



Special Issue:

Veterinary Medicine between Sustainable Development and Public Health to Confront Global Changes

Advanced Trend in Dissolution of Obstructive Urolithiasis's Calculi in Buffalo Calves

MUSTAFA ABD EL RAOUF*, MOSTAFA ABDELAZIM, ABDEL BASIT M. ABD EL-AAL, SHEBL E. SALEM

Department of Surgery, Anesthesiology and Radiology, Faculty of Veterinary Medicine, Zagazig University, Zagazig, 44519, Egypt.

Abstract | Obstructive urolithiasis is a fatal disorder affecting young male buffalo calves. The aim of the present study was to evaluate the efficacy of Walpole's solution in dissolution of urethral calculi in buffalo calves with ruptured bladder in comparison to ammonium chloride. Therefore, twenty male buffalo calves aged 4-7 months admitted to the Clinic of Department of Surgery, Faculty of Veterinary Medicine, Zagazig University then diagnosed as obstructive urolithiasis with bladder rupture based on clinical, ultrasonographic, haematological and biochemical examinations. Ten apparently healthy calves with the same age were used as a control group. The affected animals were surgically treated with tube cystostomy technique and divided into two groups; Group I (n=10): orally administered ammonium chloride 200mg/kg and Group II (n=10): Local introducing of Walpole's solution 100mL/animal. The time of resuming normal urination and urine pH intraoperatively and after recovery was measured. In Group I, 30%, 50% and 20% of animals resumed their normal urination within 3, 7 and 14 days postoperatively respectively meanwhile in Group II, 70% and 30% of animals resumed urination within 3 and 5 days postoperatively, respectively. The urine pH at the day of operation was 8.1 ± 0.47 . The observed calculi were triple phosphate crystals (n=16) and calcium carbonate calculi (n=4). After recovery, nonsignificant lower pH of urine in Group II (5.4 ± 0.2) than Group I (6.7 ± 0.14) was recorded. Consequently, in conclusion, Walpole's solution had more efficacy to dissolve urethral calculi than ammonium chloride in buffalo calves treated with tube cystostomy.

Keywords: Urolithiasis, Tube cystostomy, Walpole's solution, Ammonium chloride

Received | September 06, 2024; Accepted | October 08, 2024; Published | October 19, 2024

*Correspondence | Mustafa Abd El Raouf, Department of Surgery, Anesthesiology and Radiology, Faculty of Veterinary Medicine, Zagazig University, Zagazig, 44519, Egypt; Email: dr_mustafa13@yahoo.com

Citation | Abd El Raouf M, Abdelazim M, Abd El-Aal AM, Salem SE (2024). Advanced trend in dissolution of obstructive urolithiasis's calculi in buffalo calves. Adv. Anim. Vet. Sci. 12(s1): 277-283.

DOI | <https://dx.doi.org/10.17582/journal.aavs/2024/12.s1.277.283>

ISSN (Online) | 2307-8316; ISSN (Print) | 2309-3331



Copyright: 2024 by the authors. Licensee ResearchersLinks Ltd, England, UK.

This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

INTRODUCTION

Obstructive urolithiasis in calves is a fatal disease-causing high mortality rate if not treated and defined as urine retention due to calculus lodgment. It is considered the fifth cause of death between feedlot calves (Makhdoom and Gazi, 2013). Male ruminants were more susceptible than female due to anatomical structure of the urinary

system with narrow, long and tortuous urethra in males. The distal part of sigmoid is the common site of lodgment of calculi (Tamilmahan *et al.*, 2014).

Several factors are incriminated in urinary calculus formation including combination of physiological, nutritional, mangemental, geographical and seasonal factors in addition to age and sex of animals (Tamilmahan *et al.*,

2014). Also, urolithiasis appeared in male ruminants fed with high grain ration in management systems (Constable *et al.*, 2016). Obstructive urolithiasis is manifested clinically by three syndromes; retained urine, ruptured urethra and ruptured bladder (Constable *et al.*, 2016; Van Meter and Ortved, 2017; Kim *et al.*, 2023).

Diagnosis of obstructive urolithiasis depends on the history of anuria, restlessness, anorexia, reluctance to move, abdominal colic and the animals shows some attempts to urinate (Kushwaha *et al.*, 2016; Bayoumi and Attia, 2017). Clinical signs depend on the severity of urethral obstruction and the condition of the urinary bladder. Abdominal pain and colic, anuria, grinding of teeth, inappetance, twitching of the penis, frequent attempts to urinate, urethral pulsation and rectal prolapse are the reported signs in case of intact urinary bladder. While, relief of pain, sunken eye, abdominal distension and thrilling movement of the abdominal fluid on tactile percussion in addition to uremia and toxemia within 2-3 days unless treatment is established are the reported signs in case of rupture of the urinary bladder (Constable *et al.*, 2016; Kushwaha *et al.*, 2016).

