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Tube Cystostomy in Male Buffalo Calves (*Bubalus bubalis*) Suffering From Retention of Urine

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ABSTRACT

To evaluate tube cystostomy for the management of obstructive urolithiasis, 35 buffalo calves suffering from retention of urine were randomly selected for the study. Diagnosis was made on the basis of a history of anuria, clinical signs, abdominocentesis and ultrasonographic examinations. The confirmed cases of obstructive urolithiasis were managed by surgical tube cystostomy technique with Foley's catheter. In all the affected buffalo calves, anti-inflammatory drugs and antibiotics along with urine acidifiers (ammonium chloride) were given. The affected buffalo calves had higher Heart rate, Respiration rate, but normal Rectal temperature. Haemoglobin (Hb), Packed cell volume (PCV), Blood urea nitrogen (BUN), creatinine, phosphorus and potassium, Serum glutamic pyruvic transaminase (SGPT) and Serum glutamic oxaloacetic transaminase (SGOT) levels were higher, whereas calcium, total plasma protein, albumin, globulin and albumin:globulin (A:G) ratio were lower than normal reference value and plasma sodium, magnesium and alkaline phosphatase values were within normal reference range. Urine analysis revealed high pH and low specific gravity. *Staphylococcus spp., E.coli* and *Streptococcus spp* .were the most common organisms isolated from the urine of affected animals, which were sensitive to cephalosporine and fluoroquinolone groups of antibiotics. The overall recovery rate was 91.42%. It may be concluded that tube cystostomy was treatment of choice and feasible method for the surgical management of obstructive urolithiasis in field conditions. The oral ammonium chloride may be beneficial for the medical dissolution of urethral calculi.

Keywords: Tube cystostomy, buffalo calves, urinary retention, haemato-biochemical

Urolithiasis is defined as the formation of uroliths/calculus in any part of the urinary system. Obstructive urolithiasis is frequently encountered surgical condition in all species of animals but most commonly in cattle, buffalo and sheep. In bovines, calculi can lodge anywhere in the urinary tract, but the common sites of obstruction are distal part of Sigmoid flexure and glans penis. Urinary calculi formation is a condition of multifactorial origin, which results from a combination of physiological, nutritional and managemental factors. However, it is mainly attributed to excessive or imbalanced intake of minerals particularly calcium, phosphorus and magnesium (Radostits *et al*., 2000).

Obstruction of urethra due to calculi or concretions results in retention of urine in urinary bladder and its over distention. Failure to provide treatment at an early stage often leads to rupture of either urinary bladder or urethra ensuing in rapid deterioration of the condition of the animal. Selection of appropriate surgical therapy depends on the value and intended use of the animal, the location of the obstruction, and the integrity of the urethra and bladder. Generally, a surgical procedure is considered successful when obstruction does not recur without accounting for morbidity i.e. urine scald or cystitis (Van Metre *et al.,*1996; May *et al*., 1998). Tube cystostomy technique provides an alternative surgical treatment for perineal urethrotomy and urethrostomy techniques that have poor long term outcome *(*Haven *et al*., 1993), because of stricture formation at urethrotomy and urethrostomy site and hence may be useful in preserving the breeding ability in animals.

Incidence of obstructive urolithiasis in buffaloes has been stated to be relatively far less when compared with cattle, however from the past few years, number of cases of buffalo calves suffering from urine retention has been observed to be increased at Teaching Veterinary Clinical Complex (TVCC) of LLRUVAS, Hisar. In several of these cases, urinary bladder is already ruptured by the time treatment is provided. A detailed study on the metabolic changes in much delayed cases of urinary retention and after making by-pass for urine voiding through tube cystostomy has not been made. Performing tube cystostomy and its evaluation for metabolic as well as clinical improvement and their long term prognosis will lead to a concrete scientific recommendation for treatment of such cases under field condition.

MATERIALS AND METHODS

The study was conducted on 35 male buffalo calves suffering from retention of urine due to obstructive urolithiasis at the Division of Veterinary Surgery and Radiology and Teaching Veterinary Clinical Complex, Lala Lajpat Rai University of Veterinary and Animal Science, Hisar during the period from September 2011-January 2012.

Clinical examination

The buffalo calves were clinically examined for general body condition, colour of mucous membrane, heart rate (HR- beats/min), respiration rate (RR- breaths/min), rectal temperature (RT °C) and status of bladder (ruptured/intact) by abdominocentesis and ultrasonography.

Ultrasonography

Ultrasonographic examination was done by 5 MHz sector transducer, on day 0 to evaluate the status and the size of urinary bladder, wall thickness and the presence of urinary calculi, if any.

Hemato-biochemical examination

After clinical examination, a total 5ml of blood (4ml in heparin and 1ml in EDTA) was collected from the jugular vein for the estimation of different haemato-biochemical parameters at different intervals before and after the surgical procedures performed i.e. on days 0 (0 hours), day 1 (24 hours), day 2 (48 hours). Out of 5ml blood, 1ml blood which was collected in EDTA vial was used for the estimation of different haematological parameters by standard procedures described by Schalm *et al*. (1975). The haemoglobin (Hb) was estimated by Sahili's haemoglobinometer method. Packed cell volume (PCV) was measured by microhaematocrit method. Total erythrocyte count (TEC) was estimated by using RBC diluting fluid by standard technique using Neubar's counting chamber. Total leucocyte count (TLC) was estimated by using WBC diluting fluid by standard technique using Neubar's counting chamber. Differential leucocyte count (DLC) was estimated by making blood smear stained by Gram.s staining method. (Schalm *et al*., 1975).

