A case report on management of Urolithiasis associated with Chronic Kidney Disease in cat

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A clinical report submitted as per approved styles and contents

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Abbreviation

CKD	Chronic Kidney Disease
SGPT	Serum Glutamic Pyruvic Transaminase
SGOT	Serum Glutamic-Oxaloacetic Transaminase
TP	Total Protein
BUN	Blood Urea Nitrogen
LUTS	Lower Urinary Tract Symptoms
USG	Ultrasonography
FUO	Feline Urethral Obstruction
IRIS	International Renal Interest Society
et al.	and his associations
CVASU	Chattogram Veterinary and Animal Sciences University

Abstract

A 5-year-old male domestic shorthair cat who was brought to Shahedul Alam Quadery Teaching Veterinary Hospital with signs of dysuria, hematuria, and decreased appetite. Initial examinations revealed physical discomfort in the abdominal region. Ultrasonography was used to assess the morphology of both kidneys that confirmed the presence of uroliths within the bladder and thickened renal cortex. Blood samples were taken to estimate biochemical markers such as glucose, total protein (TP), SGPT, SGOT, serum creatinine, BUN, phosphorus, and albumin. The urine sample was tested for numerous parameters, including pH, nitrite, specific gravity, proteinuria, bilirubin, and glucose. Elevated levels of blood urea nitrogen (BUN), serum creatinine, total protein, phosphorus, proteinemia, proteinuria, acidic pH of urine suggesting urolithiasis associated with Chronic Kidney Disease (CKD). Correction of urethral obstruction with catheterization as well as treatment, fluid therapy, phosphate binder and vitamin were given with renal diet. The cat was monitored for the next month and recovered normally without any complictions.

Key words: Dysuria, hematuria, SGPT, SGOT, BUN, serum creatinine, proteinuria, bilirubin, ultrasonography, urolith, proteinemia, urolithiasis, CKD.

Introduction

Cats are the most popular pets in Bangladesh. Cats are thought to be simpler to care for than dogs, which is a popular misconception held by many people, because cats do not require much exercise, do not always require company, and do not require training. Cats are regarded to be adaptive to their surroundings. Because some cat owners do not pay close attention to the contents and compositions of their cat food, which can lead to malnutrition when necessary nutrients are lacking or uneven. Improper feed supplied over an extended length of time might disrupt the cat's metabolism.

Urolithiasis, the formation of urinary stones, is a significant health issue in veterinary medicine, particularly in cats, with potential to cause considerable discomfort and complications if left untreated. In cats, urolithiasis often manifests as lower urinary tract signs (LUTS), which can include dysuria (difficulty in urination), hematuria (presence of blood in urine), and inappropriate urination. Cats with LUTS between the ages of 1 and 10 are 55–64 percent likely to have idiopathic cystitis, 15–23% urolithiasis, 11% anatomical defects, and 1-8% UTIs (Bartges et al., 2001). Radiography is a diagnostic method that can be used to find struvite calculi. Ultrasonography or double-contrast cystography may be utilized if the calculi are less than 3 mm (Hostutler et al., 2005).

Uroliths can develop within any part of the urinary tract, including the kidneys, ureters, bladder, or urethra, and are primarily composed of minerals like struvite, calcium oxalate, or ammonium urate (Chung, 2017). While urolithiasis is more frequently encountered in middle-aged to older cats, younger cats are not immune, and their cases often pose unique diagnostic and therapeutic challenges due to their typically lower predisposition to urinary conditions. The condition can lead to a range of complications, including urinary obstruction, pain, and in severe cases, chronic kidney disease (CKD). Feline urolithiasis presents diagnostic and therapeutic challenges, especially when compounded by CKD, as it requires careful management to balance both renal health and urinary tract function. This case report describes the clinical presentation, diagnosis, treatment, and management of urolithiasis in a 5-year-old male cat diagnosed with CKD. By detailing the unique challenges and therapeutic approaches involved, this case provides valuable insights into managing complex cases of urolithiasis in cats with pre-existing renal conditions.

Chronic kidney disease (CKD), on the other hand, is one of the most common causes of morbidity in older feline populations. Though CKD affects all ages, its frequency rises in medium to old aged cats (Davies et al., 2017) and affects up to 80% over the age of 15 years (Bartges, 2012). Chronic kidney disease (CKD) is becoming more prevalent in our country.

