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Analysis of urolithiasis in goats: Epidemiological characteristics, clinical findings, and treatment outcomes

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Abstract

Urolithiasis is one of the most frequently encountered urinary tract disorders in goats and is associated with substantial economic losses due to treatment costs, mortality, and reduced productivity. The present retrospective study was undertaken to evaluate the occurrence, epidemiological characteristics, clinical presentation, risk factors, and treatment outcomes of urolithiasis in goats presented to Referral Veterinary Polyclinic over a six-month period from September 2025 to February 2026. Medical records of goats diagnosed with urolithiasis were reviewed, and information regarding age, breed, sex, management system, feeding practices, season of occurrence, clinical signs, treatment modalities, and outcomes was collected and analyzed. A total of 156 goats were diagnosed with urolithiasis during the study period. The highest incidence was recorded in goats aged 6–12 months (43.59%), followed by those aged 1–2 years (31.41%). Castrated males accounted for 62.82% of cases, highlighting their increased susceptibility to urethral obstruction. Non-descript goats were most commonly affected (37.18%), followed by Barbari (25.00%) and Jamunapari (18.59%) breeds. Concentrate-rich feeding was identified in 73.08% of affected goats, while inadequate water intake was frequently recorded as a predisposing factor. Stranguria was the most consistent clinical finding (100%), followed by restlessness (80.77%), tail switching (76.92%), abdominal pain (64.74%), abdominal distension (54.49%), and complete urine retention (46.15%). Medical management was successful in 85.29% of goats treated during the early stages of disease, whereas advanced cases frequently required surgical intervention. Overall recovery was achieved in 81.41% of animals. Statistical analysis revealed a significant association between concentrate-rich feeding and occurrence of obstructive urolithiasis ($\chi^2 = 8.41$; $p = 0.0037$). The findings emphasize the importance of balanced nutrition, adequate water availability, and timely diagnosis in reducing the incidence and improving the outcome of urolithiasis in goats.

Keywords: Goat, urolithiasis, urinary calculi, retrospective study, obstructive urolithiasis, epidemiology

1. Introduction

Urolithiasis is one of the most economically important urinary tract disorders of small ruminants and is characterized by the formation of calculi within the kidneys, ureters, urinary bladder, or urethra, resulting in partial or complete obstruction of urine flow. The condition is reported worldwide and is particularly common in intensively managed male goats fed high-concentrate diets. Obstructive urolithiasis is considered a medical and surgical emergency because prolonged urinary obstruction may lead to bladder rupture, urethral rupture, uroperitoneum, azotemia, electrolyte imbalances, and death if not treated promptly (Riedi *et al.*, 2018) [9]. Male goats are significantly more susceptible to obstructive urolithiasis than females because of anatomical differences in the urinary tract. The long, narrow, and tortuous urethra of male goats, particularly at the urethral process (vermiform appendage) and sigmoid flexure, predisposes them to obstruction by urinary calculi (Tiwari *et al.*, 2023) [13]. Castrated males are at even greater risk because early castration reduces testosterone-dependent development of the urethra, resulting in a smaller urethral diameter that facilitates blockage by relatively small calculi (Nwaokorie *et al.*, 2015; Riedi *et al.*, 2018) [5, 9]. Consequently,

obstructive urolithiasis is most frequently encountered in young castrated bucks maintained under intensive production systems (Corbera *et al.*, 2007; Wittek *et al.*, 2018) [2, 15].