For the biochemical estimations, plasma was separated by centrifugation of 4 ml of heparinised blood at 3,500 rpm for 10 minutes. The plasma samples were utilized for the estimation of blood urea nitrogen (BUN) in mmol/L by GLDH-Urease method, plasma creatinine in micromol/L by alkaline picrate method, total plasma protein in g/L by Biuret method, albumin by bromocresol green method, globulin by subtracting the albumin value from the total protein, albumin:globulin ratio (A:G) by dividing albumin value by globulin, plasma calcium by 0-cresolphthalein complexone (OCPC) method, alkaline phoshphatase (ALP) by Kind and King.s method, serum glutamic oxaloacetic transaminase (SGOT) or aspartate aminotransferase (AST) and serum glutamic pyruvic transaminase (SGPT) or alanine transferase (ALT) by 2,4- DNPH method, on Automated Clinical Chemistry Analyzer* by commercial kits supplied by Erba manheim, Transasia Biomedical Ltd. Solan (H.P).

Evaluation of the treatment for obstructive urolithiasis

After thorough clinical, haemato-biochemical and ultrasonographic examinations, of all the animals, tube cystostomy was performed using Foley.s catheter (Uro-Cath, TM No. 18 or 20 FG), which was fixed into the urinary bladder, through a left prepubic paramedian approach. After tube cystostomy, the animals were administered with ammonium chloride @500 mg/kg body weight orally by dissolving it in a water daily for 20 days to acidify the urine for dissolution of calculi.

Surgical technique

Tube cystostomy

Anaesthesia and restraining

The calf was secured on the operation table in right lateral recumbency with the left hind- limb tied to far side of the table in flexed position to expose the left ventral caudal abdomen for paramedian approach. The calf was sedated lightly by giving xylazine at the dose rate of @0.1mg/kg body weight (0.2 ml approx.) and then local infilteration of 2% lignocaine HCL was done at the site of incision and near prepucial orifice.

Preparation of animal

The animal was prepared for aseptic surgery by shaving and scrubbing of the surgical site i.e. left caudal paramedian abdomen by 2% cetrimide solution in a standard manner. The site of incision was painted with 5% povidone iodine.

Surgical procedure

After preparation of animal for aseptic surgery, a 4-6 cm long incision was made about 5 cm lateral and parallel to the penile urethra in the left pre-pubic region. Peritoneal cavity was entered by separating the abdominal muscles and incising the peritoneum. A small incision in skin was made on the lateral aspect of preputial orifice and a straight artery forceps was passed from the posterior incision site to anterior one to make a subcutaneous tunnel parallel to the penis, and then the jaws of artery foreceps was opened. The tip of Foley's catheter was grasped within the jaws of artery foreceps and passed through the subcutaneous tunnel upto the site of posterior incision. After inserting a significant portion of Foley's catheter, the urine outflow was observed through the Foley's catheter and then the bulb of the catheter was inflated with 20-25 ml normal saline solution so as to anchor the catheter inside the lumen against the urinary bladder wall. After fixation of catheter within the urinary bladder, the abdominal incision was closed using standard procedure. The part of the catheter remaining outside the body was anchored to the abdominal skin as per the procedure described by Singh *et al*. (2004).

Urine analysis

About 2-3 ml of urine was collected aseptically from the Foley's catheter immediate post-operatively in a sterile urine collection vial before injecting antibiotic for the microbiological examination. The urine was processed for bacteriological culture and isolation and antibiotic sensitivity test (Bauer *et al*., 1996). Urine samples were also examined for colour, pH (pH paper strip), specific gravity by Urinometer method.

Post-operative care

The surgical wound was dressed by 5% povidone-iodine[1] solution or ointment (Betadine) and fly repellant spray (Exoheal/topicure/healwell/D.mag spray) twice daily till the healing of the wound. Broad spectrum antibiotic e.g. cefotaxime (Biotax[2] 1gm) and Amikacin[3]-500mg and anti-inflammatory drug e.g. ketoprofen @3mg/kg body weight or Meloxicam @0.2mg/kg body weight were administered I/M for 5-7 days. Ammonium chloride @500mg/kg body weight was also (administered) orally in drinking water for 15-20 days.

After 3-4 days of surgery, the opening of Foley's catheter from where urine comes out was blocked by a sterilized wooden stick or the cap of hypodermic needle for 2-3 hours twice daily to create pressure in the urinary bladder. Once dribbling of urine was noticed through urethra, the period of occlusion of Foley's catheter was increased gradually. When free flow of urine was observed from the urethra, the Foley's catheter was closed permanently for 3-4 days. If there is no obstruction to the free flow of urine during this period, the Foley's catheter was removed by deflating the balloon.

Observations

Peri-operative observations

The different peri-operative observations viz. status of urinary bladder, site of rupture of urinary bladder, appearance of urinary bladder surface, adhesions of urinary bladder with other abdominal organ or abdominal wall, any other changes in peritoneal cavity were recorded and the time taken from skin incision to closure of skin was considered as the duration of surgery.

Post-operative observations

The results regarding the clinical parameters viz. physiological parameters; haematobiochemical parameters; and urinary physico-chemical and microbiological parameters were recorded in all the animals on day 0, day 1 and day 2.

