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Clinical, Biochemical and Ultrasonographic Findings in Buffalo Calves with Obstructive Urolithiasis

[1,2]Mohamed Tharwat and [2,3]Wael EL-Deeb

[1]Department of Veterinary Medicine, College of Agriculture
and Veterinary Medicine, Qassim University, Saudi Arabia
[2]Department of Animal Medicine, Faculty of Veterinary Medicine,
Zagazig University, Zagazig, Egypt
[3]Department of Clinical Studies, College of Veterinary Medicine and animal Resources,
King Faisal University, Al-Ahsa, Saudi Arabia
[4]Department of Internal Medicine and Infectious Diseases,
Faculty of Veterinary Medicine, Mansoura University, Egypt

Abstract: The goal of the present study is to describe the clinical, hematological, biochemical, ultrasonographic and postmortem findings in buffalo calves with acute urethral obstruction with or without bladder rupture. Inappetance or complete anorexia was seen in all calves. Three calves (25%) voided small amounts of urine in a dribbling manner and 9 (75%) had stranguria. Laboratory data revealed elevated hematocrit and erythrocyte count, neutrophilic leukocytosis, hyperprotenemia, hyperglobulenemia, hypocalcemia, hyperglycemia, hyperphospatemia, hyponatremia and hypochloremia. The greatest increases were recorded in urea nitrogen and creatinine concentrations. Ultrasound imaging demonstrated a distended bladder with anechoic urine in 7 calves and in the other 5 calves there was a massive intra-abdominal fluid, suggested bladder rupture. In 5 calves, the calculi were observed within the urethra. Calves were slaughtered or euthanased at the owners' request or because of a grave prognosis. Examination of calves at slaughter demonstrated numerous calculi causing urethral obstruction. In conclusion, ultrasonography is a valuable diagnostic aid of urinary tract obstruction in buffalo calves.

Key words: Buffalo · Calves · Ultrasonography · Urolithiasis · Uroperitoneum

INTRODUCTION

Urolithiasis is common as a subclinical disorder among ruminants raised in management systems where the ration is composed primarily of grain or where animals graze certain types of pasture. In these situations, 40-60% of animals may form calculi in their urinary tract. Urolithiasis is clinically important in castrated male ruminants when calculi cause urinary tract obstruction, usually obstruction of the urethra or a ureters [1]. Urethral obstruction is characterized clinically by a complete retention of urine, frequent unsuccessful attempts to urinate and distension of the urinary bladder and rupture of the bladder can be a sequel to acute urethral obstruction [2].

Rupture of the urinary bladder and subsequent uroperitoneum is a common problem in young male cattle. Urolithiasis is the underlying cause in the majority of cases [3]. Rare cases of bladder rupture are recorded in cows as a result of difficult parturition, possibly because of compression of a full bladder during calving [4]. After bladder ruptures, uroperitoneum results in a series of abnormalities that arise from failure of the excretory process combined with solute and fluid redistribution between the peritoneal fluid and extracellular fluid. Osmotic pressure from hypertonic urine promotes movement of extracellular water into the peritoneal cavity resulting in clinical dehydration. The bladder rupture leads to gradual development of ascites from uroperitoneum, ruminal stasis, constipation

Corresponding Author: Mohamed Tharwat, Department of Veterinary Medicine, College of Agriculture and Veterinary Medicine, Qassim University, Saudi Arabia. E-mail: mohamedtharwat129@gmail.com.

and depression. Finally, uremia may take 1-2 weeks to develop in cattle to the degree where euthanasia is recommended [5]. Cattle with urinary tract disorders may be presented with a history pointing to other disease. In these calves, blood urea nitrogen (BUN) and creatinine can be within reference ranges, although severe parenchymal anomalies are present.

Ultrasonography has the potential to aid in the diagnosis of several urinary tract abnormalities, supplementing the clinical examination and clinicopathological analysis by providing additional information on urinary tract diseases [2, 6]. To the author's knowledge, ultrasonographic findings in buffalo calves with obstructive urolithiasis have not been reported.

In Egypt, the water buffalo (*Bubalus bubalis*) can compete very successfully with and even surpasses the cattle genus *Bos* in its ability to adapt to hot climates and swampy land [7], therefore, water buffaloes is important as a source of milk and meat production in the Nile River valley in Egypt [8]. The present study was therefore designed to describe the ultrasonographic findings in buffalo calves with acute urethral obstruction, with or without uroperitoneum.

