

Full Length Research Paper

Clinico- sonographic evaluation based surgical management of urolithiasis in young calves

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The objectives of study were to screen the calves as stone and non-stone formers, to manage the calves with obstructive urolithiasis by diversified surgical approaches based on clinical and sonographic assessment. The study was conducted in bovine calves (n=27), manifesting clinical urolithiasis. All these animals and 52 calves of age group 3 to 18 months presented with any form of ailments were included in screening as normal and stone former. Anamnesis, clinical and physical examinations, ultrasonography, peri operative and post operative observations and, complications were recorded. On the basis of clinical symptoms, ultrasonographic findings of urinary system, duration of obstruction and position of calculi, were divided into five groups of 6 animals each except group T having 3 animals and most suited surgical procedure, that is, in dwelling Normograde catheterization, tube cystostomy, cystostomy and uretotomy, trocarization and Percutaneous catheterization and abdominocentesis were awarded. The highest occurrence was found in the age group of under one year (60%) followed by 40% above one year. Cross bred calves were most affected (70%). Duration of illness in calves varied from 24 to 120 h. The rectal temperature increased slightly at different postoperative intervals in all the groups. The heart rate and respiration rate showed a gradual decrease at different postoperative intervals and became normal towards end of study. In 90% cases small multiple irregular and smooth concretions were retrieved. The calves suffering from obstructive urolithiasis had the history of feeding on diets containing wheat bran, commercial cattle feed, rice bran and rice straw few days before manifesting symptoms. Trocharization followed by peritoneal catheterization helped to prolong the life of the severely diseased animals and made them more suitable for major surgery subsequently.

Key words: Urolithiasis, abdominocentesis, trocarization, ultrasonography.

INTRODUCTION

Male bullocks continue to be exclusive source of agricultural power in Kashmir valley as mechanization in agriculture using tillers is not possible due to terrain of land. Urolithiasis a disease of bullocks is now exceptionally a disease of male calves in Kashmir. It is invariable accompaniment of series of events starting with obstruction to free flow of urine, increased intra cystic pressure, vesico-urethral reflex, hydronephrosis

and alterations in urea nitrogen, creatinine, calcium, phosphorous and other metabolites. Urolithiasis results in considerable economic losses to the owner in terms of death of the animal, lower weight gain, medicinal and surgical treatment costs, loss of precious germplasm. The calculi formation results from a combination of physiological, nutritional and managerial factors. The factors that favour development of obstruction include

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anatomical long convoluted urethra-sigmoid flexures, urethral process in small ruminants, surgical factors early castration and exogenous factors, estrogens as growth promoting implants. Excessive or imbalance intake of minerals has been reported as one of the factors for formation of urinary calculi (Larson, 1996; Lonsdale et al., 1968). The incidence among male calves is enormously as high as 12% (Makhdoomi and Sheikh, 2008).

Diagnosis of Urolithiasis and rupture of the urinary bladder or urethra in cattle, sheep and goats is based on the clinical symptoms, physical examination, adbomeninocentesis, radiography and sonograph. Treatment comprises use of antibiotics, muscle relaxants (Gasthuys et al., 1993), urine acidifiers, litholytic drugs (Joshi et al., 1988) and dialysis (Radostitis et al., 2000). Complete obstructive urolithiasis demands surgical treatment (Radostitis et al., 2000). The surgical interventions include penile catheterization (Winter et al., 1987), removal of urethra or cystic calculi (Gera and Nigam, 1980), urethrostomy and bladder fistulation (Lundvall, 1974), intrapelvic cystic catheterization and penile amputation (Jenning, 1984; Winter et al., 1987). The present paper documents the clinico-sonographic evaluation based surgical management urolithiasis in calves.

MATERIALS AND METHODS

The study was conducted at University Veterinary Clinical Services Complex, for a period of nine (9) months in bovine calves (n=27), aged 3 to 18 months manifesting clinical urolithiasis. All the 27 animals with urolithiasis and 52 calves of age group 3 to 18 months presented with any form of ailments were included in screening as normal and stone former by method described by Teotia, (1975). The systematic and complete pre-operative evaluation and management of the cases is designated here under.