Complications of tube cystostomy technique

Complications like blockade of catheter due to negligence of owner or due to some concretions or pus flakes lodged at the eye of Foley's catheter, removal of catheter before recovery, withdrawl and kinking of catheter, tightening of knots of catheter, infection along subcutaneous tunnel were recorded. The complicated cases were managed by 2nd surgical procedure, if required, which were included either tube cystostomy or urethrotomy. Overall success rate was calculated using number of cases with normal recovery, number of cases recovered after complication.

Statistical analysis

The data were analysed using One-Way analysis of variance (ANOVA) to compare the values among different subgroups at corresponding intervals and Student's paired t test for the comparison of the different values with base values in different subgroups (Snedecor and Cochran, 1994). The differences were considered significant at level of $P<0.05$.

RESULTS

Clinical examination

The general body condition of the 35 selected buffalo calves included in the study varied from fair to poor depending on the time spent between the disease onset and presentation of the animal to the clinics. Twenty seven (77.14 %) buffalo calves had a fair general body condition, six (17.14 %) buffalo calves had poor body condition. However, in two cases, it was very poor to moribund condition was found in two cases (5.71 %). The clinical signs varied according to the status of the urinary bladder and duration of urethral obstruction. The urinary bladder was found intact in 13 buffalo calves (37.14 %), whereas in remaining 22 calves (62.85 %) urine was present in the peritoneal cavity either due to complete rupture of urinary bladder (12) or sub-serosal rupture of urinary bladder (10).

The clinical signs in animals with intact urinary bladder included anuria, inappetance to anorexia, reluctant to walk or move, respiratory distress, normal alertness to depressed and dull appearance, sunken eyes, engorged urethra and sphincter movement, twitching of the penis, straining for urination, maintaining urinary posture for prolonged periods and prolapsed of rectum due to straining.

Fig: 1: Bufaalo calf with retention of urine (water belly condition)

The mean ±SE heart rate (per minute) in the affected animals was 75.75±2.84, which was higher than the normal reference value (66.00± 2.91). However, the mean ±SE heart rate in the cases with intact urinary bladder (n=13) was 73.05±2.66 (50-90) and in buffalo calves with ruptured urinary bladder, it was 77.51±4.38 (23-128).

The mean ± SE respiratory rate (breaths / minute) in all the affected animals was 30.625± 2.00 (14-70), which was higher than the normal reference value (22.06± 1.56). However, it was 25.52± 2.58 (14-52) in the calves with intact urinary bladder and 33.96± 2.71 (16-70) in the calves with ruptured urinary bladder.

The mean ± SE rectal temperature (°C) in the affected buffalo calves was 37.88±0.158 (34.50-40.30). However, it was 37.93±0.16 (36.60-37.10) in the calves with intact urinary bladder and 37.76± 0.23 (34.50-40.3) in the calves with ruptured urinary bladder.

The mean±SE time of skin fold test was 4.097±0.311 seconds (1.17-10.00). However, the mean ± SE time for skin fold test in calves with intact urinary bladder and ruptured urinary bladder was 3.32 0.41 (1.19-8.92) and 4.601 0.41 (1.17-10.00) seconds, respectively.

In cases of intact urinary bladder, five calves had 4-6% dehydration, seven calves had 6-8% dehydration and one calf had 8-10% dehydration. However, in cases of ruptured urinary bladder, three calves had 4-6% dehydration, fifteen calves had 6-8% dehydration and four calves had 8-10% dehydration. Overall, 22 calves had 6-8% dehydration, eight calves had 4-6% dehydration and five calves had 8-10% dehydration.

Ultrasonographic examination

On the day of admission, ultrasonographic examination of urinary bladder was performed. The intact urinary bladder appeared as a round body with tensed bladder wall. The bladder lumen showing anechoic shadow indicating the presence of urine; however, scattered pin point hyperechoic shadows were also seen indicating the presence of suspended particles.

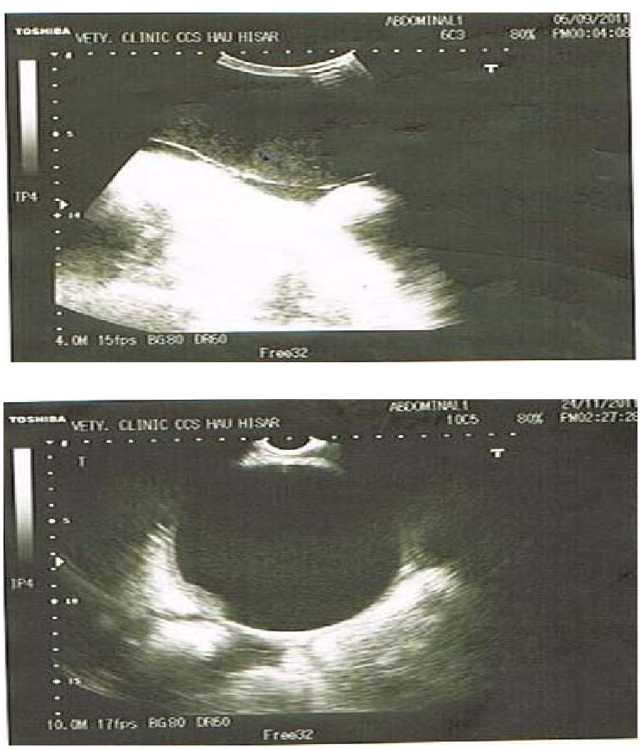

Fig. 2: Ultrasound image showing seepage of urine due to sub-serosal rupture of urinary bladder, there is disruption of wall of urinary bladder which is hypoechoic in appearance. The urine present in urinary bladder is an anechoic appearance whereas urine present in the abdominal cavity is hypoechoic in appearance

In case of ruptured urinary bladder, there was complete disruption of hyperechoic wall of the urinary bladder. In case of ruptured urinary bladder, the accumulation of urine in the abdominal cavity can be visualized as hypoechoic image with floating of intestinal loops.

