

Prevalence and Gross Characteristics of Urinary Calculi in Sheep and Goats Slaughtered at Kabul City Abattoir

Zafari Nageebullah^{1*}, Tawfeeq Mohammad Monir² & Ahmadzai Mohammad Aman³

¹Department of Pre-clinic, Faculty of Veterinary Sciences, Kunduz University, Kunduz, Afghanistan

²Department of Clinic, Faculty of Veterinary Science, Kabul University, Kabul, Afghanistan

³Department of Clinic, Faculty of Veterinary Science, Helmand University, Lashkar Gah, Afghanistan

*Corresponding author: nageebsahar@gmail.com

ABSTRACT

Urolithiasis is an important urinary disorder in small ruminants that may lead to urinary obstruction, health complications, and economic losses. This study aimed to determine the prevalence, anatomical location, and macroscopic characteristics of urinary calculi in sheep and goats slaughtered at Kabul City abattoir, Afghanistan. A cross-sectional study was conducted from April to June 2026, during which 407 small ruminants (185 goats and 222 sheep) were selected using a convenience sampling method. Animal-related data, including species, sex, age, breed, body condition score, and castration status, were recorded before slaughter. After slaughter, the entire urinary system (kidneys, ureters, urinary bladder, and urethra) was opened and macroscopically examined for urinary calculi. Data were analyzed using descriptive statistics, and the prevalence was estimated with a 95% confidence interval using the Clopper-Pearson exact method. Of the 407 animals examined, one case of urinary calculus was identified, yielding a prevalence of 0.25% (95% CI: 0.01–1.36%). The affected animal was a 4-year-old, non-castrated male goat of a local breed with a body condition score of 4. A single yellowish-brown urinary calculus, approximately 3 mm in diameter and weighing 0.205 g, was detected in the right renal pelvis. Although all animals appeared clinically normal at ante-mortem examination, the presence of a calculus in one animal indicates that subclinical urolithiasis can occur in slaughtered sheep and goats without apparent clinical signs of disease. This study provides preliminary data on urinary calculi in sheep and goats slaughtered at a Kabul City abattoir and may support future investigations on the epidemiology and prevention of urolithiasis in small ruminants in Afghanistan.

Keywords: Sheep; Goats; Urinary calculi; Abattoir; Afghanistan.

INTRODUCTION

Urolithiasis, or the formation of urinary calculi in the urinary tract of small ruminants, is an important and economically significant disease (Jones et al., 2017). These calculi can form at multiple sites throughout the urinary system (Yohannes & Tesfay, 2024b). Depending on the anatomical location, this condition is classified as nephrolithiasis, ureterolithiasis, cystolithiasis, or urethrolithiasis (Kant et al., 2023; Oryan et al., 2015). In most cases, urinary calculi remain asymptomatic until they cause urinary tract obstruction. In some animals, pyelonephritis, cystitis, and urethral obstruction can develop

(Constable et al., 2017; Yohannes & Tesfay, 2024a).

Studies have shown that urolithiasis occurs in sheep and goats in many countries worldwide, and its prevalence varies according to differences in climate, nutrition, management practices, and geographical conditions (Adhikari & Shah, 2025). Although this disease can develop in both sexes, the anatomical structure of males, particularly castrated animals, renders them highly susceptible to urinary obstruction due to the narrowness and length of their urethra (Constable et al., 2017; Kant et al., 2023). The development of uroliths in the urinary system is multifactorial, complex, and interrelated (Gazi, 2013). Urolith formation begins with the

development of a small nidus, which may consist of cell debris, bacteria, desquamated epithelial cells, and other organic materials. Mineral crystals subsequently precipitate around this nidus and gradually enlarge, eventually forming uroliths (Constable et al., 2017; Tawfeeq, 2024).

