Zagazig Veterinary Journal, ©Faculty of Veterinary Medicine, Zagazig University, 44511, Egypt.
Volume 53, Number 3, p: 256-264 September 2025
DOI: 10.21608/zvjz.2025.358760.1279

RESEARCH ARTICLE

Evaluation of Dorsal Urethrotomy Technique for Relieve Obstructive Urolithiasis in Buffalo Calves (Bubalus Bubalis) with Ruptured Bladder

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ARTICLE INFO

Article History:
Received: 28 February 2025
Accepted: 17 May 2025
Published online: 30 September 2025
Key words:

Urolithiasis, Urethrotomy, Ruptured bladder, Buffalo calves

Obstructive urolithiasis is a common surgical disorder affecting young ruminants, especially in winter season. The aim of the present study was to evaluate the efficacy of dorsal urethrotomy technique in relieving urolithiasis in buffalo calves with ruptured urinary bladder. Ten non-castrated male buffalo calves, 4-7 months old, were included in the study. The animals had a history of anuria and diagnosed as obstructive urolithiasis with bladder rupture based on clinical, ultrasonographic and biochemical examinations. Dorsal urethrotomy technique was performed in the affected calves and a Ryle's tube was applied in the urethra for four days postoperatively. The animals were followed for three months after surgery to record complications and recurrence of obstruction. Serum levels of creatinine (7.6±1.67) and blood urea nitrogen (BUN) (54.2±12.65) were significantly higher than the clinically healthy animals (1.4±0.18 and 21.1±6.05, respectively). Nine out of ten calves recovered successively without complications or recurrence of obstruction for three months after surgery. Only one case had re-obstruction 20 days post-surgical interference. In conclusion, dorsal urethrotomy technique is a successful surgical procedure in relieving urolithiasis in calves with ruptured bladder with minimal postoperative complications and re-obstruction.

ABSTRACT

Introduction

Urinary tract obstruction in young ruminants is a fatal disorder leading to high mortality rate due to advanced uremia unless the case was successfully corrected [1]. This disorder caused by formation of urinary calculi, which may lodge to different sites in the urinary system, mostly the distal end of sigmoid flexure in ruminants [2, 3].

Urolithiasis is a multifactorial disorder due to combination of several factors such as seasonal, managemental, physiological and nutritional in addition to age and sex. It is worldwide disorder occurs in all species of animals and in both sexes, but rate of obstruction is higher in male than female due to short and wide urethra in female. It occurs in male ruminants feed

on concentrated ration mostly grains [2]. Buffalo calves were the most affected when compared to cow calves and adult ruminant animals [4-6]. Animals in fattening or growing period receive more cereal and concentrated feeds which contain high levels of phosphorus and magnesium and less levels of calcium and potassium with subsequent calculus formation. In addition, management systems used for raising animals use high grain ration for rapid fattening or grazing can lead to this condition [2]. It has been reported that ruminants, physiologically with a non-functional rumen, fed on phosphate rich food results in high absorption of phosphates which is clinically results in depletion of calcium absorption and calcium being excreted through urine [7].

Urolithiasis in ruminants may be expressed clinically in three stages according to severity and duration of obstruction; urine retention with intact urinary bladder, ruptured bladder (uroperitoneum) and ruptured urethra [8, 9]. The main clinical signs of animals suffering obstructive urolithiasis with intact urinary bladder are restlessness, anorexia, lethargy, straining, penile twitching, raising of the tail, and abdominal colic [2, 5, 6, 10, 11]. While, animals with ruptured urinary bladder showed the signs of anuria, anorexia, sunken eye, dullness, abdominal distension and thrilling, uremia and toxemia within 2-3 days then death of the animal unless successful treatment is established [2, 12].

Treatment of obstructive urolithiasis in ruminants is mainly surgical, and several surgical procedures were reported to relieve the retention and remove the calculi from the urethra including urethrostomy, penile amputation, urethrotomy, bladder marsupialization, and tube cystostomy [2, 4, 8]. Urethrostomy is the simplest, rapid and cost-effective surgical procedure to relieve retention in ruminant animals through performing permanent stoma in the urethra. Due to loss of breeding ability and possibility of stricture of urethral stoma this procedure is considered undesirable [2, 11]. Tube cystostomy is the most commonly used surgical procedure to relieve retention with keeping the urethra patent through implantation of a Foley catheter in the urinary bladder and using ammonium chloride [6, 13-15] or Walpole's solution [10, 16].