Post-operative haemato-biochemical observations

The Mean±SE values of haemaoglobin (g%), Packed cell volume (%), Total Erythrocyte count ($\times 10^6$/cu.mm), Total leucocyte count ($\times 10^3$/cu.mm), neutrophil count, lymphocyte count, monocyte count and eosinophil count in the buffalo calves suffering from obstructive urolithiasis at the different post operative days have been shown in Table 1. There was non-significant progressive decrease in haemoglobin, packed cell volume, total erythrocyte count, total leukocyte count, neutrophil count, lymphocyte count, monocyte count and eosinophil count from the pre-operative value to 24 hours and 48 hours postoperatively and fluctuated within the normal range during the entire period of study.

The Mean±SE values of biochemical parameters in buffalo calves suffering from obstructive urolithiasis at the different post operative days have been shown in Table 2. The pre-operative value of BUN was higher (46.45±0.82 mmol/L) than the reference value (12.23-22.95 mmol/L), but post operatively BUN value decreased significantly at 24 hours and 48 hours and fluctuated within the normal range during the entire period of study.

The pre-operative value of creatinine was higher (433.94±40.86 μmol/L) than the normal reference range (130.25±27.25 μmol/L), but post operatively BUN value decreased significantly at 24 hours and 48 hours and the value did not return within the normal range during the entire period of study (Table 2).

The pre-operative value of total protein was lower (66.91±1.22 gl/L) than the normal reference range (83-125 g/L), but post operatively, it increased significantly at 24 hours and 48 hours but the value did not reach within normal range till 48 hours (Table 2).

The pre-operative value of Albumin, Globulin (g/L) and Albumin: Globulin ratio (A:G) was lower than the normal reference range and after surgery, it increased non significantly at 24 hours and 48 hours and the value did not reach within the normal range during the entire period of study (Table 2).

The pre-operative value of plasma calcium was below the normal reference range and post operatively, it increased non-significantly at 24 hours and 48 hours and the value was fluctuated within the normal range during the entire period of study (Table 2).

The pre-operative value of plasma phosphorus was higher but fluctuated within the normal range and post operatively, it decreased non-significantly at 24 hours but decreased significantly after 48 hours and remained within the normal range during the entire period of study (Table 2).

The plasma sodium ion value was within the normal range (132-152 mmol/L) on day zero without any significant difference at post operative interval of the study.

The pre-operative value of plasma potassium was higher than the normal range (3.9-5.8 mmol/L) and after the surgery, the level of potassium progressively decreased significantly from its corresponding pre-operative value at 24 hours and 48 hours and reached within normal range (Table 2).

The Mean±SE values of plasma magnesium (mmol/L) was within the normal range (0.74-1.10 mmol/L) on day 0 and progressively decreased significantly at 24 hours

Table 1: Mean±SE values of haematological parameters in buffalo calves suffering from obstructive urolithiasis at different intervals

Parameters (Units)	Base Value (0 hour)	24 hour after surgery	48 hour after surgery
Haemoglobin (g%)	12.92±0.23^{a}	12.60±0.20^{a}	12.36±0.21^{a}
PCV (%)	39.46±0.58^{a}	38.44±0.59^{a}	37.56±1.21^{a}
TEC (x106/cu.mm)	6.27±0.16^{a}	6.21±0.08^{a}	5.94±0.10^{a}
TLC (x103/cu.mm)	13.87±0.47^{a}	13.42±0.48^{a}	12.13±0.44^{a}
Neutrophils (%)	60.66±2.17^{a}	57.84±2.29^{a}	56.56±1.67^{a}
Lymphocytes (%)	34.37±1.67^{a}	36.07±1.97^{a}	34.37±1.67^{a}
Monocytes (%)	1.40±0.11^{a}	1.72±0.35^{a}	1.16±0.14^{a}
Eosinophils (%)	0.77±0.13^{a}	0.53±0.12^{a}	0.59±0.11^{a}

Means with different superscripts vary significantly (P<0.05)

Table 2 : Mean±SE values of biochemical parameters in buffalo calves suffering from obstructive urolithiasis at different intervals

Parameters (Units)	Base Value (0 hour)	24 hour after surgery	48 hour after surgery
BUN (mmol/L)	46.45±0.82^{b}	37.11±0.68^{a}	25.48±0.48^{a}
Creatinine (μmol/L)	433.94±40.86^{b}	268.80±29.96^{a}	212.81±21.68^{a}
Total Protein (g/L)	66.91±1.22^{b}	63.69±0.83^{a}	63.10±0.86^{a}
Albumin (g/L)	30.78±0.81^{a}	29.41±0.57^{a}	28.76±0.62^{a}
Globulin (g/L)	33.20±1.42^{a}	34.27±0.88^{a}	34.36±0.71^{a}
A:G ratio	0.88±0.03^{a}	0.87±0.03^{a}	0.84±0.02^{a}
Calcium (mmol/L)	1.92±0.03^{a}	1.81±0.03^{a}	1.82±0.03^{a}
Phosphorus (mmol/L)	3.32±0.14^{b}	3.07±0.15^{ab}	2.77±0.14^{a}
Sodium ion (mmol/L)	141.48±0.61^{a}	142.28±0.70^{a}	141.72±0.51^{a}
Potassium ion (mmol/L)	6.65±0.06^{c}	5.98±0.06^{b}	5.16±0.06^{a}
Magnesium ion (mmol/L)	0.91±0.008^{c}	0.82±0.006^{b}	0.67±0.006^{a}
ALP (IU/L)	136.34±5.60^{b}	110.78±5.28^{a}	106.62±5.39^{a}
SGOT (IU/L)	153.60±6.70^{a}	152.99±7.27^{a}	136.88±6.00^{a}
SGPT (IU/L)	57.02±2.80^{a}	52.22±2.34^{a}	50.04±13.80^{a}