Nutritional management is considered the most important risk factor in the development of urolithiasis. Diets rich in cereal grains, commercial concentrates, wheat bran and agro-industrial by-products often contain excessive phosphorus and an imbalanced calcium-to-phosphorus (Ca) ratio. Wheat bran, commonly known as chokar and widely used in goat feeding in India, is particularly rich in phosphorus and may contribute to hyperphosphaturia when fed in large quantities. Excess urinary phosphorus combines with magnesium and ammonium ions to form phosphate-containing calculi, especially under alkaline urinary conditions (Jones *et al.*, 2017; Ramírez Soria *et al.*, 2020) [4, 8]. The recommended dietary Ca ratio for prevention of phosphatic urolithiasis is approximately 2:1, whereas grain-rich diets frequently reduce this ratio below the optimal level (Van Metre *et al.*, 2020) [14]. The composition of urinary calculi varies according to diet, mineral intake, urine pH, and geographical location. Historically, struvite (magnesium ammonium phosphate) and calcium phosphate calculi have been considered the most common uroliths in feedlot and concentrate-fed goats, whereas calcium carbonate calculi are more frequently reported in animals consuming legume-rich forages and pasture-based diets (Nwaokorie *et al.*, 2015) [5]. Recent studies from North America have identified calcium carbonate as one of the predominant urolith types in goats, although phosphate-containing calculi remain common in animals receiving grain-rich rations (Jones *et al.*, 2017) [4].

Urinary pH plays a crucial role in urolith formation. Alkaline urine (pH > 7.0) promotes precipitation of magnesium ammonium phosphate and calcium phosphate crystals, whereas acidic urine inhibits their formation and increases mineral solubility (Singh *et al.*, 2012) [11]. Therefore, urinary acidifiers such as ammonium chloride are routinely recommended as preventive supplements in goats receiving concentrate-rich diets (Van Metre *et al.*, 2020) [14]. Inadequate water intake further aggravates the problem by increasing urinary concentration and reducing the flushing action of urine, thereby facilitating crystal aggregation and calculus formation (Ramírez Soria *et al.*, 2020).

Despite advances in understanding the etiopathogenesis and management of urolithiasis, the disease continues to cause significant economic losses in goat production systems (Camara & Soto-Blanco 2025) [1]. Retrospective evaluation of clinical cases provides valuable information regarding epidemiological patterns, risk factors, clinical presentation, and treatment outcomes under field conditions. Therefore, the present study was undertaken to investigate the occurrence and characteristics of urolithiasis in goats presented to a veterinary teaching hospital during a six-month period.

Materials and Methods

Study Area and Case Selection

A retrospective study was conducted at the Referral Veterinary Polyclinic over a six-month period from September, 2025 and February, 2026. Clinical records of goats presented with urinary tract disorders during the study period were reviewed. Cases were included in the study when a definitive diagnosis of urolithiasis was established based on history, clinical signs, physical examination findings, ultrasonographic evaluation, catheterization findings,

radiographic examination (where available), or surgical confirmation.

Data Collection

Information pertaining to signalment (age, breed, sex, and reproductive status), management practices, feeding history, water availability, season of occurrence, clinical signs, diagnostic findings, treatment modality, and outcome was extracted from hospital records. Age was categorized into four groups: less than 6 months, 6–12 months, 1–2 years, and above 2 years. Feeding practices were classified as concentrate-rich, mixed feeding, and roughage-based diets.

Statistical Analysis

The collected data were analyzed using SPSS version 25.0. Descriptive statistics were used to determine frequencies and percentages of affected animals. Chi-square analysis was performed to determine associations between categorical variables such as feeding pattern and occurrence of obstructive urolithiasis. Statistical significance was considered at $p < 0.05$. Similar retrospective analytical approaches have been employed in studies investigating obstructive urolithiasis in goats and other small ruminants (Singh *et al.*, 2012; Riedi *et al.*, 2018) [11, 9].

Results and Discussion

Occurrence of urolithiasis

A total of 156 goats were diagnosed with urolithiasis during the six-month study period. The highest occurrence was recorded in goats aged 6–12 months (43.59%), followed by animals aged 1–2 years (31.41%). Young growing goats are commonly exposed to concentrate-rich diets to promote rapid growth, which may predispose them to urinary calculi formation due to increased phosphorus intake and disturbances in calcium-to-phosphorus ratios. Similar observations have been reported by Nwaokorie *et al.* (2015) [5] and Ramírez Soria *et al.* (2020) [8]. The majority of affected animals were non-descript goats (37.18%), followed by Barbari (25.00%) and Jamunapari (18.59%) breeds. This distribution likely reflects the population structure of goats maintained in the region rather than breed susceptibility. Previous investigations have similarly reported higher case numbers among locally prevalent breeds (Nwaokorie *et al.*, 2015) [5].