Anamnesis

A record of previous and present history was taken. The previous history included questions eliciting information about previous treatment, nutritional history related to type of feed, change of feed. Present history included present ailment and symptoms. The clinical examination done, included status of the eyeballs, visible membrane with emphasis on urinary bladder examination regarding pattern of urination, bladder distension, ruptured and intact bladder.

Clinical observations

The clinical parameters recorded at day zero, 8, 16 and at the removal of catheter and included heart rate, respiratory rate, rectal temperature (°F), skin fold persistence test time (seconds) and extent of dehydration (Radostitis et al., 2000).

Physical examination

The urine was collected aseptically either by aseptically by percutaneous /cystocentesis in intact bladder cases and by abomenicentosis in cases with ruptured urinary bladder, using

spinal needle. The urine was collected in sterile test tubes and centrifuged at 3000 rpm for 10 min. One drop of the sediment was discarded and the sediment one drop was taken on a slide for examination of casts and crystals.

Grouping

On the basis of clinical symptoms, ultrasonographic, findings of urinary system, duration of obstruction and position of calculi and kidney function tests, groups A, B, C, D and T consisting of 6 animals each except group T having 3 animals, as follows.

Group A (Alert clinically): They included animals with urinary obstruction of 24 h duration. They were clinically alert with viable reflexes, plasma urea nitrogen up to 50 mg/dl and creatinine 2 to 3 mg/dl. They had intact bladder and the calculi were lodged in urinary bladder.

Group B (Below danger line): They included animals with urinary obstruction of 48 h duration, were clinically alert with sluggish reflexes, plasma urea nitrogen up to 50 to 100 mg/dl and serum creatinine 3 to 4 mg/dl respectively, with intact bladder (distended) and calculi were lodged in the neck of urinary bladder.

Group C (Critical): They included animals with urinary obstruction of 96 h duration. They were clinically dull with poor reflexes with plasma urea nitrogen above 100 mg/dl but up to 150 mg/dl and serum creatinine 4 to 5 mg/dl. The animals had ruptured bladder and the calculi were lodged in the neck of urinary bladder and sigmoid flexure.

Group D (Danger line): They included animals with urinary obstruction of 120 h duration. They were clinically recumbent and areflexic with plasma urea nitrogen above 150 mg/dl up to -200 mg/dl and serum creatinine 5 to 6 mg/dl respectively. The animals had ruptured bladder and calculi lodgement was in the neck of urinary bladder, ischial urethra and sigmoid flexure.

Group T (Terminal): They included animals with urinary obstruction beyond 120 h duration. They were clinically recumbent and grossly areflexic with plasma urea nitrogen above 250 mg/dl and serum creatinine 7 mg/dl. The animals had ruptured bladder and calculi lodgement was in the neck of urinary bladder, ischial urethra, sigmoid flexure and penile urethra.

Ultrasonographic examination

Ultrasonography examination for the urinary conducts was done using a real time, B mode diagnostic ultrasound scanner (Sonaliza-32, Larson and Turbo) equipped with linear array 5 MHz linear probe. The animals were subjected to ultrasonography detailed as: The animals of Group A & B were subjected to ultrasound scanning in ventrodorsal approach with animal in supine recumbency, Group C animals were scanned in ventrodorsal approach in standing position, Group D animals in ventrodorsal, left lateral and trans-rectal approach in standing position however the animal of group T in terminal stage and grossly areflexic and hence were not subjected to sonography.

Surgical interventions

Preoperatively the dehydrated animals were given dextrose saline as per the dehydration status (Radostitis et al., 2000). The status of hydration was checked by status of eyes and skin fold test. The animals were allowed to stabilize and prepared for surgery at the earliest as per standard procedures.

Group A animals were subjected to normograde indwelling catheterization using polyvinyl chloride urinary catheter. The group B animals were divided into two subgroups of animals each



Figure 1. Tube cystostomy paramedian approach.