and 48 hours post-operatively from its corresponding pre-operative value but remained within the normal range during the period of observation (Table 2).

The pre-operative value of Alkaline phosphatase was within the normal reference range (118.5±64.30 IU/L). The value decreased significantly at 24 hours and 48 hours post-operatively from its corresponding pre-operative value, but was within the normal range and there was no significant difference between 24 hours and 48 hours (Table 2).

The pre-operative value of plasma SGOT and SGPT were higher (153.60±6.70 IU/L) and (57.02±2.80 IU/L) respectively than the normal reference ranges (80-140 IU/L) and (25- 45 IU/L) respectively and post operatively, the values of both SGOT and SGPT decreased non-significantly at 24 hours and after 48 hours and the SGOT value reached within the normal range but the SGPT value did not reach within the normal reference range during the entire period of study (Table 2).

Urine analysis

Physical properties of urine

The colour of urine in buffalo calves selected in the study on the day of admission varied from light yellow to smoky coloured and brownish coloured depending upon the duration of illness and the status of urinary bladder. In cases of intact urinary bladder, the colour of urine was light yellow or straw coloured in 14 calves and dark yellow in 9 calves. In cases of ruptured urinary bladder, the colur of urine was light yellow in 4 calves, smoky in 5 calves and brownish in 3 calves.

The consistency of urine in buffalo calves suffering from obstructive urolithiasis varied from normal to slight viscous and in some cases, thick flakes (gelly like) in the urine were also found depending upon the duration of illness and the status of urinary bladder.

The Mean±SE values of pH of urine in buffalo calves suffering from obstructive urolithiasis was lower than the normal reference range on the day of admission and decreased non-significantly after 24 hours and 48 hours post operatively (Table 3).

The Mean±SE value of specific gravity of urine in buffalo calves suffering from obstructive urolithiasis was lower than the normal reference range on the day of admission and increased significantly after 24 hours and 48 hours post operatively (Table 3).

Microbiological examination of urine

A total of 35 urine samples of the affected calves on the day of admission were subjected to the isolation of micro-organisms and antibiotic sensitivity test for the isolated micro-organisms. Out of 35 samples , 24 urine samples (68.57 %) showed no evidence of growth of microorganisms atleast for 3 days. In remaining 11 urine samples (31.42%), different types of micro-organisms were isolated with the maximum occurrence of *Staphylococcus sps*. (4; 36.36%) followed by mixed growth of *Staphylococcus sps.* And *Streptococcus sps.* (3; 27.27 %), *Streptococcus* sps. (2; 18.18%) and *Escherichia coli* (2; 18.18%). The results of Antibiotic sensitivity test (ABST) of the isolated micro-organism have been shown in Table 4. The Antibiotic sensitivity test against isolated micro-organism varied greatly and did not show any specific trend. However, from the tested antibiotics, Cephalosporine and Fluoroquinolone groups of antibiotics were more effective against the micro-organisms.

Table 3: Mean±SE values of urine pH and specific gravity of urine in buffalo calves suffering from obstructive urolithiasis at different intervals

Parameters (units)	Base value (0 hour)	24 hours	48 hours
Urine pH	7.37±0.08^{a}	7.58±0.06^{a}	7.75±0.07^{a}
Specific gravity of urine	1.015±0.002^{c}	1.018±0.002^{b}	1.020±0.003^{a}

Means with different superscripts vary significantly (P<0.05)

DISCUSSION

Urolithiasis equally occurs in male and female animals, but obstruction is not generally caused in the female urethra due to the short length and flexible lumen of the urethra as tunica albuginea is not present over the female urethra (Radostits *et al*., 2000) and sigmoid flexure is only present in the urethra of male ruminants only which

Table 4: Urine isolates from buffalo calves suffering from obstructive urolithiasis on day 0 and their sensitivity to different antibiotics

Sl. No.	Micro-organism(s) Isolated	No. of isolates	Antibiotic sensitive
1	*Staphylococcus* sps.	4; (36.36%)	Norfloxacin, Gentamicin, Chloremphenicol, Ceftriaxone, Ciprofloxacin, Ofloxacin, Cefotaxime, Amikacin, Ampicillin.
2	Mixed type (*Staphylococcus* sps. and *Streptococcus* sps.)	3; (27.27 %)	Norfloxacin, Gentamicin, Chloremphenicol, Ceftriaxone, Ciprofloxacin, Ofloxacin, Cefotaxime, Amikacin, Ampicillin, Nalidixic acid, Nitrofurantoin.
3	*Escherichia coli*	2; (18.18 %)	Cefotaxime, Levofloxacin, Ciprofloxacin, Ceftriaxone, Piperacillin, Nitrofurantoin.
4	*Streptococcus* sps.	2; (18.18 %)	Norfloxacin, Ceftriaxone, Ciprofloxacin, Ofloxacin, Cefotaxime, Amikacin, Ampicillin, Nalidixic acid, Nitrofurantoin.
5	No growth	24, (68.57 %)	—

is the main site of obstruction. This could be the reason for obstructive urolithiasis recorded only in male buffalo calves in the present study.

