RESEARCH ARTICLE

Clinical Evaluation and Management of Urolithiasis in Dogs

Shree Ram Karir[1]*, Anita[2], Alka Bharia[3], Nupur Pandey[1], Pradeep Kumar[1]

Abstract

Urolithiasis, characterized by the formation of urinary tract calculi, is a common and potentially serious condition in dogs. It may result in partial or complete urinary obstruction and often recurs if not properly managed. The condition has a multifactorial etiology, involving diet, infection, breed predisposition and urinary pH. This study was focused on diagnostic imaging, surgical intervention outcomes and prevention of post-treatment recurrence of urolithiasis in ten dogs. Clinical signs, diagnostic imaging (radiography and ultrasonography), stone composition, surgical and medical management and follow-up were analysed. Stones were identified chemically and post-treatment protocols were followed. The most frequent stone type was struvite (5 cases), followed by calcium oxalate (3 cases) and urate (2 cases). Surgical intervention was necessary in 8 dogs. Two urate cases were managed with diet modification alone. Most dogs recovered fully, with recurrence in one case. Imaging was instrumental in identifying radiolucent and radiopaque calculi. Canine urolithiasis requires comprehensive diagnostic evaluation and individualized therapy. Combining surgery, diet modification and long-term monitoring offer the best outcomes. Accurate imaging and stone analysis are essential for preventing recurrence.

Key words: Canine urolithiasis, Cystotomy, Calcium oxalate, Radiography, Struvite.

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Introduction

Urolithiasis is the formation of calculi within the urinary system, including kidneys, ureters, bladder and urethra (Osborne *et al.,* 1999[a]). It is a common condition in small animal practice and may cause haematuria, dysuria, pollakiuria, urinary obstruction or recurrent urinary tract infections. In severe cases, it can lead to hydronephrosis, renal damage or even death. Its etiology is multifactorial, influenced by urinary pH, concentration, diet, breed predisposition, metabolic defects and infections, especially those caused by urease-producing bacteria (Lulich *et al.*, 2016). Lifestyle factors such as obesity, sedentary habits and low water intake also contribute (Osborne *et al.*, 1999[a]).

The most common canine uroliths are struvite, calcium oxalate and urate (Osborne *et al.*, 1999[b]). Struvite is usually infection-associated and seen more in females; calcium oxalate develops in sterile acidic urine, often in older males; while urate is linked to hepatic dysfunction or portosystemic shunts, particularly in breeds like Dalmatians and Pugs (Bartges, 2004; Killilea *et al.*, 2015; Hesse *et al.*, 2016). Diagnosis involves urinalysis and imaging, with radiography useful for struvite and calcium oxalate, while ultrasonography detects radiolucent stones like urate and cystine (Weichselbaum *et al.*, 1999; Hoelmer *et al.*, 2022). Management depends on stone size and type; small stones may be managed medically, whereas obstructive or large stones often require surgery (Cornell, 2000; Smeak, 2000). Long-term control involves dietary adjustments, eradication of infections and regular monitoring (Calabro *et al.*, 2011). This case series documents the clinical evaluation and management of ten canine urolithiasis cases, emphasizing diagnostic protocols, surgical interventions, stone composition analysis and strategies for preventing recurrence.

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Materials and Methods

The prospective study was conducted on clinical cases presented at the Veterinary Clinical Complex and Department of Veterinary Surgery and Radiology, PGIVER, Jaipur (Rajasthan, India) from January to December 2024. Dogs of either sex and any breed presented with clinical signs of urinary dysfunction were included. Confirmation of urolithiasis was made via radiography, ultrasonography or physical retrieval of stones. Detailed histories included diet, water intake, prior urinary disease and behavioural signs. Clinical examination involved abdominal palpation, bladder distension assessment and urethral patency testing (Bartges and Callens, 2015). Observed signs included haematuria, dysuria, pollakiuria, urinary incontinence, straining or anuria and abdominal pain.

