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# Research Article
# Transcutaneous and Transrectal Ultrasonography in Buffalo Calves with Urine Retention

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## Abstract

This study describes the ultrasonographic findings of the urinary tract of buffalo calves suffered from urine retention. In this study, 25 male buffalo calves with urine retention and 8 apparently clinically healthy male buffalo calves were used. All calves were subjected to thorough clinical and ultrasonographic examinations. Based on the clinical findings, the diseased calves were classified into four groups. The first group included 8 calves with severe abdominal pain and absence of urine outflow, second group included 5 calves with mild abdominal pain and absence of urine outflow, third one included 8 calves with absence of both pain reactions and urine outflow and finally, fourth group included 4 calves with severe abdominal pain and dribbling of bloody urine. Both transcutaneous and transrectal ultrasonographic examinations were carried out by using 3.5-5.0 MHz convex and 6-8 MHz linear transducers. Ultrasonographic examination revealed distended urinary bladder in first, second and fourth groups. In third group, the urinary bladder was ruptured with anechoic to hypoechoic fluid accumulated in the abdomen. In the second group, the anechoic urine was present inside and outside the urinary bladder. Hydronephrosis of variable degrees was detected in all diseased calves. Moreover, urethral calculi could be detected in 4 calves at 3rd group. Renal calculi were seen in a calf at 4th group. Both renal and urethral calculi appeared as hyperechogenic dots with acoustic shadowing. In conclusion, ultrasonography may be considered a diagnostic and prognostic tool for urine retention in buffalo calves.

**Key words:** Buffalo, calves, hydronephrosis, ruptured urinary bladder, ultrasonography, urolithiasis

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**Competing Interest:** The authors have declared that no competing interest exists.

**Data Availability:** All relevant data are within the paper and its supporting information files.

## INTRODUCTION

Urine retention is one of the most important problems in bovine resulting in high economic losses. Urolithiasis is the most common cause of urine retention in feedlot cattle, buffalo calves and bullocks (Kumar *et al*., 2011; Abu-Seida, 2012). The incidence of urolithiasis in calves is 12% (Makhdoomi and Gazi, 2013; Gugjoo *et al*., 2013).

Due to its multi-factorial etiology, high rate of reoccurrence and treatment failure, urolithiasis still provides a challenge. The recent proposed mechanism of stone formation involves urinary supersaturation, precipitation, growth, aggregation of crystals, crystal nucleation and their retention in renal tubular epithelial cells (Panigrahi *et al*., 2016).

The age, types of feed and water, season and castration have been identified as predisposing factors in occurrence of the disease (Larson, 1996; Singh *et al*., 2008). Diets high in calcium as subterranean clover may result in calcium carbonate uroliths while, plants such as halogeton or tops from the common sugar beet may be a factor in calcium oxalate uroliths formation. Vitamin A deficiency has been suggested as a precipitating factor both indoors and when cattle are grazing (Andrews *et al*., 2004). The mineral composition of water in concert with dietary mineral imbalances, probably contributes more to initiating urolithiasis than does the lack of water itself (Radostits *et al*., 2007).

Obstructive urolithiasis causes urine retention and leads to bladder distention, abdominal pain and eventual urethral perforation or bladder rupture with death from uremia or septicemia (Andrews *et al*., 2004). Clinical signs may be associated with partial or complete urethral occlusion. Animals with partial obstruction dribble blood-tinged urine after prolonged, painful (stranguria) attempts at urination, before complete occlusion occurs and urine may dry on the preputial hairs and leave detectable mineral deposits (Magda, 2006). Animals with complete urethral obstruction exhibit tenesmus, tail twitching, weight shifting and signs consistent with colic. Inappetence, bloat, depression and rectal prolapse also may be seen. Affected steers may elevate the tail and show urethral pulsations just ventral to the rectum.

Many diagnostic imaging techniques can be used for evaluation of the urinary tract of cattle including; intravenous pyelography, contrast cystography and ultrasonography. In large animal practice, ultrasonography is a valuable, applicable non invasive diagnostic imaging technique for diagnosis of various surgical affections (Kotb *et al*., 2014; Abu-Seida *et al*., 2015). Ultrasonography has also been successfully used for the diagnosis of various urinary disorders in bovines (Cote *et al*., 2002; Floeck, 2007; Saharan *et al*., 2013). This study describes the clinical and ultrasonographic findings in buffalo calves suffered from urolithiasis.