A research on companion cats in the UK found that 12.1% of deaths were caused by renal diseases, with 13.6% of deaths occurring at or after 5 years of age (O'Neill et al., 2015). A Swedish study of insured cats up to 13 years old found that kidney or ureter diseases were the leading cause of death, with an age-standardized mortality rate of 713 per 10,000 cats/year (Egenvall et al., 2009). The frequency in cats is greater than in dogs (Polzin et al 1986). Cats with CKD show similar symptoms as dogs and humans, including gradual loss of renal function, which can lead to uremic crises and mortality (Hasegawa et al., 2017). Diet and metabolites have a significant role in the course of CKD. Chronic kidney disease (CKD) is caused by many underlying diseases, resulting in irreparable kidney damage (Cannon, 2016). It can be caused by congenital abnormalities including polycystic kidney disease or renal dysplasia, glomerulonephritis from neoplasia or infection, or other unknown reasons (Lefebvre, 2011). Cats with CKD are diagnosed based on elevated serum creatinine levels. Approximately 75% of renal mass can be lost before azotemia is recognized (Ross et al., 1981). After a diagnosis of CKD, the focus shifts to treatment and management. A phosphate-restricted, renal-specific diet is the most effective way to control CKD. Effective management, in addition to medication, can significantly improve the quality of life for cats with CKD. It generally leads to systemic complications, including dehydration, electrolyte imbalances, and toxin accumulation, which may further stress the animal's body and predispose it to additional complications such as urinary stones. The combination of urolithiasis and CKD creates a particularly challenging clinical scenario, as both conditions can exacerbate each other, complicating treatment and management.

In the case of young cats, the simultaneous presence of urolithiasis and CKD is relatively rare and poorly documented. This presents a gap in both understanding and approach to care, as the physiological responses in young animals may differ from those of older animals with similar diagnoses. The mechanisms underlying stone formation in younger cats with CKD are not fully understood but are believed to involve a combination of genetic predispositions, diet, and other environmental factors. In healthy adult cats, certain breeds are more predisposed to urinary conditions; however, in young cats, the presence of kidney disease may alter the typical risk factors and make standard diagnostic and therapeutic approaches less effective. This has

prompted increased interest in studying such cases to better understand the interactions between these conditions and develop a more tailored approach to treatment.

This case is particularly significant because it highlights the diagnostic complexities and therapeutic hurdles of managing concurrent urolithiasis and CKD in a young cat. Given the need for lifelong management in cases of CKD, and the possibility of recurrence in urolithiasis, a multi-modal approach is essential to achieve both short- and long-term goals for patient welfare. In addition, the case underscores the importance of early diagnosis and continuous monitoring for cats presenting with unusual urological symptoms at a young age, as this can facilitate earlier intervention and potentially mitigate the progression of CKD and the recurrence of uroliths.

In this report, we discuss the clinical presentation, diagnostic workup, and treatment plan for this case, as well as considerations for managing young cats with similar conditions. Through this case, we aim to provide veterinarians with insights into the complexities of managing feline urolithiasis associated with CKD, particularly in young patients. This case serves as a valuable addition to veterinary literature, contributing to the growing understanding of how best to care for younger cats with overlapping chronic conditions that are more commonly seen in older felines. The successful outcome of this case highlights the importance of early intervention, comprehensive diagnostic evaluations, and individualized care plans that address both acute and chronic needs in young feline patients.

Case Presentation

Clinical history and examination

The Shahedul Alam Quadery Teaching Veterinary Hospital, Chattogram, Bangladesh received a 5-year-old male cat, weighing 4.5 kg with anorexia, vomiting and weight loss. The owner of cat noted that cat did not urinate for 2 days. On physical examination revealed that urinary bladder is full with urine and painful for patient. The cat was fed dry food and given drinking water ad libitum by the owner, kept indoors and was rarely released outside. The cat's vaccination is complete, but the last deworming was done a year ago. Clinical examination revealed the cat was dehydrated, with a sunken eyeball, dysuria, polydipsia and hematuria. Clinical investigation revealed that the cat had a body temperature of 101º F. The cat's clinical symptoms primarily suggested urolithiasis associated with CKD.