Diagnostic Investigations

For *Urinalysis* midstream urine samples were collected via catheterization or free-catch. Parameters evaluated included physical (color, turbidity, specific gravity), chemical (pH, protein, haematuria) and microscopic (crystals, WBCs, bacteria) characteristics. Crystal identification was based on morphology, consistent with techniques described by Osborne *et al.* (1999[b]).

For *Haemato-biochemistry* blood was tested for complete blood counts, blood urea nitrogen (BUN), serum creatinine, and electrolytes (Na^+, K^+, Cl^-) for detection of infection or inflammation using automated analyzers as these parameters help assess renal function and systemic effects of urinary obstruction (Franti *et al.*, 1999).

Imaging Modalities

Radiography included abdominal radiographs (lateral and ventrodorsal) using a computed radiographic X-ray machine. Radiopaque calculi were assessed based on size, shape and location (Hoelmer *et al.*, 2022).

Ultrasonography using a 5-7.5 MHz convex probe was performed to detect radiolucent stones, bladder wall thickening and acoustic shadowing (Weichselbaum *et al.*, 1999).

Surgical and Medical Management

Surgical interventions included cystotomy (for bladder stones) (Cornell, 2000) (Fig. 1-4), urethrotomy or retrograde urohydropulsion (for urethral obstruction), depending on stone location. Urate uroliths were treated using dietary dissolution therapy with low-purine prescription diets (for urate or small struvite calculi) and urine alkalinizers (Lulich *et al.*, 2016; Calabro *et al.*, 2011). Post-operative care consisted of analgesics (NSAIDs), antibiotics (based on urine culture), fluid therapy and dietary recommendations. Owners were advised on recurrence prevention through dietary changes and regular urinalysis.

Urolith Analysis

Stones retrieved (Fig. 5-7) were dried and analysed chemically using the protocol described by Osborne *et al.* (1999[b]) and Bartges (2004).

Fig. 1: Initial parapreputial incision for cystotomy

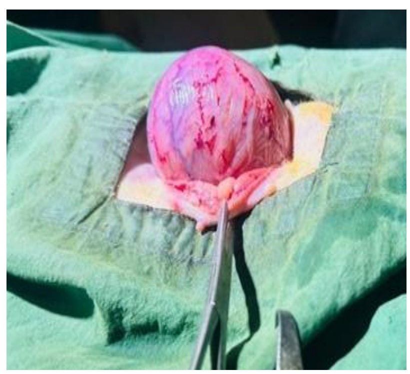

Fig. 2: Exteriorized urinary bladder for cystotomy

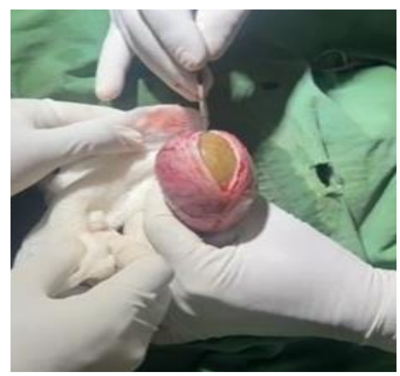

Fig. 3: Intraoperative image showing bladder cystotomy and exposure of a large urolith

