



BILATERAL NEPHROLITHIASIS IN A FEMALE CANINE: CASE REPORT AND EPIDEMIOLOGICAL CONSIDERATIONS

Gabriel Woermann Rick, Gabriele Maria Callegaro Serafini and
*Fernando Silvério Ferreira da Cruz

Regional University of the Northwest of the State of Rio Grande do Sul – UNIJUÍ, Brazil

ARTICLE INFO

Article History:

Received 28th December, 2017
Received in revised form
10th January, 2018
Accepted 19th February, 2018
Published online 30th March, 2018

Key Words:

Urinary tract,
Nephrolite, nephrotomy,
Calcium oxalate.

ABSTRACT

Nephrolithiasis is the occurrence of calculus in the renal pelvis, responsible to change the physiology of the urinary tract. Predisposing factors include anatomical changes, hereditary factors, infections of the urinary tract, variations in the urine pH, diet types and low ingestion of water. The most founded uroliths in dogs are the magnesium ammonia (struvite) phosphate and calcium oxalate. The radiography and the ultrasonography are the most used methods of diagnosis. The treatment depends of the size of the calculus and if the same it is passable to dissolved by specific drugs. This article has the objective to describe a bilateral nephrolithiasis case in Shih tzu canine female, affected by calculus of calcium oxalate, based in epidemiological studies of different geographic regions, aiming inform about the casuistry from the animals that are affected, encompassing aspects as age, sex and racial predisposition.

Copyright © 2018, Gabriel Woermann Rick et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: Gabriel Woermann Rick, Gabriele Maria Callegaro Serafini and Fernando Silvério Ferreira da Cruz, 2018. "Bilateral nephrolithiasis in a female canine: case report and epidemiological considerations", *International Journal of Development Research*, 8, (03), 19744-19749.

INTRODUCTION

Urolithiasis is the formation of calculus or uroliths, which can affect kidneys, ureters, bladder or the urethra. When these are present in the kidneys, are called nephroliths (Macphail, 2014) being only 5 to 10% of the uroliths usually founded in kidneys and ureters (Grauer, 2010). The uroliths has the potential to cause physiology changes in the urinary tract, since the development of inflammatory process at the place of affection until complete obstructions, that can cause signs of post-renal uremia (Lulich, 2004; Grauer, 2010). Among the factors that contribute to formation of the uroliths, we can cite the urine pH level, low water consumption and the type of diet that is consume, beyond the race. The main races affected by obstructive uroliths are the Schnauzer miniature, Lhasa apso, Yorkshire Terrier, Bichon Frise, Shih Tzu, Poodle and mutt dogs (Osborne *et al.*, 1999, Quitzan *et al.*, 2004; Picavet *et al.*, 2007; Houston and Moore, 2009; Caraza *et al.*, 2010; Rogers *et al.*, 2011; Vrabelova *et al.*, 2011).

The composition of the uroliths and its location are important factors, then help to determinate the different clinical, therapeutic and surgical methods employed, they vary according to this information. The most founded uroliths in dogs are composed by magnesium ammonia phosphate (struvite) and calcium oxalate (Oyafuso, 2008). The clinical signs most observed are the presence of polyuria, dysuria, and hematuria and in some cases when the obstruction of the urinary tract occurs, post-renal uremia can be identified (Lulich, 2004; Grauer, 2010; Macphail, 2014).

To get in the diagnosis of nephrolithiasis, the history of the patient, with physical exams and complementary exams are essential, and the treatment consist in the calculus withdrawal from surgical procedures or through clinical treatments that can provide the dissolution and growth interruption. This case report has the objective to describe a case of bilateral nephrolithiasis in a female dog of the breed Shih tzu with calcium oxalate calculus, taking into account the nephrolithiasis incidence in dogs, based in epidemiological studies of different geographical regions. In addition, has the purpose of inform about the casuistry of the affected animals, encompassing aspects like age, sex and racial predisposition.

