Scientific Works. Series C. Veterinary Medicine. Vol. LXVII (1), 2021
ISSN 2065-1295; ISSN 2343-9394 (CD-ROM); ISSN 2067-3663 (Online); ISSN-L 2065-1295

URINALYSIS IN THE DIAGNOSTIC WORKUP - A CASE SERIES

Ana Maria GOANTA, Roxana IGNATESCU, Carmen IONITA, Natalia RADULEA, Lucian IONITA

[1]University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Marasti Blvd, District 1, Bucharest, Romania

Corresponding author email: ana_mv@yahoo.com

Abstract

This study demonstrates the utility of performing a relatively simple, inexpensive test during the diagnostic workup of several canine patients presented in the Internal Medicine Clinic of the Faculty of Veterinary Medicine of Bucharest. Although universally recommended, urinalysis is infrequently used in our clinic when not diagnosing and monitoring lower urinary tract disease. The cases presented will reinforce the necessity of performing a simple urinalysis and various pathologies that induce alterations of the urine, either in its chemical or cellular constituents or by interfering with the ability to concentrate urine. However, urinalysis is not diagnostic in every patient - it should be interpreted in light of the clinical presentation and of the other laboratory tests. The use of this test in the diagnosis of most non-urinary diseases requires serial examinations to emphasize persistent alterations and demonstrate the need for a diagnostic workup.

Key words*: urinalysis, dog, diagnosis, screening.*

INTRODUCTION

Urine is the product of glomerular filtration, followed by tubular resorption and secretion. It can provide essential information about renal and systemic diseases; thus, a complete urinalysis should be part of the minimum database for all patients (Callens & Bartges, 2015). It is indispensable for patients with urinary tract signs, kidney injury or disease, polydipsia, and polyuria. It also has several advantages: it does not require technical expertise and it has a high diagnostic significance for a low cost.

Urinalysis comprises physical examination (color, turbidity, and urine specific gravity, abbreviated USG), chemical analysis (particularly pH, protein, glucose, ketones, bilirubin, and blood/heme), and microscopic examination. Some urine dipsticks also measure urine creatinine and microalbumin (urine albumin values under 30 mg/dL), which can assist in identifying early proteinuria (Lees et al., 2005; Elliot et al., 2017). USG measurement using the dipstick is unreliable in small animals; it should be measured using a refractometer (Stockham & Scott, 2014). The microscopic examination of the sediment describes and characterizes cells (erythrocytes, leukocytes, and epithelial cells), bacteria, casts, and crystals present in the sample.

This study supports the use of urinalysis whenever possible by presenting different pathologies and the utility of different urine abnormalities in their diagnosis.

MATERIALS AND METHODS

Basic urinalysis was performed in the diagnostic workup of most of the dogs seen in the Internal Medicine Clinic by the first two authors in 2019. For each of these patients, the complete history (signalment, past complaints, environment, diet, reproductive history, vaccination status, and current and past medication), the reason for presentation, general appearance, vital signs, and physical examination findings were noted.

Several criteria were used to select relevant cases. First, the owners' compliance, adherence to recommendations, and assent to return for follow-up examinations and laboratory testing had to be satisfactory. Second, the diagnosis had to be either definitive or to have a high degree of confidence. Thirdly, the patients had to be monitored for at least 3 months. Finally,

four different presentations were chosen to exemplify a few common urine abnormalities and situations in which urinalysis is invaluable.

RESULTS AND DISCUSSIONS

The first case is a common presentation in a veterinary clinic – an 8-year-old male intact mixed-breed dog presented for acute vomiting and malaise. It was an indoor pet fed a high-quality diet; dewormed, fully vaccinated, with no relevant prior diseases. The dog was not receiving any drugs or supplements, and its appetite had varied recently. It had vomited several times over the past few months; on this occasion, it was undigested food and bilious material.