Treatment of obstructive urolithiasis is mainly surgical and several surgical interferences were reported to relieve the retention and remove the calculi from the urethra including urethrostomy, penile amputation, urethrotomy, bladder marsupialization, and tube cystostomy (Makhdoomi and Gazi, 2013; Constable *et al.*, 2016; Van Meter and Ortved, 2017).

Tube cystostomy is a surgical technique used for relieving calculus through using urinary acidifiers with retaining normal urethral and breeding purposes of the animals. It provides a practical and quick method for urinary diversion by using a Foley catheter introduced to the urinary bladder by a stab incision (Abdallah *et al.*, 2012). It was successful and efficient in about 95% of the treated cases with minimal complications (Tamilmahan *et al.*, 2014; Mangotra *et al.*, 2017; Abdalla and Rizk, 2018; Abdallah *et al.*, 2021).

The urine pH plays an important role in calculus formation. The urine pH of ruminants is alkaline and the phosphatic calculi and struvite have the ability to formed in this condition. Therefore, changing pH is important in dissolution of urinary calculi (Constable *et al.*, 2016). Ammonium chloride was used as acidification agent to help dissolution of calculi in calves (Mavangira *et al.*, 2010; Gazi *et al.*, 2015; Abdallah *et al.*, 2021). It was administered orally and its metabolites excrete through urine and shift pH to be acidic (Abdalla and Rizk, 2018). Walpole's solution is acidifying solution used for dissolution calculus through its administration directly inside the urinary bladder. It is composed of sodium acetate, glacial acetic acid, and distilled water with a pH of 4.5. It produces

acidic condition of urine suitable for solubility of struvite (magnesium ammonium phosphate) calculi in male goats (Janke *et al.*, 2009; Van Meter and Ortved, 2017). According to knowledge, one recent study used Walpole's solution in treatment of obstructive urolithiasis in buffalo calves with intact bladder and gave good rapid dissolution of calculi (Kumar *et al.*, 2024).

Therefore, the present study aimed to evaluate the efficacy of Walpole's solution in dissolution of urethral calculi in buffalo calves with ruptured bladder in comparison to ammonium chloride.

MATERIALS AND METHODS

ANIMALS

This work was conducted on 20 non-castrated male buffalo calves with age ranged from 4 to 7 months admitted to the Clinic of Surgery department, Faculty of Veterinary Medicine, Zagazig University and suffering obstructive urolithiasis with urinary bladder rupture. The animals were surgically treated with tube cystostomy technique and divided into two groups according to the treatment protocol; Group I: the animals were orally administered 200mg/kg body weight ammonium chloride for 20 days after surgery, while Group II: 100 ml of Walpole's solution was introduced locally inside the urinary bladder for 5 days after surgery. In addition, 10 apparently healthy calves within the same age used as a control for hematological and biochemical analysis as well as urine pH measurement.

CLINICAL EXAMINATION

Thorough clinical examination was performed for all calves (Jackson and Cockcroft, 2002). The duration of retention and previous interferences were reported. Type of feeding and weaning age were also reported. Body temperature, heart rate, respiratory rate, color of the mucous membrane, and the degree of dehydration were investigated. Abdominal ballottement and abdominocentesis at the left paramedian region behind the umbilicus under aseptic condition were performed.

ULTRASONOGRAPHIC EXAMINATION

Ultrasonographic examination of the abdomen and the urinary bladder was performed using B-mode ultrasound machine (Sonoscape A5V, China) connected with 6 MHz transducer for transabdominal and transrectal examinations in standing position. In addition, urethral examination for detection the site of calculus was performed.

HEMATOLOGICAL AND BIOCHEMICAL ANALYSIS

Whole blood and serum samples were obtained from the jugular vein of the affected animals for hematological and biochemical examinations. Red blood cells (RBCs),

Hemoglobin (Hb), PCV%, and white blood cells (WBCs) were measured. In addition, serum levels of blood urea nitrogen (BUN), creatinine (Cr), calcium (Ca) and phosphorus (Ph) were measured using standard procedures.

URINALYSIS

Urine samples from the affected animals were collected directly from the bladder during surgery in clean sterile cups for pH evaluation using digital pH meter (Milwaukee, Romania). The urine pH was measured also after recovery of animals. The type of stone in urine was detected through microscopic examination.

PREPARATION OF WALPOLE'S SOLUTION

Walpole's solution was prepared as previously described (Constable *et al.*, 2016). It is composed of 1.16% sodium acetate, 1.09% glacial acetic acid, and 97.75% distilled water. The pH of the solution adjusted to 4.3-4.8 using pH meter.

