

# Prospective Analysis of Dogs Affected with Urinary Calculi: Diagnosis and Surgical Management

Bhaminiben M. Patel<sup>1</sup>, Jalendra K. Mahla<sup>2</sup>, Jay Y. Bodala<sup>1</sup>, Shital K. Patel<sup>1</sup>, Kaushal D. Patel<sup>2</sup>, Arnold R. Mecvan<sup>1</sup>

## ABSTRACT

One-year prospective study evaluated the occurrence of urinary tract affections in dogs, with a specific focus on urinary calculi, at Veterinary Clinical Complex of the College in Anand (Gujarat, India). A total of 11,525 animals were presented, among them 126 were diagnosed with urinary tract disorders. The highest incidence was observed in canines (58.73%, n=74), followed by caprines (23.81%, n=30), bovines (11.90%, n=15), and felines (5.55%, n=7). Among 74 dogs affected with urinary tract, urinary calculi were the most common condition (n=33), followed by cystitis, kidney failure, cystitis with calculi and bladder tumours. Middle aged dogs (5-10 years) showed the highest incidence of urinary calculi and Labrador Retrievers, Pomeranians and Pugs were the most commonly affected breeds. Male dogs were slightly more affected than females, although sex distribution varied between breeds. Most dogs were fed a combination of commercial and vegetarian diet compared to only vegetarian diet or non-vegetarian diet. In one year analysis it was found that urinary calculi were the most common occurrence compared to the other urinary tract affections, and it was also related to age, breed, sex, diet and water. Among 33 dogs affected with various type of urinary calculi, 6 dogs were diagnosed by imaging techniques having complete urinary obstruction or large size of the calculi in bladder or urethra, which were managed surgically by cystotomy. Rectal temperature and haemato-biochemical parameters, except BUN & creatinine, were within normal range before and after surgery. Urinalysis was a guiding force to determine nature of calculi & thereby the therapeutic management approach.

**Key words:** Cystitis, Cystotomy, Diagnosis, Dog, Imaging techniques, Urinary calculi.

*Ind J Vet Sci and Biotech* (2026): 10.48165/ijvsbt.22.1.33

## INTRODUCTION

Dogs have long been regarded as loyal companions to humans, and their popularity has grown steadily in both urban and rural parts of India due to their valued role as household pets and social partners (Bhadesiya and Raval, 2014). The term *urolith* was derived from the Greek words *ouron* (urine) and *lithos* (stone) (Osborne *et al.*, 1999). Urinary calculi were commonly encountered as painful disorder of the urinary tract, which frequently resulted in urinary obstruction and manifested with diverse clinical signs. The predisposition to urolith formation in canines is influenced by the specific urolith type, which includes variables such as breed, age, gender, reproductive status and occasionally urinary tract infections induced by struvite calculi and urease-producing microbes (Kopecny *et al.*, 2021). The development of urinary calculi is mostly secondary to multiple underlying conditions (Tiruneh and Tagesu, 2017). Numerous infectious and non-infectious disorders adversely affect the urinary system of dogs, frequently associated with poor preventive healthcare knowledge and daily care routines (Brown *et al.*, 1977).

In India, the prevalence of urolithiasis in animals has been reported as 5.04%. The species-wise distribution shows the highest incidence in goats (49.83%), followed by cattle (32.87%), dogs (14.53%), horses (1.38%), sheep (1.04%) and cats (0.34%) (Osborne *et al.*, 1999). Apart from genetic predisposition, certain breeds were more prone to developing uroliths, the Spitz/Samoyed breed exhibits

<sup>1</sup>Department Veterinary Surgery and Radiology, College of Veterinary Science & Animal Husbandry, Kamdhenu University, Anand-388001, Gujarat, India.

<sup>2</sup>Department Veterinary Surgery and Radiology, College of Veterinary Science & Animal Husbandry, Kamdhenu University, Bhuj-370001, Gujarat, India.

**Corresponding Author:** Dr. Bhaminiben M. Patel, Department Veterinary Surgery and Radiology, College of Veterinary Science & Animal Husbandry, Kamdhenu University, Anand-388001, Gujarat, India. e-mail: patelbhamini786@gmail.com

**How to cite this article:** Patel, B. M., Mahla, J. K., Bodala, J. Y., Patel, S. K., Patel, K. D., & Mecvan, A. R. (2026). Prospective Analysis of Dogs Affected with Urinary Calculi: Diagnosis and Surgical Management. *Ind J Vet Sci and Biotech*, 22(1), 170-174.