## MATERIALS AND METHODS

**Animals:** The present study was carried out on 25 buffalo calves with suspected urine retention. They were admitted to Teaching Hospital at Faculties of Veterinary Medicine, Zagazig and Cairo Universities, Egypt during the period extending from 2012-2015. The age of these calves ranged from 6-12 months and their body weights ranged between 100 and 230 kg. All animals were intensively reared with access to *ad-libitum* concentrates.

Additionally, another eight apparently healthy buffalo calves with the same ages and weights of the diseased calves were used as control and reference range for clinical and ultrasonographic investigations. Control animals were housed and fed hay/or straw plus 1-3 kg of concentrates daily.

**Clinical examination:** Case history, clinical examination, severity of pain and abdominal distension were recorded as described previously by Radostits *et al*. (2007). Dehydration was evaluated by skin tent test and degree of enophthalmia.

**Ultrasonographic examination:** On the standing position, transabdominal examination was carried out at the right inguinal region immediately cranial to the pubis for assessment of the urinary bladder size and its wall thickness. For assessment of the right kidney, the right last intercostal space (hepatic window) and the area of the right sub-lumbar fossa, immediately behind the last rib and just ventral to the traverse lumbar processes were imaged. Thickness of renal parenchyma (cortex and medulla), circumference of medullary pyramid diameter of renal sinus, vertical and horizontal lengths of the kidney were assessed (Fig. 1). Transabdominal ultrasonographic examinations were performed by a 3.5-5.0 MHz convex real-time B-mode transducers (Pie Medical 240 Parus, Maastricht, Netherlands). The penile urethra was scanned at pre and post-scrotal areas by a 6-8 MHz linear real-time B-mode transducer. Additionally, transrectal ultrasonographic examination was conducted for further examination of the pelvic urethra and urinary bladder using a 6-8 MHz linear real-time B-mode transducer (Pie Medical 240 Parus, Maastricht, Netherlands) according to Braun (1991).

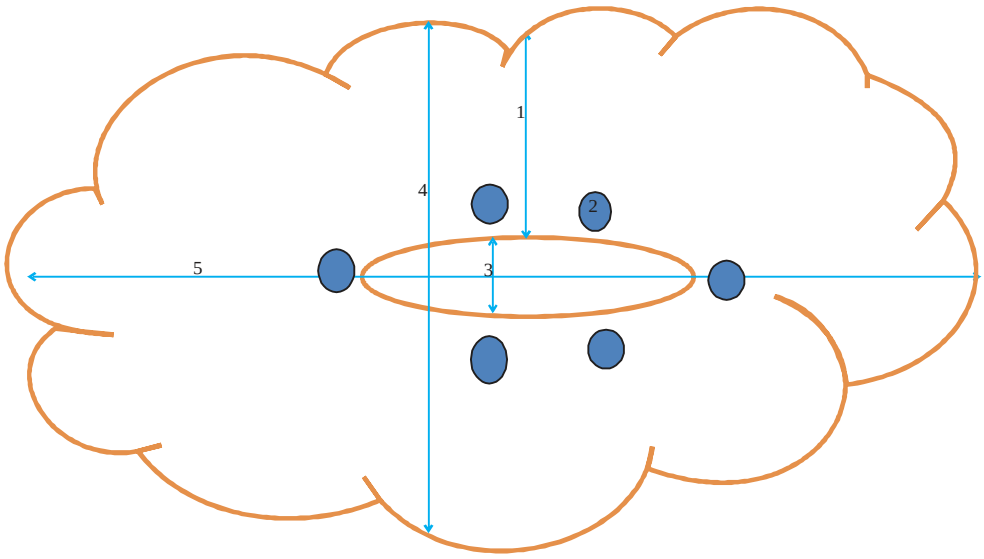


Fig. 1: Different measurements of the right kidney. 1: Thickness of renal parenchyma, 2: Circumference of medullary pyramid, 3: Thickness of renal sinus, 4: Vertical length of kidney and 5: Horizontal length of kidney

**Treatment:** Calves at 1st and 4th groups were treated by urothrostomy while all calves at 2nd group and 5 calves at 3rd group were treated by laparocystotomy and urothrostomy according to (Miesner and Anderson, 2015). Three calves with ruptured urinary bladder were slaughtered.

**Statistical analysis:** All data were analyzed using one way ANOVA (SPSS, Inc., Chicago, IL, USA). Data was expressed as Mean±Standard Deviation (SD). The differences in means were considered statistically significant at $p \leq 0.05$.

## RESULTS

**Clinical findings:** Pain reactions and frequent attempts for urination were observed in 17 calves. Severe pain reactions were described in 12 calves that exhibited grinding on teeth, grunting, restlessness and frequent attempts to urinate with severe colicky pain. Other 5 calves had mild degree of pain characterized by grunting and arched back. Pain reactions weren't detected in 8 calves.