The concentrate rations are rich in phosphate contents and may predispose them to the urolithiasis (Van Metre, 2004; Singh *et al.,* 2005). However, in buffalo calves, early weaning, feeding of phosphorus rich diet like wheat bran, rice bran and less water availability might be the reasons for the urolithiasis.

Mean heart rate was found higher than the normal reference value in most of the calves in the present study which has also been observed by earlier workers in the cases of obstructive urolithiasis (Tsuchiya and Sato, 1990; Singh, 2005). According to Radostitis *et al*. (2000), inappetance and prolonged duration of illness and myocardial asthenia resulting from hyponatraemia and hyperkalaemia in ruminants were suggested the possible cause of increased heart rate in the cases of obstructive urolithiasis.

Respiration rate was higher than the normal reference value, which could be due to pain caused by the urethral calculi, electrolyte aberrations like hypocalcaemia, hypomagnesaemia and hypovolemic shock. Radostitis *et al*. (2000) suggested hyponatraemia and hyperkalaemia as the main causes of the elevated respiration rate in uraemic animals. Bilateral distension of abdomen due to accumulation of urine in peritoneal cavity also causes pressure over diaphragm, which could result in increased and shallow respiration rate.

In the present study, the rectal temperature was within the normal reference range and the rectal temperature in intact urinary bladder cases was a bit higher than in cases with ruptured urinary bladder. The variation in the rectal temperature could probably be due to the variation in the stage of uraemia, duration of illness and degree of haemodynamic changes. In the present study, it was noticed that rectal temperature was found to be low in the terminal stages of uraemia or when the buffalo calves were presented to clinics in moribund condition. Earlier researchers have also reported variable values of rectal temperature in cases of urolithiasis.

The skin tent test and per cent dehydration are closely related to each other as the loss of skin elasticity is primarily due to loss of fluid from the interstitial and intracellular spaces (Radostitis *et al.,* 2000). In the present study, per cent dehydration varied from 4-10% (skin tent test 1.17-10.00 seconds) with most of the calves having 6-8% dehydration. However, per cent dehydration was more in the cases of ruptured urinary bladder, which might be due to shifting of more water from the interstitial and intravascular fluid into the peritoneal cavity.

Haemato- biochemical examination

The mean haemoglobin value was within the normal range, but it was more in cases of ruptured urinary bladder. The buffalo calves had considerable non-significant high values of PCV preoperatively in both intact and ruptured urinary bladder. A high haemoglobin and PCV might be attributed to haemoconcentration due to dehydration (Radoitis *et al*., 2000). This is so because the plasma concentration of total proteins was considerably low preoperatively in these animals. After treatment, there was significant reduction in plasma concentration of total proteins and can be related to the fluid therapy given to the animals. In earlier studies, levels of Hb and PCV in animals suffering from urolithiasis were not uniform. Higher values of Hb and PCV in retention of urine cases in bovines have been reported by other workers (Gangwar, 1990; and Reddy, 1992). The values of Hb and PCV decreased postoperatively towards normalcy at different intervals and it could be attributed to the onset of rehydration due to fluid therapy and normal intake of food and water following correction of the urethral obstruction (According to Pandey *et al.,* 1987). They attributed the decline in PCV and total erythrocyte count (TEC) to the toxic depression of bone marrow and reduced erythropoietin secretion from the kidneys in uraemic animal as earlier opined by Lund (2000).

Although the total leucocyte count was within the normal reference range, it was more in the cases of ruptured urinary bladder, which might be due to dehydration in the uraemic animals along with the pain and stress as a result of urethral obstruction and peritonitis. Pain and stressful conditions have been suggested to induce leucocytosis by Morris (1990). Neutrophil count was higher in the cases of ruptured urinary bladder, which might be related to stress, pain, fear, extensive tissue necrosis and peritonitis (Gaunt, 2000).

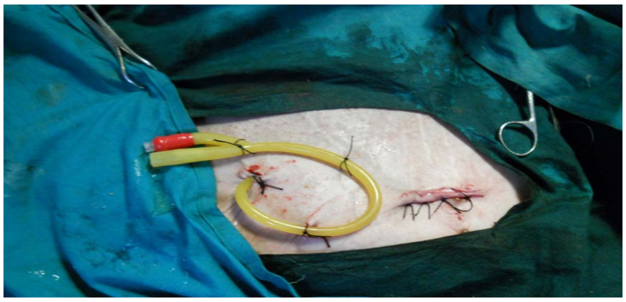

Fig: 3: Showing closure of laparotomy incision and fixing of Foley's catheter with lateral abdomen in a loop fashion using silk