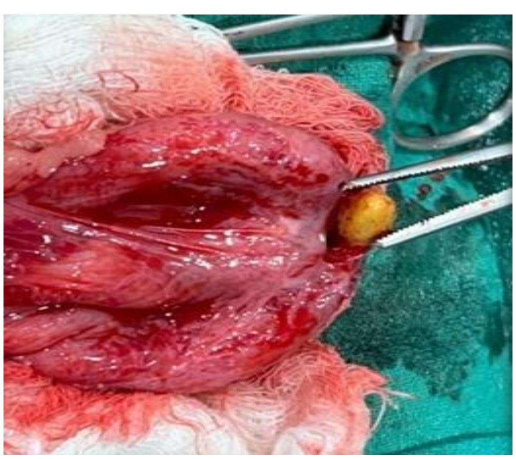

Fig. 4: Retrieval of cystic calculi by manually

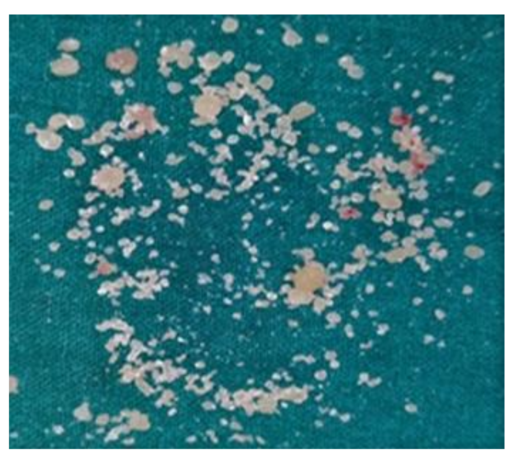

Fig. 5: Retrievedstruvite calculi

Fig. 6: Retrievedmixed struvite and calcium oxalate calculi

Fig. 7: Retrieved large struvite calculi from urinary bladder

Results and Discussion

Signalment and Clinical Presentation

Ten dogs aged between 2 and 9 years (mean 5.5 years) were diagnosed with urolithiasis. There was an equal sex distribution (5 males and 5 females). Breeds represented included Labrador Retriever (3), Pug (2), Dachshund (2), Beagle (1), German Shepherd (1) and Indian Spitz (1). Breed predispositions observed in this study concurred with earlier reports highlighting increased susceptibility in certain breeds (Franti *et al*., 1999; Houston *et al*., 2004; Ling *et al*., 2003).

The major clinical signs among 10 dogs were haematuria (70%), dysuria (60%), straining to urinate (50%), abdominal discomfort (40%) and urinary obstruction (20%). These signs were consistent with the type and location of calculi, corroborating the findings of Amarpal *et al*. (2004) and Jummai *et al*. (2018). Urolithiasis thus remains a significant diagnostic and therapeutic challenge in small animal practice (Killilea *et al*., 2015; Amarpal *et al*., 2004).

Laboratory and Imaging Findings

Urinalysis revealed pH values ranging from 5.5 (oxalate cases) to 8.2 (struvite cases). Crystalluria was detected in 9 cases, *i.e.,* struvite (4), calcium oxalate (3), urate (2) and mixed (1). Azotemia (BUN >40 mg/dL) was present in three obstructive cases.

Radiography identified radiopaque calculi in 7/10 dogs (Fig. 8-12), typically struvite and calcium oxalate, consistent with Weichselbaum *et al*. (1999), Ling *et al*. (2003) and Killilea *et al*. (2015). Multiple, radiopaque struvite calculi were observed in several cases, as described previously (Osborne *et al*., 1981).

Ultrasonography detected radiolucent urate stones in three dogs (Fig. 13-17) and also revealed bladder wall thickening and acoustic shadowing. These findings support the earlier conclusions that ultrasonography is indispensable for urate uroliths and evaluating bladder wall integrity (Weichselbaum *et al*., 1999; Defarges *et al*., 2013; Hoelmer *et al*., 2022). Struvite stones were most common (5 out of 10 cases) and were mostly found in female dogs with concurrent bacteriuria (Bartges *et al*., 1999; Bartges and Callens, 2015). Calcium oxalate (3 out of 10 cases) was prevalent in neutered males (Ling *et al*., 2003; Killilea *et al*., 2015) and urate stones (2 out of 10 cases) were exclusive to Pugs, consistent with genetic predisposition (Hesse *et al*., 2016; Florey *et al*., 2017).

Stone Analysis

Clinical Outcome

Outcome of all cases is presented in Table 1 according to breed, age, sex, clinical signs, type of stone and treatment, which concurred with the previous reports (Lulich *et al*., 2016; Queau, 2019).