MATERIALS AND METHODS

Animals, History and Physical Examination: Twelve buffalo calves (aged 4-8 months) were examined at Zagazig University Veterinary Teaching Hospital, Egypt. The owners of some calves reported signs of colic, such as treading, lying down and kicking at the abdomen. Tentative diagnoses made by the referring veterinarians were urinary tract disease. All calves underwent a thorough physical examination, which included general behavior and condition, auscultation of the heart, lungs, rumen and intestine, measurement of heart rate, respiratory rate and rectal temperature, percussion auscultation of both sides of the abdomen and rectal examination [9]. Ten apparently healthy buffalo calves were enrolled in this study as controls.

Hematological and Biochemical Analyses and Ultrasonographic Examination: From each animal, 2 blood samples were collected by puncture of the jugular vein, one on EDTA and the other without an anticoagulant. The hematocrit, erythrocyte count, total and differential leucocyte count were determined in EDTA blood. Hematological examinations were carried out using an automated veterinary hematological analyzer (Vet Scan HM5, ABAXIS, Hungary). The concentrations of total protein and albumin were determined in serum samples. Globulin was calculated by subtraction of albumin from total serum protein. The serum activities of aspartate aminotransferase (AST) and γ-glutamyl transpeptidase (GGT) and the concentrations of BUN, creatinine, total bilirubin, total cholesterol, calcium, phosphorus, sodium, potassium and chloride were also measured. An automated biochemical analyzer (Biosystems A15, Spain) was used for measurement of all serum parameters.

Ultrasonographically (SSD-500, Aloka, Tokyo, Japan), the kidneys, bladder and urethra were examined transabdominally using a 3.5 or 5 MHz real-time B-mode sector transducer [2, 10-12]. The right Kidney was scanned from the right paralumbar fossa of all calves, while the left Kidney was from the right paralumbar fossa in 4 out of 12 examined calves. However, it was not possible to scan the left kidney in the remaining 8 calves. A standoff-pad was used to scan the urethra within the preputial orifice between the preputial orifice and scrotum. Calves were then slaughtered or euthanized without treatment at the owners' request or because of the grave prognosis.

Statistical Analysis: Data are presented as means ± SD and the analysis was conducted using SPSS program [13]. Hematological and biochemical data were compared between diseased and control animals, using Student's *t* test. The level of significance was set at $P < 0.05$.

RESULTS

Anorexia or reduced appetite was seen in all the buffalo calves. Nine of the 12 calves were restless and had signs of colic, such as treading, kicking at the abdomen, tail switching and sinking of the back. The heart rate was higher than controls in 11 calves (110-140 bpm) and the respiratory rate was increased in 10 animals (40-70 breaths/min). The rectal temperature was decreased in 4 calves (37.5°C) and increased in 5 cases (39.5 – 40.2°C). Seven of the 12 calves had decreased skin turgor, uremic breath, bilateral enophthalmus, dry muzzles and the body surface was cooler than normal. Rumen motility was decreased or absent in all animals and intestinal motility was reduced or absent in 8 animals. In the calves with ruptured urinary bladders, there is a readily appreciable fluid wave on ballotment of the abdomen. Seven of the 12 calves had a decreased or no fecal output. If present, the feces contained mucus in 3 calves and were watery in 2. Three of the 12 calves voided small amounts of urine in a dribbling manner and 9 had stranguria. The urine was reddish in 2 calves, cloudy in 2 and had a foul pungent odor in 5 animals.

Table 1: Hematological and biochemical findings (mean± SD) in buffalo calves (n=12) with obstructive urolithiasis compared to healthy buffalo calves (n=10).

Parameters	Diseased calves	Healthy calves
Hematocrit (%)	42±12*	37±8
Erythrocytes × 10^4/µL	800±239*	580±78
Leukocyte count (/µL)	15000±3200**	8564±3200
Segmented neutrophils (/µL)	9850±1050***	3300±460
Lymphocytes (/µL)	4800±320	4640±350
Total protein (g/dL)	8.8±2.0*	7.2±0.9
Albumin (g/dL)	3.0±0.27	2.8±0.8
Globulin (g/dL)	5.8±0.94*	4.4±0.6
Blood urea nitrogen (mg/dL)	140±60***	18±11
Creatinine (mg/dL)	11±4.7***	0.9±0.7
Total bilirubin (mg/dL)	0.5±0.19	0.8±0.3
Glucose (mg/dL)	122±35*	55±15
Total cholesterol (mg/dL)	191±32*	87±28
Aspartate aminotransferase (U/L)	111±63	68±24
γ-glutamyl transferase (U/L)	50±38	28±15
Calcium (mg/dL)	5.9±3.5*	10.2±1.1
Phosphorus (mg/dL)	11.2±4.3*	5.2±0.8
Sodium (mmol/L)	125±8	137±8
Potassium (mmol/L)	5±0.11	4.2±0.6
Chloride (mmol/L)	75±7	95±9

*P < 0.05; **P < 0.01, ***P < 0.001

Fig. 1: Ultrasonogram of the urinary bladder in a buffalo calf with acute urethral obstruction showing severe distension of the bladder. Image was taken transabdominally at the right ventral abdomen using a 3.5 MHz sector transducer.

