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Clinicopathological Consequences of Urinary Retention due to Urolithiasis in Indigenous Goats

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Abstract:
The current research has been conducted to determine the haemato-biochemical and urological changes in goats with obstructive urolithiasis. The overall occurrence of urolithiasis of the last ten years was recorded from Veterinary Teaching Hospital, Bangladesh Agricultural University, Mymensingh. A total of 115 cases were recorded where 63% (n=73) were at the age of up to 6 months, 17% (n=19) were at the age between 7-12 months and 20% (n=23) of affected goats were >12 months old. Male goats were highly susceptible (n=110, 95.67%) than female (n=5, 4.33%). Occurrence in the winter (October-March) was higher (n=49, 42%) than rainy (n=45, 40%) and summer (n=21, 18%) season. In term of haematological variables, Hb (10.20 ± 0.47 gm/dL), PCV (28.67 ± 0.67%) and TEC (23.47 ± 0.38 $\times 10^6/mm^3$) were increased whereas TLC (10.63 ± 0.35× $10^3/mm^3$) and ESR (0.03 ± 0.03%) values were decreased in urolithiasis goats. Some important enzymes such as ALT (25.50 ± 0.25 IU/L), AST (16.20 ± 0.3 IU/L), and Creatinine (2.90 ± 0.35 mg/dL) were increased significantly in affected goats. But the values of serum Bilirubin (0.67 ± 0.12 mg/dL) were decreased in affected patients. Glucose level (6.50 ± 0.44 mmol/L) was elevated in affected goats and Total Protein was decreased (3.73 ± 0.27 gm/dL) in obstructive urolithiasis patients. Body electrolytes such as Na^+ (139.20 ± 0.55mmol/L), K^+ (4.27 ± 0.26mmol/L) and Cl^- (105.63 ± 0.46 mmol/L) were decreased in affected goats. In urinalysis, alkaline urine was found as usual. Proteinuria and calcium oxalate were detected in the urine of affected goats. During the ultrasonographic examination, distended urinary bladder with multiple calculi was observed in the patients of urolithiasis. Based on the above findings, this study might help the field veterinarians for fruitful management of obstructive urolithiasis in goats.

Keywords: Urolithiasis, clinicopathology, ultrasonography, serum biochemistry, Goats.

INTRODUCTION

In the livestock sector, the goat population plays an important role in the economy of Bangladesh. Here, veterinary practitioners and farmers are concentrated largely in goat as they are considered as one of the major sources of foods of animal origin including milk, meat, and milk products and high-quality skin (Alam *et al.,* 2005; Tamanna *et al.,* 2020). However, one of the most important health problems in goats is urine retention, which may occur as a consequence of urolithiasis and leads to high economic losses (Ismail, 2018). Uroliths are concretions of solid mineral and organic compounds that cause disease through direct trauma to the urinary tract and obstruction to urinary outflow (Maciel *et al.,* 2017). Formation of calculi and development of urolithiasis is a complex process and occurs in a series of phases from the formation of the nidus, concentration of urine, and lastly the precipitation of various salts from urine (Makhdoomi and Gazi 2013). The etiology of the disease is complex and multifactorial and is known to have many predisposing factors like age, type of feed and water, season, castration which play an important role in the pathogenesis of the disease. Also, changes in the given diet from milk to concentrate after weaning consider as the main factor for the development of obstructive urolithiasis in young ruminants (Rafee *et al.,* 2015). In addition to the anatomy of the male ruminant urinary tract where long convoluted sigmoid flexure is a common site for a lodge of calculi in ruminant species. When animal grazes pasture containing plants with high levels of silica, uroliths occur in animals of all ages and sexes (Radostits *et al.,* 2007).