Based on the degrees of pain and urine outflow, the diseased calves under investigation were classified into 4 groups: First group included 8 calves with severe abdominal pain and absence of urine outflow, 2nd group included 5 calves with mild abdominal pain and absence of urine outflow, third one included 8 calves with absence of both pain reactions and urine outflow and finally, 4th group included 4 calves with severe abdominal pain and dribbling of bloody urine.

As reported in Table 1, inappetence and congested mucous membrane of conjunctiva were reported in all diseased calves. The general condition was good and calves appeared alert but with hyperirritability in all diseased groups with exception of 3rd group, at which calves appeared dull and depressed. The abdomen was distended in all groups but pear-shaped abdomen was detectable in 2nd and 3rd groups. Mild to moderate degrees of dehydration were observed in 1st, 2nd and 4th groups while severe degree was detected in 3rd group. Body temperature, pulse and respiratory rates were within normal range in all groups; except 3 calves at 1st group had increased parameters and 3 calves at 3rd group had subnormal parameters. Urethral pulsation was palpated in 1st and 4th groups, while it wasn't palpable in 2nd and 3rd groups. In contrast, urineferous odor was severely detected in 3rd group, less in 2nd group and not detected in 1st and 4th groups. Recumbency was reported in two calves of 3rd group.

**Ultrasonographic findings:** The urinary bladder of control group appeared as a circumscribed round to oval structure in the pelvic area. Urine appeared anechoic to hypoechoic surrounded by thin echogenic wall. The urethra appeared transrectally as tube like structure in 3 calves and not detected in 5 calves. While, in diseased groups, the urinary bladder appeared intact, round, stretched with dilated urethra and detectable urethral pulsation (Fig. 2a) in 1st, 2nd and 4th groups (n = 17). Out of these 17 calves, uroperitoneum with intact urinary bladder was recorded in 5 calves of 2nd group which had anechoic urine outside the intact urinary bladder

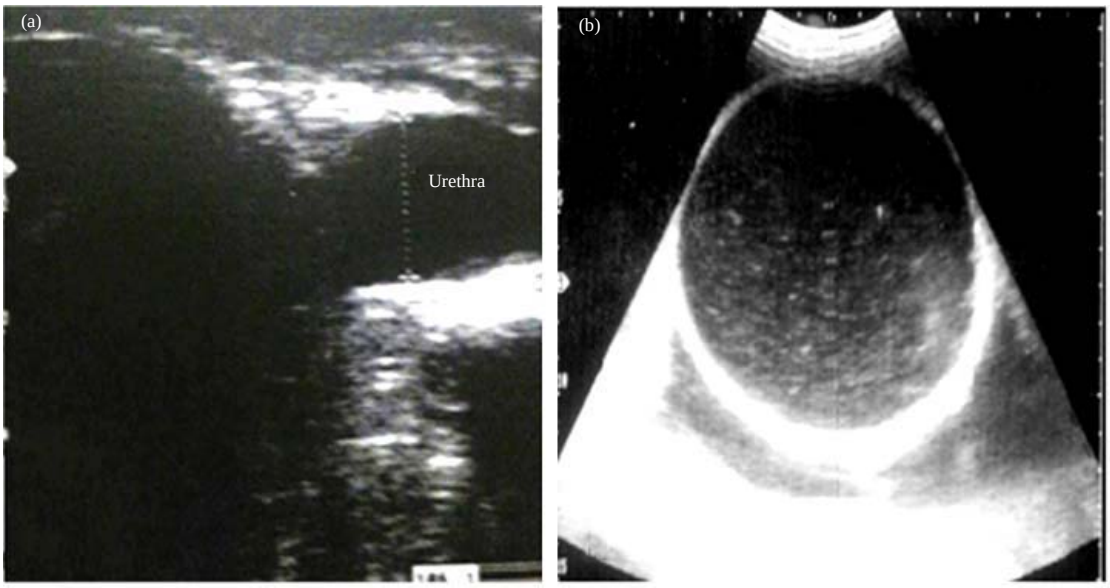


Fig. 2(a-b): (a) Transrectal ultrasonography using an 8 MHz linear transducer in a buffalo's calf of the first group showing distended urinary bladder and dilated urethra and (b) Transcutaneous ultrasonography of urinary bladder using a 3.5 MHz convex transducer at the right inguinal region in a buffalo's calf of the second group showing anechoic urine inside and outside the intact urinary bladder (uroperitoneum)