Compared to controls, Table 1 summarizes the hematological and biochemical data in the diseased buffalo calves. Results revealed elevated hematocrit and erythrocyte count, neutrophilic leukocytosis and hyperprotenemia associated with hyperglobulenemia. Data also showed that glucose and phosphorus concentrations were elevated above the normal range and calcium was decreased. The greatest increases were recorded for BUN and creatinine concentrations. Hyponatremia and hypochloremia were additional findings.

No renal abnormalities were detected in 10 calves and there was a mild dilatation of the renal pelvis in 2 calves. In 7 of the 12 buffalo calves, the urinary bladder was distended as observed ultrasonographically containing anechoic urine with a distal acoustic enhancement. There was no abdominal fluid in these calves. The urinary bladder contour was clearly visualized and the diameter of distended urinary bladder was determined easily (Figure 1). In the other 5 calves, there was abundant intra-abdominal fluid which was confirmed by abdominocentesis. The intestines, mesentery and

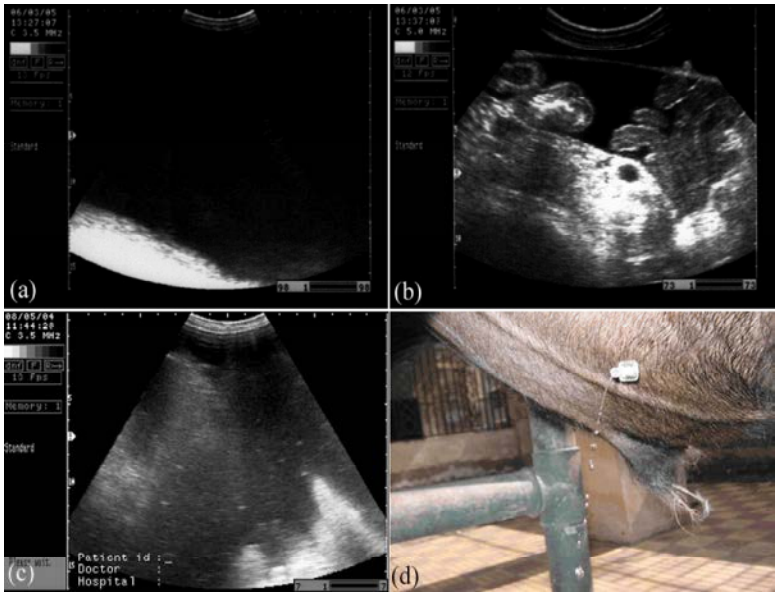

Fig. 2: Ultrasonograms in buffalo calves showing anechoic abdominal effusions (a and b) and hyperechoic fluid (C). The small intestines were imaged floating (b and c). Images were taken transabdominally using 3.5 and 5.0 MHz sector transducers. Urine samples were collected by abdominocentesis (d).

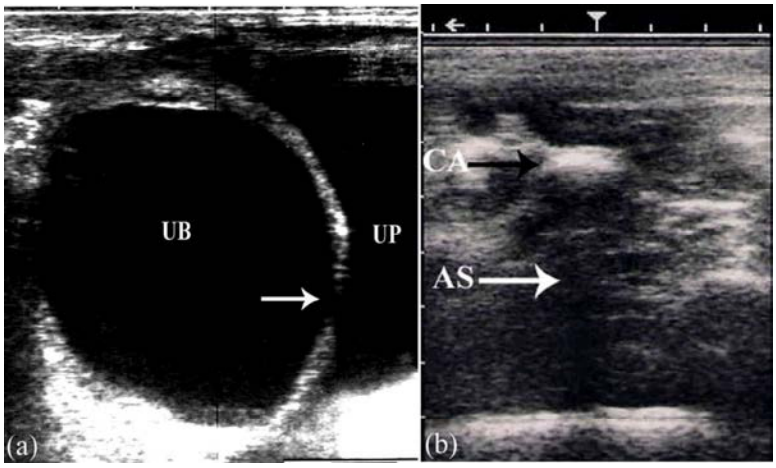

Fig. 3: Ultrasonographic findings in a buffalo calf with acute urinary tract obstruction. Left ultrasonogram (a) shows perforating urinary bladder (UB) wall (white arrows) floating in uroperitoneum (UP). Right Ultrasonogram (b) shows urinary calculus (CA) within the urethra (black arrow) with acoustic shadowing (AS) (white arrow). Images were taken transabominally using a 5.0 MHz linear transducer.

omentum were imaged floating in the fluid. This fluid was anechoic in 3 calves and hyperechoic in 2 (Figure 2). Bladder wall perforation and echogenic calculi within the urethra were imaged clearly in 5 of the 12 calves (Figure 3). Postmortem examination of four calves demonstrated numerous calculi causing urethral obstruction approximately 17±8cm from the end of the urethra. In the remaining 8 calves, no postmortem examination was performed as their owners refused to tell the date of their slaughter.