*Corresponding author: Fernando Silvério Ferreira da Cruz,
University of the Northwest of the State of Rio Grande do Sul – UNIJUÍ, Brazil.

MATERIALS AND METHODS

A female dog with four years old, breed shih tzu, weighing 7,5kg, castrated, with complaint of prostration and abdominal pain, was attended in the Veterinary Hospital from the Regional University of the Northwest of the State of Rio Grande do Sul (UNIJUÍ). Blood samples were collect, for a complete blood count and biochemical analysis of the alanine aminotransferase (ALT), alkaline phosphatase (FA) and creatinine. Urine was also collected by natural urination. The hemogram revealed the presence of neutrophilia associated with left shift and thrombocytosis. Biochemical exams results were within the reference value to the species. The analysis of the urine showed red blood cells above the reference value and the presence of rare crystals of magnesium ammonia phosphate and calcium oxalate. The patient was send to the radiology sector, where was made x-ray of the spine, thoracolumbar region. Was identified the presence of radiopaque area from bilateral kidneys region, suggesting the presence of calculus on both sides (Figure 1). To get in the definitive diagnosis, was realized ultrasound examination, where was confirmed the presence of two hyper echogenic structures forming bilateral acoustic shadows and measuring about 1cm diameter in the left kidney and 0,7cm in the right kidney (Figure 2).

Approximately three days after the diagnosis, the patient was intern for the realization of unilateral nephrostomy. The calculus presented in the left kidney had been removed (Figure 3 and 4). To do the procedure, the patient was maintained in fluid therapy with NaCl 0,9% (10ml/kg/hour), been used as pre-anesthetic medication Meperidine (3mg/kg) by intramuscular route (IM), anesthetic induction with Propofol (4mg/kg) by intravenous route, epidural analgesia with 2% Lidocaine associated with Morphine (0,1mg/kg) and anesthetic maintenance with Isoflurane. The remove calculus was send to physical/chemical analysis, revealing a composition by calcium oxalate and calcium carbonate. For three days after the procedure, the patient was kept in the institution, being used as analgesic medication Tramadol (4mg/kg) by subcutaneous route (SC), Dipyrone (25mg/kg) IV and fluid therapy with ring lactate. Was discharged with resting indication, antibiotic therapy with enrofloxacin oral (50mg), for a period of seven days and Dipyroneoral (500mg/ml) by a period of three days. To a correct food management, we recommend to the owners institute a new diet, with the introduction of a specific urinary ration, the ®Royal Canin Urinary. After a period of three months, the patient return to institution, for clinical and radiography accompaniment. In the ultrasound exam, was observed the presence of hyperechoic structures forming acoustic shadows in the left renal pelvis.

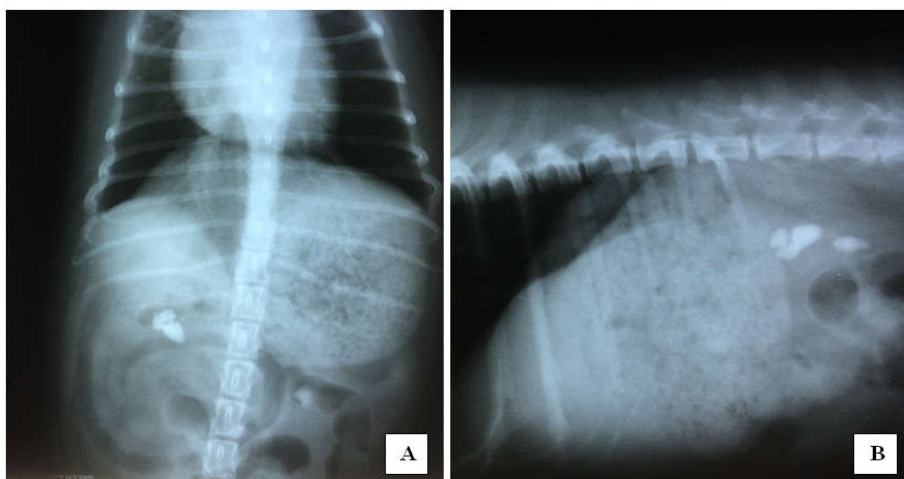


Figure 1 (A). Radiography exam of the spine (thoracolumbar region), showing the presence of radiopaque area on the bilateral kidney region. **Figure 1 (B).** Exame of the spine, thoracolumbar region, in the ventro-dorsal projection (VD), suggesting the presence of calculus, because of the radiopaque area in the bilateral kidney region