Diagnosis is based on history, clinical signs, and physical examination. Real-time transabdominal B-mode ultrasonography can be used to assess the bladder, kidneys, and abdominal cavity. In the case of suspected urolithiasis, ultrasonography is recommended to confirm the presence of a dilated bladder and to determine whether uroperitoneum is present (Riedi *et al.,* 2018). Radiopaque uroliths such as struvite and calcium oxalate calculi can be seen on plain radiographs, but contrast studies have been advocated for reliable radiological diagnosis of obstructive urolithiasis. However, radiology can also be used to differentiate patients with uroliths from urinary tract infections, granulomatous urethritis, prostatic disease, and neoplasia.

It is very crucial to understand the systemic effects of urinary retention to combat further aggravation of the situation and also important to locate the lodgment of the stone for perfect surgery. After the beginning of clinical signs, there is little chance of reversion, and if surgical treatment is required most animals become unsuitable for reproduction (Maciel *et al.,* 2017). Therefore, the biochemical profile of the animals must be known and the correction of all possible factors must be done. Therefore, the present study was designed to find a long-term pattern of occurrence of obstructive urolithiasis in goats through a record of 10 years and to evaluate a panel of biochemistry and hematology variables in uroliths patients and also to determine the lodgment of uroliths through ultrasonographic examinations.

MATERIALS AND METHODS

Animals

The research work has been performed at Veterinary Teaching Hospital (VTH), Bangladesh Agricultural University (BAU), Mymensingh. Retrospective data were collected from the clinical record sheet. Haematobiochemical study has been performed from affected animals admitted to VTH from July 2019 to November 2019. Before sample collection, animals were kept in resting conditions. Then respiration rate, heart rate, and body temperature were recorded.

Collection of Retrospective Data

Incidence data of urinary stasis were collected from the clinical record sheet of Veterinary Teaching Hospital (VTH), Bangladesh Agricultural University (BAU), Mymensingh from

the period of 2010 to 2019 where age, sex, the season of occurrence were considered.

Recording of Clinical Parameters

Physical examination was done and then clinical parameters (temperature, heart rate, respiratory rate, and rumen motility) were recorded from the affected goats.

Haematobiochemical Examinations

Collection of Blood Samples

Before the collection of a blood sample, the area was painted with gauze soaked with povidone-iodine. The blood samples were collected from the jugular vein of the affected goats with a 10 ml disposable plastic syringe. About 5 ml of blood was collected from each goat and 3 ml was transferred in a vacutainer without anticoagulant which was used for serum biochemical analysis and the remaining two milliliters of blood was transferred in a vacutainer containing EDTA which later used for the routine blood test.

Routine Blood Examinations

Blood samples collected from the urolithiasis patients with anticoagulant (EDTA) were analyzed for the determination of hemoglobin concentration, total erythrocyte count (TEC), total leukocyte count (TLC), packed cell volume (PCV %) and erythrocyte sedimentation rate (ESR). These were done in Surgery Laboratory, Department of Surgery and Obstetrics, BAU.

Biochemical Tests

Blood samples collected in the clot activator tube were centrifuged at 3000 rpm for 15 minutes and serum were collected in an Eppendorf tube for biochemical analysis of ALT, AST, Creatinine, Serum Glucose, Bilirubin, and Total Protein. The electrolytes such as Chloride, Potassium, and Sodium are also analyzed from collected serum. Those biochemical tests were done at Mymensingh Medical College Hospital (MMCH) hematology laboratory by Microlab Biochemistry Analyzer (Germany) through the kinetic Method.

Urine Examination

Collection of Urine Samples

Before the collection of the urine sample, the area was painted with gauze soaked with povidone-iodine. The urine sample was collected from the urinary bladder of the affected goats with a 10 ml disposable plastic syringe. About 10 ml of urine was collected from each goat.

Routine Examination of Urine

After collecting the urine sample from the affected goats, the urine samples were transferred to the laboratory for physical evaluation like color, pH, and for microscopic examination to detect any abnormal deposition.

Ultrasonography

Ultrasonographic examination of the perineum was done to determine the location of the obstruction. Transabdominal ultrasonography was performed with a 5 MHz linear probe. All ultrasonographic evaluations were carried out in standing position. To prepare a better image, the regional skin was cleaned, shaved, and then covered with ultrasonographic gel.