SURGICAL MANAGEMENT

All affected animals (n=20) were surgically treated with tube cystostomy technique at the left paramedian aspect as described previously (Khurma *et al.*, 2017; Abdalla and Rizk, 2018; Abdallah *et al.*, 2021). Briefly, the animals were secured in right lateral recumbency after sedation with 2% Xylazine HCL (Xyla-Ject®, ADWIA Pharmaceuticals Co., 10th of Ramadan City, Egypt) at a dose rate of 0.05 mg/kg body weight. The left paramedian region from pubis until umbilicus was aseptically prepared. Linear infiltration anesthesia extending 10 cm cranial to the rudimentary teat and parallel to the prepuce was performed at the left paramedian region using lidocaine HCL 2% (Debocaine®, the Arab Company, Obour City, Egypt). A 10 cm laparotomy incision was made along the site of anesthesia and the peritoneum opened carefully with gradual fluid evacuation. After exploration of the abdomen, cystorrhaphy with double layers of cushioning pattern after removal of necrotic parts and urinary calculi was performed. A 20 French Foley catheter was implanted into the bladder lumen through a new abdominal wall stab incision. Then the catheter fixed to the skin with a stitch (Figure 1). Abdominal lavage before abdominal incision closure using sterile 0.9% saline solution was performed.

Postoperatively, intramuscular (I/M) injection of a broad-spectrum antibiotic (Pen and Strep®, Norbrook Co., N. Ireland, 1 mL/25 kg) and anti-inflammatory (flunixin meglumine, Flunixin®, Norbrook Co., N. Ireland, 2.2 mg/kg) were performed for 5 and 3 days, respectively. Fluid therapy to correct dehydration and electrolytes imbalance was administered. In Group I, oral administration of 200mg/kg body weight ammonium chloride dissolved in 40 mL of water was performed for 20 days. Intermittent blockade of the Foley catheter for 30 min 3 times daily was performed

until resuming normal urination has occurred. In Group II, the Foley catheter was blockade for 30 minutes then 100 ml of Walpole's solution was locally introduced into the bladder lumen (half distended urinary bladder) through the Foley catheter. Then the Foley catheter was blockade again for 30 minutes then relieved. This step repeated daily for 5 days postoperatively. Urine samples were collected from the treated animals after recovery for measuring pH of urine after treatment. The time of resuming normal urination was recorded in each group. The animals followed for 3 months after treatment for recurrence and complications.

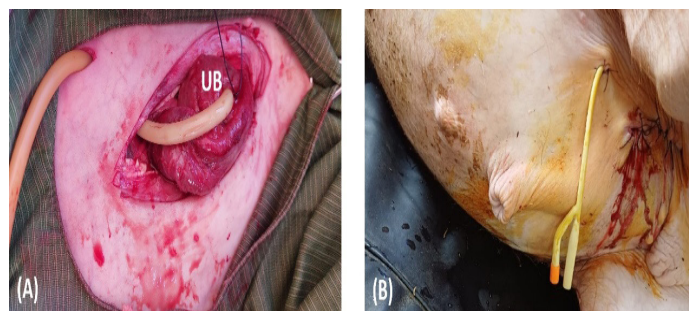


Figure 1: (A) Implantation of a Foley catheter inside the urinary bladder of a buffalo calf through an abdominal incision. (B) The Foley catheter was fixed outside at the skin with a stitch.

STATISTICAL ANALYSIS

Data of this study were reported as mean $\pm$ SD (Standard Deviation of Mean). Differences between the normal and affected animals in hematological and biochemical parameters were analyzed using one-way analysis of variance (ANOVA) followed by Tukey's multiple comparisons test as post hoc test through Statistical Package for Social Sciences version 24.0 (SPSS, IBM Corp., Armonk, NY). Significance was adjusted when $P < 0.05$.

RESULTS AND DISCUSSION

CLINICAL FINDINGS

All the affected animals revealed signs of obstructive urolithiasis with urinary bladder rupture including dullness, anorexia, pear shaped abdomen, sunken eye, rough coat, dry preputial orifice, abdominal thrilling during ballottement and uremic breath. Rectal body temperature was within normal ranges (38.3-38.7 °C). Abdominocentesis revealed uoperitoneum.

ULTRASONOGRAPHIC FINDINGS

The ultrasonographic imaging of the affected animals showed free anechoic fluid inside the abdomen with echogenic fibrinous jelly-like material during transabdominal examination. In transrectal examination, the bladder was shrinkage with thickened corrugated wall (Figure 2).