Table 1: Clinical findings of different diseased groups in comparison with control one

| | | Diseased groups | | | |
|---|---|---|---|---|---|
| Clinical parameters | Control group (N = 8) | 1st group (N = 8) | 2nd group (N = 5) | 3rd group (N = 8) | 4th group (N = 4) |
| General condition | Alert and quit | Alert and hyperirritable | Alert and hyperirritable | Dull and depressed | Alert and hyperirritable |
| Appetite | Good | Altered | Altered | Altered | Altered |
| Mucous membrane | Bright rosy red | Congested | Congested | Congested | Congested |
| Pain reactions * | Negative | Severe | Mild | Negative | Severe |
| Dehydration** | Negative | Mild to moderate | Mild to moderate | severe | Mild to moderate |
| Systemic reactions*** | Normal | Normal (n = 5)<br>Increased (n = 3) | Normal | Normal (n = 1)<br>Subnormal (n = 3) | Normal |
| Urethral pulsation | Negative | Positive | Negative | Negative | Positive |
| Uriniferous odor | Negative | Negative | Positive | Positive | Negative |
| Recumbency | Negative | Negative | Negative | 2 cases | Negative |

*Pain reactions include restlessness, arched back, grinding on teeth, grunting and frequent attempt to urinate, **Dehydration was detected by skin tent test and degree of enophthalmia (Radostitis *et al*., 2007), ***Systemic reactions at control group were temperature: 38-39°C, heart rate: 60-85 $min^{-1}$ and respiration: 25-40 $min^{-1}$

(Fig. 2b). In contrast, uroperitoneum with ruptured bladder was reported in all calves at 3rd group in which the ruptured urinary bladder appeared as hyperechogenic band with either anechoic (Fig. 3) or hypoechoic fluid distributed in whole abdomen. The renal measurements of control group were recorded in Table 2 and presented in Fig. 4. Briefly, the renal parenchyma including cortex and medulla appeared hypoechoic. The cortex and the medulla could not always be differentiated from each other. Renal parenchyma varied between 1.54 and 2.3 (1.84±0.2) cm. Round to oval structures were visible in the renal parenchyma represented the medullary pyramids which were less echogenic than the rest of parenchyma with circumference ranged from 3.5-6 (4.3±0.9) cm. Renal sinus appeared hyperechogenic and its thickness ranged between 1.3-1.9 (1.64±0.2) cm. The vertical length of the right kidney ranged from 3.9-5.0 (4.4±0.3) cm, while the horizontal length varied from 6.2-9.2 (7.8±1.1) cm.

In diseased groups, hydronephrosis was observed in all diseased calves with variable degrees, it was more severe in the first group. Hydronephrosis was described by significant reduction in renal parenchyma and significant increase in medullary pyramids, renal sinus and size of kidney. Renal sinus and medullary pyramids appeared distended by anechoic

