Case Report

Medicina Veterinária

e-ISSN 2675-6617
v. 18 n. 4 (2024)

Unilateral renal agenesis in greater rhea (*Rhea americana* Linnaeus, 1758) reared under human care in the potiguar semiarid, Brazil

Agenesia renal unilateral em ema (Rhea americana Linnaeus, 1758) criada sob cuidados humanos no semiárido potiguar, Brasil

Ana Caroline Freitas Caetano de **Sousa**[1,2*], João Augusto Rodrigues Alves **Diniz**[2,3], Igor Renno Guimarães **Lopes**[2,3], Carlos Eduardo Vale **Rebouças**[2,3], Jael Soares **Batista**[3], Juliana Fortes Vilarinho **Braga**[4], Moacir Franco de **Oliveira**[2,3]

[1]*Wild Animal Clinic and Surgery Residency, Universidade Federal Rural do Semi-Árido (UFERSA), Mossoró-RN, Brazil.*
[2]*Department of Animal Science, Laboratório de Morfofisiologia Animal Aplicada (LABMORFA), Universidade Federal Rural do Semi-Árido (UFERSA), Mossoró-RN, Brazil.*
[3]*Postgraduate Program in Animal Science, Department of Animal Science, Universidade Federal Rural do Semi-Árido (UFERSA), Mossoró-RN, Brazil.*
[4]*Universidade Federal do Piauí (UFPI), Campus Professora Cinobelina Elvas, Bom Jesus-PI, Brazil.*
**Corresponding author: carolfreitas04@outlook.com*

Article info

Keywords
Congenital changes
Ratite
Urinary system

DOI
10.26605/medvet-v18n4-6394

Citation
Sousa, A. C. F. C., Diniz, J. A. R. A., Lopes, I. R. G., Rebouças, C. E. V., Batista, J. S., Braga, J. F. V., & Oliveira, M. F. (2024). Unilateral renal agenesis in greater rhea (*Rhea americana* Linnaeus, 1758) reared under human care in captivity in the potiguar semiarid, Brazil. Medicina Veterinária, *18*(4), 275-279. https://doi.org/10.26605/medvet-v18n4-6394

Received: October 27, 2023
Accepted: August 13, 2024

Abstract

Considered the largest wild bird in South America, the greater rhea is a ratite endowed with great zootechnical value and scientific importance. Understanding the health disorders that may affect these animals is necessary since they are kept under human care. Thus, seeking effective measures to prevent diseases in livestock is important. The present report aims to describe the first diagnosis of unilateral renal agenesis in greater rhea. A male greater rhea (*Rhea americana*) approximately five years old, was euthanized, aiming at the anatomical characterization of the structures that make up the lumbosacral region. Analysis of the coelomic cavity showed the absence of the left kidney and an increase in the volume of the left ureter. The right kidney had normal topography and anatomical structures. Fragments of the right kidney and left ureter were collected, fixed in formaldehyde, and submitted to the inclusion process to obtain histological slides stained by hematoxylin and eosin. The microscopic findings showed no compensatory changes even without the contralateral kidney. The left ureter did not present preserved histological organization. The mucosa was thin due to a large amount of mucoid content in the lumen. In conclusion, unilateral renal agenesis in greater rhea is compatible with life. The contralateral kidney is fully functional and can meet the body's demands. In addition, it is important to conduct anatomopathological studies in greater rheas under captivity, aiming to expand the understanding of the aspects involved in maintaining this species and the pathologies that affect them.

Resumo

Considerada a maior ave silvestre da América do Sul, a ema é uma ratita dotada de grande valor zootécnico e importância científica. Por ser mantida sob cuidado humano, é necessário conhecer as afecções que possam acometer esses animais, e desta forma, buscar medidas efetivas de prevenir doenças no plantel. Assim, o presente relato tem como objetivo descrever o primeiro diagnóstico de agenesia renal unilateral em ema. Um macho de ema (*Rhea americana*) de aproximadamente cinco anos, foi submetido a eutanásia, visando a caracterização anatômica das estruturas que compõem a região lombossacral. À análise da cavidade celomática, observou-se a ausência do rim esquerdo e um aumento de volume do ureter esquerdo. O rim direito apresentava topografia e estruturas anatômicas normais, sendo coletados fragmentos do rim direito e do ureter esquerdo, fixados em formaldeído e submetidos ao processo de inclusão para obtenção de lâminas histológicas, sendo coradas por hematoxilina e eosina. De acordo com os achados microscópicos, mesmo com a ausência do rim contralateral, não foram encontradas alterações compensatórias, já o ureter esquerdo, não apresentou organização histológica preservada, onde a mucosa apresentava-se delgada pela presença de grande quantidade de conteúdo mucoide