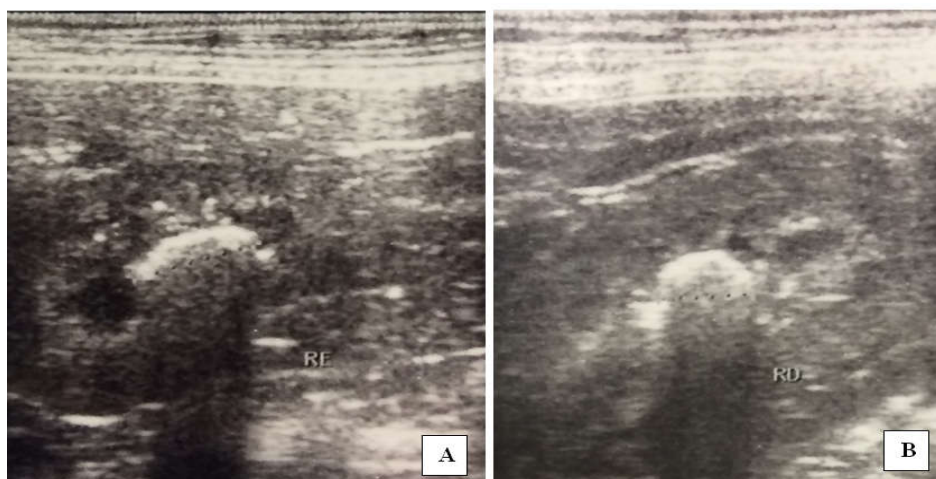


Figure 2. (A) Ultrasound evaluation of the left kidney region. **Figure 2. (B)** Ultrasound evaluation of the right kidney region. Observe in both images, symmetrical kidneys, with contour and echogenicity preserved and evidencing the presence of structures forming bilateral acoustic shadows and measuring about 1cm diameter in the left kidney and 0,7cm in the right kidney.

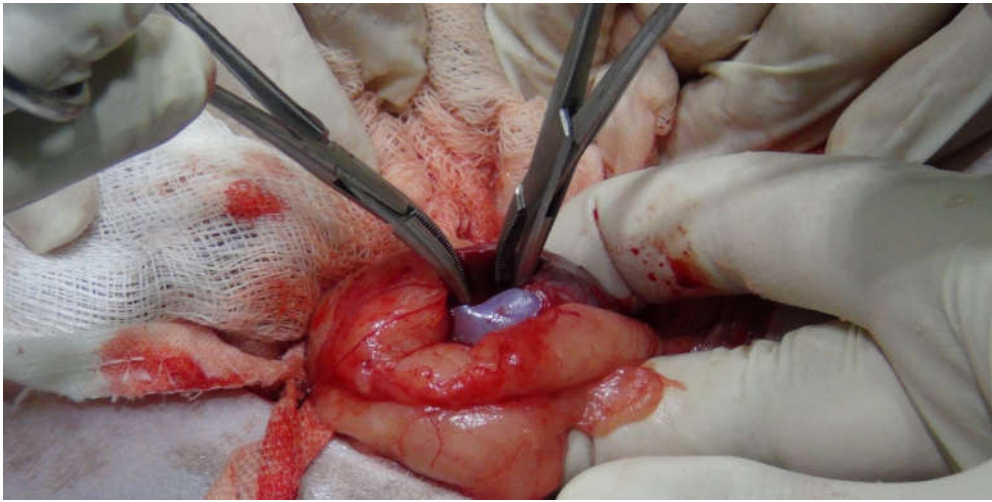


Figure 3. Unilateral nephrostomy in the left kidney, to remove the obstructive calculus.