In the present study, the preoperative levels of blood urea nitrogen were significantly higher in all animals, which was basically due to decreased glomerular filteration rate resulting in decreased urea excretion. In urethral obstruction, urine gets accumulated into the urinary bladder for more than normal period of time. Thus, the urea gets reabsorbed into the systemic circulation and causes uraemia. Further, urethral obstruction may cause back flow of urine and thus creates pressure over the kidney to reduce the urine production by decreasing glomerular filteration rate and ultimately decreased urea excretion in urine (Sharma *et al*., 2006). This could be the reason for very high levels of BUN in buffalo calves of the present study. Similar types of findings have also been reported by several authors (Singh *et al*., 2005; Sharma *et al*., 2006). Plasma urea nitrogen in the cases of ruptured urinary bladder was much higher than that in the intact urinary bladder cases, which could be due to movement of urea from the high concentration in peritoneal cavity to the interstitial and intravascular compartments. In ruminants, large amount of urea is excreted in the saliva and enters into the rumen where it is hydrolysed by urease to ammonia, which is drained to venous blood but reconverted into urea by liver. This mechanism may help in maintaining the blood urea level in normal range for some time but in long standing cases, a high level of blood urea nitrogen may occur inspite of recycling of urea through rumen (Sharma *et al*., 2006).

In the present study, the significant rise in the creatinine level might be due to increased resorption of creatine from the urinary bladder due to prolonged stasis of intact urinary bladder and renal damage due to hydronephrosis (Singh, 2005). In the present study, the plasma levels of creatinine in the cases of ruptured urinary bladder were higher than that of intact urinary bladder. This could be due to movement of creatinine from the peritoneal fluid to blood. Prolonged anorexia, starvation and dehydration can cause elevated levels of urea nitrogen and creatinine in the absence of any disease of urinary system. However, in another study, several cattle with prerenal azotemia had blood urea nitrogen concentrations greater than those with renal disease (Brobst *et al*., 1978). Such difference could pose a problem in diagnosis of renal diseases as far as only measurement of blood urea nitrogen is concerned.

Two different mechanisms might be responsible for changes in total plasma proteins. The anorexia and chronic starvation may lead to depletion of total plasma proteins. However, dehydration could lead to increased concentration of total plasma protein. In the present study, a non-significant decrease in plasma proteins was recorded during the initial preoperative period. Afterwards values increased to reach to near normal range. This lower levels of total plasma proteins might be attributed to the anorexia arising from intense pain (Kerr, 2002) or due to necrosis of subcutaneous tissue.

In the present study, albumin values were lower than the normal range, but slightly higher values were recorded in animals with ruptured urinary bladder than that in the animals with intact urinary bladder possibly due to greater degree of dehydration in the cases of ruptured urinary bladder. This decrease in albumin could be attributed to the passage of albumin into the extracellular compartment due to injury on the urinary bladder. Further, albumin is a negative acute phase protein so during acute inflammation it decreases to enhance the protective and healing functions by focussing the metabolic activities of animals towards the synthesis of protective proteins (Varshney *et al*., 1992).

No significant change in plasma globulin level was recorded in the present study. This further indicated that the generalized decrease in total plasma protein levels was mainly due to the decrease in plasma albumin. However, greater inflammatory reaction as a result of leakage and subcutaneous infiltration of urine might have led to higher postoperative levels of globulin. Kerr, 2002 also opined that the inflammation could be a reason for increased globulin level in different domestic animals.

In general, A:G ratio is an indicator of dysproteinemia and reflects general condition of the body and its response to the inflammatory reaction. An initial decreased was followed by a rise in A:G ratio which might be mainly due to decrease in albumin as already explained.

Plasma calcium levels were below the normal range whereas plasma phosphorus levels were above the normal range in all the present clinical cases. Similar findings have also been recorded by earlier researchers (Sockett *et al*., 1986; Singh *et al*., 1987). Hypocalcaemia and hyperphosphataemia in the present study might be attributed to feeding of concentrate diets rich in phosphorus and low in calcium content. Absorption of calcium is affected by calcium: phosphorus ratio within the gut and an increase in phosphorus will reduce absorption of calcium. Thus, the higher levels of phosphorus in the concentrate diets could have further reduced the calcium absorption from the gut.

The preoperative value of plasma sodium ion was within but towards the lower end of the normal range and did not vary significantly during the postoperative period in the animals. The reason for normal levels of sodium in the present study could be dehydration, which might be responsible for maintenance of sodium level in uraemic animals or may have masked the actual fall in the level of plasma sodium. When urinary bladder rupture takes place and urine invades the peritoneal cavity, a number of movement in fluid and electrolytes can be expected. Because of low concentrations of sodium and chloride in the urine, these ions move from interstitial compartment into the peritoneal cavity and depress the plasma levels (Sockett *et al*., 1986).

The plasma potassium level was higher than the normal reference range in the present study. Hyperkalaemia following retention of urine in bovines could be attributed to release of potassium from the damaged cells due to possible tissue hypoxia in uraemic conditions. The postoperative decrease in potassium values towards the normal range could be attributed to correction of uraemia and dehydration, and clearance of potassium in the urine (Sockett *et al*., 1986).

The normal preoperative values of plasma magnesium could be attributed to dehydration and the resorption of magnesium from urine in the abdominal cavity in a few calves in the present study. In the anorectic animals the magnesium level would have been lower, as magnesium concentration in the blood and extracellular fluid are determined by the balance between the dietary intake of magnesium, loss in faeces and homeostasis by kidneys (Radostits *et al*., 2000). This viewpoint could be substantiated by the fact that rehydration by administration of intravenous fluids led to fall in magnesium levels at 24 hours postoperatively. The increase in magnesium noticed could be attributed to dietary advice to the owners and return of appetite, so that volatile fatty acids were produced, which provide energy for the active transport of magnesium across the rumen wall thus increasing magnesium absorption.