no lúmen. Conclui-se que a agenesia renal unilateral em emas é compatível com a vida, quando o rim contralateral se encontra totalmente funcional e apto a atender às demandas do organismo. Ainda, ressalta-se a importância da realização de estudos anatomopatológicos em emas sob cativeiro, visando ampliar a compreensão dos aspectos envolvidos na manutenção dessa espécie, bem como as patologias que as acometem.
Palavras-chave: alterações congênitas; ratita; sistema urinário.

1 | Introduction

The greater rhea (*Rhea americana*) is one of the largest species of wild birds in South America (Sick, 1997; Picasso, 2015, Pacheco et al., 2021). It is distributed in Brazil's Northeast, Midwest, and Southeast regions, endowed with great scientific importance (Costa et al., 2018) and zootechnical value (Carolina et al., 2019). Ratites differ from other birds by having no keel on the sternum and little pectoral muscles, giving a flattened shape to the region, causing this species to be known as ratite bird, as are ostriches, emus, cassowaries (Cubas et al., 2014) and kiwis (Kummrow, 2015).

Birds have a renal system composed of a pair of kidneys and ureters responsible for producing and conducting urine to the urodeum, respectively, inside the cloaca (Echols, 2006). The kidneys are elongated and divided into three lobes, cranial, middle, and caudal, with dark red color, making dorsal syntopy with the renal fossa, extending from the caudal border of the lungs to the final region of the synsacrum (Orosz et al., 2020).

Some congenital pathologies are not commonly described in birds, are occasionally visualized, and diagnosed in accidental necroscopic findings (Schmidt, 2006). Renal agenesis is a malformation characterized by a failure in embryonic development so that there is no recognizable renal tissue. It can be characterized by its unilateral or bilateral form (McGavin e Zachary, 2013).

Unilateral renal agenesis has already been reported in some wild birds, such as the flamingo (*Phoenicopterus chilensis*) (Oliveira et al., 2020) and purple-breasted parrot (*Amazona vinacea*) (Silva et al., 2020), in wild mammals, such as the scent monkey (*Saimiri collinsi*) (Souza et al., 2013) and foxes (*Cerdocyon thous*) (Lins et al., 2021), and in companion animals, such as dogs (Pereira et al., 2019) and cats (Santos et al., 2015). However, this type of congenital pathogenesis has never been described in greater rheas (*Rhea americana*). Thus, the present study aims to describe the first case report of unilateral renal agenesis in a greater rhea raised in captivity.

2 | Case Description

On December 15th, 2020, a male greater rhea approximately five years old was euthanized for the morphological characterization of lumbosacral structures as part of a scientific experiment approved by the Ethics Commission on Animal Use (CEUA) of the Universidade Federal Rural do Semi-Árido (UFERSA) (Protocol n° 30/2020) and Chico Mendes Institute for Biodiversity Conservation (ICMBio) (Number 73638-1). This animal was obtained from the Center for the Multiplication of Wild Animals (CEMAS) of UFERSA, registered in IBAMA (Brazilian Institute of Management and Renewable Natural Resources), under number 14.789.12.

The animal lived in a 20.0 × 10.0m enclosure with sand substrate and native trees. Its diet was based on feed adapted to the species, regional fruits (papaya, banana, watermelon), green leaves, and water *ad libitum*.

The bird was euthanized with the combination of xylazine hydrochloride (Xilazin® 2% at 1mg/kg, Syntec) and ketamine hydrochloride (Quetamina® 10% at a dose of 15mg/kg, Vetnil), administered intramuscularly. The animal was sedated with an anesthetic dose of thiopental (Tiopental sódico® 1g at 150mg/kg, Richmond, División Veterinaria S.A.) intramuscularly for anesthetic induction. Upon reaching the anesthetic plan, potassium chloride (Potassium chloride® 19.1% at a dose of 2.56mEq/kg) was administered intravenously (brachial vein). The animal's death was confirmed by the cardiorespiratory arrest on cardiac auscultation.

An incision was made in the coelomic region to visualize the cavity, with skin and musculature folding. The organs were later lateralized to expose the lumbosacral structures.