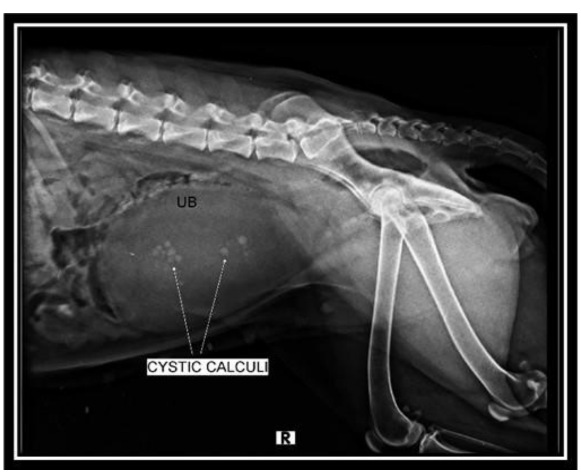

Fig. 8: Lateral abdominal radiograph showing radiopaque cystic calculi in urinary bladder

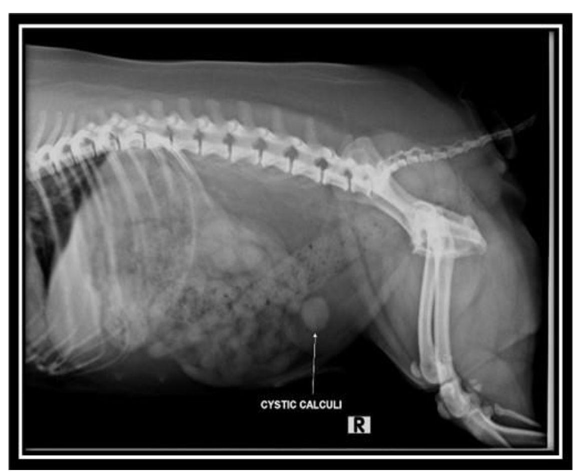

Fig. 9: Lateral abdominal radiograph revealing a single large cystic calculus in urinary bladder

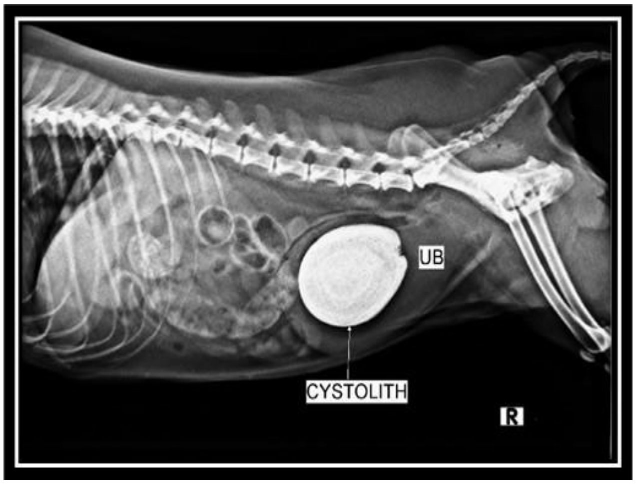

Fig. 10: Lateral radiograph showing a giant cystolith occupying the canine urinary bladder

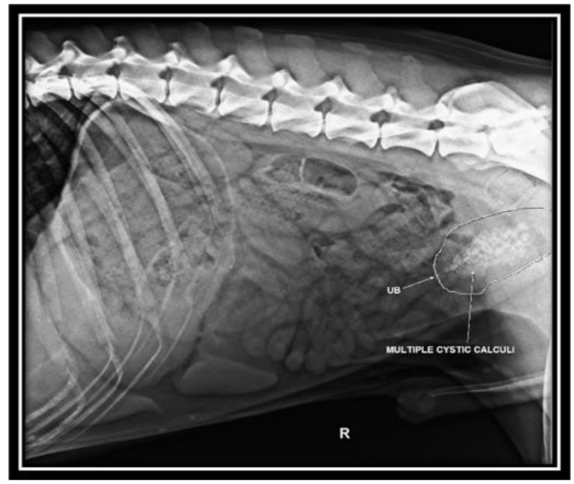

Fig. 11: Lateral abdominal radiograph showing multiple radiopaque cystic calculi in the urinary bladder