Various predisposing risk factors have been identified for the development of urolithiasis, among which the anatomical structure of the urinary system, genetic factors, dietary composition, urinary pH, and water intake level play important roles (Adhikari & Shah, 2025). Nutrition is considered the most critical risk factor for the development of urolithiasis (Nair et al., 2022). Animals raised in feedlot systems and fed grain-based diets are at a higher risk of developing struvite, amorphous magnesium calcium phosphate (AMCP), calcium carbonate, calcium oxalate, amorphous silica, and apatite uroliths (Jones et al., 2017). In contrast, grazing animals, particularly those consuming silica-rich and clover-rich pastures and oxalate-containing plants, are more susceptible to forming silica, calcium carbonate, and other mineral-based uroliths (Constable et al., 2017). Age, sex, castration status, type of feed and water, and dietary changes play important roles in the development of urolithiasis, particularly in young small ruminants (Sarker et al., 2020). Studies have shown that urolithiasis occurs more frequently in males than in females because the male urethra is longer and relatively narrower, increasing the likelihood of stone lodgment. Moreover, male goats castrated at an early age may have incomplete urethral development due to reduced testosterone influence (Gugjoo et al., 2013), whereas castration at an appropriate age allows proper development of the urethra (Kibria et al., 2016). Furthermore, this condition is of particular importance in small ruminants maintained under intensive production systems, as it may result in urinary tract obstruction, severe clinical complications, and considerable economic losses (Carrillo-Díaz et al., 2015). Climate and seasonal variations also play an important role in the epidemiology of the disease. During the winter season, reduced water intake

leads to increased urine concentration, thereby increasing the risk of urinary stone formation (Sharun et al., 2021).

Clinical signs usually appear after the development of urinary obstruction and may include stranguria, dysuria, anuria, hematuria, oliguria, abdominal pain, restlessness, and reduced appetite (Sharun et al., 2021). Urolithiasis is considered an economically important disease in small ruminants, causing considerable financial losses to livestock owners (Carrillo-Díaz et al., 2015). Prevention of the disease, particularly through proper nutritional management, regulation of water intake, and increasing farmers' awareness, is regarded as a more cost-effective approach than treatment (Sickinger & Windhorst, 2022).

Previous studies have reported variable prevalence of urolithiasis in small ruminants. A study conducted on Moghani sheep in Iran reported a prevalence of 3.7% for urolithiasis. All detected calculi were located in the renal pelvis (Nozohour & Najarneshad, 2023). Studies conducted in Bangladesh have demonstrated that urolithiasis occurs more frequently in young, male, and castrated goats. Furthermore, concentrate-based feeding and alkaline urine have been identified as important factors closely associated with the occurrence of the disease (Ahamed et al., 2022; Sen et al., 2018). Furthermore, a study conducted on does (female goats) slaughtered in Rwanda reported urinary system abnormalities in 10.6% of examined animals, among which renal calculi were the most common urinary abnormality (Mushonga et al., 2017). In Iran, a study involving the examination of the urinary system of 600 male sheep identified only two cases of urolithiasis, suggesting that regional feeding practices, environmental conditions, and management systems may influence the occurrence of the disease (Naenia et al., 2005).

Although valuable studies on urolithiasis have been conducted worldwide, no documented, published scientific research has been conducted in Afghanistan on the prevalence of urinary

calculi in sheep and goats. Therefore, the present study was conducted with the following objectives:

1. To determine the overall prevalence of urinary calculi in sheep and goats
2. To determine the prevalence of urinary calculi according to animal species, sex, age, breed, castration status, and body condition score
3. To identify the anatomical location of urinary calculi within the urinary system
4. To describe the gross characteristics of urinary calculi

The findings of this study are expected to provide preliminary scientific information on urolithiasis in Afghanistan and serve as a valuable reference for future research in this field.

MATERIALS AND METHODS

Study Area

This cross-sectional study was conducted at the Emarati Meat and Dairy Preparation Company Abattoir in Kabul City, Afghanistan. Data and samples were collected from April to June 2026. Kabul City, the capital of Afghanistan, is located in Kabul Province. The province comprises 15 administrative districts, while Kabul City is divided into 22 municipal districts (nahia). The study area was the Emarati Meat and Dairy Preparation Company Abattoir, located at the Macroryan Intersection in nahia 6 of Kabul City, Afghanistan. The city is situated at approximately 1,791 meters above sea level (Sangary & Mohmand, 2024).