The right kidney was observed macroscopically. It presented normal morphology, characterized by three lobes divided into cranial, middle, and caudal. The ureter emerged from the middle lobe, consisting of a calibrous tube of translucent color, which emptied into the urodeum. No structures compatible with the left kidney or some tissue like kidney tissue were visualized on the left

side of the cavity. However, the left ureter was enlarged in volume, with dimensions of 0.6cm thick, 14cm long, and 0.5cm wide, presenting a whitish coloring. Cross-section showed that the entire lumen was filled with translucent white material with a gelatinous consistency (Figure 1).

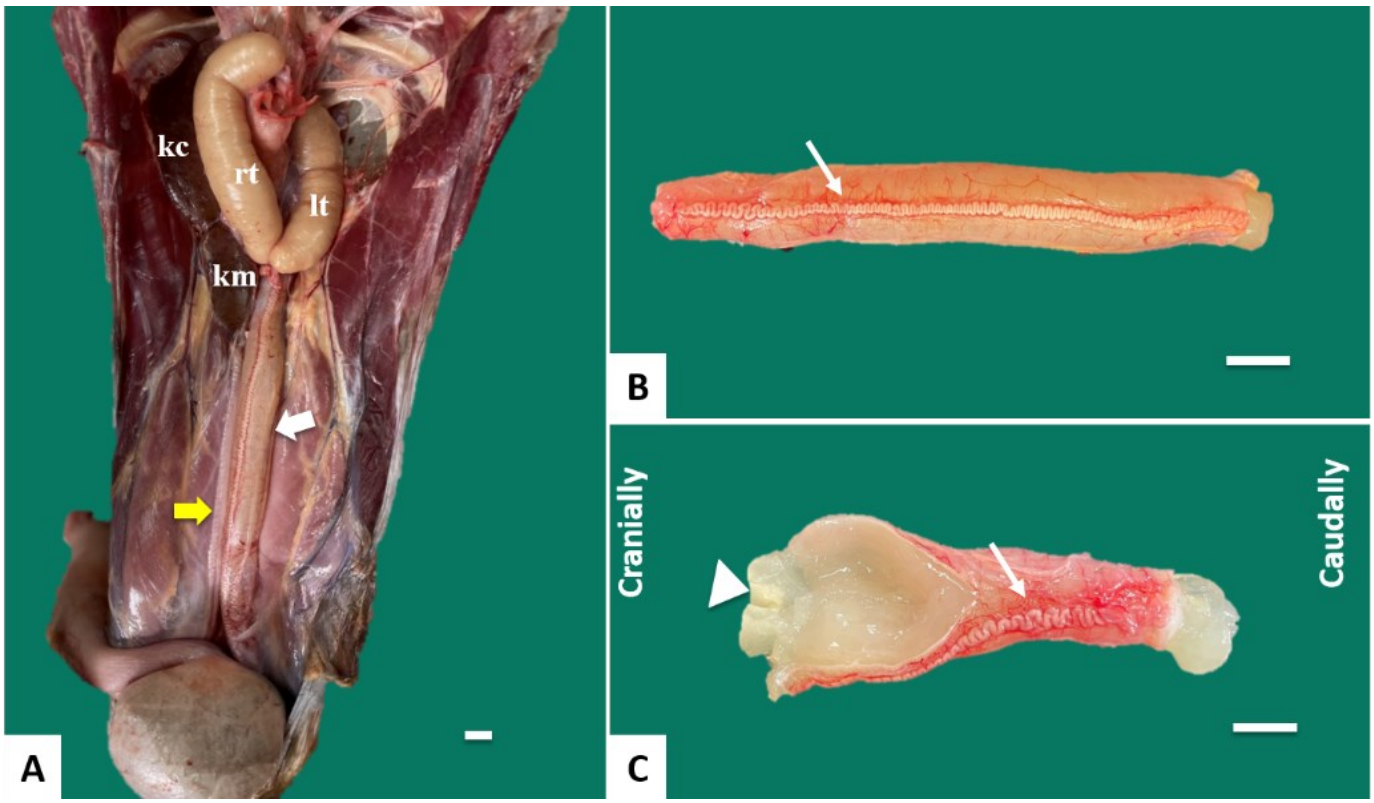

Figure 1. Macroscopic findings of the urinary system of greater rhea (*Rhea americana*). (A) lt: left testicle; rt: right testicle, kc: right kidney cranial lobe, km: Right kidney middle lobe, right ureter (yellow arrow), and left ureter (white arrow). (B) Ureter with vas deferens (white arrow). (C) Ureter sectioned in half, the white arrow indicates the vas deferens, and the white arrowhead indicates the translucent white mucoid content found. Bar: 1cm.

