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Minimal Invasive percutaneous tube cystostomy using three-way Foley Catheter for management of obstructive urolithiasis in goats[#]

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Abstract

Six clinical cases of obstructive urolithiasis in goats were chosen for this research, with the primary objective of establishing a standardised approach for minimally invasive percutaneous tube cystostomy using a three-way Foley catheter for urinary diversion. Furthermore, the study sought to assess the efficacy of urinary bladder irrigation in promptly reestablishing urethral patency. The diagnosis relied on clinical symptoms, physical examination, haematological and serum biochemical investigations, and ultrasound findings. All the animals underwent minimally invasive percutaneous tube cystostomy using a three-way Foley catheter, introduced with a custom-made forceps. This technique was refined and proven effective for treating cases of caprine obstructive urolithiasis with an intact bladder. Regular irrigation with an acidic Walpole's solution (pH 4.5) aided in the timely dissolution of stones, leading to the swift restoration of urethral patency. On an average, urethral patency was reestablished within 17 days, and the subsequent removal of the catheter resulted in a smooth recovery in four out of six cases.

Keywords: *Percutaneous tube cystostomy, obstructive urolithiasis, Walpole's solution, three-way Foley catheter, struvite crystals*

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Urolithiasis is defined by the development of stones, known as uroliths, within the urinary tract. These stones can cause blockages and impact the health of a variety of domesticated animals. Among these animals, ruminants, specifically cattle (bovines) and goats (caprines), are particularly susceptible to this condition (Radostits *et al.,* 2007). Urolithiasis is a common problem among small ruminant animals like goats, and it can have a significant impact on the health of these animals and the farm's finances, as pointed out by Gazi *et al.* (2014). Tube cystostomy is considered the gold standard for relieving obstruction and restoring normal urine flow in the urethra. This is primarily because it provides a direct route to the bladder (Nair *et al*., 2020). Traditional two-way catheters can face issues such as lumen blockage, which often necessitates periodic catheter flushing. However, the use of urolith dissolution solutions could provide a more effective resolution to this challenge.

Materials and methods

Six clinical cases of obstructive urolithiasis in goats regardless of age and breed, that were presented to University Veterinary Hospitals at Kokkalai and Mannuthy during a period of 12 months from July 2022 to July 2023 underwent minimal invasive percutaneous tube cystostomy using three-way Foley catheter.

All the animals were subjected to detailed clinical and ultrasound investigation followed by haematological and serum biochemical evaluation. Ultrasound evaluation was conducted using an ultrasound machine equipped with 5 and 7.5 MHz mechanical sector transducers, focusing on the caudal abdominal region. The purpose was to determine the condition of the bladder, including the state of its wall, contents, and the condition of the urethra (Fig.1). The assessment was done by the procedure outlined by Braun *et al.* (1992). Sedation was induced using intravenous administration of Inj. butorphanol at a dosage of 0.1mg/kg body weight, along with Inj. diazepam at a dosage of 0.1mg/kg. Subsequently, a field block was performed using a two percent lignocaine-hydrochloride solution in the form of

Fig. 1. Sludge on the floor of the urinary bladder on ultrasonographic examination

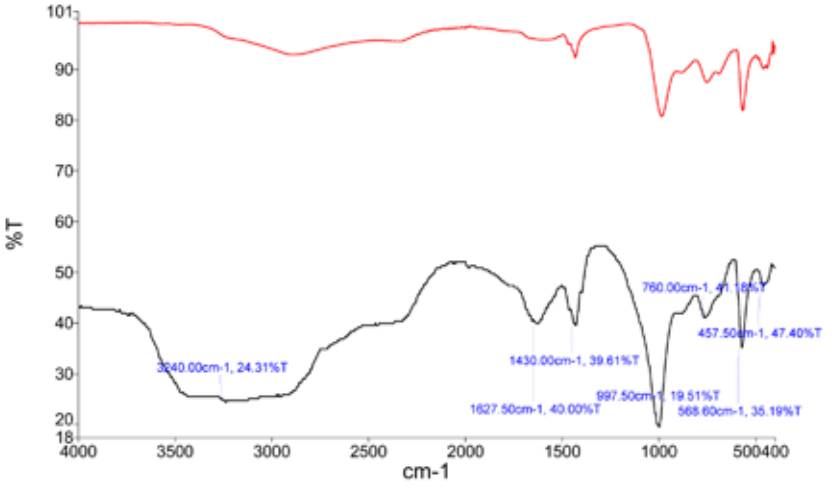

Fig. 2. Infrared spectrum of Goat-1 showing struvite bands at 3240.00, 1627.50, 1430.00, 997.50, 568.60, 760.00, 457.50