Urethrotomy is a surgical procedure as an alternative to salvage the animal to slaughter by maintaining the urethral patency and preserving the breeding ability of the animals. It is performed when the location of the obstruction can be identified through two techniques: dorsal or ventral urethrotomy technique [8, 17, 18]. It was reported that the dorsal approach was better than ventral one due to less short and long-term postoperative complication in the dorsal approach when compared with the ventral one [18].

Preservation of the patency of urethra for breeding purposes is very important in valuable male animals. Therefore, the present study aimed to evaluate the efficacy of dorsal urethrotomy technique in relieving urolithiasis in buffalo calves with ruptured urinary bladder.

Materials and Methods

Animals

Ten non-castrated male buffalo calves aged 4 to 7 months and weighing 70 to 120 Kg body weight admitted to the Clinic of Department of Surgery, Faculty of Veterinary Medicine, Zagazig University with urinary bladder rupture from 1 to 3 days. The animals were surgically treated with cystorrhaphy and dorsal urethrotomy. The animal handling and surgical procedures were conducted on the animal ethics committee of Zagazig University (ZU-IACUC/2/F/192/2024).

Clinical examination

The affected calves were examined clinically as described previously [19]. The clinical parameters including heart rate, respiratory rate, rectal temperature and ocular mucous membrane were evaluated. Length of retention and previous medications were recorded. Abdominocentesis to confirm uroperitoneum was performed.

Ultrasonographic examination

The affected calves were examined ultrasonographically using ultrasound machine (Sonoscape A5V, China) connected with 6 MHz transducer for transabdominal and transrectal examinations in standing position. The condition of the bladder and urethra was recorded.

Biochemical analysis

Blood samples from the affected and apparently clinically healthy animals were drained from the jugular vein in clean sterile plain centrifugation tubes to obtain sera. The serum levels of creatinine and blood urea nitrogen (BUN) were measured spectrophotometrically using diagnostic Zrt. Commercial kits.

Surgical management

All the affected calves were treated surgically with dorsal urethrotomy technique (Figure 1) as described previously [18]. Briefly, aseptic preparation of the ventral abdomen from the umbilicus till the pubis was performed after securing the animals in right lateral recumbency under the effect of 2% Xylazine HCL sedation (Xyla-Ject®, ADWIA Pharmaceuticals Co., 10th of Ramadan City, Egypt) at a dose rate of 0.05 mg/kg body weight. A 10 cm skin and subcutaneous incision was made in the left prepubic region after local infiltration anesthesia at the incision site. The incision was extended ventrally to include the prepuce. The penis was exteriorized from the preputial sheath. A tourniquet was applied proximal and distal to the stone to induce engorgement of the dorsal penile veins, and then an incision was performed at the dorsal surface of the penis to expose and incise tunica albuginea of corpus cavernosum and the corpus spongiosum. After incising the urethra, the stone was reached and removed using mosquito forceps. A laparotomy incision was made, and the urine was evacuated gradually. Gentle examination of the bladder to detect site of rupture and a 10 French Ryle's tube was introduced and advanced towards the external urethral orifice. The Ryle's tube passed through the urethral incision to ensure urethral patency and absence of another blockage sites. Then the dorsal penile incision was closed in a cross mattress suture pattern using vicryl 3/0 after removal of the tourniquets. The feeding port of the Ryle's tube was cut and then the Ryle's tube was fenestrated for about 10 cm and coiled inside the urinary bladder. Then cystorrhaphy using vicryl 2/0 in a double cushing suture pattern was performed after debridement of necrotic parts. After peritoneal lavage using warm normal saline solution, the abdominal incision was closed routinely, and the penile body was replaced to its original location. Postoperatively, all animals were medicated with Pen&Strep (Norbrook Co., N. Ireland) I/M at a dose rate of 1 mL/25 kg for five successive days and Flunixin (flunixin meglumine, Norbrook Co., N. Ireland) I/M at a dose rate of 2.2 mg/kg for three successive days. For correction of dehydration and electrolytes imbalance, fluid therapy was administered intravenously. The Ryle's tube was removed through the external urethral orifice within four days after operation. The animals were followed for three months after treatment for any complication and detection of the recurrence of retention.