Sample Collection

The sample size was calculated using the standard formula: $n = \frac{Z^2 P(1-P)}{d^2}$ for prevalence studies in veterinary epidemiology. Since no previous data were available on the prevalence of urinary calculi in sheep and goats in the study area, an expected prevalence of 50% was considered with a 95% confidence interval and 5% precision. In this formula, n denotes the required sample size, $Z = 1.96$ corresponds to a

95% confidence level, $P = 0.50$ represents the expected prevalence, and $d = 0.05$ represents the desired absolute precision. The calculated minimum sample size was 384 animals. To increase the reliability of the findings, a total of 407 small ruminants (185 goats and 222 sheep) were examined in the study. Animals were selected using convenience sampling (Thrusfield, 2018). During the study period, the researcher visited the abattoir on selected days and examined the sheep and goats that had been brought to the abattoir for slaughter and were accessible during each visit. Therefore, the sample may not fully represent all sheep and goats slaughtered at the abattoir during the study period, and potential selection bias associated with convenience sampling cannot be excluded.

Procedure

Each animal underwent ante-mortem examination before slaughter and was assigned a unique identification code. Relevant information, including species, sex, age, breed, castration status, and body condition score (BCS), was recorded on the data collection form. Age was estimated by examining incisor eruption and replacement patterns (*A Manual for the Primary Animal Health Care Worker*, 1994; USDA APHIS, 2026). The BCS was assessed by visual observation and palpation of the lumbar region, focusing on muscle and fat deposition around the vertebrae. Animals were classified using the standard 1-5 scoring system (Thompson & Meyer, 1994).

After slaughter and skinning, the entire urinary system was examined macroscopically by visual inspection and palpation for urinary calculi. The urinary organs were opened using a scalpel and dissecting scissors. The kidneys were removed from their attachments and incised longitudinally. The ureters were opened and examined along their entire length, while the urinary bladder was emptied, opened, and examined for calculi. The urethra was longitudinally incised from the tip of the penis to the urinary bladder to expose the urethral lumen, which was examined visually and by gentle palpation for urinary calculi. The location, number, size, and weight of any detected calculi were recorded. The diameter of detected calculi was measured using a graduated

ruler with a measurement resolution of 1 mm, and their weight was measured using a digital balance. Following procedures similar to those described by Mushonga et al. (2017) and Nozohour and Najarneshad (2023). All findings were recorded in a specially designed data collection form.

Statistical Analysis

The collected data were first entered and organized in Microsoft Excel and then imported into SPSS (IBM SPSS Statistics version 27) for statistical analysis. Data were summarized using descriptive statistics, including frequencies, percentages, and prevalence of urinary calculi. The prevalence was calculated as the proportion of positive cases among the examined animals, and the 95% confidence interval (CI) was estimated using the Clopper-Pearson exact method (Clopper & Pearson, 1934). As only one positive case was detected, only descriptive results were reported, and associations between urinary calculus and potential risk factors such as species, sex, age, breed, body condition score, and castration status could not be statistically assessed.

RESULTS

A total of 407 sheep and goats were examined at Kabul City Abattoir. During the ante-mortem examination, all animals appeared clinically healthy, and no apparent signs related to urinary disorders were observed. Among the examined animals, 222 (54.5%) were sheep and 185 (45.5%) were goats. Most of the animals were males (72.5%), and most were in the 1-3-year age group (78.9%). Regarding body condition score (BCS), most animals had a body condition score of 3 (51.4%). Among male animals, 260 (88.1%) were non-castrated, and 35 (11.9%) were castrated (Table 1).

Table 1. Demographic characteristics of sheep and goats examined at Kabul City Abattoir (N=407).

Variable	Category	Frequency	Percentage (%)
----------	----------	-----------	----------------

Species	Goat	185	45.5
	Sheep	222	54.5
Sex	Male	295	72.5
	Female	112	27.5
Age	<1 year	67	16.5
	1-3 years	321	78.9
	>3 years	19	4.7
Body condition score (BCS)	1	0	0
	2	99	24.3
	3	209	51.4
	4	98	24.1
	5	1	.2
Castration status	Intact male	260	63.9
	Castrated male	35	8.6

Note. Percentages are based on all examined animals (N = 407), except those for castration status, which are based on male animals only (n = 295).

The most common goat breed was Local (29.7% of all examined animals), whereas the most common sheep breed was Turki (23.6% of all examined animals) (Table 2).

Table 2. Distribution of breeds among examined sheep and goats (N = 407).

Species	Breed	Frequency	Percentage (%)
Goat	Asmari	23	5.7
	Beetal	25	6.1
	Kamori	16	3.9
	Local	121	29.7
Sheep	Arabi	27	6.6
	Gadik	42	10.3
	Ghiljai	18	4.4
	Hazarigi	39	9.6
	Turki	96	23.6

Post-slaughter examination revealed one case of urinary calculus among the 407 examined animals, corresponding to an observed prevalence of 0.25% (95% CI: 0.01–1.38%) (Table 3).