DISCUSSION

The clinical findings of the buffalo calves having acute urinary tract obstruction are in agreement with those of other reports [14, 15]. Together with signs of colic, the main owner complaint in calves with urine retention was dribbling of urine. In the calves with ruptured bladder, no signs of colic were observed and the main sign was abdominal distension. When the bladder rupture occurs there is an immediate relief from

discomfort, but anorexia and depression developed as uremia will develop. Abdominocentesis is necessary to detect uroperitoneum after rupture of the bladder. However, it is often difficult to identify the fluid obtained from the peritoneal cavity as urine other than by appearance and smell. Warming the fluid may facilitate detection of the urine odor. The findings in this study showed that, history and clinical findings are very important to diagnose urinary tract obstruction in the buffalo calves specially when combined with the results of ultrasonography.

In calves, rupture of the urinary bladder as a result of urolithiasis is difficult to treat and the affected animals often die [14]. Usually rupture occurs within 48h if the urethral obstruction is not relieved. In the present study, based on the owners' request or the grave prognosis, all the buffalo calves were slaughtered or euthanized. Theoretically one would expect that systemic fluid and electrolyte disturbances would differ in calves with a ruptured bladder discharging a large volume of urine into the peritoneal cavity [14]. Liquid placed into the abdomen will equilibrate its electrolytes, small molecules and osmolarity with the extracellular fluid. In an animal with obstructive urolithiasis as urine has of 2-3 times the osmolarity of interstitial fluid, water drawn from the interstitial and intravascular fluid into the peritoneal cavity causes further dehydration [16].

The results of the blood analysis are in agreement with those of other report [16]. The concentrations of total protein and globulin were increased, which is indicative of severe inflammation. The greatly increased plasma protein concentration also indicated a considerable loss of intravascular water. In all the buffalo calves, the serum concentrations of BUN and creatinine were elevated and, in agreement with the results of a previous study [17] were associated with a poor prognosis. Presumably, the impairment of renal function involves 50% of the renal tissue, which is considered the cut-off for the development of azotemia. The more extensive electrolyte changes observed with rupture of the bladder was related to the accumulation of urine in the peritoneal cavity. This study demonstrates that the changes in electrolytes occurring with rupture of the bladder in humans [18], equines [19] and dogs [20] happen also in buffaloes. In this study, the concentration of serum phosphate was increased. As reported previously, cattle with a ruptured bladder had a high serum phosphorus level that may help with the determination of the outcome [21].

Ultrasonography is a sensitive technique in viewing urinary calculi and may be used as the initial imaging method in investigating cattle and horses with such a disorder [1, 2, 5]. In this study, in the buffalo calves, the kidneys were examined for enlargement and the renal pelvis, medullary pyramids and urethra for dilation. Because of the acute nature of the disease in the buffalo calves, both kidneys in all the animals of this study had no degree of hydronephrosis. Ultrasonographically, in the normal animal, the urinary bladder appears as an anechoic sac [2]. In the present study, the majority (58%) of the buffalo calves with urine retention had a severely distended urinary bladder with a sharp hyperechoic contour. The bladder contents in all the buffalo calves were anechoic. In 42% of the calves, ultrasonography was valuable in detecting bladder wall perforation and massive urine collection in the peritoneum. In 60% of the ruptured bladder calves, the urine was anechoic pointing to a recent rupture and indicating a good prognosis. In the remaining 40% of bladder ruptures, it was hyperechoic pointing to a delayed rupture and indicating a bad prognosis. The hyperechoic nature of the fluid in these animals may be due to leukocyte infiltration or the presence inflammatory products [22].

From this study, it is concluded that ultrasonographic examination of the abdomen of buffalo calves, referred because of urinary tract obstruction, has certainly made the detection of either intact or ruptured urinary bladder and the presence of abdominal fluid more accurate. Ultrasonography should therefore be considered the preferred imaging modality for examining buffalo calves with obstructive urolithiasis and in determining their prognosis.

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