**Submitted** 9/12/2025 **Accepted** 18/12/2025 **Published** 10/01/2026

a significantly higher prevalence (39.00%) as compared to other dog breeds (19.00%) (Amarpal *et al.*, 2004). Although the formation of cystoliths does not seem to be sex-dependent, urinary calculi was more commonly observed in male dogs (Adams and Lulich, 2006). A review of the existing literature revealed that very less research has been conducted in India on the prospective incidence of urinary tract affections in dogs. Therefore, the present study was aimed to provide a prospective analysis of the occurrence of lower urinary tract affections in canines in middle Gujarat based on one-year data surveillance including diagnosis and surgical management.

## MATERIALS AND METHODS

The cases of various affections of urinary tract specifically urinary calculi presented at the Veterinary Clinical Complex (VCC), Veterinary College, Kamdhenu University, Anand, Gujarat (India) during 15<sup>th</sup> Nov 2024 to 15<sup>th</sup> Oct 2025 were examined and detailed information regarding age, breed, sex and diet were recorded, and used for calculation of incidence of different urinary tract affections specifically urinary calculi.

Total 33 dogs were diagnosed with urinary calculi (29 in urethra, 4 in bladder) using various diagnostic techniques such as haemato-biochemical analysis, and qualitative urine analysis including macro-microscopic and culture examinations. Radiographic examination confirmed radiopaque calculi in the bladder of 6 dogs, while ultrasonographic examination revealed medium sized stones in 5 dogs and large size single stone in 1 dog. These 6 dogs had complete urinary obstruction or large size calculi that were managed surgically by performing a standard cystotomy through ventral midline approach, instead of medicinal management. Rectal temperature (°F) was monitored in all dogs at days 0, 15, and 30 of surgical treatment, and blood samples were collected for analysis of haemato-biochemical parameter before (day 0) and after surgery (days 15 and 30).

The data on incidences were analysed using descriptive statistics to derive percent frequency, while those on rectal temperatures and haemato-biochemical parameter were analysed statistically to derive Mean  $\pm$  SEs and means differences were compared by using one-way ANOVA and Duncan's multiple range test at  $p < 0.05$ .

## RESULTS AND DISCUSSION

### Prevalence of Urinary Tract Affections

During one year study period, total of 11,525 animals were presented to the Veterinary Clinical Complex, Anand. Among them, 126 cases were diagnosed as urinary tract disorders. The highest incidence was observed in canines (58.73%,  $n=74$ ), followed by caprines (23.81%,  $n=30$ ), bovines (11.90%,  $n=15$ ), and felines (5.55%,  $n=7$ ). The present study recorded the highest occurrence in dogs, contrast to the findings of Amarपाल *et al.* (2013) and Sharun *et al.* (2021), who reported highest incidence in goats.

Out of 74 canine urinary affections, the highest 39.19% ( $n=29$ ) incidence was bladder calculi, followed by 28.38% ( $n=21$ ) cases of cystitis, 18.92% ( $n=14$ ) kidney failure, 5.40% ( $n=4$ ) cystitis with urethral and bladder calculi and the lowest incidence recorded was of bladder tumour 8.11% ( $n=6$ ). Similar findings were reported by Parmar *et al.* (2021b), whereas incidence of cystitis was reported higher in canines by Kandula and Karla Pudi (2014) and Patel (2025).

### Age, Breed and Sex-Wise Incidence of Urinary Calculi

Age wise incidence of urinary calculi recorded among 33 canine cases was higher (54.55%,  $n=18$ ) in above 5-10 years of

age group followed by 24.24% in up to 5 years of age group ( $n=8$ ) and lowest incidence (21.21%,  $n=7$ ) was recorded in above 10 years of age group. These findings were similar to those of Amarपाल *et al.* (2004), Pal (2015) and Parmar *et al.* (2021a). They reported similar higher incidence of urinary calculi in animals between 5 and 10 years of age. In contrast, Taskande (2015) and Patel (2025) observed a greater incidence of urinary calculi in younger to middle-aged dogs compared to older ones.