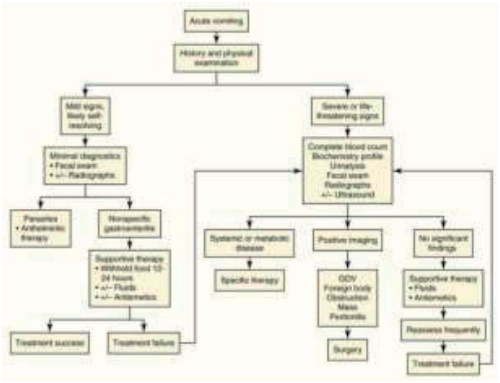

Figure 1. Algorithm to approach acute vomiting. Urinalysis is part of the minimum database. GDV, Gastric dilation-volvulus. From Ettinger et al., 2017

Clinical examination identified mild pain in the cranial abdomen, dehydration, and low normal body temperature. The initial evaluation included a CBC, serum biochemistry, and urinalysis (Figure 1). The CBC and blood smear described an inflammatory leukogram, while the biochemistry revealed increased total protein, liver enzymes (alanine aminotransferase, ALT and alkaline phosphatase, ALP), a slight increase in blood urea nitrogen and creatinine, and low normal glucose. Urinalysis of free-catch yellow urine showed 1.040 USG, 6.5 pH, 6 mg/dL bilirubin, 30 mg/dL protein, and negative glucose, urobilinogen, blood, and leukocytes. The urine sediment was inactive (Reppas & Foster, 2016; Stockham & Scott, 2014): <5 RBCs (erythrocytes) and <5 leukocytes per hpf (40x objective), no casts, small numbers of amorphous crystals, and numerous bilirubin crystals were observed. Despite applying pressure to the venipuncture site, it bled for over 5 minutes. Thus, a coagulation panel was recommended and the results were prolonged prothrombin time and partially activated thromboplastin time, normal thrombin time, and increased fibrinogen.

Urinalysis is essential to evaluate patients' renal function and any interpretation of blood urea nitrogen and creatinine should be interpreted along with the USG of a urine sample obtained at the same time (Pressler, 2013; Elliot et al., 2017). In this patient with azotemia, USG confirmed prerenal azotemia (dehydration due to emesis) and excluded overt kidney disease. It also identified the presence of bilirubinuria. Bilirubinuria with normal CBC, increased liver enzymes, and prolonged coagulation time supports a diagnosis of liver disease. The next steps were abdominal ultrasonography and SNAP cPL (canine pancreas-specific lipase) evaluation. Ultrasonographic examination identified diffuse hepatic hypoechogenicity, thickened biliary ducts, and biliary sludge. There was no identifiable pancreatic disease and the qualitative cPL was normal. The tentative diagnosis was liver disease due to cholangiohepatitis and secondary coagulopathy. The owner refused a hepatic biopsy. The dog was treated with fluid therapy, antimicrobials, analgesics, antiemetics, ursodiol, vitamin K1, antioxidants, and diet. It evolved favorably and the serum chemistry, urinalysis, and coagulation parameters normalized; however, biliary sludge was still present at subsequent ultrasonographic evaluations. In this patient, repeated urine chemistry evaluations were used to monitor bilirubin. Increases in urine bilirubin appear earlier than in plasma, and significantly earlier than bilirubinemia can be identified as icterus (Stockham & Scott, 2014).

Another common presentation in the internal medicine clinic is the polydipsic polyuric dog. A 13-year-old male intact Chihuahua presented to the clinic for increased excessive water consumption and urine production of unknown duration. It was up to date on vaccination and parasite prevention, fed a mixture of home-

cooked food and a high-quality kibble; it was not receiving any drugs. The owner noticed a variation in appetite (alternatively increased or decreased). The clinical examination revealed a dry, thinning, and lusterless hair coat, thinning of the hair on the tail ("rat tail"), a reduction in muscle mass, and a heart murmur over the mitral valve. The rest of the clinical examination was unremarkable.

The work-up began with the examination of a sample of free-catch urine to evaluate the USG and confirm polyuria (Figure 2). It was light yellow and slightly turbid. The urinalysis results were USG 1.025, pH 7, glucose 1000 mg/dL, protein 30 mg/dL, ketones 15 mg/dL and bilirubin 0.5 mg/dL. Glycosuria increases USG by 0.004-0.005 for each 1 g/dL (Stockham & Scott, 2014); in this situation, polyuria can coexist with an increased USG. The other dipstick parameters were negative. The sediment examination revealed active sediment (<5 RBC and more than 5 leukocytes per hpf and <2 hyaline casts per lpf). The urine culture was negative.

