RESEARCH ARTICLE

Minimally Invasive Percutaneous Tube Cystostomy using Pigtail Catheter for the Surgical Management of Urolithiaisis in Bucks

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Abstract

Urolithiasis is a frequent disease of ruminants caused by the formation of stones in the kidneys and urinary tract with a subsequent blockage to urine outflow leading to uraemia and death. Six male goats showing symptoms of urolithiais were subjected to physical, clinical, haematobiochemical, radiological and ultrasonographic examination. Haematobiochemical examination on day of presentation showed elevated Hb, TLC, BUN, creatinine, hyponatreamia and hypochloreamia. Radiological examination showed distended urinary bladder, and ultrsonographic assessment revealed distended bladder with hyperechoic sludge and granular like particles in four animals and cystolith with acoustic shadowing in two cases. The goats were administered with spinal anaesthesia at lumbosacal region, inj. butorphanol @ 0.2 mg/kg b.wt. I/V and inj. Diazepam @ 0.3 mg/kg b.wt. I/V for sedation. Minimally Invasive Percutaneous Tube Cystostomy (MIPCTC) was done using 14-18 FG Pigtail catheter following aseptic preparation of the surgical site and the catheter were anchored to abdominal wall using 2-3 stay sutures with polyamide. Perioperatively animals were administered with inj. Tramadol @ 2 mg/kg b.wt. and Ceftriaxone @ 10 mg/kg b.wt., intravenously. Post-operatively heamato-biochemical parameters were recorded on day 1, 5, 10 and 15. Ammonium chloride was given per orally for one month @ 200 mg/kg b.wt. as urinary acidifier. Catheter was blocked intermittently to check the urethral patency. All goats showed uneventful recovery, with the success rate of 100% through MIPCTC in animals with intact and distended urinary bladder.

Key words: Bucks, MIPCTC, Pigtail catheter, Tube cystostomy, Urolithiasis.

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Introduction

In India, goats are mostly reared by poor farmers, except for a few organized goat farms running under government projects. Obstructive urolithiasis represents a critical medical crisis in small ruminants that necessitates immediate medical intervention and clinical care. A diverse array of pathophysiological and management-related factors, encompassing aspects such as nutrition, hydration, seasonal influences, gender and hormonal dynamics, have been implicated in the onset of this condition. Early therapeutic interventions and pre-emptive management protocols in caprine urolithiasis stand as paramount considerations for upholding animal well-being and safeguarding the livelihoods of marginal and small-scale goat farmers (Nair *et al.,* 2022). The clinical signs of urethral obstruction vary depending on the duration of the obstruction, the site of obstruction, the severity of the surrounding tissue reaction, and the status of the urinary bladder (Janke *et al.,* 2009). Many surgical procedures like amputation of urethral process, urethrotomy, urethrostomy, cystotomy, tube cystostomy and bladder marsupialization have been documented by various authors for successful management of urolithiasis (Ewoldt *et al.*, 2008). Tube cystostomy has been considered a gold standard technique for the treatment of obstruction

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and restoring urethral patency due to its direct access to the urinary bladder. The minimally invasive percutaneous tube cystostomy is in infancy because of lack of good percutaneous catheters, which suits for small ruminants. Recently minimally invasive tube cystostomy was carried out using suprapubic catheter in a buck (Oman *et al.*, 2024). The current study uses polyurethane suprapubic percutaneous Pigtail catheter in the effective surgical management of urolithiasis through minimally invasive percutaneous tube cystostomy (MIPCTC) in goats.

Materials and Methods

All the six cases of bucks presented to Department of Veterinary Surgery and Radiology, Veterinary College, Hassan, Karnataka (India) for the treatment of obstructive urolithiasis showing symptoms of inappatence, stranguria, tail wagging, rectal prolapse, frequent bleating and colicy signs with intact bladder underwent urethral process amputation. The six bucks failed to urinate even after urethral process amputation with intact and distended urinary bladder, underwent Minimally Invasive Percutaneous Tube Cystostomy (MIPCTC) using suprapubic Pigtail catheter.