Breed wise data analysis (Table 1) revealed the highest incidence of urinary calculi in the Labrador Retrievers breed followed by Pomeranians, Pugs, German Shepherds, Golden Retrievers and one case each in Great Dane, Lhasa Apso, Non-descript and Shih Tzu breeds. Similar findings of a higher prevalence in Labrador Retrievers were documented by Kandula and Karlapudi (2014) and Pal (2015). Conversely, Amarपाल *et al.* (2013) reported Spitz as the most predisposed breed.

**Table 1:** Breed wise incidence of urinary calculi in dogs

Breed	No.	Percent
Labrador Retriever	9	27.27
Pomeranian	8	24.24
Pug	6	18.18
German Shepherd	4	12.12
Golden Retriever	2	6.06
Great Dane	1	3.03
Lhasa Apso	1	3.03
Shih Tzu	1	3.03
Non-Descripts	1	3.03
<b>Total</b>	<b>33</b>	<b>100</b>

The present study further revealed that males had slightly higher incidence (51.51%,  $n=17$ ) of urinary calculi as compared to females (48.49%,  $n=16$ ). Lekcharoensuk *et al.* (2000) and Allen *et al.* (2015) also reported a higher incidence of urinary calculi in males than in females. In contrast, Kandula and Karlapudi (2014) observed higher incidence of urolithiasis in female than in male dogs (63.16% vs.36.84%).

Great Dane and Shih Tzu breed showed 100% urinary calculi in males, whereas Non-Descript and Lhasa Apso breed had recorded 100% incidence in females as all of these breeds had single incidence ( $n=1$  each). German Shepherd and Golden Retriever breeds had exactly 50% incidence of urinary calculi in male and female, whereas Labrador Retriever male dogs had 55.56% ( $n=5$ ) incidence, which was slightly higher than 44.44% in females ( $n=4$ ). Pomeranian breed showed higher incidence in males (62.50%,  $n=5$ ) as compared to females (37.50%  $n=3$ ). In contrast to these, Pug breed showed 66.67% incidence in females ( $n=4$ ) and 33.33% incidence in males ( $n=2$ ). However, we could not find similar observations by any other authors in the literature.

### Influence of Diet on Urinary Calculi

Diet plays vital role in incidence of urinary calculi. In the present study, the higher incidence of urinary calculi was recorded in dogs fed on a combination of commercial and vegetarian diets (66.67%, n=22), followed by in those fed exclusively on a vegetarian diet (24.24%, n=8) and lowest incidence was recorded in dogs maintained on a non-vegetarian diet (9.09%, n=3). These findings were similar to the observations of Sowjanya (2021). In contrast, Singh (2019), Brillhante *et al.* (2022) and Loan and Dao (2024) reported the highest incidence of urinary calculi in dogs fed on a commercial diet, followed by those on vegetarian and non-vegetarian diet.

### Incidence Based on Site of Affections

The highest (87.87%) stones were located in the urinary bladder (n=29), followed by 12.13% in both urethra and urinary bladder (n=4). Similar findings were recorded by Pal (2015), and Yaygingul (2024) with a higher occurrence of stones in the bladder. Sravanthi (2007) reported contrast findings compared to the present study. Syme (2012) explained that the dogs' quadruped stance causes small crystals or stones to settle in the ventral part of the bladder, allowing them to grow or pass into the urethra.

### Clinical Signs of Urolithiasis

Urolithiasis in dogs was a common condition that usually shows no symptoms until stones obstruct urine flow. If not treated, obstructive urolithiasis can lead to recurrent UTIs and many more complications. Clinical signs observed in dogs with urinary calculi included 48.42% dysuria, 33.24% haematuria combined with dysuria, 9.09% stranguria, 9.25% anuria and 6.06% pollakiuria, Additional signs, such as abdominal distension, dullness, depression, and congested mucous membranes, were also noted. Abdominal distension was attributed to partial or complete obstruction of the urinary tract. Similar observations were recorded by Patel (2025) and Karir *et al.* (2026). In contrast, Parmar *et al.* (2021b) studied 29 dogs with urolithiasis and identified bladder distension in 48.28% canines, which was frequently detected during ultrasonographic examination. Urinary obstruction by urocystoliths causes dysuria, haematuria, or stranguria due to inflammatory irritation of the urethral and bladder mucosa. Small, smooth calculi may not cause mucosal irritation; hence haematuria may be absent. Dysuria occurs primarily due to urinary tract obstruction by calculi.