Statistical Analysis

The data were calculated and presented as mean ± SE. Unpaired t-test was done using Statistical Package for the Social Sciences software version 20.0 to analyze the data and $P<0.05$ or less was considered as statistically significant.

RESULTS

A total of 115 goats of obstructive urolithiasis were recorded from 2010 to 2019 at VTH, BAU, Mymensingh. The occurrence of

urolithiasis based on different attributes is shown below.

The occurrence of urolithiasis based on Age

The occurrence of obstructive urolithiasis in goats based on ages is presented in Figure 1. The occurrence was higher at the age of fewer than 6 months old (63%) than those of greater than 6 months (17%) of ages.

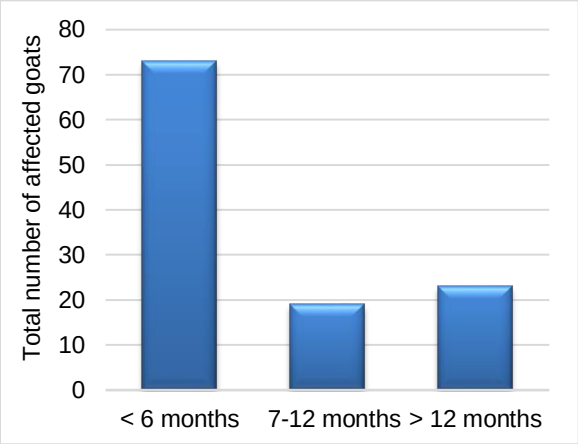

Fig. 1. The occurrence of urolithiasis in goats based on age.

The occurrence of urolithiasis based on Sex

The occurrence of urolithiasis in Black Bengal goats based on sex is presented in Figure 2. The occurrence was higher in male goats (95.67%) than those of females (4.33%).

The occurrence of urolithiasis based on the season in goats

The occurrence of urolithiasis was maximum in the summer season (42%) and lowest in the winter (18%). In the rainy season, the occurrence was 40% (Figure 3).

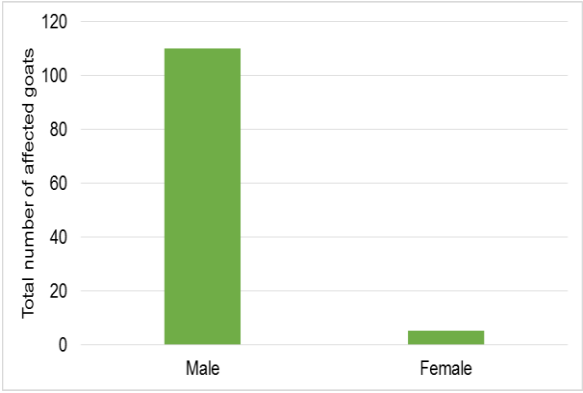

Fig. 2. The occurrence of urolithiasis in goats based on sex.

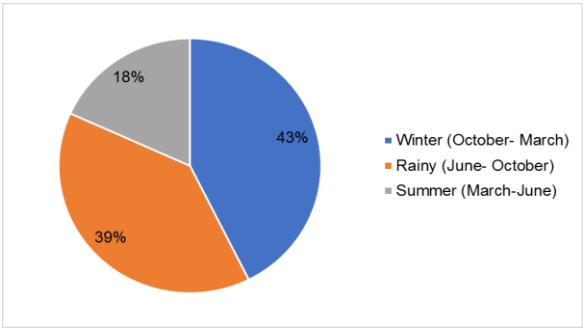

Fig. 3. The occurrence of urolithiasis in goats based on seasons.

Clinical Parameters

There are no significant changes in body temperature in urolithiasis patients. A decrease in rumen motility but a slight increase in heart and respiratory rates were observed in urolithiasis patients.

Diagnostic Imaging of Patient with Urolithiasis: Ultrasonography

Ultrasonographic examination is considered to have very high diagnostic value in all cases, based on the presence of an enlarged bladder. In our study ultrasound examination was performed to see uroliths in the bladder or elsewhere in the urinary tract. Urinary calculi were observed in the urinary bladder when an

ultrasound examination was performed (Figure 4).