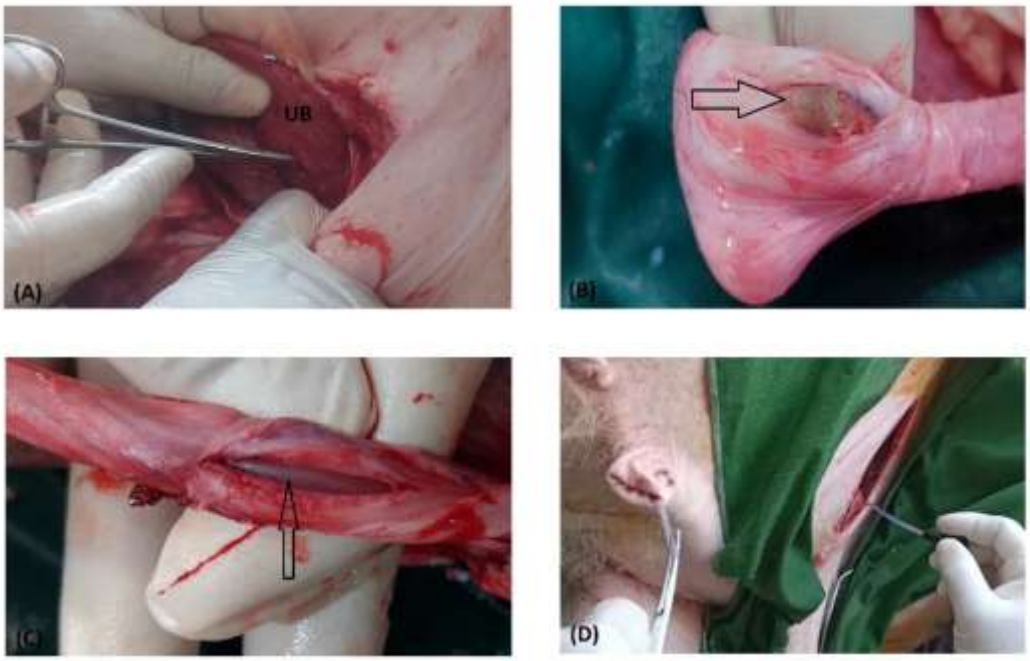

Figure 1. (A) Introducing of the Ryle's tube into the bladder lumen. (B) The stone at the urethra through dorsal penile incision (arrow). (C) The Ryle's tube passing through the urethral incision (arrow). (D) The Ryle's tube passing from the urinary bladder till the external urethral orifice before incision closure.

Statistical analysis

The results were expressed as mean ± Standard Deviation (SD). Differences between the normal and affected animals in serum levels of creatinine and BUN were analyzed using two-sample t-test through Statistical Package for Social Sciences version 24.0 (SPSS, IBM Corp., Armonk, NY). Significance was adjusted when $P < 0.05$.

Results

Clinical findings

The affected animals showed signs of bladder rupture including dullness, depression, off food, abdominal distension, abdominal thrilling, dehydration and rough coat. Abdominocentesis confirmed uroperitoneum. Vital parameters were within normal physiological range. All animals were previously medicated with diuretics (LASIX®, Furosemide, 20mg/2ml, Sanofi aventis) one to two days before admission.

Ultrasonographic findings

Abdominal ultrasonography revealed presence of free anechoic fluid in the abdomen with small-sized urinary bladder indicating uroperitoneum. Echogenic fibrinous free jelly-like material could be observed during transabdominal examination. Moreover, during transrectal examination, the bladder appeared shrinkage and corrugated with thick wall (Figure 2).