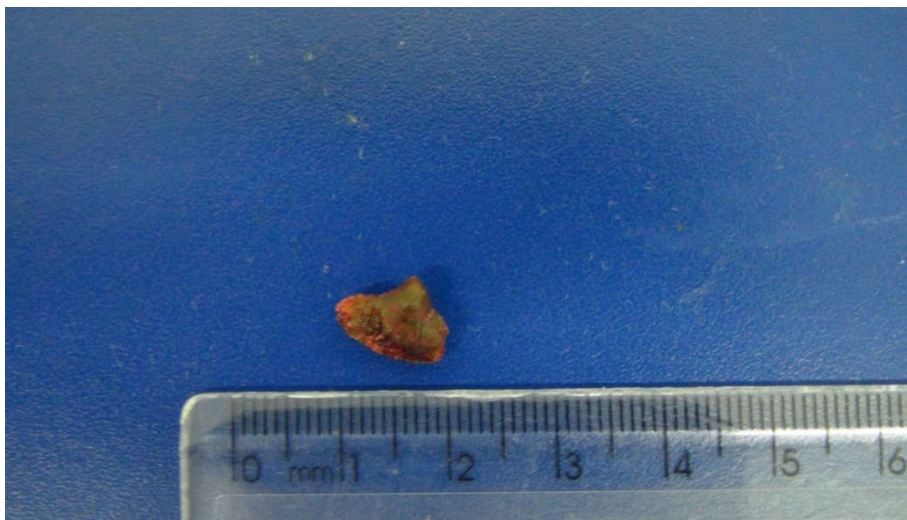


Figure 4. Obstructive kidney calculus. measuring about 1 cm in length

On the right renal pelvis was identified the calculus seen previously, but with no progression of the size. The patient was submit to a new procedure of unilateral nephrostomy, with the purpose of remove the calculus in the right kidney. For the posterior analysis, the composition of the calculus was of calcium oxalate.

RESULTS AND DISCUSSION

The patient of the present report, show a diet composed partially with dog ration and homemade food, occurring variations with different offer of homemade food. The formation of calcium oxalate uroliths, involves different predisposing factors, as hypercalcemia, the use and administration of calcitic substances like furosemide and glucocorticoids. The occurrence of hyperadrenocorticism can also be a predisposing factor. Diets composed with low index of sodium, highly moisture and highly protein concentration can elevate the risk of calcium oxalate formation in dogs of susceptible races (Monferdini, 2009). This fact can be explained, by the reasoning that the sodium in low concentrations in the diet, would not induce a low voluntary consuming of water and consequently would decrease the urinary volume. This can be applied also to the fact that the related to the moisture, seen that diets with elevated index of moisture did not take to the voluntary consuming of water, in

comparing with the use of dry diets. Currently the presence of this kind of urolith it is visualized with a more highly incidence in the feline specie. The diet of the patient can be a predisposing factor to the occurrence of calculus along with the slow daily offer of water (Lulich, 2004; Grauer, 2010). The incidence of dogs with renal calculus it is extremely slow, in comparing with occur for example in the human species (Quitzan *et al.*, 2004; Sebbenand Brum, 2007; Grauer, 2010). Different American epidemiological reviews shows that in the beginning of the XX century in humans, the incidence of calcium oxalate calculus has gradually increased. This factor can be related to the fact of population has more access and daily consume of animal protein, which favors urinary excretion of calcium and oxalate, beside environment factors and the quality of the water and the ground (Osborne *et al.*, 2008). In addition, factors like age, overweight, sedentary lifestyle and heredity can be related (Sebbenand Brum, 2007). In this way, we can conclude that because the proximal relation of man and animals, these factors passed to influence in the incidence of uroliths of calcium oxalate in them. Different epidemiological reviews in both, dogs and cats, are describing a significant increase in the index of calcium oxalate calculus and a reduction of the incidence for struvite calculus, with the pass of the years (Picavet *et al.*, 2007). Fact that can be related to new therapeutic measures employed and new antimicrobial drugs used to control infections of the