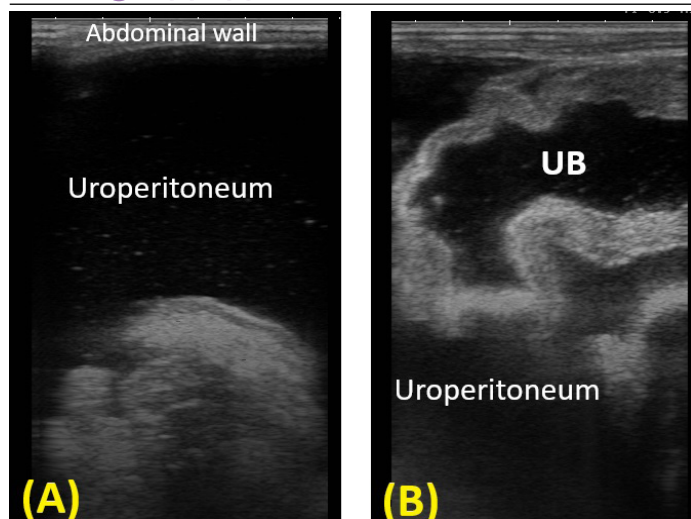


Figure 2: (A) Transabdominal ultrasonographic image of a 5-months male buffalo calf with urinary bladder rupture when examined at the caudal abdomen, note the free anechoic fluid inside the abdomen (uroperitoneum). (B) Transrectal ultrasonographic image of the same buffalo calf, note small-sized bladder with thickened corrugated echogenic wall and uroperitoneum. UB: Urinary bladder.

HEMATOLOGICAL AND BIOCHEMICAL FINDINGS

The hematological and biochemical findings were summarized in Table 1. Significant increase in PCV (%) was reported in the affected calves than the control ones. Mild non-significant leukocytosis was recorded in the affected calves. The serum levels of BUN and Cr as well as Ph were significantly higher in the affected calves than the control ones. On the other hand, the serum levels of Ca were significantly lower in the affected calves than the control ones.

Table 1: Mean $\pm$ SD of hematological and biochemical parameters in calves.

Parameters	Control	Affected calves
RBCs ($\times 10^6/\text{mm}^3$)	7.9 ± 0.41	7.8 ± 0.81
Hb (g/dL)	10.5 ± 0.94	10.4 ± 1.22
PCV (%)	31.1 ± 1.48	$39.5 \pm 3.71^*$
WBCs ($\times 10^6/\text{mm}^3$)	10.6 ± 0.69	10.9 ± 2.33
Ca (mmol/L)	10.3 ± 0.51	$6.5 \pm 0.99^*$
Ph (mmol/L)	6.6 ± 0.45	$8.2 \pm 1.17^*$
Urea (mg/dL)	21.1 ± 6.05	$54.2 \pm 16.79^*$
Creatinine (mg/dL)	1.4 ± 0.18	$7.6 \pm 1.863^*$

*Significance between groups. $P < 0.05$.

URINALYSIS FINDINGS

Urinalysis of the affected calves revealed alkaline pH (8.1 ± 0.47) at the day of operation. The most commonly detected calculi in the affected calves were triple phosphate crystals ($n=16$) and calcium carbonate calculi ($n=4$). The pH of urine in clinically healthy calves was 7.9 ± 0.29 .

After treatment of the affected cases and administration of ammonium chloride and Walpole's solution, the pH of the collected urine at the day of the Foley catheter removal was 6.7 ± 0.14 and 5.4 ± 0.2 , respectively (Table 2). Interestingly, the pH after Walpole's treatment was more significantly lower than that of the day of surgery.

Table 2: Measurements of urine pH intra-operatively and after treatment with Ammonium chloride and Walpole's buffer solution.

Items	pH
Normal animals	7.9 ± 0.29
Intra-operative	8.1 ± 0.47
After using Ammonium chloride	$6.7 \pm 0.14^*$
After using Walpole buffer solution	$5.4 \pm 0.27^*$

*Significance between groups. $P < 0.05$.

SURGICAL FINDINGS AND OUTCOMES

Intraoperatively, the bladder was small-sized sac with thick congested wall. The site of rupture was at the dorsal aspect of the bladder wall. All calves recovered without complications. Time of resuming normal urination from the external urethral orifice was different in the treated animals according to the treatment protocol. In Group I, 30%, 50% and 20% of the calves resumed their normal urination within 3, 7 and 14 days postoperatively, respectively. In Group II, 70% and 30% of the calves resumed their normal urination within 3 and 5 days postoperatively, respectively. The Foley catheter was removed after 3 days from resuming normal urination and the owners advised to supply water in sufficient amount with low feeding of concentrates. The treated calves in the treated groups were followed for 3 months after treatment without recurrence of obstruction.