Fig. 4. Ultrasonographic image of a distended urinary bladder showing some calculi

Haematobiochemical Profile of Urolithiasis in Goats

Alteration in blood profile in Goats with Urolithiasis

The changes in the routine blood profile in healthy and urolithiasis affected goats are presented in Table 1. The study showed that the mean values of different hematological parameters were changed at a different level in urolithiasis goats. The mean values of Hb (10.20 ± 0.47 gm/dL), TEC (23.47 ± 0.38×10^6/mm^3) was increased significantly (P<0.01) in urolithiasis goats than those of healthy animals (7.10 ± 0.15 gm/dL and 12.87 ± 0.46×10^6/mm^3 of Hb and TEC respectively). On the other hand, the mean values of PCV were also increased in urolithiasis goats than a healthy one but this change was not significant. Mean values of ESR (0.03 ± 0.03%) and TLC (10.63 ± 0.35 ×10^3/mm3) were decreased significantly at P<0.01 and P<0.05 respectively in goats having urolithiasis than healthy goats (ESR: 0.47 ± 0.07% and TLC: 12.13 ± 0.35×10^3/mm^3).

Alterations in Liver Enzymes in Goats with Urolithiasis

The changes in the liver enzymes of urolithiasis vs normal goats are shown in Table 2. Here we found that the mean values of the liver enzymes were remarkably different in two groups. The mean values of ALT (25.50 ± 0.25 IU/L) and AST (16.20 ± 0.36IU/L) were significantly increased in goats with urolithiasis (P<0.0001 and P<0.01) than those of healthy goats (16.57 ± 0.35IU/L and 12.63 ± 0.33IU/L of ALT and AST respectively). On the other hand, the mean values of bilirubin were decreased in urolithiasis affected goats (0.67 ± 0.12mg/dL) compared to healthy goats (1.07 ± 0.09mg/dL) but this change was not significant.

Table 1. Status of blood profile in healthy and urolithiasis affected goats

Parameters	Healthy goats	Urolithiasis affected goats
Hb (gm/dL)	7.10 ± 0.15	10.20 ± 0.47**
PCV (%)	26.67 ± 1.20 NS	28.67 ± 0.67
ESR (%)	0.47 ± 0.07	0.03 ± 0.03**
TEC (106/mm^3)	12.87 ± 0.46	23.47 ± 0.38**
TLC (103/mm^3)	12.13 ± 0.35	10.63 ± 0.35*

±=Standard Error; NS= Non-Significant; *=P<0.05; **= P<0.01; ***=P<0.0001

Table 2. Status of enzymes indicative of liver function in healthy and urolithiasis affected goats.

Parameters	Healthy goats	Urolithiasis affected goats
ALT (IU/L)	16.57 ± 0.35	25.50 ± 0.25***
AST (IU/L)	12.63 ± 0.33	16.20 ± 0.36**
Bilirubin (mg/dL)	1.07 ± 0.09	0.67 ± 0.12 NS

±=Standard Error; NS= Non-Significant; **= P<0.01; ***=P<0.0001

Changes in Kidney Function in Goats with Urolithiasis

Serum creatinine is the most reliable enzyme that indicates functional activities or injury of the kidney. We observed that the mean values of the creatinine were changed in goats suffered from urolithiasis (Table 3). The mean values of creatinine were elevated significantly (P<0.05) in urolithiasis affected goats (2.90 ± 0.35mg/dL) than those of healthy goats (1.40 ± 0.38mg/dL).

Alterations in Glucose and Total Protein

In this study, it was observed that the mean values of glucose were significantly (P<0.05) increased in goats with urolithiasis (6.50 ± 0.44mmol/L) than healthy goats (3.53 ± 0.31mmol/L). On the other hand, the mean value of Total Protein (TP) was decreased in urolithiasis affected goats (3.73 ± 0.27gm/dL) than healthy goats (4.83 ± 0.31gm/dL) but this decrement was not significant (Table 4).

