Obstructive urolithiasis is a condition in which calculi lodge anywhere in the urinary tract, causing urine retention. The stones are most commonly found in the urinary bladder, whereas, ultrasonography revealed distended intact bladder containing hyperechoic sludge and granular particles in all six cases and alongside cystoliths with acoustic shadowing in two cases. The goats received spinal anaesthesia at the lumbosacral region, along with intravenous administration of inj. for sedation. Minimally Invasive Percutaneous Tube Cystostomy (MIPCTC) was performed under spinal anaesthesia and deep sedation with inj.Butorphanol at 0.2 mg/kg B.W and inj. Diazezapam at 0.3 mg/kg B.W intravenously, using 14-18 FG Malecot catheters following aseptic surgical site preparation and catheter were secured to the abdominal wall using 2-3 stay sutures made of monofilament polyamide. Throughout the perioperative period, animals received intravenous inj. Tramadol at 2 mg/kg B.W and inj. Ceftriaxone at 10 mg/kg B.W. Hematobiochemical parameters were recorded on day 0, postoperatively on day 1, 5, 10 and 05. Factors like age, sex, intake are considered to play a major role the development of urolithiasis in ruminants [1]. It is very common and frequently encountered in the veterinary practice. It is a multifactorial disease and is caused by factors such as breed, season and water intake. It can affect males and females and is more common in males [2]. The female urethra is generally shorter and straighter than the male urethra, making it less likely to form calculi [3]. It is very common and frustrating problem in small and large ruminants for owners and also for veterinarians [4]. The urethral process is the most common site of obstruction in sheep and goats. In animals whose urethral process has been amputated the renal pelvis, ureters, sigmoid flexure, urethra and urethral process [8]. Both sexes appear to be affected, but problems occur mainly in males because of their anatomical conformation of their urinary tract. Anatomically, the urethral passage of male goats are long, twisted and have urethral process as compared to short and straight urethra in females [8]. It is very common and frustrating problem in small and large ruminants for owners and also for veterinarians [4]. The urethral process is the most common site of obstruction in sheep and goats. In animals whose urethral process has been amputated the renal pelvis, ureters, sigmoid flexure, urethra and urethral process [2]. In obstructive urolithiasis mainstay of treatment is the surgical intervention. The surgical options include the percutaneous nephrostomy tract nephrostomy, cystolithotomy, cystoscopy balloon catheterization, and nephrostomy. The percutaneous nephrostomy tract nephrostomy is a procedure in which a catheter is inserted into the kidney through the skin and into the renal pelvis. The catheter is then used to drain urine from the kidney and to provide access for further procedures, such as stone removal. The cystolithotomy is a procedure in which stones are removed from the bladder. The cystoscopy balloon catheterization is a procedure in which a balloon catheter is introduced into the bladder to help remove stones. The nephrostomy is a procedure in which a catheter is inserted into the kidney through the skin and into the ureter. The catheter is then used to drain urine from the kidney and to provide access for further procedures, such as stone removal. The treatment of urolithiasis in ruminants, arises due to formation of stones in the kidneys and urinary tract resulting in obstructed urine flow, uremia and if left untreated, leads to fatality. Present study includes six bucks exhibiting symptoms of urine retention underwent comprehensive physical, clinical, hematobiochemical, radiological and ultrasonographic examinations. Initial haematobiochemical analysis on the day of presentation revealed elevated levels of total leucocyte count (TLC), blood urea nitrogen (BUN), creatinine, as well as hypertriglyceridaemia and hypochlorhaemia. Radiographic investigation depicted distended urinary bladder, whereas, ultrasonography revealed distended intact bladder containing hyperechoic sludge and granular particles in all six cases and alongside cystoliths with acoustic shadowing in two cases. The goats received spinal anaesthesia at the lumbosacral region, along with intravenous administration of inj. for sedation. Minimally Invasive Percutaneous Tube Cystostomy (MIPCTC) was performed under spinal anaesthesia and deep sedation with inj.Butorphanol at 0.2 mg/kg B.W and inj. Drazepam at 0.3 mg/kg B.W intravenously, using 14-18 FG Malecot catheters following aseptic surgical site preparation and catheter were secured to the abdominal wall using 2-3 stay sutures made of monofilament polyamide. Throughout the perioperative period, animals received intravenous inj. Tramadol at 2 mg/kg B.W and inj. Ceftriaxone at 10 mg/kg B.W. Hematobiochemical parameters were recorded on day 0, postoperatively on day 1, 5, 10 and 15. Ammonium chloride was administered at a dosage of 200 mg/kg B.W per orally to acidify urine. Intermittent catheter blockage was utilized to assess urethral patency. All bucks exhibited uncomplicated recovery, achieving a 100 Per cent success rate through MIPCTC using Malecot catheter in cases with intact and distented urinary bladder. Keywords: Urolithiasis, malecot catheter, percutaneous tube cystostomy, bucks