Obstructive urolithiasis is a common disease of ruminants caused by calculus formation anywhere of the urinary tract with subsequent blockade of urine outflow leading to uremia and eventually death if not properly treated (Rafee *et al.*, 2015). This disorder is commonly recorded in male buffalo calves with less incidence in cow calves. Young animals are commonly susceptible to the disorder with age ranged most commonly from 3 to 7 months (Amarpal *et al.*, 2004; Kushwaha *et al.*, 2009; Mahajan *et al.*, 2017). In young calves, early weaning with lack of water intake especially in winter season and sudden change of diet to highly concentrated rations might the reason for high incidence of the disease among young animals (Amarpal *et al.*, 2013; Abdallah *et al.*, 2021). In addition, narrowed urethra due to lack of testosterone causing difficulty in expelling calculus (Mahajan *et al.*, 2017). These findings agreed with our findings as the age of the affected calves was between 4 to 7 months.

The main reported clinical signs in calves with bladder

rupture were anorexia, sunken eye, dullness, abdominal distension and thrilling, and uremic breath. Similar findings were reported in previous studies (Khosa *et al.*, 2016; Bayoumi and Attia, 2017; Mahajan *et al.*, 2017; Riedi *et al.*, 2018; Abdallah *et al.*, 2021). Ultrasound is a non-invasive diagnostic tool for obstructive urolithiasis and gives a chance to evaluate the bladder condition (Braun, 1993; Parrah *et al.*, 2014; Bhangu *et al.*, 2019). In the present study, ultrasound gave a descriptive feature about the bladder condition and its wall. The bladder appeared small anechoic sac with thickened wall. Similar findings were reported previously (Bayoumi and Attia, 2017; Abdallah *et al.*, 2021).

In the present study, significant increase in levels of BUN and Cr was reported in all affected calves with ruptured bladder. Similar findings were reported by previous studies (Gazi *et al.*, 2015; Rafee *et al.*, 2015; Bayoumi and Attia, 2017; Khurma *et al.*, 2017; Mangotra *et al.*, 2017; Abdalla and Rizk, 2018; Abdallah *et al.*, 2021). This might be attributed to wide area of absorption from the peritoneal activity after rupture of the bladder and escaping the urine in the peritoneum (Sharma *et al.*, 2006). The level of phosphorus was significantly high in the affected calves of the present study, while calcium level was significantly low in the affected calves. Increased level of phosphorus leads to calcium excretion with subsequent secondary hypocalcemia (Saurabh *et al.*, 2016; Bayoumi and Attia, 2017; Mangotra *et al.*, 2017).

It was reported that feeding concentrates to the animals which rich in phosphorus and magnesium but low in calcium and potassium causing hypocalcemia in animals (Sultan, 2017). Also, anorexia of the animals reduces calcium oral intake and absorption from the gastric tract (Sharma *et al.*, 2005). Obstructive urolithiasis in ruminants is frequently associated with metabolic alkalosis and subsequent reduction in the proportion of the ionized serum calcium, which might also have been responsible for the lower serum calcium levels (Saurabh *et al.*, 2016). Significant increase in PCV (%) was reported in the affected calves of the present study might be due to dehydration and hemoconcentration in the blood of the affected calves (Constable *et al.*, 2016).

In urinalysis, the pH of urine collected from the affected calves during surgery was alkaline (8.1 ± 0.47) and the type of calculi found in the collected urine samples were triple phosphate crystals ($n=16$) and calcium carbonate calculi ($n=4$). It was reported previously that the preoperative pH of urine was (8.18 ± 0.07) which attributed to decomposition of urea to ammonia (Benjamin, 1985; Carlson, 1990) and/or urinary tract infection (Kumar *et al.*, 2024). The pH of ruminant urine is alkaline as found in the clinically healthy calves (7.9 ± 0.29). It was suggested that urine alkalinity leads to the precipitation of calcium and magnesium phosphates

and carbonates, triple phosphates crystals (Powe, 1986; Pugh, 2002). Alkaline urine might be due to the feeding of ruminants on forages and concentrates (Kumar *et al.*, 2024). After recovery, the pH of urine was 6.7 ± 0.14 in Group I and 5.4 ± 0.2 in Group II. It was reported that the use of urine acidifiers shift the pH to acidic condition (Constable *et al.*, 2016; Van Meter and Ortved, 2017).

In the present study, the use of Walpole's solution shifted the urine pH to acidic to be 5.4 ± 0.2 after recovery of animals. This finding was in agreement with the previous study where the use of Walpole's solution in treatment of obstructive urolithiasis in buffalo calves progressively decreased the urine pH to acidic condition to be 5.5 after 24 hours from the treatment (Kumar *et al.*, 2024). It was reported that Walpole's solution as a urinary acidification is mostly effective in animals with struvite calculi which have solubility in acidic conditions (Van Meter and Ortved, 2017). In a goat study, the use of Walpole's solution in treatment of obstructive urolithiasis was effective in 80% of cases but recurrence was observed in 30% of cases (Janke *et al.*, 2009). Follow up of the treated calves in the present study for 3 months postoperatively did not observe recurrence of obstruction.

