

## Clinical and molecular evaluation of *Proteus mirabilis* in a family pet dog with urolithiasis

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### Abstract

Urinary tract infections are a major concern in family pet dogs. Golden Retriever dog was found to have urinary incontinence, haematuria, stranguria and foul-smelling urine. Radiography and ultrasonography confirmed multiple nephroliths in the right kidney and urethral calculi measuring 5.28 mm. Elevated BUN, creatinine, phosphorus, anemia, haematuria, proteinuria, and struvite crystalluria were noticed. The isolation and characterization of *Proteus mirabilis*, using both conventional and molecular methods, including 16S rRNA gene sequencing, confirmed its association with urolithiasis. Urethral calculi were relieved by retrograde urohydropropulsion, and the dog was treated with Amoxicillin-Clavulanate along with dietary and supportive therapy. Post-treatment urinalysis by the fourth week showed no abnormalities, indicating clinical improvement.

**Keywords:** *Proteus mirabilis*, dog, struvite crystals.

Urinary tract infections (UTI), occur in approximately 14% of dogs in their lifetime (Decome *et al.*, 2020), particularly in individuals with anatomical or functional urinary tract abnormalities, urolithiasis or long-term indwelling urinary catheters (Warren *et al.*, 1982; Smarick *et al.*, 2004). The most common uropathogens isolated from dogs are *Escherichia coli*, *Staphylococcus* spp., *Enterococcus* spp., and *Proteus* spp (Wong *et al.*, 2015 ; Aurich *et al.*, 2022). The emergence of multidrug-resistant (MDR) *Proteus mirabilis* has been described in both human and veterinary medicine (Harada *et al.*, 2014). This study documents the *Proteus mirabilis*-associated urolithiasis in a pet dog.

A two-and-a-half-year-old Golden Retriever dog was presented with complaints of urinary incontinence, haematuria, stranguria, passing turbid and malodorous urine, and inappetence. The dog had a previous history of urethral and cystic calculi and an emergency cystotomy

to remove the calculi. The dog appeared dull, depressed, and lethargic, with a rectal temperature of 103°F, tachycardia, tachypnea, and a congested conjunctiva and mucous membrane, suggesting the clinical status of the infections. Similar findings were reported earlier by Subapriya *et al.* (2020) and Chauhan *et al.* (2025). The abdominal palpation revealed a distended bladder and evinced pain. Decreased levels of RBC, PCV, and Hb (Hemoglobin Level of 8.2 g/dL, PCV of 29%, RBC count of 3.8 x 10<sup>9</sup>/cmm) were noticed. Total leukocyte count of 27500/cmm, Neutrophil Count of 22000/μL, Lymphocyte Count of 4400/μL, monocyte count of 1100/μL, and platelet count of 98000/cmm were observed. The radiography showed multiple nephroliths in the right kidney with cystic calculi (Fig.1) while abdominal ultrasonography revealed urethral calculi measuring 5.28 mm (Fig.2a) and multiple nephroliths in the right kidney (Fig. 2b) with hydroureter.

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**Fig.1. Multiple nephroliths in the right kidney with Cystic calculi**



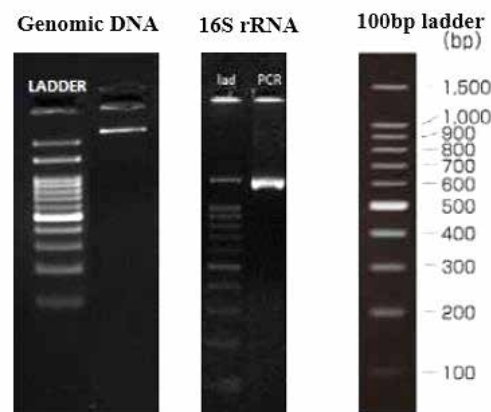
**Fig.2. Kidney -Urinary Bladder (KUB) Ultrasonography**