Introduction
Urolithiasis is the most widespread and economically important disease of ruminants [1]. Obstructive urolithiasis is a condition in which calculi lodge anywhere in the urinary tract, causing urine retention. The stones are most commonly found in the urinary bladder, however they can also be found in the renal pelvis and urethra. Other potential sites of urine obstruction include the renal pelvis, ureters, sigmoid flexure, urethra and urethral process [2]. Both sexes appear to be affected, but problems occur mainly in males because of their anatomical conformation of their urinary tract. Anatomically, the urethral passage of male goats are long, twisted and have urethral process as compared to short and straight urethra in females [3]. It is very common and frustrating problem in small and large ruminants for owners and also for veterinarians [4]. The urethral process is the most common site of obstruction in sheep and goats. In animals whose urethral process has been amputated the distal aspect of the sigmoid flexure is the usual site for blockage [5]. Factors like age, sex, breed, season and water intake are considered to play a major role the development of urolithiasis in ruminants. The urethral blockage may also occur due to cystitis. Urine retention is the inability of animal to urinate which may be partial and complete. If calculi increase in number or size, obstruction of tract anywhere from urethral process or verminform appendix upto bladder [6].
Incidence of urolithiasis was found to be 4.14% in animals out of which highest incidence was recorded in caprine 44.44% followed by 18.69% in cattle, 21.21% in buffalo and 15.66% in canine [7]. 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 [8]. Many surgical procedures like amputation of urethral process, urethroctomy, urethrostomy, cystotomy, tube cystostomy, bladder marsupialisation and modified proximal perineal urethrostomy using direct guided urethral catheterisation technique had been followed by various authors for successful management of urolithiasis [9, 10]. Tube cystostomy has been considered a gold standard technique for the treatment of obstruction and restoring urethral patency due to its direct access to the urinary bladder. Whereas 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. [11]. The current study uses polyurethane suprapubic percutaneous Malecot catheter in the effective surgical management of urolithiasis through Minimally Invasive Percutaneous Tube Cystostomy (MIPCTC) in bucks.

Materials and Methods
In the present study all the cases of male goats presented to Department of Veterinary Surgery and Radiology, Veterinary College Hassan, Karnataka for the treatment of obstructive urolithiasis showing symptoms of urine retention like stranguria, tail wagging, haematuria, frequent bleating and colicy signs with intact bladder (Fig.1) were underwent urethral process amputation. The six animals failed to pass urine even after vermiform appendage amputation with intact and distended urinary bladder were underwent Minimally Invasive Percutaneous Tube Cystostomy (MIPCTC) using suprapubic Malecot catheter (Fig.2). The complete history of the animals like age, status of castration, feeding history and clinical signs were recorded. Physiological parameters like rectal temperature, heart rate, respiratory rate were recorded. All the goats were subjected for plain radiography as well as ultrasonography on day 0 and plain radiography on day 5 to know the catheter insitu. Haemato-biochemical assessment was performed on day 0, day 1, day 5, day 10 and day15. Animals were stabilised before the surgery with fluid therapy, antibiotics and analgesics. The surgical site, left paramedian/inguinal region for MIPCTC was clipped, cleaned and prepared for aseptic surgery. Spinal anaesthesia was performed at lumbosacral region @ the dose rate of 1ml/7 kg B.W using 2% Lignocaine hydrochloride. Upon inducing spinal anaesthesia, animals were positioned on the surgical table in right lateral recumbency with the left hind limb tied to the far side of the table in a flexed position of stifle to expose the left ventral caudal abdomen for surgical approach. I/V cannulation were done at jugular vein to administer the fluids and drugs. The bucks were administered with inj. Butorphanol @ 0.2 mg/kg B.W I/V and inj. Diazepam @ 0.3 mg /kg B.W I/V for sedation. After restraining the animal, the site was prepared aseptically and animal was draped (Fig.3). The site after localization of distended urinary bladder a nick incision of about 0.5-1 cm was made on the skin while holding the distended urinary bladder against ventral abdominal wall with the surgeon non dominant hand; the subcutaneous and abdominal muscles were dissected bluntly. After confirmation, no other visceras in between the bladder and abdominal wall through digital palpation, Malecot catheter with trocar was thrust gently into the distended urinary bladder. Once the catheter was within urinary bladder, the trocar of the catheter was removed. Urine started flowing through the catheter and then it was gently pushed in to the bladder and as we move the cannula (trocar introducer) slowly the catheter opens like flower /mushroom (Fig.4). 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 stich sutures. Postoperatively goats were administered with inj. Tramadol @ 2 mg/kg body weight for 3 to 5 days and inj.Ceftriaxone @10 mg/kg body weight for 5 days intravenously. Ammonium chloride per orally for one month @ 200 mg/kg body weight as urinary acidifier and incisional site was dressed daily with antiseptic spray. The catheter was blocked now and then 3-5 days postoperatively to check the patency of urethra (Fig.5A). If bucks 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 flows from the prepucial orifice, the catheter was removed after straightening the catheter and the site was flushed with povidone iodine (Fig.5B).