Sample collection for laboratory investigation

To confirm CKD, blood samples were obtained in two vacutainers, one with and one without anticoagulant. Blood glucose, total protein (TP), SGPT, SGOT, serum creatinine, BUN, phosphorus, and albumin levels were estimated. To confirm, a urine sample was taken in a sterile glass vial and biochemical tests such as urine nitrite, specific gravity, pH, and proteinuria were performed.

Laboratory investigation of blood and urine

To conduct biochemical tests, blood without anticoagulants was allowed to coagulate for 30 minutes in a slant position. Serum was then carefully separated from the supernatant. The biochemical test was done using the Humalyzer 3000, following the manufacturer's recommended procedure. Blood tests revealed levels of glucose, TP, SGPT, SGOT, BUN, creatinine, phosphorus, and albumin. Urine samples were analyzed for pH, specific gravity, glucose, and protein content.

Ultrasonography (USG)

A right ventro-lateral lower abdominal ultrasound was conducted for confirmation of urolithiasis. USG was carried out at 15A and 4.0MHz frequencies. To prepare the animal, the ventral lower abdomen was shaved using a disposable razor. After properly confining the animal, a USG probe was placed on the right ventro-lateral lower abdomen to locate the urinary bladder. Again to know the condition of kidney, the USG probe was placed on the venral lower abdomen to locate cortex of both kidneys.

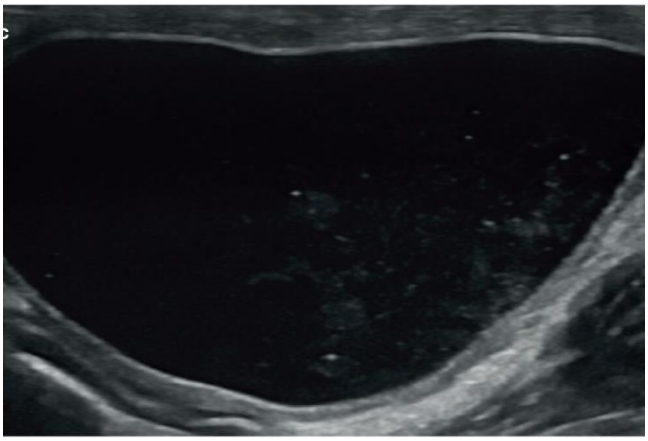

Figure 1: Ultrasound results showing the presence of hyperechoic particles in the urinary bladder

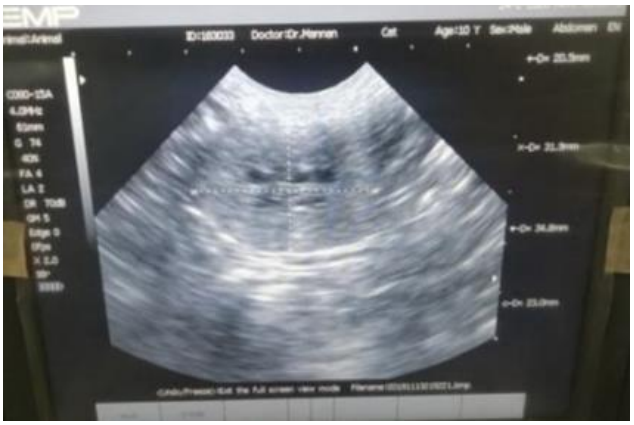

Figure 2: Hyperechoic and thickened cortex of kidney

Table 1: Biochemical analysis of blood of the cat

Blood analysis	**Result**	**Reference Value**
Total protein (gm/dl)	15.3	5.2-8.8
Albumin (gm/dl)	5.30	2.5-3.9
Glucose (mg/dl)	110	50-170
Serum creatinine (µg/dl)	3.75	0.6-1.5
BUN (mg/dl)	41.0	14-36
SGPT(u/l)	56.6	10-100
SGOT(u/l)	40.1	10-100
Phosphorus(mg/dl)	13.2	2.4-8.2

Table 2: Biochemical analysis of urine of the cat

Urine analysis	Result	Reference value
pH	5.0	6.3-6.6
Specific gravity	1.008	1.001-1.085
Proteinuria(gm/dl)	8.0	0.5-1.0
Bilirubin (gm/dl)	2.1	0-0.9
Glucose(gm/dl)	100	80-120

Final Diagnosis

The physical examination of the cat revealed dysuria, hematuria, polydipsia, anorexia, and weight loss, all of which indicated the early stages of chronic kidney failure with urolithiasis. The animal was also discovered to be feeble and anemic, both of which are indicators of CKD.