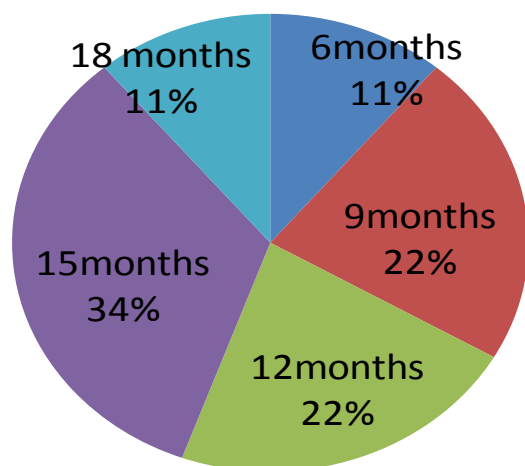


Figure 2. Age wise break up of cases.

subjected to tube cystostomy using Foleys catheter by two different approaches. In one subgroup para-median approach (Figure 1) and in another subgroup left paralumbar fossa was adopted. The group C animals were subjected to cystostomy and urethrotomy. The cystostomy was done using left supra pubic approach. The operation was done by standard procedure and the wound was sutured and sealed. Post-operatively animals received injections of Ampicillin-cloxacillin¹ and Meloxicam² at 12 and 0.5 mg/kg b.wt .respectively intravenously for 7 days. Group D animals were subjected to rocharization and percutaneous peritoneal catheterization. The group T was recumbent and comatose, abdominocentesis was attempted.

Intraoperative and post operative observations

The observations were made by assessing the conditions of urinary bladder, location of calculi, technical ease, difficulty encountered and re-invasive surgery needed if any. The animals were examined

clinically 24 h and at 8 and 16 days and at the time of removal of catheter for vital signs like rectal temperature, heart rate, respiration rate, uremic breath and capillary refill time. The wound sites were examined for complications if any and urine dribbling free flow from the natural orifices. The catheter was checked for leakage and patency. Minimal invasive surgery as demanded by particular animal was done and the patient discharged under a post-operative advisory note.

Statistical analysis

The data so procured were classified and subjected to statistical analysis. The inferences were drawn using analysis of variance (ANOVA) and Duncan's Multiple Range test (Snedecor and Cochran, 1976).

RESULTS

Screening of the calves

A total of 27 aging 3 to 18 months (Figure 2) calves presented to the Teaching Veterinary Clinical Service Complex of the University for the Treatment of obstructive urolithiasis conditions were screened as positive stone formers (100%). A total number of 52(A) calves were presented for various treatments other than urolithiasis. Within 3 to 4 months, from (A), 35 cases were reported to the clinics and out of them 19 were positive for urolithiasis. The percentage of positive cases from "A" was 54.28% and 8 calves were from these animals treated, included in total number of 27 cases, which form the material of this study (Table 1). Thus screening can be a test for early detection of urolithiasis to the level of 67% accuracy. The microscopic examination of the urine collected at days 0, 8, 16 and at the time of removal of catheter for observation of casts and crystals revealed that heavy score of crystals was recorded in the animals of all groups on the day zero without any significant difference.

Postoperatively the crystal showed progressive declining trend irrespective of the severity of the disease.

Anamnesis

The history record revealed that occurrence of the obstructive urolithiasis was age related. The age of the calves varied from 3 to 18 months. A study of age break up of cases revealed that 60% calves were in the age group up to 12 months and 40% above 12 months. Of all the cases presented with urolithiasis were Cross bred Jersey calves 70%, while local non-descript calves constituted 10% and only 20% cases were Frisian crosses. All these calves were uncastrated males except one calf which was female. The different feeds/fodders given to the calves of the study included wheat bran, rice bran, rice straw, commercial cattle feed, oats, oil cakes, soybean straw alone or in combination. Wheat bran alone

¹ and ² AC-Vet Forte, 3g vial, and Melonex, 30 ml vial. Intas Pharmaceuticals Ltd, 2nd floor Ashram road, Ahmadabad- 380009, INDIA.

Table 1. Showing screening of calves as stone and non stone formers.

The animals without any clinical manifestation of clinical Urolithiasis but presented with other diseases	52
Number of animals that show clinical manifestation of Urolithiasis	24
Animals that were positive (stone former)	24
Percentage of positive animals that show clinical Urolithiasis	10%
Animals presented at earlier (normal), manifested clinical Urolithiasis	35
Percentage of positive cases	67.30%

was given to (70%) of the cases. Wheat bran was provided in combination with rice straw to 30% of the cases. A common factor recorded was that the calves were feed concentrates at too early age before their rumen started functioning.