Table 3. Changes in serum creatinine to indicate kidney status in healthy and urolithiasis affected goats.

Parameters	Healthy goats	Urolithiasis affected goats
Creatinine (mg/dL)	1.40 ± 0.38	2.90 ± 0.35*

±=Standard Error; *=P<0.05

Table 4. Changes in blood glucose and total protein in healthy and urolithiasis affected goats.

Parameters	Healthy goats	Urolithiasis affected goats
Glucose (mmol/L)	3.53 ± 0.31	6.50 ± 0.44*
Total Protein (gm/dL)	4.83 ± 0.31	3.73 ± 0.27 NS

±=Standard Error; NS= Non-Significant; *=P<0.05

Changes in Body Electrolytes

The changes in the electrolytes in urolithiasis patients are shown in Table 5. We found that level of different electrolytes was altered after the development of urolithiasis. The mean values of Na^+ (139.20 ± 0.55mmol/L) and K^+ (4.27 ± 0.26mmol/L) were decreased significantly ($P<0.01$ and $P<0.05$) in goats with urolithiasis than healthy goats (145.33 ± 0.58mmol/L and 5.06 ± 0.08mmol/L of Na^+ and K^+ respectively). On the other hand, the mean value of Cl^- was also decreased but that was not significant.

Urinalysis

The changes in the routine urine profile are presented in Table 6. Urine samples collected from both healthy and diseased goats were examined to find out the changes of various urological parameters. Urinalysis revealed no changes in urine pH. However, a trace amount of protein was detected in the urine of goats with urolithiasis indicating damage to the glomeruli. Calcium oxalate was also detected in the urine of affected animals.

Table 5. Level of serum electrolytes in healthy and urolithiasis affected goats.

Parameters	Healthy goats	Urolithiasis affected goats
Na+ (mmol/L)	145.33 ± 0.58	139.20 ± 0.55**
K+ (mmol/L)	5.06 ± 0.08	4.27 ± 0.26*
Cl- (mmol/L)	107.03 ± 0.40	105.63 ± 0.46 NS

±=Standard Error; NS= Non-Significant; *=P<0.05; **= P<0.01

Table 6. Routine urine profile in healthy and urolithiasis affected goats.

Parameters	Healthy goats	Urolithiasis affected goats
pH	Alkaline	Alkaline
Protein	Nil	Present
Glucose	Nil	Nil
Crystals (Calcium Oxalate)	Absent	Present

DISCUSSION

Urinary obstruction in young ruminants is due to either formation of urinary calculi in the urinary tract or pathological conditions like necrotic urethritis. Formation of calculi may lead to obstruction of urinary passage resulting in urinary retention and requires emergency attention.

During the study period, it was found that among 115 urolithiasis goats registered at BAU VTH, 73 goats were at the age of up to 6 months old, 19 goats were at 7-12 months and 23 goats were of > 12 months old. We observed that young animals were more prone to the development of urolithiasis. It may be due to the early castration of young goats. Makhdoomi and Gazi (2013) reported that it affects both sexes but it is a common problem encountered in male goats because of the anatomical conformation of their urinary tract, early castration of male goat leading to arresting of male reproductive organ and urethra. In our study, the prevalence was higher in winter (42%) than the other seasons. The occurrence of urolithiasis in feedlot animals peak in winter may be due to the decreased water intake and deficiency of vitamin- A arising from lesser availability of green fodder. In our study, we found a decrease of rumen motility, an

increase of heart and respiratory rate but no significant change in body temperature in affected goats which is similar to the finding of Maciel et al. (2017).

