animals and recurrence was not uncommon (Plate 5).

Urethrotomy consisted incision of the urethra at any
site along the perineum, but the site of perineum (Perineal urethrotomy) was preferred to minimise the urine scalding. In a few cases prepubic urethrotomy for the relief of a urethral obstruction secondary to perineal urethrotomy was done but the recurrence of the obstruction and was encountered. Perineal urethrotomy in cases with gritty calculi entire length of urethra was done and showed good long-term outcome. Retrograde catheterization with flushing catheterisation of small ruminants was rather a difficult technique due to the entrance of the catheter in the urethral recess. The potential complications of the catheter passage and urohydropulsion included traumatic urethritis and urethral rupture. Attempts at retrograde catheterization with flushing (attempted prior to surgery for tube cystotomy) had unsuccessful rates to either partially or completely relieve the obstruction. Additional combination of retrograde with normograde flushing had successful results in surgery, followed by the placement of a temporary indwelling urethral catheter.

Modified urinary bladder marsupialisation was a simple technique, demanding little surgical instrumentation, shorter hospitalization time and duration of medical treatment, decreased requirement for postoperative care and fewer complications, compared to cystotomy and tube cystotomy. It offered the best clinical outcome in animals with a ruptured urethra or those who had undergone multiple (Plate 6).

**DISCUSSION**

Conservative medical treatments of urolithiasis in small ruminants may be attempted in early Stages e.g antispasmodic agents, medical dissolution, fluid therapy, cystocentesis and retrograde catheterization with flushing (Radostits et al., 2000; Gazi et al., 2012). Abdeirhman et al. 2012 recommended it as an association with surgical treatments and anti-inflammatory drugs to reduce urethral swelling. Administration of antispasmodic agents, such as promazine or acepromazine (derivatives from phenothiazine) or butylisopropamine, aims to promote calculus passage reducing the urethral smooth muscle spasm and relaxing the retractor penis muscle (Mavangira et al., 2012). The rest treatment of urolithiasis should be surgical (Van Metre, 2004; Abdeirhman et al., 2012) reported in steers a 73% recovery rate. The diagnosis of urolithiasis was based on a complete anamnesis and physical examination, complemented by laboratory tests (of blood and urine), ultrasonography. Besides these diagnostic approaches Radostits et al. (2000) included radiography as tool for diagnosis of urolithiasis. Preoperative observations were pivotal for the grouping and classifications were compared with the...
sonographic findings. Ultrasonography has undoubtedly resulted in an improved success rate of urolithiasis because of being easiest mode of detection of clinical condition by being non invasive method for diagnosis of urolithiasis (Makhdoomi and Sheikh, 2008). It helps in localization of urethral calculi, detection of dilated urethra, cystitis, urethritis and rupture of the urethra or the urinary bladder (Braun et al., 2006; Gazi et al., 2012). Braun et al. (2006) in 20 healthy, adult male white alpine sheep has been done to locate the position, dimensions, and structure of the kidneys, ureters, bladder, and urethra, in order to determine the normal sonographic appearance of the urinary tract. All kidneys could be visualised, but not the course of the ureters. High plasma urea nitrogen (PUN) and creatinine levels noticed in the animals of present study indicated retention of urine. The reason being that excretory metabolites remain unexcreted from the body. High PUN and creatinine levels are detrimental for surgical procedures (Gazi et al., 2012) hence, PUN and creatinine together with ultrasonographic findings were formed basis for grouping and grading of animals in the present study.

Khan et al. (2010) reported that the median time of initiation of urine through natural orifice was 16 days in calves after treatment however prolonged in some cases up to 26 days. In present study as restoration of normal urine flow was much earlier. The rupture of the urinary bladder is suspected whenever there is accumulation of urine into the peritoneal cavity and little urine in the urinary bladder lumen (Khan et al., 2010). It can also be suspected when we do not get any visual on the ultrasound examination, especially in the large animals (Braun et al., 2006). The hyper echoic structure showing acoustic shadow is a confirmation of the calculi in the kidneys, urinary bladder or urethra (Makhdoomi and Sheikh, 2008).

An analysis of ruptured and intact bladder showed that the incidence of rupture was maximum in caprine (50%) followed by ovine (47.05%) and bovine (42.43%). The cases of bovines being presented at 48 post obstructive hour showed relatively less number of ruptured urinary bladders than caprine being presented at 45 post obstructive hour and sheep presented at (50.75 ± 4.20), this clearly indicates that obstructive pathophysiology gets altered at an earlier stage in goats followed by sheep. This may be probably due to the fact that there is the capacity of detrusor muscles to withstand increasing intracystic pressure developing in pace with duration of obstruction as has been documented by Makhdooomi and Sheikh (2008) in calves. However such studies in sheep and goat are not available in the literature. Ewoldt et al. (2006) revealed that the success rate of tube cystotomy is 76%, although 90% of the patients were discharged from the hospital. Less than 20% had a recurrence after 6 to 12 months. Tube cystotomy has shown to be the elective treatment of urolithiasis in small ruminants. The results are in agreement with (Van Metre et al., 2006).

Amarpal et al. (2004) performed the amputation of urethral process by subcutaneous incision however in present study simply the penile sheath was desleeved and urethral process was quite visible. (Van and Fubini, 2006) recorded urethral process as site of obstruction in 17 of 43 sheep and 22 of 51 goats (40 and 43%, respectively). Ewoldt et al. (2006) reported in a retrospective study that 86% of the cases had the uroliths located in the urethral process. Prescrotal urethrostomy has been reported to be superior to perineal one as it requires shorter surgical duration and is associated with milder bleeding (Abdeirhman et al., 2012). In our study no animal demanded prescrotal urethrostomy. Attempts at retrograde catheterisation with flushing (attempted prior to surgery for tube cystotomy) have highly unsuccessful rates to either partially or completely relieve the obstruction. Normograde flushing alone, through the cystotomy site in order to relieve the obstruction obtained unsuccessful results and may predispose the animals to the rupture of the urethra. Fortier et al. (2004) reported bladder marsupialisation may also offer the best clinical outcome in animals with a ruptured urethra or those animals operated by different or many procedures. Abdeirhman et al. (2012) has related bladder marsupialisation to bladder prolapse in the fistula site, mild urine scald in the skin and stricture.

**Conflict of Interests**

The author(s) have not declared any conflict of interests.

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REFERENCES