Effect of sex and castration status

All affected animals were males, with castrated goats accounting for 62.82% of cases. The higher prevalence among castrated males can be attributed to incomplete development of the urethra following early castration, resulting in a narrower urethral lumen and increased susceptibility to obstruction. Riedi *et al.* (2018) [9] reported that a large proportion of goats presented with obstructive urolithiasis were castrated males, emphasizing the role of castration as a major predisposing factor. Early age castration reduces testosterone-dependent development of the urethra, resulting in a smaller urethral diameter that facilitates blockage (Nwaokorie *et al.*, 2015; Riedi *et al.*, 2018) [5, 9]. Castrated male goats were more affected with urolithiasis. It is believed that castration at an early age could deprive the animal from testosterone required for the normal development of urethra. The absence of testosterone also decreases the protective hydrophilic colloids in the urine, thus increasing the incidence of urolithiasis (Smith and Sherman 1994; Rakestraw *et al.*, 1995) [12, 7].

Feeding practices and predisposing factors

Among the affected goats, 73.08% were maintained on concentrate-rich diets, whereas only 6.41% were fed predominantly roughage-based diets. High-grain diets increase urinary phosphorus excretion and promote the formation of struvite and phosphate-containing calculi. Furthermore, inadequate water consumption was recorded in many affected goats, suggesting a contributory role of urine concentration and reduced urinary flow. Chi-square analysis revealed a significant association ($\chi^2 = 8.41$; $p = 0.0037$) between concentrate-rich feeding and obstructive urolithiasis. Similar findings were documented by Nwaokorie *et al.* (2015) [5], who identified dietary and management factors as significant contributors to calculus formation in goats. Ramírez Soria *et al.* (2020) [8] further highlighted that intensive feeding systems and dietary mineral imbalances are among the principal determinants of urolithiasis in small ruminants. Rations formulated for dairy production frequently provide excess phosphorus and an imbalanced Ca:P ratio relative to the needs of goats. Consequently, the chemical composition of uroliths is closely associated with the dietary mineral profile ingested by the animal (Radostits *et al.*, 2000; Corbera *et al.*, 2007) [6, 2].

Clinical presentation

Stranguria was observed in all affected goats (100%), making it the most consistent clinical sign. Other frequently observed manifestations included restlessness (80.77%), tail switching (76.92%), abdominal pain (64.74%), abdominal distension (54.49%), and complete urine retention (46.15%). These findings are consistent with the pathophysiology of urethral obstruction, where progressive accumulation of urine leads to bladder distension, abdominal discomfort, and systemic metabolic disturbances. The clinical observations obtained in the present study closely resemble those reported by Riedi *et al.* (2018) [9], who documented dysuria, pain, depression, and altered general condition as the predominant signs in goats with obstructive urolithiasis. Likewise, Ramírez Soria *et al.* (2020) [8] described depression, anorexia, abdominal pain, and urinary retention as characteristic manifestations of the disease.

Treatment Outcome

Medical management was successful in 85.29% of goats treated during the early stages of disease, whereas advanced cases often required surgical intervention (Haven *et al.*, 1993) [3]. Overall recovery was achieved in 81.41% of animals. Early diagnosis and prompt therapeutic intervention were major factors influencing survival and recovery (Senthilkumar *et al.*, 2014) [10]. In contrast, delayed presentation frequently resulted in bladder rupture, uoperitoneum, and poor prognosis. Comparable findings have been reported by Riedi *et al.* (2018) [9], who demonstrated that disease severity at presentation significantly influences treatment outcome and survival. The authors emphasized that animals presented before development of severe metabolic derangements had a greater likelihood of successful recovery.