We observed that TEC, Hb, and PCV were increased and ESR was decreased in urolithiasis goats than healthy goats. This may be due to dehydration which resulted from decreased water intake by goats and loss of appetite, which the common clinical symptom in the patients. On the other hand, TLC was decreased in affected goats than healthy individuals. Leukopenia which was observed in affected animals in comparison to the healthy group may be related mainly to lymphopenia which occurred as a result of the changes in lymphocytes kinetics stimulated by acute inflammatory mediators (Ismail, 2018). Lymphopenia occurs as a result of increased migration of lymphocytes to inflamed tissue or reducing the rate of lymphocytes moving from lymph node back to the circulation. Mainly, lymphopenia occurs in the cases as a result of stress state which associated with an acute inflammatory condition more than the inflammatory process itself (Stockham and Scott, 2008). Significantly increased level of serum creatinine was observed in the affected goats in comparison to their healthy counterparts. The reason may be due to an increased rate of creatinine reabsorption from prolonged stagnant urine in the intact urinary bladder along with renal insufficiency as a result of urine flow back and accumulation inside the kidneys termed as hydronephrosis.

We also observed an increase in liver enzymes (ALT, AST) in affected goats. It may be due to renal tissue injury leading to increased activities of AST. Accumulation of excessive amounts of urea and different nitrogenous waste products in the blood may cause uremic syndrome which leads to liver dysfunction (Ronco *et al.,* 2008). We observed a remarkable fall of serum bilirubin concentration in the affected animals. Normally in urolithiasis animals, serum bilirubin is increased but in our study bilirubin level was decreased. This could be due to decreasing degree of pressure on the stretching receptors of the urinary bladder wall and lowering back pressure degree after the leakage of urine from the ruptured urinary bladder into the abdominal cavity and subsequently, reduces pain (Radostits *et al.,* 2007), while in patients with intact urinary bladder complete blockage of urine flow induce severe pain and subsequent anorexia and rumen stasis. An increased level of glucose in goats with uroliths was observed. The hyperglycemia found in most of the urolithiasis goats might have triggered hyperinsulinemia, which causes hypophosphatemia because of the phosphorus shift into the intracellular space (Marinella, 2005). In our study, in urolithiasis goats, the total protein was 3.73 gm/dL. This was in agreement with Ismail (2018) which may be due to concurrent hyperglobulinemia which occurred as a result of inflammatory condition (cystitis) which produced from a decreased frequency of urination, incomplete voiding, and urine retention. This condition stimulated the synthesis of different globulin fractions (Zachary and McGavin, 2017). Hyponatremia and hypochloremia observed in the affected goats in comparison to the healthy goats which may be due to impairment of tubular reabsorption of sodium and chloride. In this study, a lower concentration of potassium was observed in urolithiasis goats than healthy goats. Anorexia may contribute to hypokalemia by decreasing the intake of potassium.

In our current investigation, urinalysis revealed an alkaline pH, and protein was detected in all affected goats. Proteinuria usually occurs in animals when glomeruli are damaged. Prolonged urinary retention may lead to glomerular damage which might be the cause for the detection of protein in urine in this study. In the ultrasonographic examination, we found crystals in the urinary bladder. Ultrasonography can identify stones located in the calyces, pelvis, and phyllo-ureteric and vesicoureteric junctions, as well as upper urinary tract dilatation. For stones > 5 mm, ultrasound has a sensitivity of 96% and specificity of nearly 100% (Basiri *et al.,* 2008). For all stone locations, sensitivity and

specificity of ultrasound reduce to 78% and 31%, respectively (Basiri *et al.,* 2008).

CONCLUSION

Based on the findings of the present study it can be concluded that urolithiasis occurred mostly in male goats of age less than six months of age. This disease is more prevalent in the winter season (October-March). The liver, kidney, and other vital organs may be compromised due to prolonged urinary stasis leading to elevation of serum biochemical parameters of these organs. Ultrasonography may be a useful tool to detect lodgment of uroliths. It is suggested to the farmers that early castration should be stopped, sufficient water should provide to the goats, goats should keep in dry and hygienic conditions. Once the condition is developed all the measures should be taken to prevent damage of vital organs that may help the survival of the patients.

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CONFLICT OF INTEREST

All the authors have declared that no conflict of interest exists.

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