### Thermal and Haemeto-Biochemical Findings

Mean rectal temperatures (°F) recorded were generally within the expected normal range of 99.5°F to 102.5°F in all 6 dogs with obstructive uroliths before (day 0) and on day 15, and 30 of surgery, and showed a non-significant decrease after surgery. These findings were in line with those of Pal (2015), Fromsa and Saini (2019), Maiti *et al.* (2020), and Patel

(2025), but in contrast with those of Konwar *et al.* (2017) and Saravanan *et al.* (2024), who recorded high temperatures in affected dogs.

The haemato-biochemical parameters evaluated pre- and post-operatively in 6 dogs with obstructive uroliths revealed that most of the parameters were within normal range and showed a non-significant variation (Table 2). These findings supported the reports of Taskande (2015), Synghal *et al.* (2016), Pandurangrao (2017), and Satar *et al.* (2024). In contrast, Pal (2015) and Singh (2019) recorded significant alterations in these parameters in dogs with urothiasis, may be due to chronic condition and delayed presentation to the hospital.

**Table 2:** Mean  $\pm$  SE values of haemato-biochemical parameters post-cystotomy in dogs with obstructive urinary calculi (n=6)

Parameter	0 Day	15 <sup>th</sup> Day	30 <sup>th</sup> Day
Rectal temperature (°F)	101.45 $\pm$ 0.09	101.43 $\pm$ 0.09	101.38 $\pm$ 0.06
Haemoglobin (g/dL)	15.95 $\pm$ 1.16	14.56 $\pm$ 1.15	16.00 $\pm$ 1.12
Packed cell volume (%)	50.98 $\pm$ 3.76	49.58 $\pm$ 2.69	49.18 $\pm$ 2.17
Total leucocyte count ( $\times 10^6/\mu\text{L}$ )	16.47 <sup>b</sup> $\pm$ 1.63	13.24 <sup>ab</sup> $\pm$ 8.59	10.79 <sup>a</sup> $\pm$ 5.69
Neutrophils (%)	71.50 $\pm$ 2.61	68.83 $\pm$ 2.44	66.33 $\pm$ 2.61
Lymphocytes (%)	24.11 $\pm$ 4.33	28.83 $\pm$ 3.18	31.13 $\pm$ 3.13
Monocytes (%)	3.16 $\pm$ 0.50	1.66 $\pm$ 0.49	1.70 $\pm$ 0.37
Eosinophils (%)	3.33 $\pm$ 0.47	3.00 $\pm$ 0.68	2.18 $\pm$ 0.52
Platelets ( $\times 10^5/\mu\text{L}$ )	3.71 $\pm$ 0.36	3.80 $\pm$ 0.38	3.65 $\pm$ 0.39
Blood urea nitrogen (mg/dL)	30.60 <sup>b</sup> $\pm$ 4.02	22.54 <sup>ab</sup> $\pm$ 2.02	19.07 <sup>a</sup> $\pm$ 1.29
Serum creatinine (mg/dL)	1.37 <sup>c</sup> $\pm$ 0.03	1.16 <sup>b</sup> $\pm$ 0.06	0.91 <sup>a</sup> $\pm$ 0.04

Means with different superscript within the row differ significantly ( $p < 0.05$ ).

Blood urea nitrogen and creatinine levels were significantly ( $p < 0.05$ ) higher at 0 day in dogs with obstructive uroliths, which reduced significantly and gradually on day 15th and 30th after surgery as it relived the obstruction establishing normal glomerular filtration. These findings supported the report of Sahoo *et al.* (2016), who also documented higher BUN levels in a six-year-old Spitz dog with a catheter stuck in the bladder. Satar *et al.* (2024) reported a reduction in serum creatinine levels following surgical intervention. However, Taskande (2015), Pandurangrao (2017) and Patel (2025) reported insignificant variation in BUN and creatinine.