Previous treatment given to calves revealed that, about 50% cases received Frusemide injections either from owner himself/herself or by the Vet or Paravet and another 50% received sedatives, analgesics and tablet Cystone¹.

Clinical observation

Groups A and B were clinically alert, group C were dull and depressed whereas groups D and T were recumbent. Results depicting Mean \pm SE of vital signs like rectal temperature, heart rate, respiration rate, and capillary refill time were recorded and are presented in Table 2.

The rectal temperature at day zero was slightly higher in the animals which were clinically alert rectal temperature (102.86 \pm 0.16°F) and below danger line (102.60 \pm 0.33°F). However, the rectal temperature started declining to normal with the progression of the disease and it decreased significantly ($p < 0.05$) from groups A and B to groups D and T.

At 0 day, tachycardia was recorded in all the groups, which varied from 115.83 to 129.00 beats per minute. With the progression of recovery from the disease, the heart rate in different groups at days 8th, 16th and on the day of removal of catheter varied between 78.66 \pm 1.50 and 93.66 \pm 1.00; 83.16 \pm 0.83 to 94.00 \pm 0.16 and 82.00 \pm 0.50 to 83.33 \pm 1.00. Results from Table 2 revealed that at the time of catheter removal, the heart rate of the calves came within physiological limits irrespective of severity of the disease.

In all the cases in general there was significant ($p < 0.05$) decreasing trend of heart rate post-operatively till day 8th, 16th and up to the end of study where heart rate touched near normal (Table 2). The capillary refill time in different groups varied between 2.33 \pm 0.16 and 6.33 \pm 0.33). It showed an increasing trend in the animals with different levels of severity of disease. On 8th post-treatment, it decreased from 2 \pm 0.00 to 2.83 \pm 0.16 s. The

capillary refill time fell within range in all the groups except in group D. On day 16th, this group also showed reduction in capillary refill time which was comparable to rest of the groups. There was significant ($p < 0.05$) reduction in the capillary refill time from day 8th toward normal.

Ultrasonographic findings

Results of sonography in the groups under study revealed that there was intact bladder in group A and B as evident by the round hypo echoic image on bladder (Figure 3). It was however distended in group B. Sonography revealed a mild seepage of urine into the pelvic cavity, uroperitoneum, as evident by the hypo echoic image with floating of intestinal loop. The urethra was intact with mild urethritis. The concretions and calculi were located in the lumen and towards the neck of urinary bladder as evident by the multiple unevenly spread tiny hyper echoic patterns (Table 3).

In group C and D showed hyper echoic wall of the bladder. The tear was on the dorsal side in group C and at the neck in group D. There was moderate to severe seepage of urine into the pelvic cavity, uroperitoneum, as evident by the hypo echoic image. The urethra was ruptured in both the groups with severe urethritis and subcutaneous urine accumulation. The concretions and calculi were located in sigmoid flexure, ischial urethra, pelvic urethra and the penile urethra. Whole of the tract was occupied with the concretions as evident by the multiple unevenly spread tiny hyper echoic patterns (Table 3).

Perioperative results

Perioperative results were compared with the sonographic findings.

Group A and B

The urinary bladder was intact and shows serosal haemorrhages. There were concretions the lumen of the bladder. The distension was however more in group B animals. In group C animals bladder was ruptured on its dorsal aspect, tear measuring about 3 inches in length.

¹ *Himalyan drug ,manufactured by Indian Herbs Limited,Saharanpur,India.

Table 2. Mean±SE Rectal temperature (F°), heart rate (beats/minute), respiratory rate (per minute) and capillary refill time (in seconds) at different intervals in calves with obstructive Urolithiasis.