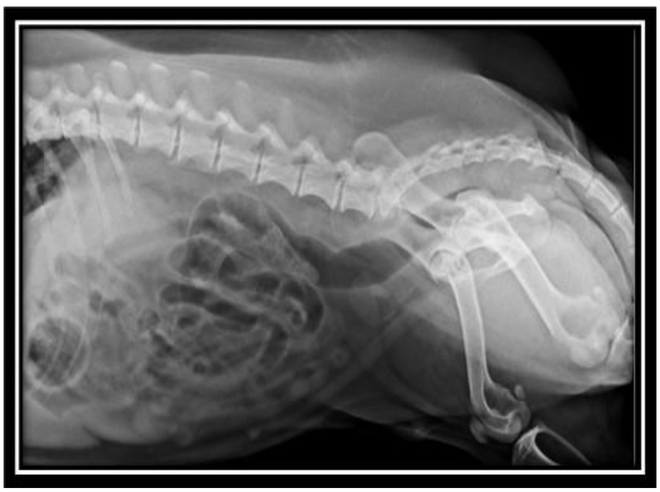

Fig. 12: Radiographic image showing a small central bladder stone

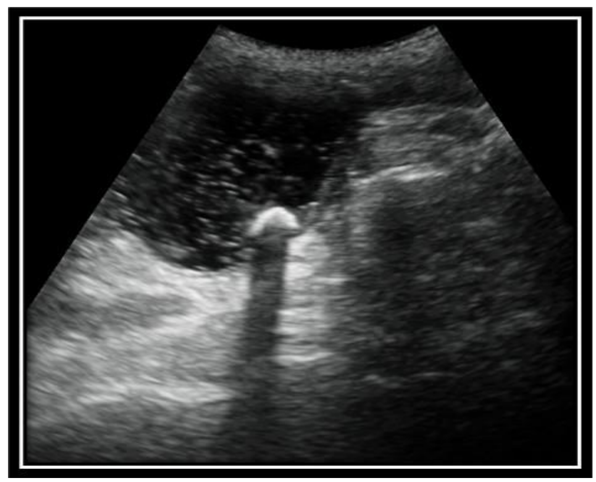

Fig. 13: Ultrasonogram revealing hyperechoic urolith with acoustic shadowing

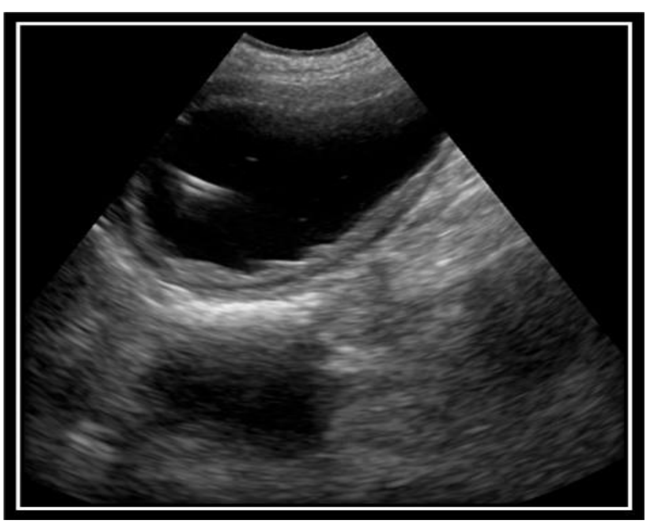

Fig. 14: Ultrasonographic view of the urinary bladder with uroliths

Fig. 15: Ultrasonogram showing bladder wall thickening and sediment accumulation

Fig. 16: Ultrasonographic image showing single hyperechoic urolith with clear acoustic shadowing