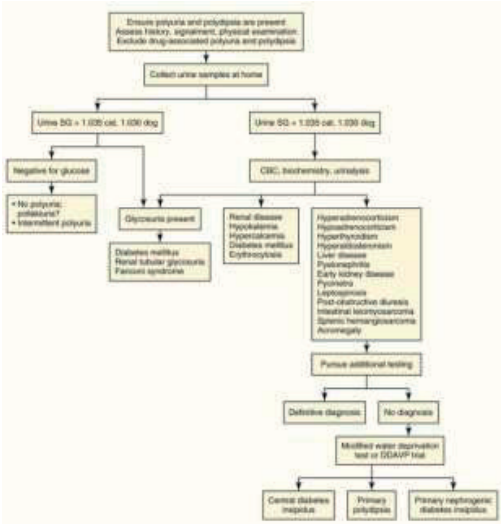

Figure 2. Algorithm for polyuria and polydipsia in dogs. Urinalysis is essential for a diagnosis. From Ettinger et al., 2017

The data confirmed polyuria and identified significant glycosuria, which occurs in diabetes mellitus, renal tubular glycosuria, and Fanconi syndrome (Ettinger et al., 2017; Bruyette, 2003). The Chihuahua had hyperglycemia, increased liver enzymes (ALP>700 U/L, ALT 250 U/L), triglycerides, and cholesterol; uremia was not present. Fructosamine was also increased in this patient (450 μmol/L). CBC and blood smear revealed an inflammatory leukogram and normocytic normochromic anemia of chronic disease. An autoimmune polyendocrine syndrome was suspected, but the owners refused further testing; the dog was administered long-acting insulin 2x/day. The owners were encouraged to use urine dipsticks at home to monitor glycosuria and present the animal for a glucose curve if an insulin dose change was required based on worsening clinical signs and presence of significant and persistent glycosuria. Its evolution was favorable.

A clinical presentation in which urinalysis is irreplaceable is the cat presented for lower urinary tract disease. A 7-year-old neutered female shorthair was presented for discolored urine, dysuria, and periuria (house soiling). The history revealed a history of recurrent urinary tract infections treated symptomatically (with compliance on behalf of the owner) and intermittent urinary tract disease signs for the past years. A thorough history identified several stress factors: a 2-year-old baby in the family, changes in its environment, and imposed restrictions. The cat was fed dry kibble and occasionally wet food. Its appetite, defecation, and fecal appearance were normal. The only significant findings on the physical examination were an empty bladder and thinning hair in the perineal region. The kidneys had a normal size, shape, and position.

To obtain a urine sample, intravenous fluids were administered; cystocentesis was performed after a few hours. Ultrasonography was also completed, describing an irregular hypoechoic thickening of the urinary bladder wall; no anatomical defects, crystalluria, or calculi were observed. Urinalysis is essential for the diagnosis of lower urinary disease, to which cats are particularly susceptible (Figure 3). Physical examination and abdominal ultrasonography findings, as well as CBC and biochemistry results in the reference range ruled out systemic diseases in this patient.

The urine was light red due to hematuria, confirmed by centrifugation of the sample. The USG was 1.040. The dipstick was positive for heme (a speckled pattern on the reagent pad

that results from intact RBCs), protein (100 mg/dL), urobilinogen (1 mg/dL); the other tests were negative. It is important to stress that leukocyte esterase evaluation with a dipstick is unreliable in veterinary medicine, particularly for cats (Reppas & Foster, 2016).

Microscopic evaluation identified active sediment, and numerous RBCs, leukocytes, epithelial cells, rods, and struvite crystals. The urine culture was positive for a multi-drug resistant beta-hemolytic Escherichia coli, possibly because of the previous antimicrobial therapies. This was a complicated urinary tract infection (Weese et al., 2011), thus the antibiotic choice was based on the susceptibility results and administered for 4 weeks. Analgesics and a diet for cats with urinary tract disease living in stressful environments were also recommended. At 6 weeks, all clinical signs except periuria had abated; another urine culture was negative. The repeated urinalysis identified active sediment, a sign that inflammation was still present. The presumptive diagnosis was idiopathic cystitis, and the therapeutic options were presented to the owner. The cat improved with multimodal environment modification.