Groups	Parameter	0 day	8 day	16 day	*At the time of removal of catheter
Alert clinically (Group A)	Temperature (°F)	102.86±0.16 ^{aA}	101.33±0.58 ^{aB}	100.33±0.33 ^{aB}	100.96±0.13 ^{aB}
	Heart rate	115.83±2.83 ^{aB}	88.00±1.33 ^{aA}	85.33±0.33 ^{aA}	83.33±0.33 ^{aA}
	Respiration rate	43.16±0.83 ^{aC}	14.66±1.50 ^{aB}	11.33±0.66 ^{abA}	12.16±0.50 ^{aA}
	Capillary refill time	2.33±0.16 ^{aC}	2.00±0.00 ^{aB}	1.00±0.00 ^{aA}	1.00±0.00 ^{aA}
Below danger line (Group B)	Temperature (°F)	102.66±0.33 ^{aA}	101.33±0.41 ^{aAB}	100±0.66 ^{aB}	101.5±0.25 ^{aAB}
	Heart rate	117.66±2.66 ^{abC}	91.16±0.66 ^{aB}	87.33±2.00 ^{aaB}	83.66±0.66 ^{aA}
	Respiration rate	43.83±1.00 ^{aB}	13.16±1.50 ^{aA}	10.50±0.16 ^{aA}	12.66±0.66 ^{aA}
	Capillary refill time	2.83±0.33 ^{abB}	2.66±0.33 ^{abB}	1.00±0.00 ^{aA}	1.00±0.00 ^{aA}
Critical (Group C)	Temperature (°F)	100.91±0.41 ^{bA}	101.25±0.41 ^{aA}	100.83±0.33 ^{aA}	100.75±0.25 ^{aA}
	Heart rate	120.66±2.66 ^{abB}	94.00±0.16 ^{aA}	78.66±1.50 ^{bA}	82.00±0.50 ^{aA}
	Respiration rate	45.66±1.00 ^{aB}	13.83±1.50 ^{aA}	12.33±0.83 ^{abA}	12.83±0.66 ^{aA}
	Capillary refill time	3.50±0.50 ^{bC}	2.00±0.00 ^{aB}	1.00±0.00 ^{aA}	1.00±0.00 ^{aA}
Danger line (Group D)	Temperature (°F)	94.83±0.66 ^{cB}	91.33±0.66 ^{bA}	100.06±0.03 ^{aC}	100.16±0.16 ^{aC}
	Heart rate	124.16±4.33 ^{abC}	93.66±1.00 ^{aB}	83.16±0.83 ^{aA}	83.33±1.00 ^{aA}
	Respiration rate	56.00±1.16 ^{bB}	15.16±1.33 ^{aA}	13.16±0.83 ^{bA}	12.50±0.16 ^{aA}
	Capillary refill time	4.50±0.16 ^{cD}	2.83±0.16 ^{cC}	2.00±0.00 ^{aB}	1.00±0.00 ^{aA}
Terminal (Group T)	Temperature (°F)	88.33±1.66 ^d	-	-	-
	Heart rate	129±4.96 ^b	-	-	-
	Respiration rate	57.00±0.66 ^b	-	-	-
	Capillary refill time	6.33±0.33 ^d	-	-	-

*Above thirty days. Means with different superscripts differ significantly ($p < 0.01$). Small letters show comparison between groups. Capital letters show comparison between treatments.

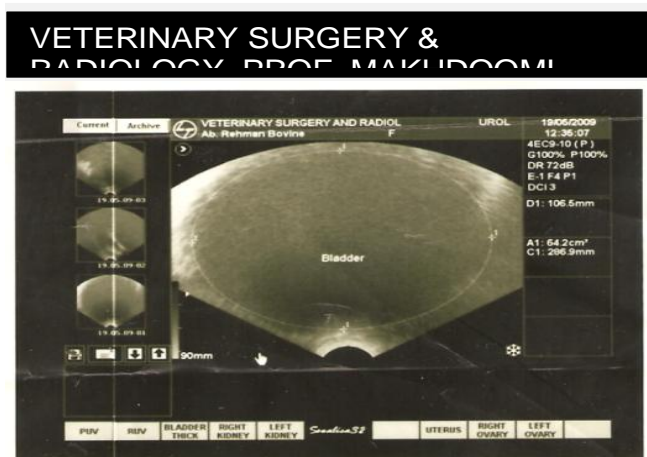


Figure 3. Sonogram showing distended intact bladder at 48 h obstruction.