Fragments of the left ureter and right kidney were collected for histological analysis and fixed in 4% paraformaldehyde, buffered with 0.1 M PBS (phosphate-buffered saline), and pH 7.4 for 72 hours. After fixation, the fragments were dehydrated in increasing concentrations of alcohol (alcohol 70%, 80%, 90%, 95%, 100%, 100% and 100% for 1 hour) and diaphanized in xylol for inclusion in paraffin. Histological slides were then prepared with 5µm sections of the tissues for staining by hematoxylin and eosin (HE) technique, according to the methodology described by Tolosa et al. (2003). Histological analysis was performed using a light microscope (Leica ICC50 HD), and photomicrographs were recorded using the Leica LAS EZ software (v2.0.0. Microsystems Ltd., Heerbrugg, Switzerland).

On histopathological analysis, the right kidney presented a normal organization and the presence of two types of nephrons, mammalian and reptilian, both with preserved histological architecture (Figure 2).

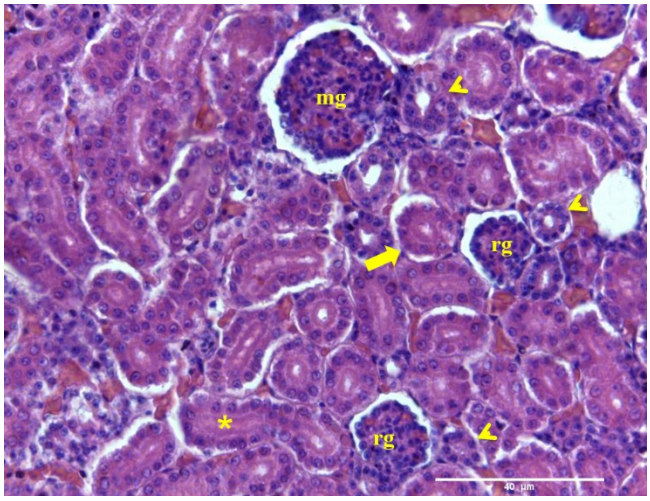

Figure 2. Photomicrograph of the right kidney. Mammalian-type glomerulus (mg), reptilian-type glomerulus (rg), collecting duct (arrowhead), proximal convoluted tubule (arrow), distal convoluted tubule (asterisk). Hematoxylin and Eosin (HE), Objective 40X.

The left ureter lost its histological organization due to the large compression exerted by the mucoid

contents in the lumen, presenting thin mucosa due to a large amount of mucus (Figure 3).

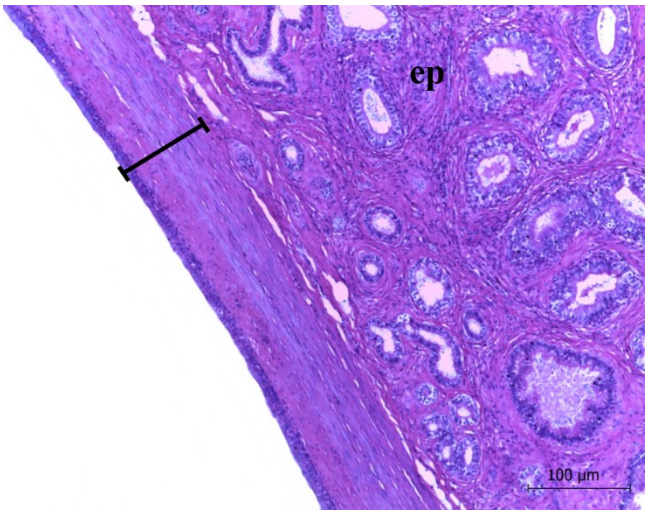

Figure 3. Photomicrograph of compressed left ureter (line); epididymis (ep). Hematoxylin and Eosin (HE), Objective 40X.

3 | Discussion

Congenital abnormalities are considered rare in small animals (Oliveira et al., 2020; Ferreira et al., 2022), and while renal agenesis has been reported in cats and dogs, its occurrence in wild and zoo animals is scarce (Souza et al., 2013; Oliveira et al., 2020; Lins et al., 2021). However, this number is not well elucidated in birds, and few cases of agenesis have been reported (Siller, 1981). If one of the kidneys is absent, the remainder can supply the functions satisfactorily, being compatible with life (Oliveira et al., 2020). Ipsilateral ureteral agenesis and compensatory hypertrophy of the remaining kidney may occur in association (Silva et al., 2020).