The ultrasonography report shows the presence of uroliths in bladder (Figure 1) which signifies urolithiasis and the hyperechoic and thickened renal cortex (Figure 2) specifies CKD. Biochemical examination of blood indicated elevated levels of total protein (15.3 g/dl) and albumin (5.3 g/dl) compared to the reference value (table 1). Over the last decade, research has shown that proteinemia and proteinuria are strongly associated with reduced survival rates in both azotemic and non-azotemic cats and dogs (Littman et al., 2013; Lees et al., 2005; Cook et al., 1996; Jepson et al., 2009). It has also been established that a renal diet high in omega 3 poly unsaturated fatty acids can decrease proteinuria and proteinemia (De Caterina et al., 1993).

Creatinine, the most critical measure of renal disease, was also found to be elevated in blood tests, which is a marker for kidney dysfunction and implies that the kidneys may not be effectively filtering waste indicating a definitive diagnosis of CKD. In this case Creatinine and BUN levels were 3.75 µg/dl and 41 mg/dl, respectively (table 1). Based on creatinine and urea levels measured antemortem, 23.3% of cats with diabetes and 31.6% of controls were judged to have CKD (Zini et al., 2014). Again high phosphorus (13.2 mg/dl) contributes to worsening kidney function and bone metabolism issues, making it a significant marker of advanced CKD.

Urine analysis (table 2) shows a lower pH (5.0) which indicates presence of certain types of urinary stones, specifically calcium oxalate stones, which form more readily in acidic environments. This may also result from CKD's effect on the body's acid-base balance. Proteinuria was also found. Elevated protein (8.0 g/dl) in the urine is a hallmark of kidney damage, and this high level suggests significant renal impairment. Bilirubin is elevated (2.1 g/dL), which indicates liver dysfunction or hemolysis that can complicate kidney disease.

Procedure of correction of urethral obstruction

Gently restrained the patients and penis was exposed through hand pressure. After detection the penile urethra manually, 2% Jasocaine jelly was used for local anesthesia and then penile urethra was pulled out (Figure 3A) and a tom catheter was inserted into the lumen of urethra (Figure 3B). Flashing of the bladder was done by saline water and blood containing urine expelled out (Figure 3C). Flashing was continued until the clear urine came out (Figure 3D). Once the urine became clear and rechecked blood flow and removed the catheter from penile urethra.