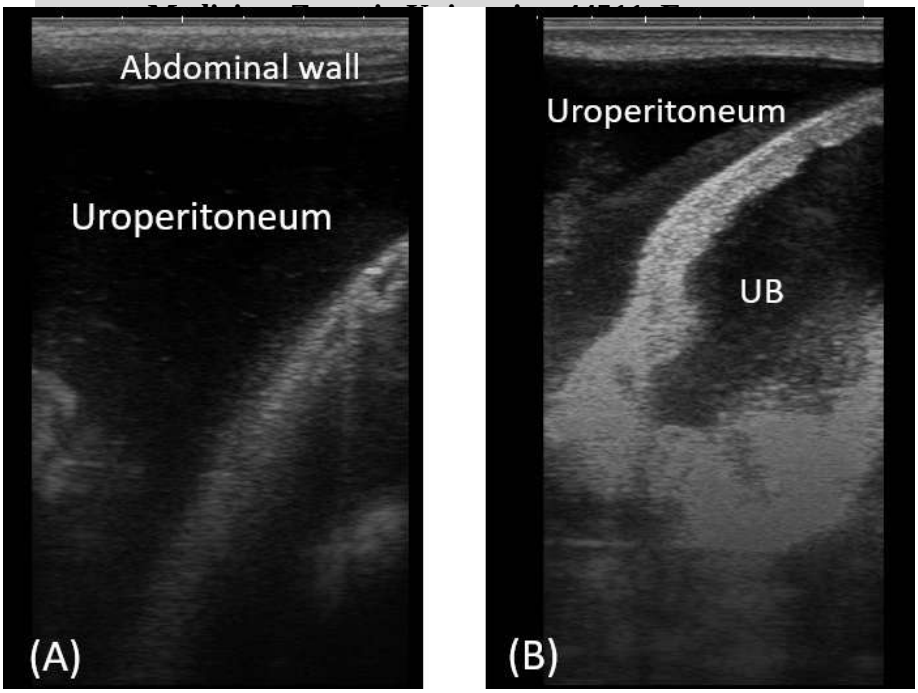

Figure 2. (A) Transabdominal ultrasonographic image of a male buffalo calf with ruptured bladder when examined at the caudal abdomen, uroperitoneum appeared as free anechoic fluid inside the abdomen. (B) Transrectal ultrasonographic image of the same buffalo calf, uroperitoneum with thickened wall, corrugated and shrinkage urinary bladder were noted. UB: Urinary bladder.

Biochemical findings

The serum levels of creatinine and BUN were significantly increased in the affected animals with ruptured bladder in comparison to the clinically healthy animals as illustrated in Table 1.

Table 1. Mean ± standard deviation (SD) of the serum levels of creatinine and blood urea nitrogen (BUN) in clinically healthy and affected calves.

Parameters	Control	Affected calves
BUN (mg/dL)	21.1±6.05	54.2±12.65*
Creatinine (mg/dL)	1.4±0.18	7.6±1.67*

* Significance between groups. $P < 0.05$.

Surgical findings and outcomes

During surgery, the urinary bladder was small in size with thick congested wall. During examination of the bladder, the rupture site was detected dorsally. Out of 10 operated calves, one calf had complication of urethral obstruction 20 days after surgery. The nine calves were followed for three months after treatment without recurrence of obstruction or complications.

Discussion

Urine retention also known as obstructive urolithiasis occurs most commonly in ruminant animals due to calculus formation in the urinary tract leads to blockade of the urine outflow with subsequent uremia and death when unsuccessfully treated [20]. It is commonly recorded in young male buffalo calves few months after weaning with age ranged from 3 to 7 months due to sudden shifting diet to high

concentrates with lack of water intake especially in winter season. In addition, the narrow urethral diameter that interferes with calculus expelling [3, 6, 16, 21]. These findings were also reported in the present study where the age of the affected male buffalo calves ranged from 4 to 7 months. Calculus formation occurs in several steps, include nidus formation, precipitation and concentration of solutes. There are several factors interfere with each step such as factors promote nidus development then precipitation of solutes and concentration of precipitated salts to form calculus [2].

In the present study, calves with ruptured bladder showed signs of dullness, depression, anorexia, abdominal distension and thrilling and dehydration. These findings were in accordance with those reported in previous studies [3, 5, 6, 22, 23]. All admitted animals were injected with diuretics one to two days before admission. It has been reported that administration of diuretics to animals suffering complete obstructive urolithiasis leads to over distension of the urinary bladder with subsequent its rupture [8].

Diagnosis of this disorder was confirmed by using ultrasonographic examination as previously reported [5, 6]. Ultrasound is an important non-invasive diagnostic tool for ruminant disorders including gastrointestinal, thoracic, cardiac and urinary disorders [20, 24-26]. In addition, ultrasound gives a chance to evaluate the bladder condition in animals with urine retention [26-28]. The bladder of the examined animals appeared shrinkage and small in size. The wall was thick and corrugated with anechoic urine inside the abdomen (uroperitoneum). These findings also reported previously [5, 24]. Abdominocentesis under aseptic precautions at the caudal abdomen revealed presence of urine inside the peritoneal cavity. This confirmatory diagnostic aid was reported in previous studies [16, 24].

In the present work, the serum levels of creatinine and BUN were significantly increased in all affected calves with ruptured bladder in comparison to the clinically healthy calves. Similar findings were reported in previous studies [6, 7, 13-15]. The reason for higher levels of creatinine and BUN in the serum might be due to increased surface area of absorption created by the peritoneum and presence of urine inside the peritoneal cavity after bladder rupture which leads to increase absorption of creatinine and urea from the urine to the blood stream [29].

During surgical procedure, the ruptured site of the urinary bladder was at the dorsal aspect in all cases with small thick bladder wall. Similar findings were reported in previous studies [6, 30] where they found the rupture site was mainly at the dorsal aspect of the urinary bladder. It has been reported that the bladder rupture was reported commonly at the dorsal bladder neck followed by dorsal vertex and ventral vertex. Also incomplete subserous rupture might be observed [6].