Results and Discussion
This study aimed to assess the efficacy of minimally invasive percutaneous tube cystostomy (MIPCTC) utilizing the Malecot catheter for the management of obstructive urolithiasis in bucks.

In this investigation, clinical signs observed in the animals such as anuria, dysuria, stranguria, haematuria, tail wagging, colic signs, standing with legs stretched backward were in consistent with those documented by previous studies in animals with urolithiasis [12]. Abdominal palpation revealed an intact, tensed and distended urinary bladder. Urethral process examination indicated varying colour changes, including reddish congestion, bluish discoloration and blackish necrotic processes [13]. The plain radiography on day of presentation did not visualize any calculi or obstruction sites, however helped in knowing the status of urinary bladder as intact and distended. These radiographic results were in comparable with the observation made by the author in his study [14]. Plain radiography on fifth postoperative day revealed partially dislodged catheter in one case and remaining four animals showed catheter in situ (Fig. 6). Study revealed that the Malecot catheter displacement was observed in one animal on comparison with Foleys catheter [15]. Additionally, ultrasonography on the day of presentation revealed intact, distended bladders with calculi, sludge, and sand-like particles in all six animals along with two animals exhibiting hyperechoic calculi with acoustic shadowing (Fig.7). Kidney examination showed normal findings in four...
animals and mild hydronephrosis in two with obstructive urolithiasis. These findings like hydronephrosis in our study were also recorded by previous studies [16, 17]. The previous studies highlight the value of ultrasonography as a non-invasive and cost-effective diagnostic tool for assessing urinary bladder status in ruminants with obstructive urolithiasis [18].

Dehydration was common among the animals, manifesting in various levels of severity and likely contributing to changes in vital signs such as tachycardia and polydipsia, as supported by previous studies [13, 19]. Additionally, systemic disruption may have caused hypothermia due to the buildup of toxic waste products. Haematological parameters stayed within normal range, except for an elevated total leukocyte count with neutrophilia and lymphocytopenia [16]. Biochemical tests showed increased levels of blood urea nitrogen (BUN) and creatinine, indicating urinary obstruction and stasis, in line with previous findings [20, 21]. It was evident from the previous report, that hyponatremia and hypochloremia were linked to ion movement into the peritoneal cavity or urinary bladder [22]. Variations in urine colour, transparency and turbidity were observed, with the pH shifting from alkaline to acidic during treatment period. These changes were attributed to the oral administration of ammonium chloride, which acidified the urine. These findings in the current study were in consistent with those reported by earlier studies [23]. Specific gravity remained within normal limits, while levels of proteinuria, haematuria, leucocyturia and glycosuria decreased furthermore normalized by day 10. Microscopic examination of urine identified calcium phosphate and hippuric acid crystals in two animals, which were in consistent with previous studies [17].