Extensive haemorrhages on the serosal surface of the bladder were seen. There were concretions in the neck of the bladder, pelvic urethra and ischial urethra and group D animals showed ruptured bladder on the neck, tear

measuring up to 4.5 inches in length. There were concretions in the neck of the bladder, pelvic urethra and ischial urethra, sigmoid flexure and penile urethra.

Surgical interventions

The institution of surgical treatment in different groups was found more suited to clinical status, levels of clinical stress, duration of obstruction and ruptured or intact bladder. Earlier the time of diagnosis and presentation of the case for treatment earlier was the recovery. The animals with more derangement of clinical status received surgical approach with less intervention and duration. The time of initiation of dribbling of urine in the animals of group A was at the time of accomplishment of the surgery and the average time of initiation of urination through natural orifice was 16 days (19 days in case of Para lumbar approaches) treated by tube cystotomy. In groups C and D the time of initiation of urination was 22 and 26 respectively. The free flow of urine through the external urethral orifice could be due to interplay of many factors. Reduction in inflammation and urethral spasm by administration of anti-inflammatory drugs, drying up of

Table 3. Status of urinary conducts and position of calculi in groups A, B, C and D as revealed by ultrasonography.

Sonographic findings	
Disease conditions	Groups
Cystitis	A,B,C and D
Intact bladder	A and B
Ruptured bladder	C and D
Intact urethra	A and B
Ruptured urethra	C and D
Urethritis	
Mild	A and B
Moderate	A and B
Severe	C and D
Location of the calculi/concretions	
Lumen of the bladder	A
Neck of the bladder	B
Pelvic urethra	C (20%) and D (24%)
Ischial urethra	C (10%) and D (10%).
Sigmoid flexure	C (60%) and D (56%).
Penile urethra/ Glans	C (10%) and D (10%).



Figure 4. Sonogram showing ruptured bladder at 96 h obstruction.

calculi by diversion of urine through the tube cystostomy catheter, dissolution of urethral calculi by acidic urine caused by oral administration of ammonium chloride and of sodium chloride along with drinking water, pulverisation of calculi by litholytic effect of cystone tablets at 1 tablet twice daily, and occlusion of tube cystostomy catheter helped in achieving urethral patency by flushing the urethra of all debris and calculus material.

Post-operative complications

Different post-operative complications recorded in different groups included. Two cases of the group A

showed catheter blockage with fibrin clots and clotted blood, which were relieved by flushing with normal saline. Catheter dislodgement was observed in 3 cases each in group A and D. Second surgical intervention was needed in 6 of cases, and minimal invasive surgery was performed because of loss of the PVC catheter. Second laparotomy was performed and the Foley's catheter was fixed through Para median approach. Multiple nicks on the ventral abdomen were made in the cases of secondary urethral rupture to drain accumulated urine, to prevent urine scald and the gangrene. These cases recovered without any further complications. The mean time for removal of different types of catheters in different groups was almost same and depended upon the establishment of normal urine flow, following removal of urinary obstruction, fixation of catheter and suturing of the ruptured bladder (Figure 4). It was however instant in animals of group A and B.

DISCUSSION

Screening of the calves

Large numbers of crystals in dilute urine, persistent crystalluria and large crystals have greater significance in relation to stone formation and the crystal number is of greater significance than crystal shape and size (Khan and Hackett, 1987). Screening proved a good index for prediction of urolithiasis cases to 54% accuracy. The percentage could be more as during the study, only 35

cases out of 52 recorded cases reported to the clinical complex, fate of the rest cases goes unrecorded. Teotia (1975) reported the test 60% accurate.

Anamnesis

The duration of obstruction in calves varied from 24 to 120 h, our 50% (three cases in each group) cases were presented within 24 to 96 h of illness. The delay in the presentation of cases for the surgical intervention could be due to the time taken by the field veterinary staff in diagnosing and then treating the cases with medical options.

Equal number of calves had ruptured (groups C and D) and intact urinary bladders (groups A and B) at the time of presentation. The high occurrence of ruptured urinary bladder could be due to the delay caused in the diagnosis of the disease and consequent delayed presentation of the animal to the hospital, administration of diuretics to increase the urine output (Adam, 1995). The high occurrence of ruptured bladder cases has also been reported by earlier researcher (Amarpal et al., 2004). Prasad et al. (1978) also reported rupture of bladder in 37.5% of obstructive urolithiasis cases in cattle. During the study, urethra was found ruptured in 50% cases. Rupture of urethra is more common with irregularly shaped stones, which cause pressure necrosis of the urethral wall (Radostitis et al., 2000).