urinary tract that is the main factor related to the presence of struvite calculus (Moore, 2010; Oyafuso et al., 2010). In a study realized in the south region of Brazil, was evidenced that between 76 necropsied dogs with urolithiasis, 14 had present renal calculus, becoming the second anatomic place most frequently of the present study (Inkelmann et al., 2012). The urinary excessive excretion of calcium, associated with the gastrointestinal hyperabsorption are the factor that lead to hypercalciuria in humans and animals, and consequently the occurrence of calcium oxalate calculus (Robinson et al., 2008). In a general way, the presence of calculus it is widely related in males (Houston and Moore, 2009; Kaufmann, 2009; Caraza et al., 2010; Inkelmann et al., 2012), showing itself a bigger incidence of urethral obstruction by calculus in comparing to the females dogs (Osborne et al., 1999). In contrast, female canines present a bigger incidence for formation of struvite calculus comparing to the males, possible because they are related to infections of the urinary tract (Kaufmann, 2009; Macphail, 2014). In relation to calcium oxalate uroliths, this are related mostly in males (Picavet et al., 2007; Vrabelova et al., 2011) differentiating them of the struvite calculus, that are more visualized in females (Oyafuso et al., 2010). As an exception, the females from the Schnauzer breed per recently epidemiological studies, can present a bigger incidence of calcium oxalate calculus than the struvite calculus. That fact are relate to the sedentary lifestyle associated to the slow urine volume and number of urinations, which can lead to an increase of the mineral concentration leading to this predisposition (Houston and Moore, 2009). Taking into account the anatomical site of affection and being a local of slow impairment in dogs, there are not direct studies that indicate higher prevalence of kidney stones in males than in females. However, we can take in consideration studies that involve human patients, due the proximity of this species, where men present at elevated tax of incidence of these, comparing to the women (Petrouanu et al., 2001; Sebben and Brum et al., 2007; Peres et al., 2010).

In relation to the age, evaluation studies of uroliths in different countries prove that are a higher occurrence of these, in dogs that already old, average of 7 years old (Picavet et al., 2007; Houston and Moore, 2009; Caraza et al., 2010; Rogers et al., 2011; Vrabelova et al., 2011). From racial predisposition, studies show that mutt dogs are between the most affected (28%) follow by small dogs like Shih tzu, Schnauzer miniatura, Bichon fris e, Lhasa apso, Yorkshire, Poodle and Cocker spaniel (Osborne et al., 1999; Quitzan et al., 2004; Picavet et al., 2007; Houston and Moore, 2009; Caraza et al., 2010; Rogers et al., 2011; Vrabelova et al., 2011). These mentioned breeds are relate with over 50% of the cases of urolithiasis in dogs (Houston and Moore, 2009). Between the large dogs, the breeds Dalmatian and Labrador are frequently affected (Caraza et al., 2010). In a study, where the objective was to comparing the mineral composition and the incidence of uroliths from different geographic regions, in Brazil, between over 143 samples obtained, the occurrence of calcium oxalate was present in 7% of these. The rest, 16% was from struvite, 8% de urate, 0, 5% de silica, 2% mixed and 66, 5% de composite uroliths (Caraza et al., 2010). The diagnosis of urolithiasis involve the association of image exams, physical exams and laboratory findings. In the patient of this present report, the definitive diagnosis was obtain by ultrasound, a method that is widely employed that allows determinate the approximately size of the urolith. This was visualized, when already was in such an advanced size, so it was decided by the