Table 3. Prevalence of urinary calculi and 95% confidence interval among examined sheep and goats.

Parameter	Value/Percentage
-----------	------------------

Total examined animals	407
Positive cases	1 (0.25%)
Negative cases	406 (99.75%)
Observed prevalence	0.25%
95% Confidence interval	0.01–1.36%

95% confidence interval calculated using the Clopper-Pearson exact method.

A single calculus was observed in a 4-year-old non-castrated male goat of the local breed, with a body condition score (BCS) of 4. The urinary calculus was located in the right renal pelvis. The stone measured approximately 3 mm in diameter and weighed 0.205 g. Grossly, the calculus was yellowish-brown, irregular in shape (approximately round to polyhedral), and had a rough surface (Figure 1). No clinical signs of urinary disease were observed in the affected animal during ante-mortem examination. The renal calculus was detected only during post-slaughter examination.



Figure 1. Gross appearance of the calculus recovered from the right renal pelvis.

DISCUSSION

The present study investigated the prevalence and macroscopic characteristics of urinary calculi in slaughtered sheep and goats at Kabul City Abattoir. Among 407 animals examined, only one case of urinary calculus was detected, resulting in a prevalence of 0.25% (95% CI: 0.01–1.36%). The prevalence observed in the present study was lower than that reported in several previous studies. Nozohour and Najarnezhad (2023) reported a prevalence of

3.7% among 384 Moghani sheep in Iran after examination of the urinary system, with all detected calculi located in the renal pelvis. Similarly, Mobini and Sorbi (2012) reported a higher prevalence of renal calculi (6%) among 800 slaughtered sheep in Iran. In contrast, Naenia et al. (2005) detected only two cases of urinary calculi among 600 examined male sheep in the Fars region of Iran, which is more comparable with the findings of the present study. The lower prevalence observed in the current study may be explained by differences in geographical conditions, climate, feeding practices, mineral composition of diets and drinking water, management systems, and the characteristics of the studied population and sampling methods. Furthermore, the present study was conducted on apparently healthy animals slaughtered at an abattoir, whereas some previous studies included clinically affected animals presented to veterinary hospitals. For example, Morais et al. (2016), Ahamed et al. (2022), and Sarker et al. (2020) evaluated mainly clinical cases of obstructive urolithiasis, which may contribute to higher reported prevalence compared with abattoir-based studies.

Regarding animal species, the only positive case in the present study was observed in a goat, while no urinary calculi were detected in sheep. Due to the detection of only one positive case, statistical comparison between species was not possible. Although goats have been reported to be susceptible to urinary calculi in previous studies, the present finding should be interpreted cautiously because only one positive case was detected. Clinical studies, including those conducted by Sharun et al. (2021), have reported a higher proportion of obstructive urolithiasis cases in goats. Similarly, Sen et al. (2018) and Ahamed et al. (2022) reported a higher occurrence of urinary calculi in male goats.

In the present study, the only affected animal was a 4-year-old, non-castrated male goat of a local breed with a body condition score of 4. The detection of a urinary calculus in a male animal is in agreement with previous reports indicating that males are more susceptible to urinary obstruction

caused by calculi than females. This difference is mainly related to the anatomical characteristics of the male urinary tract, including a relatively narrow and elongated urethra. Early castration has also been suggested as a predisposing factor (Gugjoo et al., 2013). However, because only one positive case was detected in the present study, the effect of sex and castration status could not be evaluated.

Regarding age, the affected animal in the present study was 4 years old, suggesting that urinary calculi can occur in adult animals. Previous studies have reported variable age distributions among affected small ruminants. Nozohour and Najarnezhad (2023) detected renal calculi in sheep of different ages, including adult animals, whereas Sen et al. (2018) and Ahamed et al. (2022) reported a higher occurrence among younger goats, particularly young males. Morais et al. (2016) also observed that most affected goats and sheep were younger than 3 years of age. Differences in age distribution among studies may be related to variations in study population, disease stage, feeding systems, and management practices.