The radiographic and ultrasonographic diagnostic imaging techniques confirmed large size of stone either single or multiple in 6 dogs, as has been reported by Bartges and Callens (2015) and Karir *et al.* (2026).

### Urine Analysis Finding

Macroscopic urine examination of obstructive uroliths cases showed reddish urine in 66.66% samples (n=4) and yellow urine in 33.33% (n=2) samples. These findings were similar to



those of Parmar *et al.* (2021b). The microscopic examination of urine revealed cast cells, pus cells, crystals and other constituents. Among these, urinary crystals were the most reliable indicator for preliminary chemical identification. 66.66% of the dogs had struvite urinary calculi and 33.33% dogs had calcium oxalate calculi. Dogs having cystitis combined with urolithiasis revealed leucocytes and intact RBCs in all the samples on microscopic examination, however in some samples epithelial cells were noticed. Similar findings were noted by Taskende (2015), Pandurangrao (2017) and Karir *et al.* (2026), who identified struvite as the most common urinary calculi in dogs followed by calcium oxalate. Parmar *et al.* (2021b) observed absence of crystalluria in 68.97% of 29 dogs with urolithiasis, with struvite and calcium oxalate crystals seen in 27.58% and 3.44%, respectively.

### Qualitative Urine Analysis Using Multistrip Technique

The urinary pH ranged from 6.5 to 9, with leucocytes present in 2 cases, nitrite in 1 case, protein in 3 cases, and bilirubin in 2 cases. The average specific gravity in this group was 1.021, while urobilinogen, ketones, and glucose remained absent. These findings were consistent with the observations reported by Fromsa and Saini (2019). However, they differ from the results of Pandurangrao (2017), who reported proteinuria in 85% of samples, leukocyturia in 25%, ketonuria in 45%, and glucosuria in 25%.

### Surgical Management

Cystotomy was performed through a ventral midline approach, with the incision placed along the linea alba, which provided excellent access for exteriorisation of the bladder, evacuation, and removal of calculi. The majority of animals showed uneventful recovery, except in one 10-year-old female Pomeranian that developed recurrence of uroliths within a month of surgery. In 3 cases where both urethral and urinary bladder calculi were present, retrograde hydropropulsion was performed prior to cystotomy using a 1:1 mixture of liquid paraffin and normal saline, which successfully pushed the urethral stones back into the bladder for complete removal. Minor postoperative complications included transient dysuria in one dog (resolved with medical management) and self-removal of two skin sutures in another dog that required open wound dressing. Overall, the surgical procedures were effective, and complications were minimal.

The observations made in the current study are in agreement with studies of Pal (2015), Parmar *et al.* (2021b) and Karir *et al.* (2026).

### CONCLUSION

The overall 1.09% incidence of urinary tract affections was recorded in dogs during the study. Males were affected more than females, and Labrador Retriever had highest incidence amongst all other dog breeds. Age related incidence recorded was higher at middle-aged dogs (5-10 years), and in those offered combination of commercial and vegetarian diets. For diagnosis of urinary calculi haemato-biochemical analysis was not accurate compared to the urine analysis. In most of the cases blood parameter remained in normal range, except BUN and serum creatinine, which were increased showing the status of kidney damage. Macroscopic examination of urine revealed reddish urine seen in dogs affected with urinary calculi and microscopic examination of urine revealed pus cell, cast, intact RBC. Microscopic examination was useful for the identification of urinary calculi composition which helps in appropriate treatment approach. Large sized calculi were removed safely with cystotomy.

### ACKNOWLEDGMENTS

We gratefully acknowledge the help and cooperation from the Principal, Veterinary College, and authorities of Kamdhenu University, Anand for extending financial support for conducting this work.

### REFERENCES

- Adams, L.G., & Lulich, J.P. (2006). Laser lithotripsy for removal of uroliths in dogs. In: *Photonic Therapeutics and Diagnostics II* (Vol. 6078, pp. 536-540), SPIE.
- Allen, H.S., Swecker, W.S., Becvarova, I., Weeth, L.P., & Werre, S.R. (2015). Associations of diet and breed with recurrence of calcium oxalate cystic calculi in dogs. *Journal of the American Veterinary Medical Association*, 246(10), 1098-1103.
- Amarpal, A., Aithal, H.P., Pawde, A.M., Pratap, K., & Gugjoo, M.B. (2013). A retrospective study on the prevalence of obstructive urolithiasis in domestic animals during a period of 10 years. *Advances in Animal and Veterinary Sciences*, 1(3), 88-92.
- Amarpal, A., Kinjavdekar, P., Paithal, H.P., Pawde, A.M., Singh, T., & Pratap, K. (2004). Incidence of urolithiasis: A retrospective study of five years. *The Indian Journal of Animal Sciences*, 74(2), 175-177.