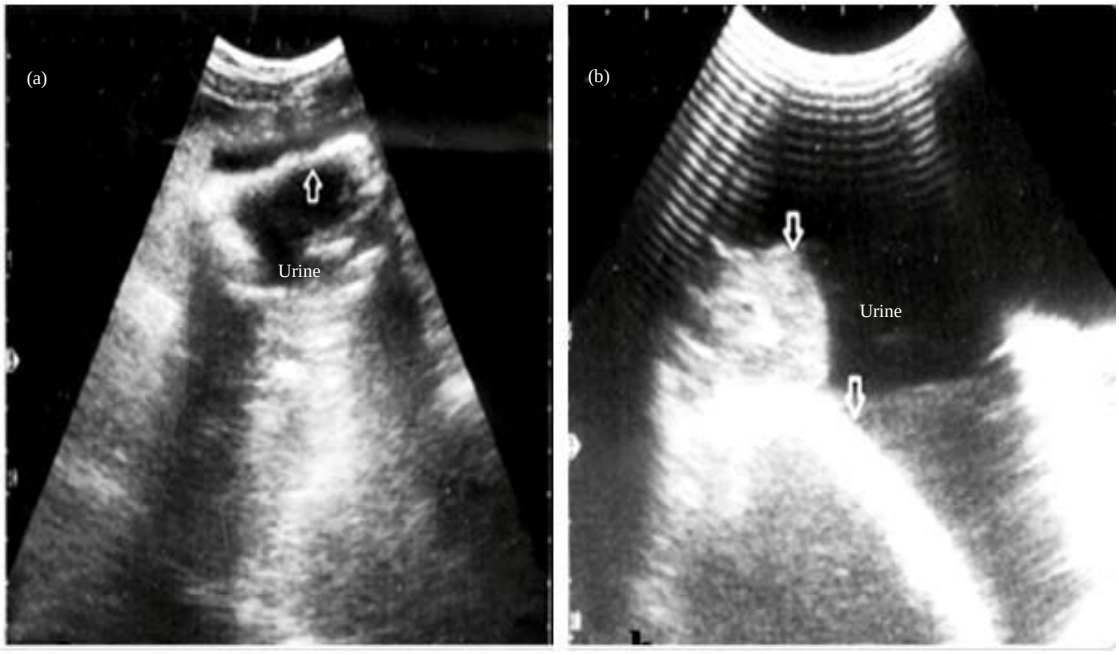


Fig. 3(a-b): (a) Transcutaneous ultrasonography in a buffalo calf with ruptured urinary bladder using a 3.5 MHz convex transducer placed on the right inguinal region showing an echogenic band (arrow) represents the ruptured bladder and (b) Anechoic urine distributed in-between the viscera (arrows) and abdominal cavity when the probe placed on ventral abdomen behind umblical region

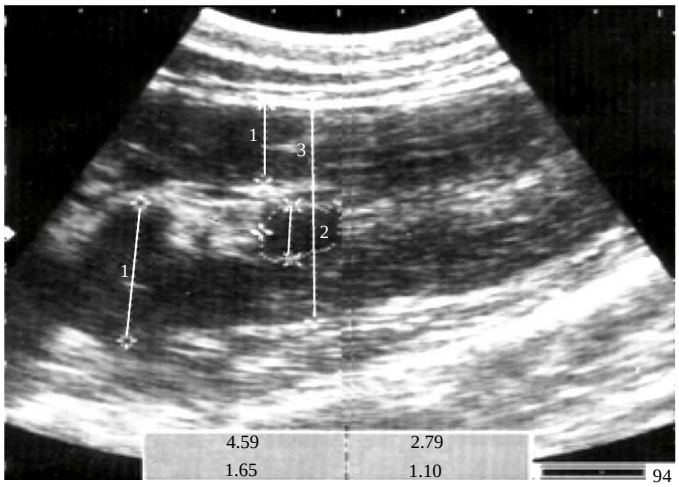


Fig. 4: Transcutaneous ultrasonography of normal right kidney in a buffalo calf using a 3.5 MHz convex transducer obtained at the right last intercostal space (hepatic window) showing the different echogenicity of renal structures. Renal sinus appears more echogenic than renal parenchyma and medullary pyramid, 1: Renal parenchyma, 2: Medullary pyramid, 3: Vertical length and 4: Renal sinus

urine (Fig. 5). On ultrasound examination, urethral calculi could be detected inside the penile urethra between the preputial orifice and scrotum in 4 calves at 3rd group. In addition, two renal calculi were seen in a calf at 4th group. Both urethral and renal calculi appeared as hyperechogenic dots with acoustic shadowing (Fig. 6 and 7). Neither ureteral nor cystic calculi were observed in this study. Apart from the difficult examination of the left kidney, no other limitations

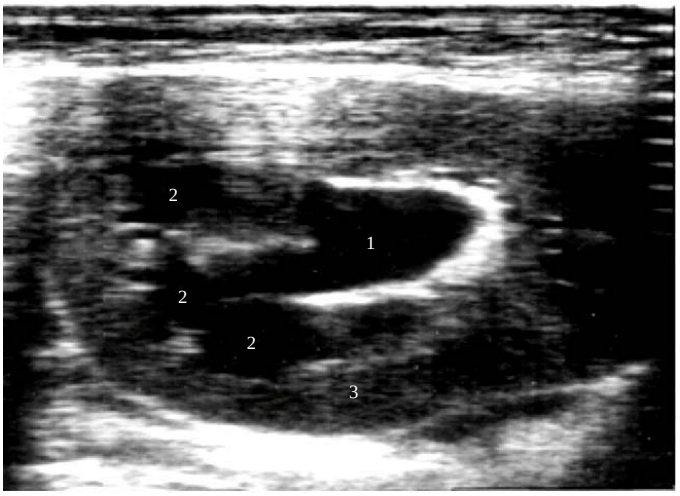


Fig. 5: Transcutaneous ultrasonography of the right kidney using an 8 MHz linear transducer in a buffalo calf of the first group showing, 1: Dilatation of renal sinus and 2: Medullary pyramids by anechoic urine. The image was obtained from right last intercostal space (hepatic window)