Intraoperatively, the urinary bladder appeared as a small-sized sac with thick congested wall and ruptured at the dorsal aspect. These findings were in line with the previous studies where they reported that bladder rupture was mainly dorsally (Kushwaha *et al.*, 2014; Abdallah *et al.*, 2021). The main treatment of obstructive urolithiasis in male ruminant is surgical (Metre *et al.*, 1996). Tube cystostomy technique was performed in affected calves of the present study with good recovery. In previous studies, this surgical technique was successful in more than 95% of the treated cases with minimal complications (Tamilmahan *et al.*, 2014; Mangotra *et al.*, 2017; Abdalla and Rizk, 2018; Abdallah *et al.*, 2021). In comparison to other surgical procedures this technique maintains patency of urethra with subsequent preserve the breeding purposes of calves and urinary continence (May *et al.*, 1998).

The operated animals in the present study resumed their normal urination through the external urethral orifice at different time according to treatment group. In Group I, 30%, 50% and 20% of the calves resumed their normal urination within 3, 7 and 14 days postoperatively, respectively. In Group II, 70% and 30% of the calves resumed their normal urination within 3 and 5 days postoperatively, respectively. In previous studies of using tube cystostomy technique in treatment of obstructive urolithiasis in male buffalo calves with oral supplementation of ammonium chloride, the animals resumed their normal urination within 12-15 days (Abdalla and Rizk, 2018) and 7-14 days postoperatively (Abdallah *et al.*, 2021). These findings agreed with our

findings where the normal urine flow resumed within 3 to 14 days after using ammonium chloride powder orally. In a recent study using Walpole's solution after tube cystostomy technique, the median time of resuming urine flow was 7 to 8 days postoperatively (Kumar *et al.*, 2024). These findings agreed with our findings where the normal urine flow resumed within 3 to 5 days after using Walpole's solution locally. In the present study, the use of Walpole's solution had the ability to dissolve calculi rapidly in comparison to the use ammonium chloride where 70% of calves resumed their normal urination within 3 days postoperatively after using Walpole's solution, while 30% of calves resumed normal urination within 3 days postoperatively after using ammonium chloride powder. This early free urine flow attributed to strong acidic condition of urine inside the urinary bladder after using Walpole's solution and rapid dissolution of struvite calculi (Kumar *et al.*, 2024). The urine pH became 5.4 ± 0.2 after using Walpole's solution on the other hand the pH became 6.7 ± 0.14 after using ammonium chloride. Recurrence of the condition was not reported after follow up of cases for 3 months as reported in previous study (Abdallah *et al.*, 2021) where they did not record recurrence after 5 months from the treatment. It was suggested that successful surgical technique is considered when there was not recurrence of obstruction (Fortier *et al.*, 2004).

CONCLUSIONS AND RECOMMENDATIONS

Obstructive urolithiasis is an important clinical disorder affecting young buffalo calves within 4 to 7 months of age. Sequelae for delay intervention are rupture of the bladder or urethral rupture. Tube cystostomy technique is a practical efficient surgical procedure to relieve the retention and preserve breeding purposes of animals. Acidification of urine shifts the urine pH to acidic condition to provide a good condition for dissolution of calculi. Walpole's solution had better ability to induce acidic urine pH than ammonium chloride with subsequent early dissolution of calculi and resuming normal urination. The use of Walpole's solution led to resume normal urination in 70% of calves within 3 days. On the other hand, 30% of calves resumed normal urination within 3 days. The owners should be awarded to introduce balanced diet to the weaning and growing animals and supply sufficient amount of water to the animals.

ACKNOWLEDGMENTS

The authors would like to thank Department of Surgery, Radiology 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.

NOVELTY STATEMENT

To our knowledge, this study is the first to compare the dissolution efficacy of Walpole's solution to urethral calculi in buffalo calves in comparison to ammonium chloride.

AUTHORS' CONTRIBUTION

All authors designed, planned, drafted, and revised the manuscript. MA contributed to statistical analysis. MA, MA, AMA and SES contributed to clinical and ultrasonographic examinations in addition to surgical interference and post-operative follow-up of cases. All authors read and approved the final manuscript.

ETHICAL APPROVAL

During this study, the surgical procedures and animal manipulations conducted in accordance with ethical committee of Zagazig University (ZU-IACUC/2/F/192/2024).

CONFLICT OF INTEREST

The authors have declared no conflict of interest.