Fig. 3. Three-way foley catheter

Fig. 4. Modified alligator forceps

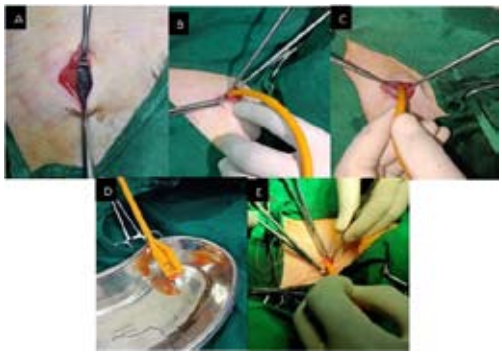

Fig. 5. A- Oblique lower flank incision followed by blunt dissection, **B**-Introduction of catheter using modified forceps, **C**-Conforming position within the bladder, **D**-Urine draining through the catheter, **E**-Applying purse-string suture

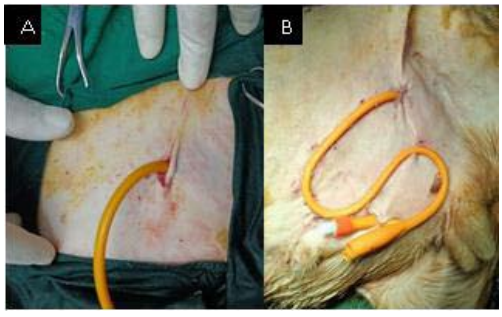

Fig. 6. A- Abdomen wall closure using nylon, **B**-Catheter fixed to skin by stay sutures in Chinese finger trap pattern

an inverted 'L' block. The animals were placed in a right lateral recumbent position, with the left hind limb abducted and flexed to expose the designated site. The postero-lateral area of the left lower flank region was aseptically prepared for the minimally invasive percutaneous tube cystostomy procedure.

A two centimetre long oblique lower flank incision was made on the skin of the left lower postero-lateral aspect of flank region. Subcutaneous fascia and abdominal muscles were bluntly separated followed by peritoneum to enter the abdomen. Muscles and peritoneum were separated to visualise the turgid urinary bladder (Fig. 5).

The turgid distended bladder was then firmly fixed against the ventral abdominal wall towards the left side using the hands of an assistant. After securing the turgid bladder, bladder was pierced at the least vascular area with the custom-made alligator forceps holding the three- way Foley catheter. The balloon part of the catheter was then inflated with 30 ml of normal saline to keep the catheter tip locked inside the bladder. Purse-string suture was placed using chromic catgut of suitable size around the insertion point of the catheter to the bladder (Fig. 5). The peritoneum, muscle and skin layers were apposed with figure of eight sutures using nylon carefully without pricking the inflated balloon. The remaining catheter length was curled and attached with ventral abdominal wall with Chinese finger trap pattern.

All the animals were administered with Inj. tetanus toxoid (0.5 ml) *via* intramuscular injection on the day of surgery. Inj. Enrofloxacin at the rate of 5.0 mg/kg, once daily for 5 days, and Inj. Tramadol at the rate of 2.0 mg/kg daily for three days were administered intramuscularly following surgery. Ammonium chloride (200 mg/kg body weight) was given orally daily until urethral patency was restored.

Urine samples were gathered in sterile vials on the day of the surgery, as well as on the 7th, 14th and 21st days. These samples were subjected to physical and biochemical examinations. Additionally, the calculi present in the urine were analysed using Fourier Transform Infrared Spectrophotometry with Attenuated Total Reflectance (FTIR-ATR) (Fig. 2).