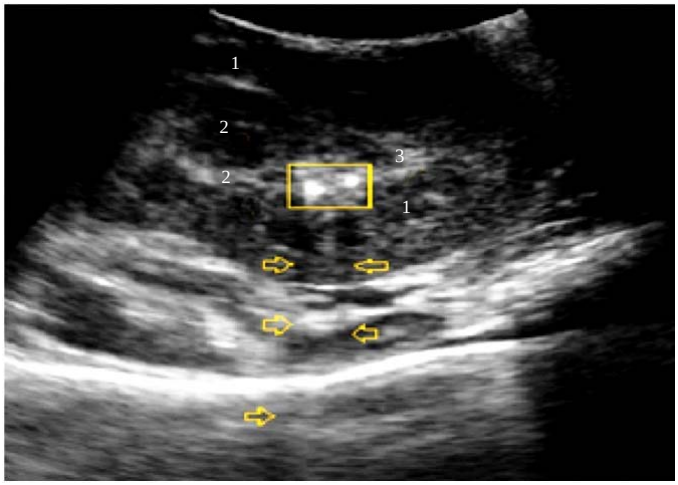


Fig. 6: Trans-cutaneous ultrasonography of the right kidney in a buffalo calf using a 3.5 MHz convex transducer showing two hyperechogenic renal calculi with acoustic shadowing (arrows), 1: Renal parenchyma, 2: Medullary pyramid and 3: Renal sinus, the image was obtained from right last intercostal space (hepatic window)

Table 2: Ultrasonographic findings of different diseased groups in comparison with control one

| | | Diseased groups | | | |
|---|---|---|---|---|---|
| Ultrasonographic parameters | Control group (N = 8) | 1st group (N = 8) | 2nd group (N = 5) | 3rd group (N = 8) | 4th group (N = 4) |
| **Urinary bladder** | | | | | |
| Shape | Round to oval | Round, stretched | Round, stretched | Shrinked, ruptured | Round, stretched |
| Wall thickness (mm) | 1.60±0.5$^{a}$ | 0.74±0.2$^{b}$ | 0.81±0.1$^{b}$ | - | 0.85±0.06$^{b}$ |
| Diameter (cm) | 7.40±1.4$^{a}$ | 12.8±2.2$^{c}$ | 10.5±0.7$^{b}$ | - | 10.6±0.6$^{b}$ |
| **Right kidney** | | | | | |
| Renal parenchyma (cm) | 1.48±0.2$^{a}$ | 0.58±0.1$^{c}$ | 0.90±0.16$^{b}$ | 0.7±0.06$^{b}$ | 0.77±0.2$^{b}$ |
| Circumference of medullary pyramid (cm) | 4.30±0.9$^{a}$ | 12.8±2.7$^{c}$ | 7.90±1.4$^{b}$ | 7.9±0.9$^{b}$ | 7.50±1.1$^{b}$ |
| Renal sinus (cm) | 1.64±0.2$^{a}$ | 2.20±0.3$^{c}$ | 1.70±0.2$^{b}$ | 1.93±.12$^{b}$ | 1.80±0.1$^{b}$ |
| Vertical length (cm) | 4.40±0.3$^{a}$ | 7.10±06$^{c}$ | 5.30±0.7$^{b}$ | 5.2±0.6$^{b}$ | 5.50±0.3$^{b}$ |
| Horizontal length (cm) | 7.80±1.1$^{a}$ | 10.01±0.45$^{c}$ | 8.90±0.53$^{b}$ | 8.1±0.3$^{a}$ | 8.96±1.2$^{b}$ |

Different superscripts in the same row indicate a significant difference at $p \leq 0.05$

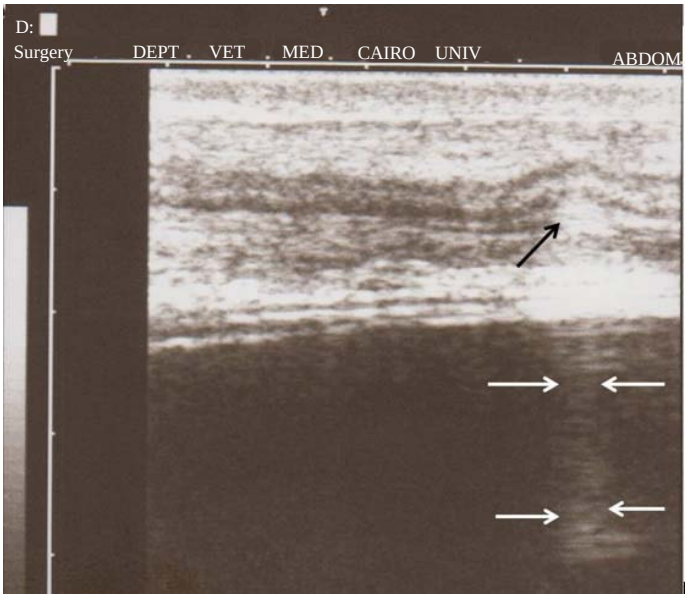


Fig. 7: Longitudinal scan of the penile urethra at pre-scrotal area in a buffalo calf using an 8 MHz linear transducer showing hyperechoic urethral calculus (black arrow) with acoustic shadowing (white arrows)

were associated with ultrasonographic examination of the urinary system in buffalo calves.