The greater rhea in this report did not exhibit any clinical signs related to renal abnormalities, such as renal agenesis, given that animals with this condition can remain asymptomatic throughout their lives (Ferreira et al., 2022). The right kidney presented normal size, topographic boundaries, and histological structures. It is known that, when present, the primary symptom is related to renal failure caused by a compensatory overload in the remaining kidney (Bernstein et al., 2009). In small animals, unilateral renal agenesis can be asymptomatic throughout life, however, the most frequent symptoms include weight loss, polyuria, polydipsia, anorexia, emesis, halitosis, gastroenteritis, and gastric ulcers (Ferreira et al., 2022). In this case report, no alteration or hypertrophy of the right kidney was observed to compensate for the absence of the left kidney, a finding also reported in a study with Chilean-Flamingo (Oliveira et al., 2020).

The left ureter of the absent kidney was in its normal topography but had increased volume compared to the right ureter. The increase was due to the presence of a large amount of whitish gelatinous fluid. In birds, the ureter has acinar glands in the mucosa and lamina propria, which produce mucus to lubricate excretion, rich in uric acid crystals (Oliaii and Mobini, 2017). The increase in volume may be due to the accumulation of this mucoid secretion that was not excreted along with renal metabolites, which are absent on the left side. The ureter of the absent kidney emerged from the cranial lobe of the contralateral kidney in flamingos (*Phoenicopterus chilensis*) (Oliveira et al., 2020), which was not observed in this report.

Urography and endoscopy can be used to diagnose this type of congenital pathology (Lierz, 2003). In most cases, unilateral renal aplasia is diagnosed by necroscopic examination (Silva et al., 2020). This report made the diagnosis occasionally since the animal would be used to study the lumbosacral structures.

This report demonstrates that unilateral agenesis in greater rheas (*Rhea americana americana*) is compatible with life even in the absence of compensatory hypertrophy of the contralateral kidney, which was not observed in this case. Furthermore, the report highlights the relevance of necroscopic examinations diagnosing congenital malformations in animals, which may not be associated with clinical changes and may be incidental findings, but are fundamental for understanding the pathologies that affect species in conservation.

4 | Conflict of Interest

The authors declared no potential conflicts of interest concerning this article's research, authorship, and/or publication.

5 | Acknowledgements

We acknowledge the Center for Multiplication of Wild Animals (CEMAS/UFERSA) for making the animals available.

6 | References

Bernstein, M.; Bernstein, K.K.; Britto, L.M.P.; Loli, P.A. Agenesia renal unilateral em um cão: relato de caso. [Unilateral renal agenesis in a dog: case report]. **MEDVEP Revista Científica de Medicina Veterinária. Pequenos Animais e Animais de Estimação**, 7: 140-142, 2009.

Carolina, A.C.; Ophélie, L.; Jeff, J.; Miguel, G.; Gustavo, N.; Steve, W. Analysis of ancient DNA from South American rhea bones: Implications for zooarchaeology and biogeography. **Journal of Archaeological Science: Reports**, 25: 624-631, 2019.

Costa, H.S.; Araújo Júnior, H.N.; Bezerra, F.V.F.; Rebouças, C.E.V.; Menezes, D.J.A.; Moura, C.E.B.; Oliveira, M.F. Macroscopic Anatomy and Brain Vascularization in the Greater Rhea (*Rhea americana americana*). **Acta Scientiae Veterinariae**, 46:1-8, 2018.

Cubas, Z.S.; Silva, J.C.R.; Catão-dias, J.L. Tratado de Animais Selvagens. In: Lovato, M.; Santos, E.O. **Rheiformes (Ema) e Struthioniformes (Avestruz, Emu e Casuar)**. 2ª ed. São Paulo: Roca, 2014. 457p.

Echols, M.S. Evaluating and Treating the Kidneys. In: Harrison GJ, Lightfoot TL. **Clinical Avian Medicine**. 2nd ed. Florida: Sphinx Publishing, 2006, 451-492p.

Ferreira, H.M.; Assis, M.M.Q.; Marangon, W.F.; Da Silva, M.C.; De Melo, J.B.; Gusso, A.B. F.; Merlini, N.B. Unilateral Renal Agenesis in Kitten. **Acta Scientiae Veterinariae**, 50: 1-15, 2022.