Fig. 7. Animal regaining the urethral patency

Following the surgical intervention, the goats underwent periodic evaluation of clinical, haematological and serum biochemical parameters conducted on the 7th, 14th and 21th days and irrigation of the catheter with Walpole's solution was performed on these days to ensure its patency and dissolution of the calculi in the urethra. Owners were advised to regularly block the Foley catheter for at least half an hour daily to check urethral patency at the normal site. Once the urine outflow returned to normalcy, the catheters were removed and dietary modifications were recommended based on the findings of urinalysis.

Results and discussion

Temporary urinary diversion was effectively achieved in all animals using this technique. The smaller incision size contributed to faster healing. Among the six animals, four (Goat-2, 3, 5 and 6) exhibited complete healing without any post-operative complications. No cases of catheter lumen obstruction were observed.

The highest incidence of urethral obstruction in goats was within the age group of 3 to 15 months. Higher occurrence of obstructive urolithiasis was in non-descript breed goats. This finding is consistent with the findings of Amarpal *et al*. (2008), The average body weight of goats presented with urolithiasis was observed to be 23.63 kg which was in accordance with Nair *et al*. (2020).

All the animals exhibited complete anuria, continuous straining, anorexia, wide hind stance, raised tail, bowed head, and intense straining, often accompanied by vocalisation. These symptoms were in line with the observations of Khairuddin *et al*. (2016), and Hansoge, (2020). These symptoms persisted for one to five days before presentation, with an average duration of 2.7 days.

Ultrasonographic evaluation of all goats selected for the study revealed a distended bladder with an evident hyperechoic bladder wall. Multiple hyperechoic foci were detected as sludge on the bladder floor and fluctuations visible upon applying a gentle tap along with transducer movement which was in agreement with the findings reported by Tan *et al*. (2017) and Soumya *et al*. (2018).

All the goats in the study initially had an alkaline urine pH ranging from 8.5 to 9. There was a consistent downward trend in pH across all animals aligns with the findings reported by Janke *et al*. (2009). During the irrigation procedure, all animals exhibited signs of discomfort and abdominal straining with an immediate reduction in pH observed following the irrigation process. In one case (Goat-5), during irrigation, the solution simultaneously drained through the normal urethra. Irrigation using Walpole's solution through the catheter was effective in dissolving urethral calculi, thus relieving obstruction in goats (Dar, 2011).

A slightly larger defect was observed in some cases (Goat 1 and 4) during the process of catheterisation which was effectively addressed by applying a purse string suture around the catheter, which was helped to tighten the opening and prevent urine leakage as per the procedure explained by Soumya *et al*. (2018). Applying a purse string suture to the bladder was slightly challenging due to the smaller incision size, the presence of intestinal loops or mesenteric fat obscuring the bladder surface.

The complications such as urine scald formation and dermatitis, loosening of the stay sutures documented by May *et al*. (1998) and Streeter *et al*. (2002) were also observed in this study. In one instance (Goat-1)

catheter dislodgement occurred 14thday postoperatively which led to urethral rupture and subsequently progressed to an abscess that eventually ruptured, causing urine seepage from the perianal region Similar postoperative complications were noted in studies conducted by Parrah *et al.,* (2011) and Seddek and Bakr (2013) involving ruminants.

Conclusion

Minimal invasive tube cystostomy with a three-way Foley catheter demonstrated its effectiveness in providing a reliable and precise catheter placement, facilitated efficient bladder irrigation and helped in timely restoration of urethral patency. This technique has proven to be an excellent method for urinary diversion in cases of obstructive urolithiasis in goats. FTIR-ATR analysis conclusively identified the existence of struvite crystals in all cases. Bladder irrigation using Walpole's solution (pH 4.5) was helped in an instant reduction in urine pH. Urethral patency was reestablished within an average of 17 days, and the subsequent catheter removal resulted in a successful recovery in four out of the six cases.

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Conflict of interest

The authors declare that they have no conflict of interest.

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