The complete history of the animals like age, castration status and feeding practices and clinical signs were recorded. Physiological parameters like rectal temperature, heart rate, respiratory rate and hydration status were recorded. All the goats were subjected for plain radiography, ultrasonography on day 0 and haemato-biochemical examination as well as urinalysis on days 0, 1, 5, 10 and 15 post-operatively. Animals were stabilised prior to the surgery with fluid therapy, antibiotics and analgesics. The surgical site (left paramedian/inguinal) was clipped, cleaned and prepared for aseptic MIPCTC surgery. Spinal anaesthesia was performed at lumbosacral region using 2% lignocaine @ 1 mL per 7 kg b.wt. Once the effect of spinal anaesthesia was achieved, animals were secured on the operation table in right lateral recumbency with the left hind limb tied to the far side of the table in a flexed position to expose the left ventral caudal abdomen for paramedian approach. IV cannulation was done at jugular vein to administer the fluids and drugs. The bucks were administered with inj. Butorphanol @ 0.2 mg/kg b.wt., I/V and inj. Diazepam @ 0.3 mg /kg b.wt., I/V for sedation. After restraining the animal, the site was prepared aseptically and animal was draped.

After localization of distended urinary bladder a nick incision of about 0.5-1 cm was made while holding the distended urinary bladder against ventral abdominal wall with the surgeon's non dominant hand, the subcutaneous and abdominal muscles were dissected bluntly. After proper confirmation of the status of the bladder and no other organs in between the bladder and abdominal wall through digital palpation, Pigtail catheter with trocar was thurst gently into the distended urinary bladder. Once the catheter was within urinary bladder wall, the trocar of the catheter was removed. Urine started coming through catheter and then it was gently pushed in to the bladder and as we remove the trocar introducer slowly the catheter curved like pigtail. The urine was collected during the procedure for urinalysis and for microscopy. Skin incision was closed by one or two simple interrupted suture using monofilament polyamide of varying sizes. The catheter was anchored to the abdominal wall using monofilament polyamide with 2-3 stay sutures.

Post-operatively goats were administered with Inj. Tramadol @ 2 mg/kg b.wt. and Inj. Ceftriaxone @ 10 mg/kg b.wt. for 5 days, intravenously. Ammonium chloride was administered per orally for one month @ 200 mg/kg b.wt. as urinary acidifier and incisional site was dressed daily. The catheter was blocked intermittently 3-5 days post-operatively to check the patency of urethra. If buck showed dribbling of urine from the prepucial orifice then the catheter was blocked for 2 days continuously and then examined for steady flow of urine. Once the steady stream of urine flew from the prepucial orifice, the catheter was removed after straightening the catheter and the site was flushed with povidone iodine. The owner was advised not to feed concentrate and continue the ammonium chloride orally till 30 days.

The efficacy of pigtail catheter was evaluated based on time taken for procedure, easiness in catheterization, catheter dislodgement and blockade, time taken for normal urination and easiness in removal of catheter.

Results and Discussion

In the current study, the clinical signs exhibited by the animals with urolithiasis were in consistent with those observed by Khairuddin *et al.* (2016) and Shivaraju *et al.* (2022). Abdominal palpation revealed an intact, tensed, and distended urinary bladder. Urethral process examination showed a normal urethra in two cases, and with varying colour changes in rest 4 cases (reddish with congestion in two, bluish discoloration in one, and blackish necrotic process in one).

Examination of physiological parameters on the day of presentation showed hypothermia, and increased capillary refill time (Table 1). The Physiological parameters returned back to normal reference range post-operatively as the treatment progressed. Davoodi *et al.* (2020) recorded decreased rectal temperature, Kimeli *et al.* (2014) observed tachycardia, tachypnea and Tan *et al*. (2017) recorded increased capillary refill time in their studies. Kumari (2018) opined that, above findings of the study were due to toxaemia as a result of retention of excess metabolic waste products in urolithiatic animals.