The only positive case in the present study was detected in a local-breed goat. Due to the detection of only one case, the association between breed and urinary calculus occurrence could not be evaluated. Previous studies have reported variable effects of breed on the occurrence of urinary calculi. Sen et al. (2018) observed differences in prevalence among goat breeds, with Jamunapari goats showing higher susceptibility.

The positive case in the present study was observed in a goat with a BCS of 4, indicating good body condition. Although body condition is not considered a direct cause of urolithiasis, it may reflect the nutritional status and feeding management of animals. Previous studies have emphasized that dietary factors, particularly excessive concentrate feeding and mineral imbalance, play an important role in urinary calculus formation (Jones et al., 2017; Sickinger & Windhorst, 2022). Because dietary factors

were not evaluated in the present study, no conclusion can be drawn regarding their contribution to urinary calculus formation in the affected animal.

In the present study, a urinary calculus was detected in the right renal pelvis of the affected goat. This finding is consistent with previous abattoir-based studies that reported the renal pelvis as an important site of urinary calculus formation. Nozohour and Najarnezhad (2023) reported that all detected calculi in Moghani sheep were located in the renal pelvis, with no calculi observed in the ureters or urinary bladder. Similarly, Mobini & Sorbi (2012) reported renal calculi in slaughtered sheep during macroscopic examination. However, the anatomical location of the calculus in the present study differed from many clinical reports of obstructive urolithiasis, where calculi are commonly found in the lower urinary tract, particularly at the urethral process, sigmoid flexure, and urinary bladder. Naenia et al. (2005) reported urinary calculi in the sigmoid flexure and urethral process of male sheep from the Fars region of Iran. These differences may be related to variations in study populations, disease stages, and study designs.

The macroscopic characteristics of the renal calculus detected in the present study were comparable to those reported by Nozohour and Najarnezhad (2023), who described urinary calculi with diameters ranging from 2–7 mm, weights of 0.087–0.600 g, and predominantly rough surfaces (85.7%). The calculi in their study were also described as grey-white or yellowish-brown in color. The rough surface observed in the present calculus may reflect its pattern of mineral deposition; however, chemical analysis would be required to confirm its composition.

Furthermore, post-slaughter examination revealed a single renal calculus, documenting an asymptomatic renal calculus in one slaughtered goat. The detection of a renal calculus in an apparently healthy animal may suggest that urinary calculus formation may occur before the development of clinical signs, particularly in the absence of obstruction. Therefore, abattoir-based

studies provide valuable information regarding the subclinical occurrence of urinary calculi in apparently healthy slaughtered animals.

The primary limitation of the present study was the low number of positive cases, which prevented statistical analysis of the association between urinary calculus prevalence and risk factors. In addition, the use of convenience sampling may have introduced selection bias, and the study was conducted at a single abattoir over a relatively short sampling period from April to June 2026, which may limit the generalizability of the findings to other abattoirs, seasons, and livestock populations. Dietary composition, water availability, and management practices were not assessed, limiting the interpretation of potential contributing factors. Furthermore, the chemical composition of the recovered calculus was not determined, which limited further characterization of the calculus. Overall, the present study documented a low prevalence of urinary calculi (0.25%) among slaughtered sheep and goats at the Kabul City Abattoir and identified a renal calculus in one apparently healthy goat.

CONCLUSION

Among the 407 examined animals, a single urinary calculus was detected, resulting in a prevalence of 0.25%. The affected animal was a 4-year-old, non-castrated male goat of a local breed with a body condition score of 4. The detected calculus was single, small, yellowish-brown, irregular in shape (approximately round to polyhedral), and had a rough surface. The detection of a renal calculus during post-slaughter examination documents an asymptomatic renal

calculus in an apparently healthy slaughtered goat. This study provides baseline information on the prevalence, anatomical location, and macroscopic characteristics of urinary calculi in sheep and goats at Kabul City Abattoir. Further studies involving larger sample sizes and evaluation of calculus composition are recommended to better characterize urinary calculi in small ruminants in Afghanistan.

ACKNOWLEDGMENTS:

The authors sincerely thank the management and staff of the slaughterhouse for their valuable cooperation and assistance during data collection. We also appreciate all the individuals who contributed to the successful completion of this research. No external funding was received for this study.

CONFLICT OF INTEREST: The authors declare no conflicts of interest.

FUNDING: This research received no external funding.