Incidence of urolithiasis was highest (60%) in age group of about 12 months and lowest (40%) in the calves of above one year. The observations recorded by Larson (1996) reported that castration causes reduction in urethral diameter, predisposes castrates for the lodgement of calculi does not seem to be the cause in our study.

Seventy percent calves were jersey crosses, 20 percent Friesian crosses and rest 1 percent non-descript. The highest percentage of urolithiasis in Jersey cross bred calves cannot be attributed to breed, as our population had highest number of jersey cross animals. The massive jersey cross breeding drive started in Kashmir during the years, have replaced our livestock with jersey population. Amarpal et al. (2004) reported incidence of urolithiasis in mixed breeds of cattle, buffalo and goats.

Previous treatment provided

Hundred percent cases were treated in the field before being presented to us with analgesic and anti-inflammatory, antibiotics, B complex preparations, urinary antiseptics, urinary alkalizers, antispasmodics and sedatives various. Half of the population under study had received injections of Lasix (Frusemide Hcl), a loop diuretic. Lasix increases urine formation and flow by its loop diuretic action and might clear obstruction in a few

cases with partial obstruction (Adam, 1995). Excessive production of urine may cause the rupture of the urinary bladder due to development of retrograde intra cystic pressure in bladder resulting rupture (Radostitis et al., 2000). This was one of the factors responsible for a high percentage of ruptured urinary bladder cases in this study.

Clinical examination

The rectal temperature in intact urinary bladder cases was slightly higher than the cases with ruptured urinary bladder. Broadly temperature was within normal range in groups A, B and C. However, it was significantly ($p < 0.05$) low in group D and T due to shock state as evidenced by clinical parameters for these groups. This substantiates the findings of Kulkarni et al. (1985); Sockett and Knight, (1986) and Radostitis et al. (2000). The results are not however in agreement with Jadon et al. (1987) and Singh and Sahu (1995).

Tachycardia recorded in the present study is in total agreement with the reports by (Jadon et al., 1987; Joshi et al., 1989; Monaghan and Boy, 1990; Tsuchiya and Sato, 1991; Singh and Sahu, 2005; Hooper, 1998; Smith, 1989). Increased heart rate could be attributed to the reflex response of baro-receptors and chemo-receptors, sympathetic stimulation or para-sympathetic inhibition of SA node (Sobti et al., 1986), progressive hyperkalaemia (Sharma et al., 2005; Bhokre and Deshpande, 1987), dehydration, biochemical alterations, inter-compartmental fluid shifts and myocardial asthenia (Kelly, 1984), accumulation of toxic metabolic waste products (Lavana et al., 1973), pain and progressive systemic disturbances (Monaghan and Boy, 1990). Inappetance and prolonged duration of illness and myocardial asthenia resulting from hyponatraemia and hyperkalaemia in ruminants could also be the possible.

Increased respiratory rate recorded corroborates with Hooper (1998) and Smith (2002). Increased respiratory rate could be attributed to toxemia as a result of retention of excretory metabolites due to pain caused by urethral calculi, abdominal crisis, electrolyte alterations like hypocalcaemia, hypomagnesaemia and hypovolumic shock (Wilson and Lofstedt, 1990) during obstructive urolithiasis. However, Radostitis et al. (2000) attributed the increased respiratory rate in uraemic animals to dehydration, myocardial asthenia, with hyponatraemia and hyperkalaemia as main causes. The delayed capillary refill time (2 to 4 s), an index of cardiovascular dynamics, could be due to dehydration and haemoconcentration, which is in total agreement with the statements given by Chew and Bateman (1999) and Radostitis et al. (2000).