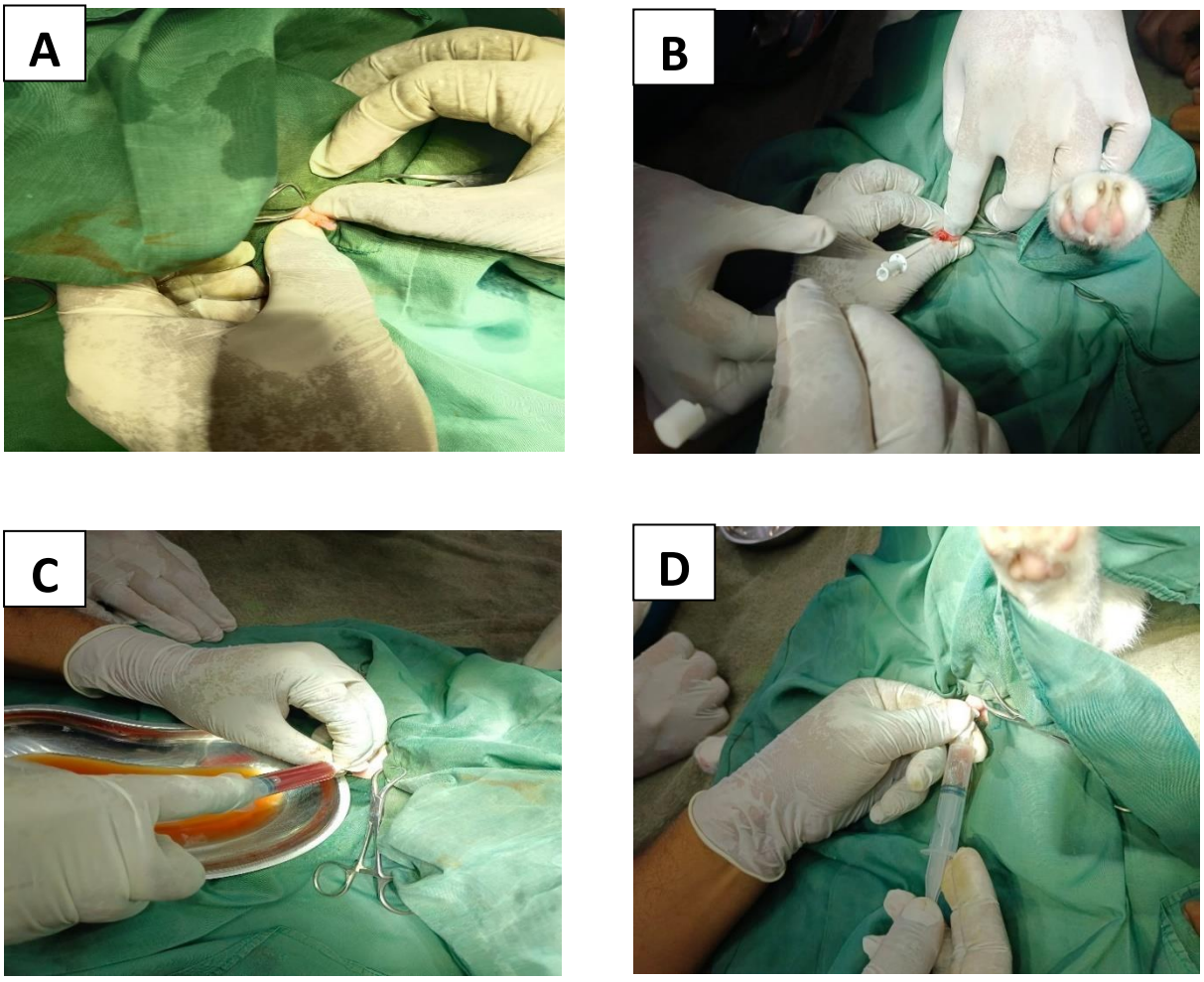

Figure 3: Pulling out penile urethra(A), Insertion of tom catheter (B), flashing the penile urethra by saline water and expelled out bloody urine (C), clear urine from urinary bladder (D).

Post-operative care and Treatment

Dextrose 5% saline was used intravenously for 7 days, antibiotic amoxicillin was used @10mg/ kg body weight intramuscularly for 7 days. Non-steroid drug, Meloxicam was used @0.3mg/kg body weight subcutaneously for single dose. After 7 days antibiotic amoxicillin combined with clavulanic acid was given orally in the form of syrup, 2ml q12 for 6days. Urinary alkalizer (Uro support by Vetina), urinary and kidney tonic (UTKID by SkyEc Pharma), and urinary anticeptic (Nefrotec DS by Himalaya) were also used to manage the acidic environment of bladder, prevent urinary infection and formation of stones.

Based on the International Renal Interest Society (IRIS) value (table 3), the cat in our study was Stage 3 of CKD (IRIS, 2009). Cats with moderate renal azotemia often have biochemical values within reference ranges; however, because creatinine concentration is insensitive as a screening test, cats with creatinine levels near to the upper limit frequently have renal disease. In the research of Jepson et al. (2009), it was found that 30% of the cats recruited acquired azotemia by 12 months, and proteinuria was substantially related with the development of azotemia, however the reason could not be determined (Jepson et al., 2009).

Table 3: IRIS classification system for staging CKD in cats on the basis of creatinine values (IRIS, 2009).

Stage	Serum creatinine µg/dl (µmol/L)	Comments
1	<1.6 (<140)	Non azotemic: Some renal abnormalities other than azotemia are present such as abnormal findings of renal imaging or palpation or progressively increasing the creatinine level.
2	1.6-2.8 (140-249)	Mild renal azotemia: Clinical signs are typically mild or absent.
3	2.9-5.0 (250-439)	Moderate renal azotemia: Systemic clinical signs may be present.
4	>5.0 (>440)	Severe renal azotemia: Systemic clinical signs are usually present.