**Outcome of treatment:** All the surgically treated calves showed uneventful recovery without any complications. Three calves with ruptured urinary bladder and severe systemic reactions were slaughtered.

## DISCUSSION

Buffaloes are an important part of livestock agriculture in Asia since 5000 years, producing milk, meat, hides and draft power (Al-Abbadi *et al*., 2014). Urolithiasis is a potential cause of high economic losses and even death in buffalo calves. Generaally, urolithiaisis includes nephrolithiasis (renal calculi), ureterolithiasis (ureteral calculi), cystolithiasis (bladder calculi) and urethrolithiasis (urethral calculi) (Panigrahi *et al*., 2016).

Clinical signs associated with urolithiasis depend upon the severity of blockade and the reaction of surrounding tissue (Radostits *et al*., 2007). In current study, pain reactions with arched back, stranguria, grinding of teeth and grunting were observed in 1st, 2nd and 4th groups. These signs resulted from complete blockage of urethra while bladder was still intact (Andrews *et al.,* 2004). On the other hand, the absence of pain reactions, depression and dullness of calves at the third group indicated rupture of the urinary bladder and consequently uroperitoneum (Van Metre, 2004). Rupture of the urinary bladder is the most common sequel to obstructive urolithiasis especially in buffalo calves (Makhdoomi and Gazi, 2013). Moreover, the reduction or absence of pain in second group could be attributed to the leakage of urine from urinary bladder into abdominal cavity while, urinary bladder still intact, this seepage results in reduction of pressure on the stretching receptors of bladder wall and decreases the degree of back pressure (hydronephrosis) and subsequently, reduces pain (Divers *et al*., 1989; Radostits *et al*., 2007).

Clinical symptoms of dehydration and abdominal distension were similar to that reported previously by Van Metre (2004). These symptoms were obvious at the third group with urinary bladder rupture. Rupture of the urinary bladder secondary to complete urethral obstruction by uroliths with leakage of urine into the abdominal cavity causes gradual accumulation of fluid from uroperitoneum resulting in a severely distended abdomen as suggested in previous reports (Van Metre *et al*., 1996; Tharwat and El-Deeb, 2015). Additionally, the osmotic pressure from hypertonic urine together with acute fibrinous peritonitis promotes rapid movement of large amounts of extracellular water into the peritoneal cavity resulting in more abdominal distension and dehydration.

As regards the systemic disturbance; hyperthermia, increased respiratory and heart rates were observed in three calves at first group while, hypothermia, decreased respiratory and heart rates were reported in 3 calves at the third group. These results were in accordance to Khan *et al.* (2013). Increased temperature, heart and respiratory rates could be

attributed to pain, hyperdynamic stage of toxemia and dehydration which accompanied with metabolic acidosis, hyperkalemia and hyponatraemia with subsequence cardiac arrhythmia (Sharma *et al*., 2005). In this respect, Sobti *et al.* (1986) stated that an increase in systemic states is a reflex response of baro-receptors and chemo-receptors, sympathetic stimulation or para-sympathetic inhibition of SA node. On the other hand, the decrease of these parameters occurs at late stage of renal dysfunction and development of uremia and hypodynamic stage of toxemia (Radostits *et al*., 2007). Urethral pulsation was detected in calves at the first and fourth groups while, urineferous odor was smelled in the second and third groups. These signs are in agreement with those reported by Radostits *et al.* (2007). Urethral pulsation is a good prognostic parameter and indicates that the urinary bladder is still intact, while urineferous odor and recumbency are considered as bad prognostic signs and indicate development of renal failure (Andrews *et al*., 2004).

In last decade, ultrasonography attracts the attention of scientists in the large animal practice as a diagnostic and prognostic imaging tool for various surgical affections (Abu-Seida *et al*., 2012; Abdelaal *et al*., 2014a, b; Mostafa *et al*., 2015).