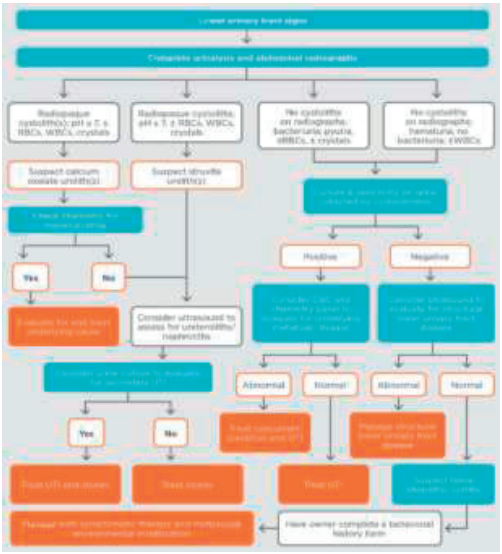

Figure 3. A diagnostic approach for the cat with non-obstructive lower urinary tract signs.
From Heseltine, 2019

A common finding on urinalysis is proteinuria. Persistent proteinuria should be investigated after concurrent inflammation in the lower urinary or genital tract is addressed. Its significance is greater in patients that present with inactive sediment or low USG. A 7-year-old outdoor neutered female German Shepherd was presented for progressive weight loss, decreased appetite, and reduced activity levels of several months' duration. The physical examination identified a right-sided heart murmur, normal lung sounds, and a body condition score of 2/5, with a noticeable loss of muscle mass. The vital signs were in reference intervals for large breed dogs. The minimum database, in this case, was composed of a CBC, biochemistry, urinalysis, as well as radiological and cardiological examinations. CBC revealed an increased number of reticulocytes, mature neutrophilia, and eosinophilia; microfilariae were detected in the direct blood smear and stained smear. A rapid enzyme-linked immunosorbent assay for Dirofilaria immitis antigen was positive. Blood chemistry identified low normal albumin, high-normal globulin, decreased albumin/globulin ratio, slight increases in alkaline phosphatase, alanine aminotransferase, blood urea nitrogen, and creatinine. The thoracic radiographs were normal and the cardiologist identified right ventricular hypertrophy. The dog was diagnosed with moderate heartworm disease. However, there was concern over the significant weight loss and the increased renal parameters.

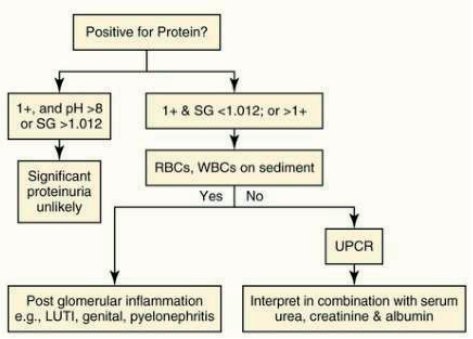

Figure 4. Interpretation of dipstick positive results for protein. From Ettinger et al., 2017

Urinalysis identified significant proteinuria (300 mg/dL) with inactive sediment and lipid droplets. The USG of 1.015 confirmed kidney disease. Proteinuria was further investigated by

measuring the urine protein to creatinine ratio (UPCr) on a fresh sample collected in an EDTA tube (Figure 4). The value obtained was 2.5; in an azotemic dog, this is suggestive of glomerular disease (Lees et al., 2004; Elliot et al., 2017). This created an index of suspicion for glomerulonephritis due to circulating immune complexes or microfilariae antigens. Urine protein electrophoresis was not available. The dog was referred for heartworm treatment with Melarsomine, and 6 months later proteinuria levels had decreased to values of 30-100 mg/mL, while the UPCr decreased to 1.3. Repeated evaluations of the degree of proteinuria and the UPCr are useful to evaluate the progression of renal disease and the patient's response to therapy (Elliot et al., 2017).