REFERENCES

- Abdalla A, Rizk A (2018). Clinical, haematological and biochemical findings based surgical management of obstructive urolithiasis by tube cystostomy in buffalo calves (*Bubalus bubalis*). Alex. J. Vet. Sci., 56(2): 69-77. <https://doi.org/10.5455/ajvs.291609>
- Abdallah A, Ezzeldeen S, Eisa E, Abd El Raouf M, Bayoumi Y (2021). Obstructive urolithiasis in buffalo calves (*Bubalus bubalis*): Serum changes of Vitamins A and D and efficacy of surgical management using tube cystostomy. Vet. World, 14(1): 129-136. <https://doi.org/10.14202/vetworld.2021.129-136>
- Amarpal A, Kinjavdekar P, Paithal HP, Pawde AM, Singh T, Pratap K (2004). Incidence of urolithiasis: A retrospective study of five years. Indian J. Anim. Sci., 74: 2.
- Amarpal KP, Aithal HP, Pawde AM, Pratap K, Gugjoo MB (2013). A retrospective study on the prevalence of obstructive urolithiasis in domestic animals during a period of 10 years. Adv. Anim. Vet. Sci., 1(3): 88-92.
- Bayoumi YH, Attia NE (2017). Comparative study of obstructive urolithiasis and its sequelae in buffalo calves. Vet. World, 10(2): 156. <https://doi.org/10.14202/vetworld.2017.156-162>
- Benjamin MM (1985). Outline of veterinary clinical pathology Iowa State University Press, Ames, Iowa.
- Bhangu SS, Saini NS, Mohindroo J, Singh T, Mahajan SK (2019). Ultrasonography as a decision making tool for surgery of obstructive urolithiasis in bovine. Indian J. Vet. Surg., 40(2): 116-118.
- Braun U (1993). Ultrasonographic examination of the left kidney, the urinary bladder, and the urethra in cows. J. Vet. Med. Ser. A, 40(1-10): 1-9. <https://doi.org/10.1111/j.1439-0442.1993>