**Fig.2a. Urethral calculi measuring 5.28 mm**

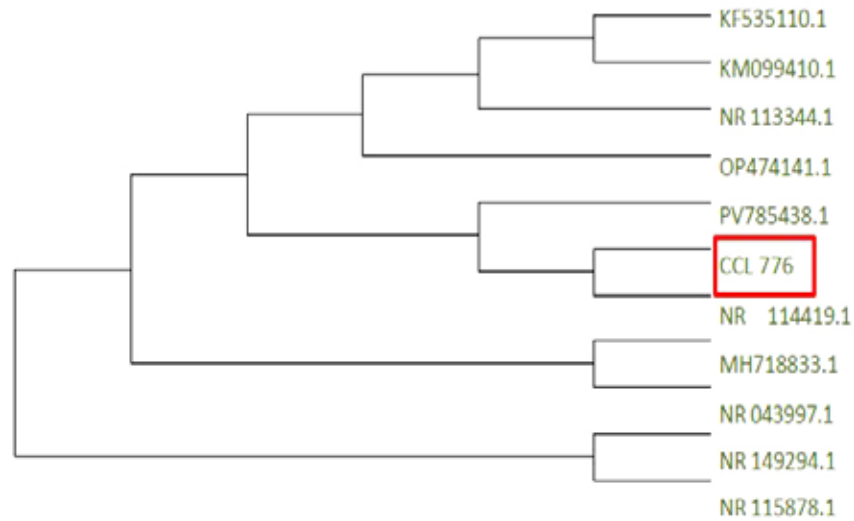
**Fig.2a. Right kidney with multiple nephroliths**

An increased leukocyte count and neutrophilia observed in this case, agreed with the findings of Devipriya *et al.* (2018) and Sonu *et al.* (2019). Elevated blood urea nitrogen (104 mg/dl), creatinine (3.56 mg/dl), ALT (141 IU/L), ALP (219 IU/L), Calcium (10.50 mg/dl) and Phosphorus (8.9 mg/dl) were observed. The urine sediment cultured on Brain Heart Infusion agar showed a thin, filmy, widespread growth of bacteria across the entire surface, rather than individual, isolated colonies. On characterization of the isolated bacteria, it was identified as Gram-negative, motile, catalase-positive, urease-positive, producing hydrogen sulphide,

and oxidase-negative. Based on the biochemical tests, it was tentatively identified as *Proteus* spp. A fragment of the 16S rRNA gene of the isolate with an amplicon size of 1500 bp was amplified by PCR (Fig. 3). On nucleotide BLAST analysis, the partial sequence of the 16S rRNA gene of the isolate showed 100% percent identity with 16S rRNA gene sequences of *Proteus mirabilis* strain ATCC 29906. The phylogenetic analysis revealed that the isolate was closely related to *Proteus mirabilis* and distantly related to other species in the genus *Proteus* (Fig. 4).



**Fig.3. Agarose gel electrophoresis showing amplified 16S rRNA gene of *Proteus* sp**



**Fig.4. Phylogenetic analysis of isolates based on the 16S rRNA gene sequences. The dendrogram was built from a 1500 bp-based alignment of nucleotide sequences by the Neighbor-joining method.**

Based on laboratory investigation and imaging studies, the present case was diagnosed as a complicated urinary tract infection due to *Proteus mirabilis* and its associated recurrent urolithiasis, nephroliths, and hydroureter syndrome. Similarly, complications of urolithiasis due to *Proteus mirabilis* have been reported by Singh *et al.* (2011) and Decome *et al.* (2020). Based on clinical findings, treatment was initiated with

Amoxicillin-clavulanic acid for 4-6 weeks. A similar approach was used by Weese *et al.* (2019). After the treatment, urine samples were collected for urinalysis and culture studies, which did not reveal any abnormalities over a period of one month. The owner was advised to provide special diets for better renal health and to review health every month.