CONCLUSIONS

In veterinary medicine, urinalysis provides useful information at a low cost. The quantity produced and the macroscopic evaluation of the sample are highly informative through specific findings such as anuria or polyuria, color, and turbidity. The USG (that evaluates tubular function) and the presence of proteinuria (frequently more severe in glomerular disease) are essential to exclude or diagnose and stage kidney disease in small animals. The presence of glucose, bilirubin, protein, and ketones can also signal the presence of organ or system disease, and are essential in the diagnosis of most metabolic diseases. The sediment is invaluable in characterizing lower urinary tract disease and be helpful in diagnosing other pathologies (e.g. Ethylene glycol poisoning, proximal tubular disease, portosystemic vascular malformation). Finally, serial measurements of specific parameters can be used to monitor disease progression and adjust therapy accordingly.

REFERENCES

Bryuette, D. (2003). Polyuria & Polydipsia in Dogs and Cats Diagnostic Tree. *Clinician's Brief* November 2003: 24, accessed on Feb 1st, 2021 at https://www.cliniciansbrief.com/columns/45/polyuria

Callens, A.J., Bartges, J.W. (2015). *Urinalysis. Vet Clin North Am Small Anim Pract. 2015 Jul;45*(4):621-37.

Elliot, J., Grauer, G.F., Westropp, J.L. (2017). BSAVA *Manual of Canine and Feline Nephrology*, Third Edition. Gloucester: British Small Animal Veterinary Association.

Ettinger, S.J., Feldman, E.C., Côté, E. (2017). Figure 39-3 *Algorithm for diagnosis of acute vomiting*. In: Textbook of Veterinary Internal Medicine: Diseases of the Dog and the Cat, 8th edition, St. Louis: Elsevier, Missouri, USA, p. 615.

Ettinger, S.J., Feldman, E.C., Côté, E. (2017). Figure 72-1 *Interpretation of dipstick positive results for protein, glucose and blood. In: Textbook of Veterinary Internal Medicine: Diseases of the Dog and the Ca*t, 8th edition, St. Louis: Elsevier, Missouri, USA, p. 662.

Ettinger, S.J., Feldman, E.C., Côté, E. (2017). Figure 45-1 *Algorithm reviewing the diagnostic approach to polydipsia and polyuria in dogs. In: Textbook of Veterinary Internal Medicine: Diseases of the Dog and the Ca*t, 8th edition, St. Louis: Elsevier, Missouri, USA, p. 853.

Heseltine, J. (2019). Figure 1. Diagnostic approach to cat with nonobstructive lower urinary signs. In: Diagnosing and Managing Feline Lower Urinary Tract Disease. *Today's Veterinary Practice 9*(5):43-52, p. 44.

Lees, G.E., Brown, S.A., Elliott, J., Grauer, G.F., Vaden, S.L. (2004). Assessment and management of proteinuria in dogs and cats: 2004 ACVIM Forum Consensus Statement (small animal). *J Vet Intern Med., 19*:377–385.

Pressler, B.M. (2013). Clinical approach to advanced renal function testing in dogs and cats. *Vet Clin North Am Small Anim Pract, 43*(6): 1193 ‑ v.

Reppas, G. & Foster, S.F. (2016). Practical urinalysis in the cat: 1: Urine macroscopic examination 'tips and traps. *Journal of Feline Medicine and Surgery, 18*(3), 190–202.

Reppas, G. & Foster, S.F. (2016). Practical urinalysis in the cat: 2: Urine microscopic examination 'tips and traps. *Journal of Feline Medicine and Surgery, 18*(5), 373–385.

Stockham, S.L. & Scott, M.A. (2014). *Urinary system. In: Fundamentals of Veterinary Pathology*, 2nd Ed., Blackwell Publishing, Ames, Iowa, USA, p. 414–494.

Weese, J. S., Blondeau, J. M., Boothe, D., Breitschwerdt, E. B., Guardabassi, L., Hillier, A., Lloyd, D. H., Papich, M. G., Rankin, S. C., Turnidge, J. D., & Sykes, J. E. (2011). Antimicrobial use guidelines for treatment of urinary tract disease in dogs and cats: antimicrobial guidelines working group of the international society for companion animal infectious diseases. *Veterinary Medicine International*, *2011*, 263768.