Surgical interference is the suitable choice for treatment of such cases in ruminants [31]. Urethrostomy is a cost-effective surgical procedure and salvaged the animal to slaughter. It can be performed either at higher site (ischial urethrostomy) or at lower site (post scrotal urethrostomy) [8]. In recent years, tube cystostomy was performed to relive retention in animals with good results. The efficacy of treatment using tube cystostomy in most studies was over 95% [1, 6, 10, 13]. Urethrotomy is an alternative surgical procedure in relieving urine retention with preservation of urethral patency and breeding ability of the animals. There are two surgical urethrotomy techniques, dorsal and ventral. Ventral urethrotomy technique showed several complications at either short term or long term [8, 17, 18].

In the present study, dorsal urethrotomy technique was successful in nine out of 10

cases and only one case recorded with recurrence of obstruction after 20 days postoperatively, which might be attributed to fibrosis and stricture of the urethral lumen at the surgery site [18]. It was reported that dorsal urethrotomy was effective with minimal postoperative complications in comparison with ventral urethrotomy in calves with ruptured bladder [18]. Urethral re-obstruction occurs due to inflammation of the urinary bladder with tissue debris that provide a nidus for calculus formation [11]. Complication with urethral re-obstruction was also reported in previous study [18]. Keeping the Ryle's tube for long period may lead to inflammation of the urinary bladder [18]. Therefore, in the present study. the Ryle's tube was removed within four days after surgery. This time period was nearly similar to the period of application of the Foley catheter in tube cystostomy technique [6, 15]. The animals were followed for three months after surgery with good success rate with keeping patency of the urethra. These findings were in agreement with those previously reported [18]. It was suggested that successful surgical techniques are considered when there was not recurrence of obstruction [32]. Unlike urethrostomy technique, the urethral patency was achieved with minimal complications. Therefore, this surgical technique is useful in valuable animals to keep breeding ability [18]. From complications of urethrotomy is ruptured urethra. This complication could not be avoided by either longer catheterization period or urethral incision proximal to the uroliths. It might be related to urethral necrosis or suturing technique in a trial to avoid stenosis [8, 17, 18]. It was reported that urethral rupture might be occurred in the treated cases with tube cystostomy as reported in a previous study [1].

Conclusion

Obstructive urolithiasis is a fatal disorder in young buffalo calves after weaning, especially in winter season within age ranged from 4 to 7 months. Dorsal urethrotomy was a successful surgical technique keeping patency of the urethra and the animals could be used in breeding. It might be used for calves with either intact or ruptured urinary bladder but not urethral rupture due to friable urethral wall for primary closure. This technique is considered an alternative surgical procedure to tube cystostomy technique.

Conflict of Interests

The authors declare that they have no conflict of interest.

Acknowledgments

The authors would like to thank Department of Surgery, Anesthesiology and Radiology, Faculty of Veterinary Medicine, Zagazig University, Egypt, for providing necessary facilities for the present study. The authors did not receive any specific funds for this study.

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الملخص العربي

تقييم فعالية تقنية بضع الإحليل الظهري في علاج احتباس البول الانسدادي في عجول الجاموس المصابة بتمزق المثانة البولية

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يعتبر احتباس البول الانسدادي من الإصابات الجراحية الشائع حدوثها في صغار المجترات خاصة في فصل الشتاء. وهدفت هذه الدراسة الي تقييم مدي فعالية تقنية بضع الإحليل الظهري في علاج احتباس البول في عجول الجاموس المصابة بتمزق المثانة البولية. تم استخدام عشرة عجول جاموس من الذكور الغير مخصية تتراوح أعمارها بين 4-7 أشهر وتعاني من احتباس البول وتم تشخيصها على أنها احتباس بول مع تمزق المثانة بناءً على الفحوصات السريرية واستخدام الموجات فوق الصوتية وتحاليل الدم. تم إجراء تقنية بضع الإحليل الظهري في العجول المصابة وتم متابعتها لمدة ثلاثة أشهر بعد الجراحة لتسجيل المضاعفات وحدوث تكرار الانسداد. تسعة من أصل عشرة عجول تعافت بدون مضاعفات أو إعادة انسداد بعد ثلاثة أشهر من الجراحة. حالة واحدة فقط حدث لها إعادة الانسداد بعد عشرون يومًا من التدخل الجراحي. وبالتالي، فإن تقنية بضع الإحليل الظهري هي إجراء جراحي ناجح في علاج احتباس البول الانسدادي في العجول المصابة بتمزق المثانة مع قلة فرصة حدوث مضاعفات ما بعد الجراحة ومعاودة الانسداد.