Plain radiography did not visualize any calculi or obstruction sites, but aided in determining an intact and distended bladder. On the fifth post-operative day, radiography confirmed catheter placement in all the six animals. These findings were in line with those reported by Shivaraju *et al.* (2022). Pandiyan *et al.* (2018), however, successfully identified radiopaque stones in one case and radiolucent stones in five cases using radiography.

Ultrasonography of the urinary bladder revealed an intact, distended bladder with calculi, sludge, and sand-like particles floating within the bladder in five animals. One animal had hyperechoic calculi with distal acoustic shadowing (Fig. 1). The examination of the kidneys in four animals showed normal architecture, while the remaining two with obstructive urolithiasis exhibited mild hydronephrosis. These findings were in accordance with Shivaraju *et al.* (2022) and Pandiyan *et al.* (2018). Mahajan *et al.* (2017) emphasized the significant utility and affordability of ultrasonography in confirming the urinary bladder status in obstructive urolithiasis.

In this study, a higher proportion of animals were found to be mildly dehydrated (41.66%), followed by moderately dehydrated (25.00%), severely dehydrated (8.33%), with the remaining 25.00% being normal without dehydration. Similar alterations in vital signs of diseased animals, including tachycardia and polypnea, were observed in studies by Kimeli *et al.* (2014) and Riedi *et al.* (2018), which were likely attributed to dehydration, pain, and stress. Additionally, systemic disruption leading to the accumulation of toxic waste products might have contributed to hypothermia in affected animals.

Haematological parameters such as total erythrocyte count, packed cell volume, haemoglobin and platelet counts were within normal physiological range (Table 2). Increased total leucocyte count with neutrophilia and lymophocytopeania was observed on the day of presentation. Vinodhkumar *et al.* (2010) also observed leucocytosis, neutrophilia in affected animals. All diseased animals showed a significant rise in blood urea nitrogen (BUN) and creatinine levels, indicating potential issues with the excretion of waste metabolites from the body. Elevated BUN and creatinine levels were attributed to increased absorption and reduced excretion of metabolic waste compounds due to urinary obstruction and stasis (Table 2), as reported by Mahajan *et al.* (2017). Hyponatremia and hypochloremia, as observed in this study, could arise from the movement of sodium and chloride ions from the extracellular compartment into the peritoneal cavity or urinary bladder, as reported by Bayoumi and Attia (2017).

Physical examination of urine revealed variations in colour, transparency, and turbidity. Initially, on day of presentation, urine pH was alkaline above the normal reference range, gradually shifting towards acidic as treatment continued. This finding aligned with the observations of Pandiyan *et al.* (2018). Specific gravity of urine was at normal reference range but towards the higher side, reduced to mid normal range on first day and fluctuating within the normal range throughout the study. Proteinuria, haematuria, leucocyturia, and glycosuria were noted on day 0, gradually reducing and reaching normal levels by day 10. Microscopic examination of urine revealed erythrocytes in 4 animals and the presence of calcium phosphate and hippuric acid crystals in 2 animals on the day of presentation. Struvite calculi were reported by