Alkaline phosphatase increases in hepatic injury and hepatic disorders (Kerr, 2002), hyperparathyroidism, renal diseases and osteosarcoma and in presence of endogenous and exogenous corticosteroids (Jhonson and Sherding, 1999). Plasma alkaline phosphatase levels were within the normal range in the buffalo calves of the present study. This indicated that liver or kidney damage was not a major concern in the cases of obstructive urolithiasis in buffalo calves.

The plasma SGOT level was non-significantly higher than the normal reference range in the present study. High levels of SGOT have also been recorded in sheep by Singh

(2005) in goat suffering from obstructive urolithiasis. Kerr (2002) reported that SGOT is a non-specific indicator of the tissue damage and is normally present in tissues like skeletal muscle, cardiac muscle, liver, RBC.s and kidneys. Therefore, the elevated level of SGOT could be due to cellular damage in various organs due to uraemia and dehydration.

The plasma SGPT level was non-significantly higher than the normal reference range in the present study. In general, high values of SGPT are noticed when damage occurs to liver, kidney, heart and muscles. However, in contrast to present study, Singh (2005) reported a high level of SGPT in the urinary obstruction in small ruminants.

Urinary analysis

The variation in the colour of urine of the affected animals in the present study was probably due to the variation in concentration of urine, accumulation of sediment and haemorrhage. The concentrated urine was dark yellow and diluted urine is pale yellow in colour (Finco, 1997). Dirty yellow coloured urine might be due to the presence of sabulous materials in the urinary bladder. Brownish urine indicated inadvertent mixing of blood in the urine, whereas dark yellow colour urine indicated concentration of urine due to more duration of illness. Some samples of urine were more opaque with some offensive odour, which could be due to mild to moderate degree of infection in the urinary bladder, which imparted opacity and offensive odour.

In ruminants, urine is neutral or slightly alkaline due to feeding of cereal diets or mostly forages. Alkaline urine is also seen in metabolic/respiratory alkalosis due to reduced H^+ excretion into urine and urethral obstruction that causes decomposition of urea to ammonia (Carlson, 1990). Formation of phosphate, carbonate and struvite calculi was favoured at the alkaline urine pH as their precipitation is more rapid at alkaline pH (Belknap and Pugh, 2002). In the present study, the base value of urine pH were alkaline, however, a non-significant high pH values might be due to decomposition of urea to ammonia and urinary tract infection which was recorded in few cases.

Microbiological examination of urine

In the present study, out of 35 urine samples subjected to microbiological examination, 24 urine samples (68.57%) showed no evidence of growth of microorganisms and 11 urine samples (31.42%) showed growth of different micro-organisms. The maximum occurence of *Staphylococcus sps*. was found in four buffalo calves (36.36%) followed by mixed growth by *Staphylococcus sps.* and *Streptococcus sps .* in three buffalo calves (27.27 %), streptococcus sps. in two buffalo calves (18.18%) and *Escherichia coli* in two buffalo calves (18.18%). Therefore, urinary tract infection might also be considered as one of the cause for the genesis of uroliths, particularly concretions. Sharma *et al*. (2006) has also isolated *E. coli* (57.10%), *Staphylococcus spp.* (28.5%) and *Klebsiella spp.* (14.4%) bacteria in the cases of uroperitoneum and concluded that bacterial infection might be the predisposing cause for urethral concretion formation in buffalo calves. The isolated micro-organisms were sensitive to the cephalosporine and fluoroquinolone groups of antibiotics and corroborated the findings of Monoghan and Boy (1990) and Sharma *et al*. (2006).

Fig 4: Buffalo calf after completion of tube cystostomy

The affected buffalo calves treated with tube cystostomy showed 91.42% normal recovery rate without showing complications. However, in some cases, blockade of Foley's catheter was reported by owners due to improper post-operative care including untimely flushing of catheter. A higher success rate with tube cystostomy could be attributed to its simplicity, less complication and early relief from the urinary obstruction. Failure of technique was noticed in terms of animal either fail to recover normally or died. Tube cystostomy technique failed to produce desirable results in 8.58% cases due to advanced cases of uraemia and delayed presentation. In the earlier studies, Rakestraw *et al*. (1995) treated twelve goats (85.74%) out of fourteen goats with tube cystostomy;

Singh (2005) reported 95% success rate of tube cystostomy with medical dissolution of urinary calculi in goats. Van Meter *et al*. (1996) reported 80% success rate in small ruminants. In the present study, the overall success rate of tube cystostomy technique with oral administration of ammonium chloride for medical dissolution of uinary calculi is lower than the earlier reports. This might be due to improper post-operative care by the animal owners, delayed presentation of cases for treatment, difference in the species treated and incomplete follow-up of the cases.

CONCLUSION

The occurrence of urolithiasis is higher in male uncastrated buffalo calves in winter season. Obstructive urolithiasis can cause severe alterations in haemato-biochemical profile of the animal including PCV, plasma BUN, creatinine, calcium, phosphorus, albumin, globulin, A:G ratio, sodium, potassium, magnesium, ALP, SGOT and SGPT. Tube cystostomy is simple, less time consuming, helps in early return of disturbed hemato-biochemical parameters, appropriate procedure for male animals intended for breeding and is associated with lesser complications. Thus it may be recommended as the first choice of treatment for the management of the obstructive urolithiasis in buffalo calves with or without ruptured urinary bladder. Ammonium chloride could be useful in the dissolution of urethral concretions.

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