Successful CKD therapy is dependent on correct treatment with a specific renal diet. In this example, the cat improved significantly after receiving the treatment recommended by Polzin et al. (2009), which included an appetizer, phosphate binder, and a renal diet and was

determined to be the best option for treating CKD animals (Sparkes et al., 2015; Plotnick, 2007).

When a high phosphorus level is identified in the bloodstream, phosphorus restriction should be implemented, and fluid treatment can assist correct the acid-base balance, allowing the normal phosphorus potassium level to be restored (Dow et al., 1990; Elliott et al., 2000).

According to Polzin et al., renal diet has an important influence in improving CKD state (Polzin et al., 2009). In this case, diet was given based on the following features:

- Phosphorus Content: ≤0.5% on a dry matter basis (DMB).
- Protein Content: 25–35% on a DMB, depending on the cat's condition and muscle mass.
- Omega-3 Fatty Acids: Inclusion of fish oil or equivalent sources for anti-inflammatory effects.
- Caloric Density: ≥4.0 kcal/g to support energy needs in smaller food portions.
- Low Sodium: ≤0.3% on a DMB to control hypertension risk.

Carbohydrate and fat were delivered in a 3:1 ratio, whereas protein was lowered in consumption. Urinary infection was periodically evaluated, and vitamin B complex was administered to control anemia. Royal Canine Renal Support, a commercial diet was suggested for the cat to adapt gradually. In general, it is usually preferable to propose that diet modifications be implemented gradually rather than suddenly. Most patients can be converted to a new diet in 2-3 weeks by gradually incorporating the new diet into their current diet. In our experience, cats are more likely to adopt a new diet if it is introduced gradually over a three-week period. The cat's physical condition improved after the therapy and management described above. However, the biochemical readings could not be further investigated due to the cat owner's refusal.

Discussion

In this research, a 5-year-old Persian male cat was treated for urethral blockage after experiencing symptoms such as dysuria, dribbling, bloating, hematuria and pain for two days. The clinical sign shared by both the current and previous reported instances. After diagnostic protocols, the cat was diagnosed with urolithiasis associated with CKD. At first, to avoid the risk of cystitis during cystocentesis, catheterization was used instead. Feline urethral obstruction (FUO) is a common yet manageable medical emergency (Hetrick and Davidow, 2013). Indoor cats are more likely to develop urine crystals and urethral plugs due to decreased activity and frequency of urination (Houston et al., 2003). Male neutered cats with long and narrow urethras are more likely to develop this condition (Brace et al., 2014). Idiopathic cystitis (IC) is the leading cause of FUO (Balakrishnan and Drobatz, 2013). Patients with severe symptoms may experience hyperkalaemia, post-renal azotaemia, metabolic acidosis, hypocalcaemia, dehydration, and hypovolaemia, which can lead to cardiovascular complications (Drobatz and Cole, 2008). Balakrishnan and Drobatz (2013) recommend addressing electrolyte imbalances, administering suitable analgesics, removing or easing the blockage, and managing post-catheterization.

This cat was also suffering with stage 3 of CKD based on IRIS. As the disease progresses, metabolic derangements like hyperphosphatemia, metabolic acidosis, and anemia emerge, exacerbating clinical symptoms (Chew et al., 2019). CKD also predisposes cats to systemic hypertension, which can lead to ocular, neurological, and cardiac complications (Syme et al., 2016). Treatment for CKD in cats focuses on slowing disease progression and alleviating clinical signs. Dietary management is a cornerstone, with renal-specific diets shown to prolong survival by reducing protein, phosphorus, and sodium intake (Elliott et al., 2000). Fluid therapy remains essential for managing dehydration and improving renal perfusion (Langston 2004). This cat had proteinuria, proteinemia, hyperphosphatemia, high serum creatinine and bilirubin. In this case, dietary management of feline chronic kidney disease (CKD) has been the standard of care for decades and is still the most widely recommended therapy. Based on clinical study findings, the IRIS Board recommends that renal diets be investigated for cats with IRIS CKD Stage 2 and fed to cats with IRIS CKD Stages 3 and 4. Renal diets are typically designed to contain less phosphorus, more high-quality protein, higher caloric density, added B vitamins,

more omega-3 polyunsaturated fatty acid and antioxidant content, potassium supplementation, and a neutral acid-base balance. Early-stage renal diets that are phosphorus limited but not protein restricted have just been accessible for cats (Parker, 2021). therapeutic investigations have demonstrated the therapeutic advantages of "kidney diets" that are comparable to these dietary adjustments.