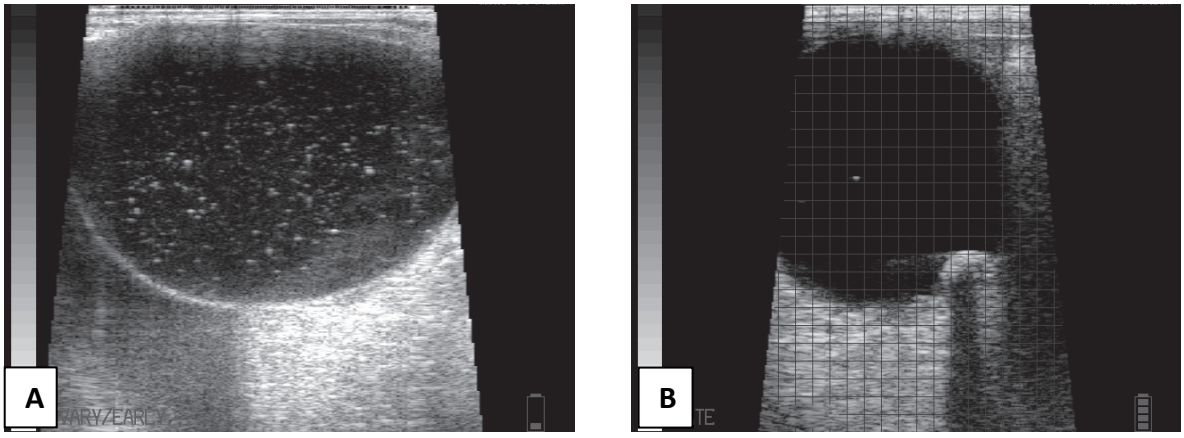

Fig. 1: A. Showing distended urinary bladder with hyperechoic sand like particles floating in the anechoic urine suggestive of cystistis. B. Showing hyperechoic calculi with acoustic shadowing in the distended urinary bladder.

Table 1: Mean ±SE values of physiological parameters in bucks with urolithiasis post-operative

Physiological parameters	Days of catheterization				
	0th day	1st day	5th day	10th day	15th day
Rectal temperature (^{0}F)	100.85±0.79^{ab}	101.51±0.27^{a}	102.66±0.22^{b}	102.52±0.26^{ab}	102.40±0.21^{ab}
Heart rate (beats/min)	118.83±6.93^{a}	81.50±4.61^{b}	78.50±0.92^{b}	76.00±0.63^{ab}	71.25±1.43^{ab}
Respiratory rate (breaths/min)	40.16±6.86	25.66±1.45	23.83±1.13	23.00±0.77	21.75±1.10
Capillary refill time (Seconds)	2.33±0.21^{a}	1.67±0.^{17ab}	1.08±0.08^{b}	1.00±0^{b}	1.00±0.00^{b}

Mean±SE bearing different superscripts within the row are statistically significant at $p<0.05$

Pandiyan *et al.* (2018), while calcium carbonate and calcium oxalate calculi were detected in one case each.

In current study, MIPCTC using a Pgtail catheter was performed on six bucks and catheter was evaluated. The mean duration taken for surgical procedure was 8.16±0.47 min, which was 1/3rd of the time required for surgical tube cystostomy. We observed effortless insertion of pigtail catheter because the resistance from the bladder wall was less. On catheter removal day, incomplete blockade of catheter was noticed in one animal. Initiation of dribbling, free flow of urine and days of catheter removal were found to be 4.25±0.75, 6.75±1.75 and 8.75±1.75 days, respectively. Based on the study findings MIPCTC using Pigtail catheter was advantageous in terms of procedure time, ease of catheter insertion into the bladder, no dislodgement and less time taken for initiation of normal urination. All the six animals under study recovered uneventfully without any complication, except partial catheter blockade in one animal giving 100% success rate. Fazili *et al.* (2010) evaluated the effectiveness of a MISTC technique via the paralumbar fossa, achieving an 80% success rate in small ruminants with intact urinary bladder and urethras. Sandeep (2016) compared different catheters, including Foley's catheter, supracath, Foley's catheter, and Pigtail catheters, through ultrasound-guided tube cystostomy in 4 bucks of each group, concluding that the Pigtail catheter was superior to the supracath and Foley's catheters. Sutradhar *et al.* (2018) investigated the efficacy of minimally invasive tube cystostomy (MITC) for managing obstructive urolithiasis in 61 goats and 23 calves, and concluded that MITC represents a promising alternative to traditional open cystotomy due to its numerous advantages, including rapid surgical time, practicality for field applications, cost-effectiveness, and minimal invasiveness.