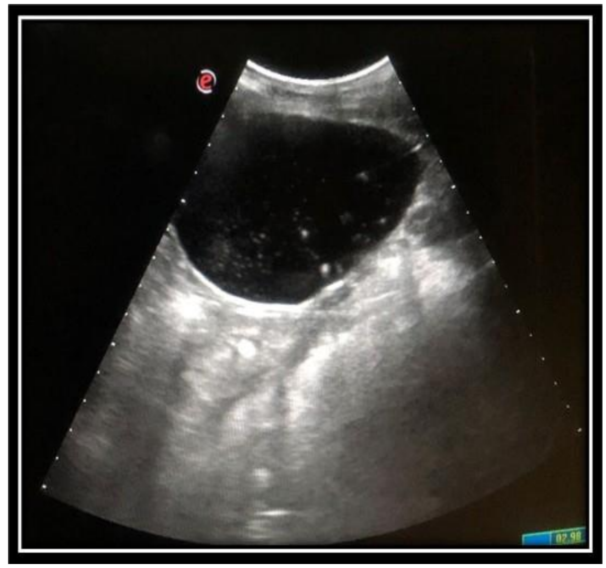

Fig. 17: Ultrasonographic appearance of urolithiasis in urinary bladder

Table 1: Summary of case-wise clinical data including breed, age, sex, clinical signs, type of urolith, treatment modality and clinical outcome in ten dogs

Case	Breed	Age (yrs)	Sex	Clinical Signs	Type of Stone	Treatment	Outcome
1	Labrador Retriever	6	M	Hematuria, dysuria	Struvite	Cystotomy	Full recovery
2	Pug	4	F	Incontinence	Urate	Diet therapy	Improved
3	Dachshund	5	M	Anuria	Ca Oxalate	Urethrotomy	Full recovery
4	German Shepherd	7	M	Hematuria, straining	Struvite	Cystotomy	Full recovery
5	Beagle	3	F	Pollakiuria	Struvite	Cystotomy	Full recovery
6	Indian Spitz	8	M	Dysuria, lethargy	Ca Oxalate	Cystotomy	Partial recovery
7	Labrador Retriever	5	F	Painful urination	Struvite	Cystotomy	Full recovery
8	Pug	2	M	Dribbling urine	Urate	Urethrotomy	Full recovery
9	Dachshund	6	M	Haematuria, discomfort	Ca Oxalate	Cystotomy	Recurrence
10	Labrador Retriever	9	F	UTI, incontinence	Struvite	Cystotomy	Full recovery

The predominance of struvite (50%) and calcium oxalate (30%) in this study mirrors global patterns (Franti *et al.*, 1999; Houston *et al.*, 2004). Struvite uroliths were associated with infection and female predisposition, while calcium oxalate stones occurred in males and showed recurrence potential. Urate uroliths, although fewer, highlighted the significance of breed-linked metabolic disorders in Pugs.

Radiography proved reliable for radiopaque calculi, whereas ultrasonography was vital for urate stones and bladder wall evaluation. This complements earlier reports that recommend multimodal imaging for accurate diagnosis (Osborne *et al.*, 1999[a]; Defarges *et al.*, 2013). Surgical procedures (cystotomy/urethrotomy) yielded favourable results, but recurrence risk emphasizes the role of postoperative dietary therapy, infection control and regular follow-up (Jummai *et al.*, 2018; Queau, 2019; Naeverdal *et al.*, 2023). Thus, this case series highlights that successful management of canine urolithiasis requires comprehensive diagnostic work-up, individualized therapy and lifelong preventive strategies (Bartges *et al.*, 1999; Osborne *et al.*, 1999b; Killilea *et al.*, 2015).

Conclusion

Urolithiasis in dogs is a complex, multifactorial disorder that requires a systematic and individualized approach for effective treatment and long-term control. The type and location of stones determine the treatment plan, which may include surgery or medical dissolution. This study demonstrates that a multimodal management strategy-incorporating diagnostic imaging, stone analysis, appropriate surgical techniques and post-operative dietary adjustments-can result in successful outcomes in most cases. Prevention of recurrence remains a key goal and requires ongoing veterinary care and client compliance.

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