To compensate for the fall in phosphorus excretion in advanced CKD, dietary phosphorus intake must be lowered. Most maintenance diets are high in phosphorus, with protein accounting for a major portion of the total. It is possible that many people believe that renal diets are designed to limit protein intake. There is limited agreement on the optimal quantity of protein in renal diets, although there is much data supporting the relevance of phosphorus restriction (Geddes et al., 2013; Parker, 2021). Recent research reveals that not only the amount of phosphorus is crucial, but also the shape of phosphorus might influence phosphorus balance. (Parker, 2021). Inorganic phosphorus (such as sodium or potassium phosphate salts) is more accessible than organic phosphorus (such as meat, bone meal, and cereals). Feeding highly bioavailable phosphorous salts with insufficient calcium can cause renal damage in previously healthy cats (Dobenecker et al., 2018a; Dobenecker et al., 2018b; Alexander et al., 2019). Dietary treatment can take several weeks to have a noticeable effect on phosphorus; in cats with CKD, the complete dietary effect was evident after 28 to 49 days (Barber et al., 1999). Thus, blood phosphorus levels should be rechecked 4-6 weeks after starting the renal diet. If in the IRIS goal range, the diet should be maintained, and serum phosphorus levels should be checked every 3 to 4 months (every 4-6 months may be sufficient for IRIS CKD stage 3). In patients with Stages 2 and 3 CKD, renal diet alone is more likely to control phosphorus levels. If a renal diet alone fails to meet the serum phosphorus target after 4-6 weeks, an intestinal binding agent is indicated.

Recently, the use of renal diets in treating cats with CKD has been contentious, with debate regarding the possible advantages of these diets in minimizing the clinical effects of CKD vs the putative danger of protein deficiency. Much of this argument has centered on cats, who are considered obligate carnivores and hence have higher protein needs than dogs and humans (Zoran, 2002; Zoran, 2011). One research in cats with surgically induced illness found that animals fed a high protein diet (52%) had considerably higher morphologic kidney alterations than cats fed a low protein diet (Adams et al., 1994). As the mentioned cat had high protein value in blood and urine, it was suggested to have renal diet plan by Polzin DJ as it is the best

way to recover CKD. The guidelines also recommend monitoring treatment response, recognizing that individual cats at each stage will require dietary therapy adjustments (modifying protein content based on nutritional need, increasing phosphorus restriction if serum phosphorus fails to meet the target level through the addition of phosphate binders, or reducing phosphorus restriction when serum calcium rises and hypercalcemia is a concern). The idea is that nutritional treatment, like any other form of therapy, must be personalized to the individual cat.

Conclusion

Urolithiasis with stage 3 CKD in cats poses a complex challenge, especially in younger cats. Early detection via ultrasonography and blood/urine analysis is crucial to prevent obstruction and kidney damage. Catheterization helps remove stones, while dietary changes, hydration therapy, and medications address symptoms and prevent recurrence. Regular monitoring of kidney function and urine composition ensures effective treatment adjustments. Early diagnosis and a multimodal approach significantly improve outcomes and quality of life for affected cats.

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Biography

I am Sabikun Nahar, daughter of SM Mizanur Rahman and Nur Nahar Begum. In 2016, I passed my SSC examination from Silver Bells Kindergarten and Girls High School, Chattogram, obtaining a GPA of 5.00, and in 2018, I passed my HSC examination from Chattogram City College, Chattogram, obtaining a GPA of 4.58. Currently, I am working as an intern veterinarian under the Faculty of Veterinary Medicine at Chattogram Veterinary and Animal Sciences University, Bangladesh. I have a strong interest in both animals and pets. I want to keep learning more about these fields, use my expertise to benefit of the country, and contribute to the betterment of this sector.