**Table 1: Details of *Proteus sp* used in phylogenetic analysis**

Description	Query Cover	Per. Identity	Accession
<i>Proteus mirabilis</i> strain BAB-199	100%	99.80%	KF535110.1
<i>Proteus mirabilis</i> strain TCR46	100%	99.80%	MH718833.1
<i>Proteus mirabilis</i> strain PS01	100%	99.80%	OP474141.1
<i>Proteus mirabilis</i> strain MNNIT PN40	100%	99.80%	KM099410.1
<i>Proteus mirabilis</i> strain CX05	100%	99.80%	PV785438.1
<i>Proteus mirabilis</i> strain ATCC 29906	99%	100.00%	NR_114419.1
<i>Proteus mirabilis</i> strain NCTC 11938	99%	99.73%	NR_043997.1
<i>Proteus mirabilis</i> strain JCM 1669	98%	99.93%	NR_113344.1
<i>Proteus terrae subsp. cibarius</i> strain JS9	99%	99.12%	NR_149294.1
<i>Proteus vulgaris</i> strain ATCC 29905	99%	98.99%	NR_115878.1

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## References

- Aurich, S., Prenger-Berninghoff, E. and Ewers, C. 2022. Prevalence and Antimicrobial Resistance of Bacterial Uropathogens Isolated from Dogs and Cats. *Antibiotics* **11**: 1730.
- Chauhan, V., Katoch, A., Sharma, A., Patil, R. D. and Kumar, A. 2025. Haematobiochemical examination and urinalysis in dogs with renal disease. *Indian J. Vet. Med.*, **45**(1): 21–24.
- Decome, M., Cuq, B., Fairbrother, J. H., Gatel, L. and Conversy, B. 2020. Clinical significance of *Proteus mirabilis* bacteriuria in dogs: Risk factors and antimicrobial susceptibility. *Can. J. Vet. Res.*, **84**(4): 252–258.
- Devipriya, K., Lavanya, C., Selvaraj, P. and Napoleon, R. E. 2018. Early diagnosis of renal insufficiency in dogs with haemato-biochemical findings. *J. Entomol and Zoology Studies*, **6**(5):703–705.
- Harada, K., Niina, A., Shimizu, T., Mukai, Y., Kuwajima, K., Miyamoto, T. and Kataoka, Y. 2014. Phenotypic and molecular characterization of antimicrobial resistance in *Proteus mirabilis* isolates from dogs. *J. Med. Microbiol.*, **63**:1561–1567.
- Singh, K., Raghunath, M. and Gill, J. P. S. 2011. Bacteriological evaluation of urine, bladder mucosal biopsy and uroliths in dogs suffering from urolithiasis. *Indian J. Anim. Sci.*, **76**(1).
- Smarick, S. D., Haskins, S. C., Aldrich, J., Foley, J. E., Kass, P. H., Fudge, M. and Ling, G. V. 2004. Incidence of catheter-associated urinary tract infection among dogs in a small animal intensive care unit. *J. Am. Vet. Med. Assoc.*, **224**(12):1936–40.
- Sonu, Kumar, A., Charaya, G., Bangar, Y., Agnihotri, D. and Kumar, T. 2019. Haemato-biochemical alterations in dogs suffering from chronic renal failure. *Indian J. Vet., Med.* **39**(1): 31–35.
- Subapriya, S., Vairamuthu, S., Chandrasekar, M., Balagangatharathilagar, M., Ramesh, S., Areshkumar, M. and Thangaraj, M J. 2020. Clinicopathological profile of canine renal disorders. *J. Entomol. and Zoology Studies*, **8**(2): 770–774.
- Warren, J. W., Tenney, J. H., Hoopes, J. M., Muncie, H. L. and Anthony, W. C. 1982. A prospective microbiologic study of bacteriuria in patients with chronic indwelling urethral catheters. *J. Infectious Diseases*, **146**(6): 719–723.
- Weese, J. S., Blondeau, J., Boothe, D., Breitschwerdt, E., Guardabassi, L., Hillier, A., Lloyd, D. H., Papich, M., Rankin, S., Turnidge, J. and Sykes, J. 2019. International Society for Companion Animal Infectious Diseases (ISCAID) guidelines for the diagnosis and management of bacterial urinary tract infections in dogs and cats. *Vet. J.* **247**: 8–25.
- Wong, C., Epstein, S. E. and Westropp, J. L. 2015. Antimicrobial susceptibility patterns in urinary tract infections in dogs (2010–2013). *J. Vet. Internal Med.*, **29**(4): 1045–1052.