In this study, MIPCTC using the Malecot catheter was conducted on six bucks, resulting in a shorter surgical duration compared to traditional surgical tube cystostomy. The average duration for the procedure was 9.83±0.70 minutes, which is approximately one-third to one-fourth of the time required for the conventional method. Catheter insertion was easy, and catheter-related complications were minimal with partial dislodgement of catheter in two animals, only one instance of complete blockage and one instance of partial blockage. The complete blockage of the Malecot catheter encountered after urine dribbling began but before the catheter removal from the bladder.

In a previous research the author also reported shorter duration of procedure, easy insertion and no blockage of the Malecot catheter compared to tube cystostomy using Foley’s catheter [15]. The present study showed initiation of dribbling, free flow of urine and catheter removal occurred at 4.5±0.50, 6.75±0.94, and 9.5±1.65 days, respectively (Table 1). The study concluded that MIPCTC with the Malecot catheter is advantageous in terms of procedure time, ease of catheter insertion into the bladder and quicker initiation of normal urination. All six animals in the study recovered uneventfully, except for catheter dislodgement in two animals, complete catheter blockage in one animal, and partial blockage in another. The study resulted in 100 per cent success rate after 30 days of postoperative follow-up. The effectiveness of a minimally invasive modified tube cystostomy technique was evaluated by previous study [11], achieved a 70.58% success rate in small ruminants with intact urinary bladder and urethra, meanwhile authors concluded that this modified technique is effective for catheterizing the urinary bladder in small ruminants, offering a field-applicable option for temporary urine drainage.

The comparative evaluation of Malecot, Pigtail and supracath Foley’s catheter in cattle calves was made by earlier studies [24], wherein the author found that Malecot catheter followed by Pig tail catheter had showed superior results than Foley’s catheter in animals understudy. The tiny calculi, mucous shreds and blood clots pass liberally through these catheters along with urine and prevent probability of recurrent post surgical calculi development. The efficacy of minimally invasive tube cystostomy (MITC) for managing obstructive urolithiasis in 61 goats and 23 calves were studied earlier [25] and authors 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.

Fig 1: Picture A & B showing signs of urine retention, tail wagging, leg treading and backward stretching of hind leg with colic signs.
Fig 2: Picture showing Malecot catheter A. Malecot catheter B. Cannula/Needle introducer C. Trocar/Needle

Fig 3: A. Picture showing aseptic preparation of surgical site with 7.5% povidone iodine solution B. Aseptic Surgical draping of ventral abdomen and surgical site.
Fig 4: A. Picture showing making nick incision of about 0.5 to 1 cm at inguinal region B. Picture showing insertion of Malecot catheter percutaneously C. Picture showing closure of nick incision and anchor of catheter to body wall using size 0 non absorbable monofilament polyamide D. Buck immediately after MIPCTC procedure.

Fig 5: A. Buck showing free flow of urine after catheter blockade with 2 mL syringe B. Buck passing free flow of urine after Malecot catheter removal

Fig 6: A. Picture showing Malecot catheter within the urinary bladder B. Picture showing partly dislodged Malecot Catheter
Fig 7: A. Showing distended bladder with sand like particle floating within the anechoic urine. B. Distended urinary bladder with cystolith and acoustic shadowing.

Table 1: Time taken for normal urination and catheter removal in days (Mean±SE)

<table>
<thead>
<tr>
<th>Catheter</th>
<th>Initiation of urine dribbling(days)</th>
<th>Onset of free flow of urine(days)</th>
<th>Catheter removal days</th>
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<tr>
<td></td>
<td>Mean Range</td>
<td>Mean Range</td>
<td>Mean Range</td>
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<tr>
<td>Malecot</td>
<td>4.5±0.50 3-5</td>
<td>6.75±0.94 4-8</td>
<td>9.5±1.65 5-13</td>
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Conclusion
Minimally Invasive Percutaneous Tube Cystostomy (MIPCTC) using a suprapubic Malecot catheter, combined with urine acidification, provided a reliable, less invasive and cost-effective alternative to conventional surgical tube cystostomy for the management of obstructive urolithiasis in small ruminants. This technique allowed for same-day discharge, requires minimal post-operative follow-up and can serve as an initial stabilization method for temporary drainage prior to definitive procedures such as urethrotomy or ureterostomy.

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References
13. Riedi AK, Shweizer GK, Meylan M. Clinical findings and diagnostic procedures in 270 small ruminants with