Kummrow, M.S. Ratites or Struthioniformes: Struthiones, Rheae, Cassuarii, Apteryges (ostriches, rheas, emus, cassowaries, and kiwis), and Tinamiformes (tinamous). In: Miller, R.E.; Fowler, M.E. **Fowler's Zoo and Wild Animal Medicine**, 2015. 75p.

Lierz, M. Avian renal disease: pathogenesis, diagnosis, and therapy. **Veterinary Clinics of North America: Exotic Animal Practice**, 6(1): 29-55, 2003.

Lins, B.B.; Sousa, M.S.; Frade, A.D.A.; Oliveira, R.L.; Almeida, P.G.T.; Oliveira, D.M.N.M.; Araújo, J.L. Diaphragmatic hernia and unilateral renal agenesis in a crab-eating fox (*Cerdocyon thous*). **Brazilian Journal of Pathology Veterinary**, 14(1): 66-69, 2021.

McGavin, M.D.; Zachary, J.F. O Sistema Urinário. In:_____. Bases da patologia em veterinária. 5ª ed. Rio De Janeiro: Elsevier Editora, 2013. p.620-645.

Oliaii, A.; Mobini, B. The histological differences of the ureter in Japanese Quail (*Coturnix japonica*) compared with some other domestic avian species. **International Journal of Morphology**, 35(1): 193-198, 2017.

Oliveira, E.L.R.; Costa, A.L.M.; Borges, M.F.; Nemer, V.C.; Baldissera, R.A.; Vasconcelos, M.; Schimming, B.C. Unilateral renal agenesis in Chilean-Flamingo (*Phoenicopterus chilensis*). **Acta Scientiae Veterinariae**, 48(1): 1-4, 2020.

Orosz, S.E.; Echols, M.S. The Urinary and Osmoregulatory Systems of Birds. **Veterinary Clinics of North America: Exotic Animal Practice**, 23(1): 1-19, 2020.

Pacheco, J.F. et al. Annotated checklist of the birds of Brazil by the Brazilian Ornithological Records Committee - second edition. **Ornithology Research**, 29(2): 94-105, 2021.

Pereira, K.H.N.P.; Burini, C.H.P.; Oliveira, E.L.R.; Canuto, L.E.F.; Correia, L.E.C.S.; Lopes, M.D.; Rocha, N.S.; Chiacchio, S.B.; Lourenço, M.L.G. Hypoplasia of ribs associated with cleft palate, cleft lip, and unilateral renal agenesis in a neonate dog of undefined breed. **Semina: Ciências Agrárias**, 40(1): 497-502, 2019.

Picasso, M.B.J. Ontogenetic Scaling of the Hindlimb Muscles of the Greater Rhea (*Rhea americana*). **Anatomia, Histologia, Embryologia**, 44(6): 452-459, 2015.

Santos, E.R.D. et al. Agenesia renal unilateral e criptorquidismo ipsilateral em um felino: relato de caso. **Arquivo Brasileiro de Medicina Veterinária e Zootecnia**, 67(2): 400-404, 2015.

Schmidt, R.E. Types of renal disease in avian species. **Veterinary Clinics of North America: Exotic Animal Practice**, 9(1): 97-106, 2006.

Sick, H. **Ornitologia brasileira** [Brazilian ornithology]. Rio de Janeiro (Brasil): Editora Nova Fronteira. Portuguese, 1997. 482p.

Siller, W.G. Renal pathology of the fowl-a review. **Avian Pathology**, 10(3): 187-262, 1981.

Silva, M.L.; Moreira, M.A.; Silva, G.B.C.; Silva, A.B.C. Achado acidental de agenesia renal unilateral em um papagaio-de-peito-roxo (*Amazona vinacea*) em exame necroscópico-relato de caso. **Archives of Veterinary Sciences**, Anais da Semana Acadêmica da Pós-Graduação em Ciências Veterinárias - UFPR (I SAPGCV), 25(5): 57, 2020.

Souza, N.F. et al. Agenesia Renal Unilateral em *Saimiri sciureus*: Relato de Caso. [Unilateral Renal Agenesis in *Saimiri sciureus*: Case Report]. **II Congresso Brasileiro de Patologia Veterinária/XVI Encontro Nacional de Patologia Veterinária (Curitiba, Brasil)**, Curitiba, Paraná, Brasil, 2013, p. 392.

Tolosa, E.M.C.; Rodrigues, C.J.; Behmer, A.O.; Neto, A.G.F. **Manual de técnicas para histologia normal e patológica**. 2ª ed. Barueri, SP: Manole, 2003. 331p.