Ultrasonography

Ultrasonography anon invasive method for diagnosis

has undoubtedly improved success rate of urolithiasis because of being earliest mode of diagnosis (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, 1992; Cartee et al., 1980). Ultrasonography is done without sedation (Braun, 1993; Magda, 2006; Makhdoomi and Sheikh, 2008). During the present study, transducers with different frequencies viz (3.5 MHz) for urinary bladder, 6.5 MHz for urinary bladder and pelvic urethra. Trans rectal scanning with trans-rectal transducers having frequency of (7.5 MHz) and percutaneous scanning of penile urethra with necessary adjustments of machine gains were used. In animals of group A, B, C and D cystitis revealed highly thickened and single layered hyperechoic cystic wall, with or without hyperechoic material within the lumen and/or attached to the mucosal layer but without any acoustic shadow. These hyperechoic materials without any acoustic shadows were blood clots and were differentiated ultrasonographically from the intramural growth and cystoliths, by subjecting the animals to moderate shaky movements to allow movement of the gravity dependent debris and clots. All the cases were confirmed intra-operatively by thickened cystic wall, hemorrhagic inflammation of cystic mucosa and tissue debris and massive blood clots in the cystic lumen and on mesentery.

Uroperitoneum is evident as anechoic fluid accumulation in the abdomen, within which the organs appear to be floating (Braun et al., 2006). In 18 cases of this study uroperitoneum was predominant and was correctly diagnosed on ultrasonographic examination as confirmed on laparo cystotomy. During this study acoustic shadow due to a single calculus or mass of calculi in a single unit was seen in three cases only from groups C and D, in rest cases ultrasonographic multiple small hyperechoic structures of varying size swirling in the anechoic fluid (urine) without any acoustic shadows were seen.

Peri-operatively, urinary bladder was found intact in all the cases of groups A and B (100%). This could be attributed to their early presentation with median duration of illness of 24 h. Haemorrhagic serosal surface could be due to the rupture of vessels and capillaries at the time of bladder rupture, while chocolate colour of bladder surface observed could be because of decreased perfusion due to overstretching of the bladder before rupture. Adhesions of urinary bladder with omentum and peritoneum could be due to the fact that upon rupture, eroded serosal surface could come into contact with adjacent omentum and peritoneum. Secondly in both such cases there was history of field diagnostic abdominocentesis/cystocentesis, which could have damaged both the serosal surface of the bladder and peritoneum/omentum and brought them together for healing. Bovine peritoneum lacks the plasminogen activators, which convert plasminogen to plasmin, a specific fibrinolytic inhibitor, which blocks the lysis of fibrin

(Trent and Bailey, 1986). A favourable environment for adhesion formation is thus provided after initial trauma of the peritoneum in cattle. The highest quantity of urine could be obtained from the cases with the prolonged duration of illness. In group C and D prolonged duration of illness with (96 to 120 h) seemed to be the predisposing factor for the rupture of urinary bladder. More ruptures on ventral side of the urinary bladder contradict the observations of Monaghan and Boy (1990) and Sockett and Knight, (1986). Ruptures were distributed throughout the bladder wall, that is, apex, body and neck, thereby suggesting that weak points anywhere in the bladder wall could rupture by the intraluminal urine pressure. Variable degree of roughness, haemorrhagic necrosis and leathery appearance of bladder surface in ruptured urinary bladder cases could be due to rupture of vessels and capillaries at the time of bladder rupturing. Bladder rupture seemed to have no effect on the uroliths retrieval sites within the bladder, as uroliths could be retrieved equally from cases of intact and ruptured urinary bladders.

Post-operatively, mild leakage of urine at 24 post-operative hours in tube cystotomy groups (Paralumber fossa approaches) was due to seepage of urine along the sides of catheter from uroperitoneum. Leakage from urethrotomy site as complication of this procedure has been documented (Sharma et al., 2005) which has been attributed to pressure necrosis of urethra caused by calculi which makes urethra more prone to leakage (Radostitset et al., 2000). Weaver and Schulte (1962) and Edwards and Trott (1973) were of the view that urethral stents like catheters may sometime have deleterious effects as they over distended urethral lumen at the injured site and thus leading to leakage of urine. However, tube cystotomy via paralumber fossa was easy, safe and simple procedure. The leakage was the main constraint. There was blockade of catheter in a few animals due to urinary sludge, blood clots, sandy material left in urinary bladder, and mucosal shreds.

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