- tb00594.x
- Carlson GP (1990). Clinical chemistry tests. In: Smith, B.P. (Editor). Large animal internal medicine. The C.V. Mosby Co., Missouri, US: pp. 386-414.
- Constable PD, Hinchcliff KW, Done SH, Grünberg W (2016). Veterinary medicine: A textbook of the diseases of cattle, horses, sheep, pigs and goats. Elsevier Health Sci., pp. 1141-1151.
- Fortier LA, Gregg AJ, Erb HN, Fubini SL (2004). Caprine obstructive urolithiasis: Requirement for 2nd surgical intervention and mortality after percutaneous tube cystostomy, surgical tube cystostomy, or urinary bladder marsupialization. Vet. Surg., 33(6): 661-667. <https://doi.org/10.1111/j.1532-950X.2004.04089.x>
- Gazi MA, Makhdoomi DM, Parrah JD, Dar SH, Ganai AM (2015). Tube cystostomy following urethral obstruction in a crossbred calf-a report.
- Jackson PGG, Cockcroft PD (2002). Clinical examination of farm animals Blackwell Science Ltd. pp. 113-124. <https://doi.org/10.1002/9780470752425>
- Janke JJ, Osterstock JB, Washburn KE, Bissett WT, Roussel AJ, Hooper RN (2009). Use of Walpole's solution for treatment of goats with urolithiasis: 25 cases (2001-2006). J. Am. Vet. Med. Assoc., 234(2): 249-252. <https://doi.org/10.2460/javma.234.2.249>
- Khosa JS, Singh D, Gharu S, Gahlot TK (2016). Evaluation of tube cystostomy through laparotomy as a surgical treatment for obstructive urolithiasis in male buffalo (*Bubalus bubalis*) calves. Int. J. Sci. Environ. Technol., 5(2): 585-588.
- Khurma J, Choudhary C, Sharma DV, Singh K (2017). Tube cystostomy for management of obstructive urolithiasis in buffalo calves. Int. J. Sci. Environ. Technol., 6(1): 413-419.
- Kim YJ, Ha SM, Ku JY, Yoon JS, Park J (2023). Hematological differentiation of bladder rupture and complete/partial urethral obstruction in castrated Hanwoo (Korean indigenous cattle) with urolithiasis. J. Vet. Sci., 24: 5. <https://doi.org/10.4142/jvs.23010>
- Kumar A, Saharan S, Tiwari DK, Sharma M, Kumar P (2024). Use of walpole's solution and ultrasound-guided tube cystostomy for the treatment of obstructive urolithiasis in male buffalo calves. Vet. Pract., 25:1.
- Kushwaha RB, Amarpal HP, Kinjavdekar P, Pawde AM (2014). Clinical appraisal of 48 cases of obstructive urolithiasis in buffalo calves treated with tube cystostomy and urethrotomy. Adv. Anim. Vet. Sci., 2(2): 106-110. <https://doi.org/10.14737/journal.aavs/2014/2.2.106.110>
- Kushwaha RB, Kinjavdekar P, Aithal HP, Pawde AM (2016). Haemato-biochemical alterations in relation to urinary bladder status, duration of urethral obstruction and age of buffalo calves suffering with obstructive urolithiasis. Indian J. Vet. Surg., 37(2): 124-129.
- Kushwaha RB, Kinjavdekar P, Aithal HP, Pawde AM, Pratap K (2009). Urolithiasis in buffalo calves: A review of 91 cases. Indian J. Vet. Surg., 30(1): 9-12.
- Mahajan A, Gupta AK, Bhadwal MS, Bhat MA, Bhardwaj HR (2017). Occurrence and management of obstructive urolithiasis in ruminants. J. Anim. Res., 7(4): 723-731. <https://doi.org/10.5958/2277-940X.2017.00111.5>
- Makhdoomi D, Gazi MA (2013). Obstructive urolithiasis in ruminants. A review. Vet. World, 6: 4. <https://doi.org/10.5455/vetworld.2013.233-238>
- Mangotra V, Singh K, Proch A (2017). Tube cystostomy in male buffalo calves (*Bubalus bubalis*) suffering from retention of urine. J. Anim. Res., 7(2): 279-291. <https://doi.org/10.5958/2277-940X.2017.00041.9>
- Mavangira V, Cornish JM, Angelos JA (2010). Effect of ammonium chloride supplementation on urine pH and urinary fractional excretion of electrolytes in goats. J. Am. Vet. Med. Assoc., 237(11): 1299-1304. <https://doi.org/10.2460/javma.237.11.1299>
- May KA, Moll HD, Wallace LM, Pleasant RS, Howard RD (1998). Urinary bladder marsupialization for treatment of obstructive urolithiasis in male goats. Vet. Surg., 27(6): 583-588. <https://doi.org/10.1111/j.1532-950X.1998.tb00534.x>
- Metre DV, House JK, Smith BP, George LW, Angelos SM, Angelos JA, Fecteau G (1996). Obstructive urolithiasis in ruminants: Medical treatment and urethral surgery. Compend. Contin. Educ. Pract. Vet., 18: 317-328.
- Parrah JD, Moulvi BA, Gazi MA, Makhdoomi D, Athar H, Hamadani H, Khan Q (2014). Evaluation of different surgical techniques for the management of bovine obstructive urolithiasis. J. Vet. Sci. Technol., 5: 5. <https://doi.org/10.4172/2157-7579.1000203>
- Powe TA (1986). Diseases of the urinary system. In: Howard, L. (Editor). Current Veterinary Therapy 2-Food Animal Practice, 1st ed. W.B. Saunders, Philadelphia: pp. 816-818.
- Pugh DG (2002). Sheep and goat medicine, 1st ed. Elsevier Publishing Co., Philadelphia, U.S.A.
- Rafee MA, Mahendra BMB, Sangeetha PSP, Suvarna HSH (2015). Obstructive urolithiasis in buffalo calves: A study on pattern of occurrence, aetiology, age, clinical symptoms and condition of bladder and urethra. Buffalo Bull., pp. 261-265.
- Riedi AK, Knubben-Schweizer G, Meylan M (2018). Clinical findings and diagnostic procedures in 270 small ruminants with obstructive urolithiasis. J. Vet. Intern. Med., 32(3): 1274-1282. <https://doi.org/10.1111/jvim.15128>
- Saurabh S, Bisla RS, Tayal R, Ganguly A (2016). Evaluation of sub-ischial urethrotomy for the treatment of obstructive urolithiasis in male buffalo calves. Haryana Vet., 55(2): 224-228.
- Sharma AK, Mogha JV, Singh GR, Amarpal A, Aithal HP (2005). Clinico-physiological and haematobiochemical changes in urolithiasis and its management in bovine. Indian J. Anim. Sci., 75: 10.
- Sharma PD, Singh K, Singh J, Kumar A (2006). Bacteriological, biochemical and histopathological studies in uroperitoneum in buffalo calves (*Bubalus bubalis*). Indian J. Anim. Sci., 76: 2.
- Sultan B, Tesfaye W, Yonas Y, Bihonegn T (2017). Bovine urethral obstruction and its treatment: A review. Int. J. Curr. Res. Biol. Med., 2(7): 15-25. <https://doi.org/10.22192/ijcrbm.2017.02.07.003>
- Tamilmahan P, Mohsina A, Karthik K, Gopi M, Gugjoo MB, Zama MMS (2014). Tube cystostomy for management of obstructive urolithiasis in ruminants. Vet. World, 7: 4. <https://doi.org/10.14202/vetworld.2014.234-239>
- Van Meter DC, Orved K (2017). Urolithiasis. In: Fubini, S.L. and Ducharme, N.G. (Editors). Farm animal surgery, 2nd edition. St. Louis, Missouri Elsevier, Inc.: pp. 584-595.