As regards ultrasonographic findings of the present study, urinary tract ultrasonography allowed noninvasive assessment of urethra, urinary bladder and right kidney by using transcutaneous and/or trans-rectal techniques. Unfortunately, neither transcutaneous nor trans-rectal examination of left kidney was applied in the present study. This is due to gases of the rumen which obscure the visibility of left kidney through trans-abdominal ultrasound examination. Also, tans-rectal examination of the left kidney was difficult due to the narrow rectum of the examined calves which did not permit passage of the hand with transducer. Meanwhile, the urethra and urinary bladder could be imaged using trans-rectal technique because these structures required only the insertion of transducer without the hand.

During transcutaneous examination, the right inguinal region immediately cranial to the pubis was cleaned using a mild detergent solution diluted in warm tap water to remove superficial grease and debris. The right inguinal region was chosen because the left side of the abdomen is largely occupied by the rumen.

At health condition, the urinary bladder was detected trans-abdominally and trans-rectally in all examined calves. It appeared as oval to rounded structure with echogenic wall which surround anechoic urine. The urethra appeared trans-rectally only in 3 calves as a tube like stricture. These results agree with those reported by Floeck (2009). Moreover, right kidney was easily detected via trans-abdominal technique at right flank as well as last intercostal space (hepatic windows) while left one wasn't seen in our study through trans-abdominal examination. These results also have been observed by Braun (1991, 1993). In contrary to these results, the left kidney could be imaged at the same site of ultrasonographic examination of the right one but it depended upon the degree of ruminal filling (Imran and Sharma, 2014; Tharwat and El-Deeb, 2015).

In the current study, renal structures appeared with varying degrees of echogenicity. High echogenicity was observed in renal sinus then renal parenchyma and medullary pyramid. The cortex and medulla could not be differentiated and defined as renal parenchyma. These results are in accordance with Braun (1991).

In the present study, different complications of urine retention were clarified by ultrasound. Distended bladder, dilated urethra and urethral pulsation were observed in 17 calves of 1st, 2nd and 4th groups. These results were obtained previously by Magda (2006). Uroperitoneum was evident as anechoic or hypoechoic fluid accumulation in the abdomen, within which the internal organs appear to be floating (Braun *et al*., 2006). Anechoic uroperitoneum indicated recent urinary bladder rupture and pointed to a good prognosis. Meanwhile, hypoechoic uroperitoneum indicated long standing bladder rupture and pointed to a bad prognosis. The hypoechoic nature of the abdominal fluid in these animals could be attributed to the accumulation of inflammatory exudates and fibrin. These findings were confirmed during laparocystotomy in both 2nd and 3rd groups. Also these findings are in agreement with Khan *et al.* (2013) and Tharwat and El-Deeb (2015). Uroperitoneum with intact bladder could be attributed to presence of minute pores in the urinary bladder which result in leakage of urine into abdomen (Scott, 2013).

Renal ultrasonographic evaluation of the right kidney was valuable in determining degree of hydronephrosis at different diseased groups. Hydronephrosis appeared with a significant increase in size of right kidney when compared with control one. Anechoic appearance of renal sinus and medullary pyramid was also a diagnostic feature for hydronephrosis. This result is similar to that obtained by Harrison *et al.* (1992). In contrast, Tharwat and El-Deeb (2015) did not found any degree of hydronephrosis in the examined buffalo calves with urine retention due to the acute nature of obstruction of the urinary tract.

Although renal and urethral calculi could be imaged in five calves in the present study, urolithiasis could not be clearly identified in the other calves. This could be attributed

to the nature, size and location of the urinary calculi. In addition, other causes such as urinary tract infection, severe constipation and anatomic, neurogenic, myogenic or idiopathic abnormalities have been incriminated in the pathogenesis of urine retention in bovine. Renal and urethral calculi appeared as hyperechogenic dots with acoustic shadowing. Similarly, Divers *et al.* (1989) reported renal calculi at necropsy and Tharwat and El-Deeb (2015) recorded urethral calculus on ultrasound examination.

In the present study, the affected calves were treated with either urethrostomy in cases with intact urinary bladder or with laparocystotomy and urethrostomy in calves with ruptured urinary bladder. In this respect, there is no satisfactory drug available for the treatment of urolithiasis, especially for the prevention of its recurrence. Medicinal plants have also been used as an alternative therapy for both prevention and treatment of renal calculi since ancient Vedic era. Nowadays, several studies are shifted towards medicinal plants for evaluating their antiurolithiatic efficacy but, most of these plants were yet to be scientifically validated (Panigrahi *et al*., 2016).

## CONCLUSION

Clinical findings of urine retention in buffalo calves are diagnostic but don't clarify the possible complications. In contrast, ultrasonography is an ideal tool for diagnosis and prognosis of urine retention in buffalo calves.

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