surgical procedure, seen that in the presence of big calculus, these can lead to significant anatomic alterations and renal impairment (Peres et al., 2010; Macphail, 2014). After the stone was removed, the urolith was evaluated, and was confirmed the composition of calcium carbonate and calcium oxalate, which lead to the indication of a new procedure to take the other stone in the opposite kidney, because of that fact that uroliths composed by calcium oxalate don't present an effective clinical dissolution (Monferdinand Oliveira, 2009). In the presence of bilateral nephrolithiasis cases, the surgery it is recommend in cases of obstruction and not possible dissolution, like in the presence of calcium oxalate calculus (Petrouanu et al., 2001) and when there is a formation of stones in more than one place in the urinary tract (Silva et al., 2013; Silva et al., 2015). The procedure are made with a brief period (a few weeks) between the remove of one calculus from the one affected kidney to another, with the purpose of reduce the chances to occur acute renal failure, because the procedure reduce about 20% to 50% of the renal function, from a brief period (Rawlings et al., 2007). In the case related, as a selection criterion to remove the calculus was the size of then, being made the remove of the stone in the left kidney first and after in the right. The nephrolithiasis may lead to significant changes, when not identified soon. As analysis methods, the dosage of urea and creatinine is a method that allow us identify renal alterations, however these values only start to change in the presence of 66% to 75% of impairment of renal function (Freitas et al., 2014). In the patient of the present report the dosage of creatinine, show values in reference standards, seen the maximum value identified been 1,5mg/dl, before the realization of the second procedure of nephrostomy, when after the procedure the value reduce significantly, remaining in the standards values.

Some cases can evolve to the occurrence of pyelonephritis and hydronephrosis associate, causing a pionesrosis due the prolonged obstruction. In more advanced cases, the occurrence of chronic or acute renal failure can happen, where the ultrasound evaluation it is necessary to get in the early diagnosis and to the search of more information in front of the chronic nephropathy (Notomi et al., 2006; Fadel et al., 2014; Macphail, 2014; Diniz et al., 2016; Waki et al., 2010). The patient that present nephrolithiasis can also present overweight, beside high ingestion of oxalate and sodium, lack of calcium ingestion, potassium, vitamin C and highly ingestion of protein associated with a more excretion of citrate, how it is observe in human patients (Gordiano et al., 2014). In this way, it is indispensable, that the clinical don't restrig herself only to lab exams, seen that image exams confer more credibility to the diagnosis, where is possible identified preview alterations, obtain the definitive diagnosis and stablishing an ideal treatment protocol. After the period of the remove of the bilateral renal calculus, the patient return to the institution to remove the stitches after 10 days, with a good healing of the surgical wound, do not returning posteriorly for a new avaliation.

Conclusion

The nephrolithiasis it is an illness in the level of the urinary tract, that when identified early, can result in an effective and adequate treatment, without cause other systemic alterations, that can compromise effectively the quality of the life from the patient. With the base of the evidence studies, the occurrence of this illness has become present in the daily more often, in a

way that for the clinical, are essential the study and the analysis of your patient. Aiming select the effective treatment, with base in the analysis of the composition of the identify calculus, having also the responsibility of monitoring the patients who are affected and already treated, avoiding recurrences of the disease together with the adequate dietary management.