The urine protein (mg/dL) 0 regarded as negative, 1-30 mg as 1, 30-100mg as 2, 100-1000mg scored as 3. The leucocytes (cells/µL) in urine <15 as 0, 15-70 as 1, 70-125 as 2, >125 as 3. The RBCs (cells/µL), 0-1 as 0 (normal), 1-2 as 1, 3-5 as 2, 5 and above as 3. Similarly for urine glucose (mg/dL), 0 as normal/ negative, up to 250 mg/dL, as 1, 250-500 mg/dL, as 2 , 500-1000 mg/dL as 3.

Conclusion

Based on the findings of the present study, it was concluded that MIPCTC using suprapubic Pigtail catheter, along with urine acidification using ammonium chloride, offers an alternative to conventional surgical techniques. It is reliable, field applicable, less invasive, requires minimal instruments, involves less post-operative follow-up, allows for same-day discharge of animals, and is cost-effective for the surgical

Table 2: Mean ±SE values of haemato-biochemical observations in bucks with urolithiasis post-operative

Parameters	Days of catheterization				
	0	1	5	10	15
Total erythrocyte count (10^6/µL)	9.75±1.88	10.16±0.84	10.85±0.41	9.86±0.69	10.51±0.61
Haemoglobin (g/dL)	10.80±0.41	10.63±0.21	10.71±0.21	10.99±0.24	10.55±0.17
Packed cell volume (%)	29.4±0.66	28.45±0.88	28.12±1.68	28.85±0.23	29.86±0.97
Total leucocyte count (10^3/µL)	30.29±4.03^{a}	22.29±2.73^{ab}	14.95±2.19^{b}	11.79±1.4^{ab}	10.46±0.70^{ab}
Platelet count (10^3/µL)	371.33±10.35	383.3±8.97	375.68±6.09	385.08±12.94	359.4±2.17
Neutrophils (%)	60.73±4.16^{a}	59.97±4.33^{ab}	43.44±3.76^{b}	32.04±2.22^{ab}	33.40±1.32ab
Lymphocytes (%)	32.52±4.84^{a}	35.88±4.36^{a}	51.09±3.85^{ab}	62.00±1.71^{ab}	63.28±0.99^{ab}
Blood urea nitrogen (mg/dL)	36.67±3.26	31.24±367	18.96±1.00	18.22±1.78	17.8±0.64
Serum creatinine (mg/dL)	3.04±0.68	2.27±0.48	1.61±0.33	1.08±0.14	1.02±0.04
Sodium (mEq/L)	137.58±7.30^{ab}	136.69±4.23^{a}	146.05±2.28^{ab}	154.72±3.36^{b}	147.3±3.42^{ab}
Potassium (mEq/L)	5.92±0.37	5.81±0.25	5.41±0.44	5.11±0.36	4.78±0.29
Chloride (mEq/L)	91.83±1.84^{ab}	94.84±1.69^{b}	103.3±1.91^{ab}	104.19±0.51^{ab}	101.51±1.86^{ab}

Mean±SE bearing different superscripts within the row are statistically significant at p<0.05

Table 3: Mean ±SE values of urine biochemical parameters in bucks with urolithiasis post-operative

Parameters	Days of catheterization				
	0	1	5	10	15
Protein	2.17±0.31^{a}	1.33±0.21^{b}	0.83±0.17^{abc}	0.40±0.24^{c}	0.00±0.00^{abc}
Leucocytes	1.83±0.31^{ac}	1.33±0.21^{ab}	0.33±0.21^{bd}	0.00±0.00^{d}	0.00±0.00^{cd}
RBCs/Blood	2.00±0.26^{a}	1.50±0.22^{ab}	0.50±0.22^{ab}	0.20±0.20^{ab}	0.00±0.00^{b}
Glucose (mg/dL)	175±33.54^{a}	125±28.14^{a}	62.50±15.48^{ab}	0.00±0.00^{b}	0.00±0.00^{ab}

Mean±SE bearing different superscripts within the row are statistically significant at p<0.05

management of obstructive urolithiasis in small ruminants with intact, distended bladder. It can be employed for initial stabilization of animals for temporary drainage before undergoing urethrotomy/urethrostomy procedures.

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