AUTHOR CONTRIBUTIONS:

All authors contributed substantially to the completion of this study. Nageebullah Zafari designed the study, conducted the investigation and collected the data, analyzed and interpreted the data, and drafted the manuscript. Mohammad Monir Tawfeeq designed and supervised the study. Mohammad Aman Ahmadzai performed data analysis and interpretation. All authors reviewed the manuscript and approved the final version.

REFERENCES

- A Manual for the Primary Animal Health Care Worker*. (1994). Food and Agriculture Organization of the United Nations. <https://www.fao.org/4/t0690e/t0690e05.htm>
- Adhikari, K., & Shah, M. K. (2025). Obstructive Urolithiasis in Small Ruminants: A Global Review Relevant to the Nepalese Context. *Veterinary Sciences: Research and Reviews*, 11(2), 128–145. <https://doi.org/10.17582/journal.vsr/2025/11.2.128.145>
- Ahamed, B., Saha, M., Alam, M., & Alam, M. (2022). Occurrence of Urolithiasis and Its Surgical Management in Goats. *Annals of Bangladesh Agriculture*, 25(2), 1–12.

- <https://doi.org/10.3329/aba.v25i2.62408>
- Carrillo-Díaz, F., Salgado-Moreno, S., Escalera-Valente, F., Carmona-Gasca, C., Peña-Parra, B., & Macías-Coronel, H. (2015). Urolitiasis en ovinos. *Abanico Veterinario*, 5(3), 49–57. https://www.scielo.org.mx/scielo.php?pid=S2448-61322015000300049&script=sci_arttext
- Clopper, C. J., & Pearson, E. S. (1934). The Use Of Confidence Or Fiducial Limits Illustrated In The Case Of The Binomial. *Biometrika*, 26(4), 404–413. <https://doi.org/10.1093/biomet/26.4.404>
- Constable, P. D., Blood, D. C., & Radostits, O. M. (2017). *Veterinary medicine: A textbook of the diseases of cattle, horses, sheep, pigs, and goats* (11th edition). Elsevier.
- Gazi, D. M. A. (2013). *Surgical Management of Clinical Urolithiasis in Ruminants: Haematobiochemical and Ultrasonographic Studies* [Master Thesis, SKUAST Kashmir]. <https://krishikosh.egranth.ac.in/handle/1/5810188822>
- Gugjoo, M. B., Zama, M., Amarpal, A., Mohsina, A., Saxena, A., & Sarode, I. P. (2013). Obstructive Urolithiasis in Buffalo Calves and Goats: Incidence and Management. *Journal of Advanced Veterinary Research*. <https://www.semanticscholar.org/paper/Obstructive-Urolithiasis-in-Buffalo-Calves-and-and-Gugjoo-Zama/037cb6afda06258241535647ed5bbba053b67b29>
- Jones, M. L., Gibbons, P. M., Roussel, A. J., & Dominguez, B. J. (2017). Mineral Composition of Uroliths Obtained from Sheep and Goats with Obstructive Urolithiasis. *Journal of Veterinary Internal Medicine*, 31(4), 1202–1208. <https://doi.org/10.1111/jvim.14743>
- Kant, S., Singh, K. D., Verma, A. K., Verma, M. K., & Jaiswal, S. (2023). Dietary based managemental concepts for preventing urolithiasis in animals. *Indian Farmer*, 10(11), 445–450.
- Kibria, A. G., Rahman, M. L., Ahasan, A. S. M. L., Uddin, M., & Quasem, M. A. (2016). Effects of castration on penile and urethral development in Black Bengal Goat. 48, 501–506.
- Mobini, B., & Sorbi, M. (2012). A frequency of sheep nephrolithiasis and determination of calculi composition in Alashtar slaughterhouse. *J. Vet. Pathobiology*, 4(13), 11. <https://www.magiran.com/paper/1108169> [In Persian]
- Morais, M. V. D., Silva, A. P., Alencar, S. P. D., Mendonça, C. L. D., Costa, N. D. A., & Afonso, J. A. B. (2016). Indicadores clínico-epidemiológicos da urolitíase em pequenos ruminantes atendidos na rotina hospitalar. *Revista Brasileira de Ciência Veterinária*, 23(1–2), 9–14. <https://doi.org/10.4322/rbcv.2016.021>
- Mushonga, B., Twiyizemina, S., Habarugira, G., Kandiwa, E., Chinyoka, S., Samkange, A., & Bishi, A. (2017). Study of Incidence of Gross Urogenital Lesions and Abnormalities on Does Slaughtered at Nyagatare Slaughterhouse, Eastern Province, Rwanda. *Journal of Veterinary Medicine*, 2017, 1–7. <https://doi.org/10.1155/2017/7564019>
- Naenia, T., Rezakhanian, A., & Ghasrodashti, R. (2005). Prevalence and types of urinary calculi in male sheep in Fars province, southern Iran. *Iranian Journal of Veterinary Research*, 6(3), 52. <https://www.magiran.com/paper/686115> [In Persian]
- Nair, S., Jennes, D., Hansoge, A., Ramankutty, S., S, A., & D., J. (2022). Caprine Obstructive Urolithiasis—A Review. *International Journal of Livestock*