REFERENCES

- Caraza, J. D. A., García, C. C. P. and Rodríguez, M. B. G. 2010. Composition of lower urinary tract stones in canines in Mexico City. *Urological Research*, v.38, n.3, p.201-204.
- Diniz, F. M., Souza, M. F. S., Rossit, S. M., Mota, F. C. D. and Alves, A. E. 2016. Nefrolitíase associada à hidronefrose tratada cirurgicamente. *Veterinária notícias*, v.22, n.1, p.38-42.
- Fadel, L., Bluwol, K. and Silva, D. R. 2014. Pioneafrose associada anefrólitos em um cão. *Medvop-Revista científica de medicina veterinária*, v.12, n.40, p. 176-180.
- Freitas, G. C. ; Cambraia, J. C. V. ; Carregaro, A. B. (2014) Testes de avaliação de injúria renal precoce em cães e gatos. *Semina: Ciências Agrárias, Londrina*, v. 35, n.1, p. 411-426.
- Frreira, P. C. and Matera, J. M. 2005. Ureterolitíases obstrutivas em cães: avaliação da função renal na indicação da ureterotomia ou ureteronefrectomia. *Revista de Educação Continuada CRMV-SP*, v. 8, n.1, p.38-47.
- Gordiano, E. A., Tondin, L., Miranda, R. C., Baptista, D. R. and Carvalho, M. 2014. Avaliação da ingestão alimentar e excreção de metabólitos na nefrolitíase. *Jornal Brasileiro de Nefrologia*, v.36, n.4 , p.437-445.
- Grauer, G. 2010. Manifestações clínicas dos distúrbios urinários; Urolitíase canina. In: NELSON, R and COUTO, G. *Medicina Interna De Pequenos Animais*. 4ª. ed.Elsevier. Cap.41, p.611-616.
- Houston, D. M. and Moore, A. E. P. 2009. Canine and feline urolithiasis: Examination of over 50.000 urolith submissions to the Canadian Veterinary Urolith Centre from 1998 to 2008. *The Canadian Veterinary Journal*, v.50, p.1263-1268
- Inkelmann, M. A., Kommers, G. D., Trost, M. E., Barros, C. ; Figuera, R. A., Irigoyen, L. F. and Silveira, I. P. 2012. Urolitíase em 76 cães. *Pesquisa Veterinária Brasileira*, v.32, n.3, p.247-253.
- Kaufmann, C., Neves, R. C. and Habermann, J.C.A. 2009. Doença do trato urinário inferior dos felinos. *Anuário de Produção Científica dos cursos de pós-graduação*, v.4, n.4, p. 193-214
- Lulich, J.P., Osborne, C.A., Bartges, J.W. and Lekcharoensuk, C. 2004. Distúrbios do trato urinário inferior dos caninos. In: ETTINGER, S.J.; FELDMAN, E.C *Tratado de medicina interna veterinária*. 5ª.ed. Guanabara Koogan. 176 p.1847-1874
- Macphail, M.C. 2014. Cirurgia do Rim e Ureter. In: FOSSUM, W.T. *Cirurgia de pequenos animais*. 4ª. ed. Rio de Janeiro: Elsevier, cap.25 p.726-729
- Monferdini, R .P. and Oliveira, J. 2009. Manejo nutricional para cães e gatos com urolitíase – Revisão bibliográfica. *Acta Veterinaria Brasileira*, v.3, n.1, p.1-4.
- Notomi, M. K., Kogika, M. M., Ikesaki, J. Y. H., Monteiro, P. R. M. and Marquesi, M. L. Estudo retrospectivo de casos de insuficiência renal crônica em cães no período de 1999 a 2002. *Brazilian Journal of Veterinary Research and Animal Science*, v.43, p.12-22, 2006.
- 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. and Sudo, S. Z. 1999. Analysis of 77, 000 canine uroliths. Perspective from the Minnesota UrolithCenter. *The Veterinary clinics of North America. Small Animal Practice*, v. 29, n.1, p. 17-38.
- Osborne, C. A., Lulich, J. P., Kruger, J. M., Ulrich, L., Koehler, L. A. 2008. Analysis of 451,891 canine Uroliths, and feline urethral plugs from 1981 to 2007: Perspectives from the Minnessota Urolith Center. *The Veterinary clinics of North America. Small Animal Practice*, v. 39, n.1, p.183-187.