**Table 3:** Qualitative urine analysis using multistrip of dogs affected with urinary calculi

Case No.	Urine PH	Leucocytes	Nitrite	Urobilinogen	Protein	Bilirubin	Sp.Gravity	Ketones	Glucose
1	8	-	-	-	-	-	1.015	-	-
2	7.5	+	-	-	++	+++	1.01	-	-
3	9	-	+	-	+++	-	1.025	-	-
4	7	-	-	-	-	+	1.05	-	-
5	8	+	-	-	-	-	1.01	-	-
6	6	-	-	-	+/-	-	1.02	-	-

- Bartges, J.W., & Callens, A.J. (2015). Urolithiasis. *Veterinary Clinics of North America Small Animal Practice*, 45, 747-768.
- Bhadesiya, C.M., & Raval, S.K. (2014). Percentage analysis of knowledge level for dog-ownership in rural areas of Gujarat. *International Journal of Social Science and Human Research*, 2(4), 300-302.
- Brilhante, A.B., Mansano, C.F.M., & Macente, B.I. (2022). Retrospective of urolithiasis in dogs and cats at the Veterinary Hospital of University Brazil-Fernandopolis/State of Sao Paulo between January 2018 and April 2019. *Research, Society and Development*, 11(11). <https://orcid.org/0000-0002-8161-5829>
- Brown, N.O., Parks, J.L., & Greene, R.W. (1977). Canine urolithiasis: Retrospective analysis of 438 cases. *Journal of the American Veterinary Medical Association*, 170(4), 414-418.
- Fromsa, A., & Saini, N.S. (2019). Canine urolithiasis and concurrent urinary bladder abnormalities: Symptoms, haematology, urinalysis and comparative radiographic and ultrasonographic diagnosis. *Veterinary Medicine-Open Journal*, 4(1), 18-26.
- Kandula, S., & Karlapudi, S.K. (2014). Prevalence of renal disorders in dogs - A clinical study. *International Journal of Agricultural Sciences and Veterinary Medicine*, 2(3), 146-148.
- Karir, S. R., Anita, Bharia, A., Pandey, N., & Kumar, P. (2026). Clinical evaluation and management of urolithiasis in dogs. *The Indian Journal of Veterinary Science and Biotechnology*, 22(1), 149-154.
- Konwar, B., Sarma, K., Saikia, B., Talukdar, D. J., Shah, S., & Cheda, M. (2017). The diagnosis of struvite cystolith with imaging techniques in a dog and its management. *International Journal of Current Research*, 9(3), 48071-48074.
- Kopcny, L., Palm, C.A., Segev, G., & Westropp, J.L. (2021). Urolithiasis in dogs: Evaluation of trends in urolith composition and risk factors (2006-2018). *Journal of Veterinary Internal Medicine*, 35(3), 1406-1415.
- Lekcharoensuk, C., Lulich, J.P., Osborne, C.A., Pusoonthornthum, R., Allen, T.A., Koehler, L.A., & Swanson, L.L. (2000). Patient and environmental factors associated with calcium oxalate urolithiasis in dogs. *Journal of the American Veterinary Medical Association*, 217(4), 515-519.
- Loan, N.V.T.H., & Dao, D.H. (2024). Urolithiasis and the effectiveness of treatments in dogs and cats in Ho Chi Minh City, Viet Nam. *Veterinary Integrative Sciences*, 23(2), 1-9.
- Maiti, S.K., Shivaraju, S., Amitha, B.S., Kalaiselvan, E., Mishra, M., Pipelu, W. & Khan, S. (2020). Surgical management of obstructive urolithiasis in a dog. *Archives of Veterinary and Animal Sciences*, 2(2), 2.
- Osborne, C.A., Lulich, J.P., Polzin, D.J., Sanderson, S.L., Koehler, L.A., Ulrich, L.K., Bird, K.A., Swanson, L.L., Pederson, L.A., & Sudo, S.Z. (1999). Analysis of 77,000 canine uroliths. Perspectives from the Minnesota Urolith Center. *The Veterinary Clinics of North America: Small Animal Practice*, 29(1), 17-38.