- Research*, 12(1), 1–11.
<https://doi.org/10.5455/ijlr.20211031064642>
- Nozohour, Y., & Najarnezhad, V. (2023). Study on the frequency and chemical composition of urinary stones of Moghani sheep in Northwest of Iran. *Journal of the Hellenic Veterinary Medical Society*, 73(4), 4841–4846.
<https://doi.org/10.12681/jhvms.27984>
- Oryan, A., Azizi, S., Kheirandish, R., & Hajimirzaei, M. R. (2015). Nephrolithiasis among Slaughtered Cow in Iran: Pathology Findings and Mineral Compositions. *Journal of Veterinary Science & Medical Diagnosis*, 4(1).
<https://doi.org/10.4172/2325-9590.1000148>
- Sangary, M., & Mohmand, W. (2024). Prevalence of Common Diseases in Kabul City Broiler Chicken Farms through the Evaluation of Macroscopic Pathological Changes. *Journal of Natural Science Review*, 2(4), 36–47.
<https://doi.org/10.62810/jnsr.v2i4.102>
- Sarker, D., Akter, M. A., Rahman, S., & Alam, M. (2020). Clinicopathological Consequences of Urinary Retention due to Urolithiasis in Indigenous Goats. *Veterinary Research*, 5(2), 28–37.
- Sen, A. R., Akter, N., & Chanda, T. (2018). Prevalence Of Urolithiasis In Goat At Upazilla Veterinary Hospital, Feni, Bangladesh.
<https://doi.org/10.21276/sjavs.2018.5.6.4>
- Sharun, K., Manjusha, K. M., Kumar, R., Pawde, A. M., Malik, Y., Kinjavdekar, P., Maiti, S. K., & Amarpal. (2021). Prevalence of obstructive urolithiasis in domestic animals: An interplay between seasonal predisposition and dietary imbalance. *Iraqi Journal of Veterinary Sciences*, 35(2), 227–232.
<https://doi.org/10.33899/ijvs.2020.12662.1358>
- Sickinger, M., & Windhorst, A. (2022). A systematic review on urolithiasis in small ruminants according to nutrition-dependent prevalence and outcome after surgery. *Veterinary World*, 15(3), 809–817.
<https://doi.org/10.14202/vetworld.2022.809-817>
- Tawfeeq, M. M. (2024). *Veterinary Internal Medicine* (First Edition). Aazem. [In Persian]
- Thompson, J., & Meyer, H. H. (1994). *Body condition scoring of sheep (EC 1433)*. Extension Catalog publication. Oregon State University Extension Service.
<https://extension.oregonstate.edu/catalog/ec-1433-body-condition-scoring-sheep>
- Thrusfield, M. (2018). *Veterinary epidemiology* (4th ed). Wiley Blackwell.
- USDA APHIS. (2026, January 13). *NVAP Reference Guide: Sheep and Goat Identification* | APHIS. Animal and Plant Health Inspection Service (APHIS), USDA.
<https://www.aphis.usda.gov/nvap/reference-guide/animal-identification/sheep-goat>
- Yohannes, G., & Tesfay, S. (2024a). Review on Surgical Managements of Urolithiasis in Ruminants. *Mathews Journal of Surgery*, 7(1), 1–9.
<https://doi.org/10.30654/MJS.10029>
- Yohannes, G., & Tesfay, S. (2024b). Urethral Obstruction And Its Surgical Treatment. *Quantum Journal of Medical and Health Sciences*, 3(2), 36–48.
<https://qjmhs.com/index.php/qjmhs/article/view/74>