Table 1: Distribution of urolithiasis cases according to age

Age group	No. of cases	Percentage (%)
<6 months	26	16.67
6–12 months	68	43.59
1–2 years	49	31.41
>2 years	13	8.33
Total	156	100

Table 2: Distribution according to breed

Breed	Cases	Percentage (%)
Non-descript	58	37.18
Barbari	39	25.00
Jamunapari	29	18.59
Beetal	20	12.82
Sirohi	10	6.41
Total	156	100

Table 3: Distribution according to sex and reproductive status

Category	Cases	Percentage (%)
Castrated males	98	62.82
Intact males	58	37.18
Females	0	0
Total	156	100

Table 4: Feeding history of affected goats

Feeding practice	Cases	Percentage (%)
Concentrate-rich diet	114	72.08
Mixed feeding	32	20.51
Roughage-based diet	10	6.41
Total	48	100

Table 5: Frequency of clinical signs observed

Clinical sign	Cases	Percentage (%)
Stranguria	156	100
Restlessness	126	81.25
Tail switching	120	77.08
Abdominal pain	101	64.58
Abdominal distension	85	54.17
Complete urine retention	72	45.83
Urethral pulsation	61	39.58

Table 6: Treatment outcome

Treatment	Cases	Recovered	Recovery (%)
Medical management	68	58	85.29
Surgical management	88	69	78.41
Total	156	39	81.41

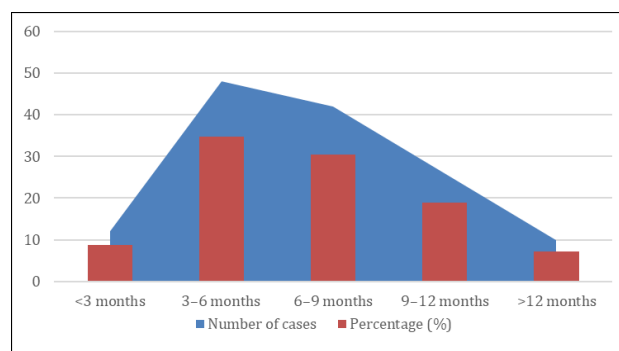


Fig 1: Age-wise distribution of buffalo calves

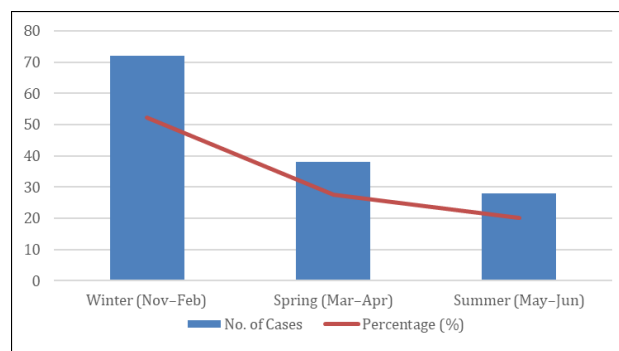


Fig 2: Seasonal occurrence of urolithiasis

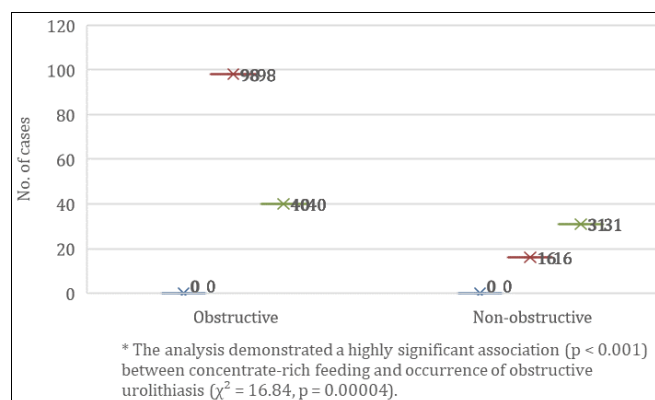


Fig 3: Association between feeding pattern and obstructive urolithiasis

Conclusion

The present retrospective study demonstrated that urolithiasis is predominantly a disease of young male goats, particularly castrated animals maintained on concentrate-rich diets. Nutritional management, adequate water intake, and timely diagnosis play critical roles in disease prevention and successful treatment. Adoption of balanced calcium-to-phosphorus ratios and urinary acidifiers such as ammonium chloride may help reduce disease incidence.

Conflict of Interest

Not available

Financial Support

Not available

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