- Pal, A.J. (2015). Clinical studies on surgical management of canine urolithiasis. *M.V.Sc. Thesis*. Anand Agricultural University, Anand, Gujarat, India.
- Pandurangrao, B.A. (2017). Surgical management of urinary calculi by using different urethral approaches in dog. *M.V.Sc. Thesis*. Maharashtra Animal and Fishery Sciences University, Nagpur, India.
- Parmar, J.J., Parikh, P.V., Panchal, M.T., Ghodasara, D.J., & Bhandari, B.B. (2021b). Clinico-diagnosis and surgico-therapeutic management of lower urinary tract disorders in dogs. *Indian Journal of Animal Research*, 55(11), 1315-1322.
- Parmar, J.J., Parikh, P.V., Shah, A.I., & Dabhi, P.B. (2021a). Retrospective analysis of lower urinary tract disorders in dogs: Study of five years. *Indian Journal of Animal Research*, 55(8), 941-945.
- Patel, P. (2025). Clinical studies on incidence of urinary tract affections and its surgical management in dogs. *M.V.Sc Thesis*. Kamdhenu University, Navsari, Gujarat, India.
- Sahoo, M., Nath, I., & Singh, J. (2016). Urolithiasis with unusual complication of lodged catheter in the bladder of spitz dog. *Indian Journal of Canine Practice*, 8(1), 41-43.
- Saravanan, S., Ramprabhu, R., Sundararajan, R.C., & Vishnugurubaran, D. (2024). Secondary renal azotemia and peritonitis associated with urolithiasis in a Cocker Spaniel dog-Diagnostic and clinical management. *Indian Journal of Animal Health*, 39, 1-4.
- Satar, S.N., Kamble, M., Akhare, S.B., Bhadane, B.K., Upadhye, S.V., & Sonkusale, P.M. (2024). Haematobiochemical estimation in canine obstructive urolithiasis with special reference to enteral dialysis. *International Journal of Veterinary Sciences and Animal Husbandry*, 9(5), 481-486.
- Sharun, K., Manjusha, K.M., Kumar, R., Pawde, A.M., Malik, Y.P., Kinjavdekar, P., & Iraqi, A. (2021). Prevalence of obstructive urolithiasis in domestic animals: An interplay between seasonal predisposition and dietary imbalance. *Iraqi Journal of Veterinary Science*, 35(2), 227-232.
- Singh, A. (2019). Clinical studies on the hospital prevalence and surgical management of canine obstructive urolithiasis. *M.V.Sc. Thesis*. Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, India.
- Sowjanya, S. (2021). Clinical studies on cystourethroliths in dogs. *M.V.Sc. Thesis*. Sri Venkateswara Veterinary University, Tirupati, Andhra Pradesh, India.
- Sravanthi, P. (2007). A clinical study of urolithiosis in dogs. *M.V.Sc. Thesis*. PVNR Telangana Veterinary University, Rajendranagar, Hyderabad, India.
- Syme, H.M. (2012). Stones in cats and dogs: What could be learnt from them? *Arab Journal of Urology*, 10, 230-239.
- Synghal, A., Omer, K., & Synghal, A. (2016). Cystotomy for management of cystolithiasis in a bitch. *Intas Polivet*, 17(1), 170-172.
- Taskande, P.E. (2015). Clinical studies on bovine and canine urolithiasis with special reference to dissolution protocol in dogs. *Ph. D. Thesis*. Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, India.
- Tiruneh, D., & Tagesu, A. (2017). Review on canine urolithiasis. *American Research Journal of Veterinary Medicine*, 1(1), 1-7.
- Yaygingul, R. (2024). Clinical, laboratory, radiography and ultrasonography findings and surgical treatment the lower urinary system urolithiasis in cats and dogs. *Animal Health Production and Hygiene*, 13(1), 23-30.