- Oyafuso, M. K. 2008. Retrospective and prospective study of urolithiasis in dogs. *Estudo retrospectivo e prospectivo da urolitíase em cães*. Dissertação (Mestrado em Medicina Veterinária) – Faculdade de Medicina Veterinária e Zootecnia, Universidade de São Paulo
- Oyafuso, M. K., Kogika, M. M., Waki, M. F., Prosser, C. S., Cavalcante, C. Z. and Wirthl, V. A. B. F. 2010. Urolitíase em Cães: avaliação quantitativa da composição mineral de 156 urólitos. *Ciência Rural*, v.40, n.1, p.102-108.
- Peres, L. A. B., Ferreira, J. R. L., Beppu, A. K., Junior, E. R. A., Vicenzi, G. and Yamamoto, R. Y. T. 2010. Alterações anatômicas em pacientes com nefrolitíase. *Jornal Brasileiro de Nefrologia*, v. 32, n.1, p.35-38.
- Petroianu, A., Neto, J. E. O. and Alberti, L. R. 2001. Dados epidemiológicos da litíase renal, em hospital de referência, em belo horizonte, minas gerais. *Medicina, Ribeirão Preto*, v.34, n.1, p. 85-88
- Picavet, P., Dettleux, S., Verschuren, S., Sparkes, A., Lulich, J., Osborne, C., Istasse, L. and Diez, M. 2007. Analysis of 4495 canine and feline uroliths in the Benelux. A retrospective study: 1994-2004. *Journal of Animal Physiology and Animal Nutrition*, v.91, n.5-6, p. 247-251.
- Quitzan, J. G., Brandão, C. V. S., Takahira, R. K., Ranzani, J. J. T. and Trindade, J. C. S. (2004) Análise qualitativa de cálculos relacionada com idade, sexo, raça e localização no trato urinário de cães. *Brazilian Journal of Veterinary Research and Animal Science*, v. 41, p.188-189.
- Rawlings, C. A., Bjorling, D. E., Christie, B.A. In: Slatter, D. H. 2007. *Manual de Cirurgia de Pequenos Animais*. 3ª edição. Cap. 109. V.2 p.1.606-1.611
- Robinson, M. R., Norris, R. D., Sur, L. R. and Preminger, G. M. 2008. Urolithiasis: not just a 2-Legged Animal Disease. *The Journal of Urology*, v.179, p.46-52.
- Rogers, K. D., Jones, B., Roberts, L., Rich, M., Montalto, N. and Beckett, S. 2011. Composition of Uroliths in small domestic animals in the United Kingdom. *The veterinary Journal*, v.188, n.2, p.228-230.
- Sebben, S. and Brum, S. P. B. 2007. Urolitíase e fatores associados. *Arquivos catarinenses de medicina*, v. 36, n. 2, p.99-106.
- Silva, C. R. A., Silva, F. L., de Sá, E., Nunes, M. H. V., Silva, H. M. O. G., Santos, P. V. G. R., Rodrigues, H. W. S., Oliveira, J. R. A. and Silva, L. M. O. G. 2015. Cálculo vesical e nefrolitíase bilateral: relato de caso. *PUBVET*, v. 9, n.2, p. 76-78
- Silva, F. L., Lopes, R. R. F. B., Silva, C. R. A., Vieira, A. A. R. and Leal, J. S. 2013. Nefrolitíase bilateral associada a calculo vesical em um cão: relato de caso. *Anais do 34º Congresso brasileiro da anclivepa*
- Vrabelova, D., Silvestrini, P., Ciudad, J., Gimenez, J. C., Ballesteros, M., Puig, P. and Ruiz de Gopegui, R. (2011) Analysis of 2735 canine Uroliths in Spain and Portugal. A

- retrospective study: 2004-2006. *Research in veterinary science*, v.91, n.2 p.208-211.
- Waki, M. F., Martorelli, C. R., Mosko, P. E. and Kogika, M. M. 2010. Classificação em estágios da doença renal crônica em cães e gatos-abordagem clínica, laboratorial e terapêutica. *Revista Ciência Rural*, v.40, n.10, 2226-2234
- Wisener, L. V., Pearl, D. L., Houston, D. M., Smith, R. J. R., Moore, A. E. P. 2010. Spatial and temporal clustering of calcium oxalate and magnesium ammonium phosphate uroliths in dogs living in Ontario, Canada between 1998 and 2006. *Preventive Veterinary Medicine*, v.95, n.1, p.144-151.
