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DOENÇAS DE PRIMATAS NÃO HUMANOS DE VIDA LIVRE E EM CATIVEIRO NO NORDESTE DO BRASIL

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RÔMULO FREITAS FRANCELINO DIAS

DOENÇAS DE PRIMATAS NÃO HUMANOS DE VIDA LIVRE E EM CATIVEIRO NO NORDESTE DO BRASIL

Dissertação apresentada ao Programa de Pós-Graduação em Ciência Animal da Universidade Federal da Paraíba para obtenção do título de Mestre em Ciência Animal.

Orientador: Prof. Dr. Ricardo Barbosa de Lucena

Coorientador: Prof. Dr. Jeann Leal de Araújo

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DADOS CURRICULARES DO AUTOR

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RESUMO

Esta dissertação foi dividida em dois capítulos. O primeiro capítulo aborda as doenças que acometeram os primatas não humanos entre os anos de 2013 e 2020 de acordo com os registros do Laboratório de Patologia Veterinária - LPV da Universidade Federal da Paraíba - UFPB. Foram identificadas 09 espécies diferentes de primatas. As doenças parasitárias foram as mais prevalentes, compreendendo 22 (40%) casos, seguido por doenças bacterianas, com 15 (27,3%) casos, doenças neoplásicas e virais tiveram igualmente 01 (1,8%) caso cada. Condições traumáticas contabilizaram 7 (12,7%), multifatoriais 6 (10,9%), eletroplessão 2 (3,6%) casos e idiopática 1 (1,8%) caso. Dentre as doenças parasitárias foram identificados *Molineus torulosus*, *Trypanoxyuris callitricis*, *Platynosomum illiciens*, *Pneumonyssus simicola* e *Dipetalonema gracile*. Agente bacteriano isoloado foi *Staphylococcus aureus, Salmonella* sp., *E. coli* e *Clostridium* sp. Adenocarcinoma renal foi a neoplasia identificada. O vírus herpes humano 1 foi o responsável pela infecção. A diversidade de doenças identificadas na diferentes espécies brasileiras e africana reforçam a necessidade de estudos contínuos para identificar as doenças que afetam os primatas brasileiros. O segundo capítulo foi um relato de caso descrevendo um caso fatal de doenças de baixa frequência em primata não humanos. Um macaco-rhesus de adulto, macho, proveniente de zoológico e sem histórico de doenças pregressas apresentou severo quadro respiratório com dispneia, tosse e espirros. Devido ao prognóstico ruim e a não responsividade ao tratamento com anti-inflamatório e antibióticos foi optado por eutanásia. Macroscopicamente o pulmão continha múltiplas lesões redondas por vezes coalescente, amarela a cinza, firme medindo 2 a 5 mm; o rim continha lesão arredondada e elevada na superfície capsular com 0,8 cm de diâmetro, bem delimitada e branca, ao corte era firme superfície regular branca e arredondada limitando-se a região cortical. Microscopicamente havia bronquiolite e bronquite piogranulomatosa e eosinofílica caracterizada por lesões multifocais onde substituíam e distendiam o parênquima pulmonar adjacente decorrente do grande número de neutrófilos, macrófagos, eosinófilos, menos células gigantes multinucleadas, linfócitos e células plasmáticas. No córtex renal notou-se neoplasma circular bem delimitado, encapsulado, com margens livres e densamente celular composto por células poligonais uniformes dispostas em papilas suportadas por fino estroma fibrovascular, a imunohistoquímica demonstrou neoplasia epitelial maligna primária. Através do exame de necrópsia foi possível observar duas condições de consideradas de baixa frequência no macaco-rhesus a bronquite e bronquiolite por ácaro e adenocarcinoma renal unilateral.

Palavras-chave: Primatologia. Patologia. Saúde Pública.

ABSTRACT

This dissertation was divided into two chapters. The first chapter addresses the diseases that affected non-human primates between the years 2013 and 2020 according to the records of the Veterinary Pathology Laboratory - LPV of the Federal University of Paraíba - UFPB. Nine different primate species were identified. Parasitic diseases were the most prevalent, comprising 22 (40%) cases, followed by bacterial diseases, with 15 (27.3%) cases, neoplastic and viral diseases also had 01 (1.8%) cases each. Traumatic conditions accounted for 7 (12.7%), multifactorial 6 (10.9%), electroplession 2 (3.6%) cases and idiopathic 1 (1.8%) case. Among the parasitic diseases, Molineus torulosus, Trypanoxyuris callitricis, Platynosomum illiciens, Pneumonyssus simicola and Dipetalonema gracile were identified. Isolated bacterial agent was Staphylococcus aureus, Salmonella sp., E. coli and Clostridium sp. Renal adenocarcinoma was the neoplasm identified. The human herpes virus 1 was responsible for the infection. The diversity of diseases identified in different Brazilian and African species reinforces the need for continuous studies to identify the diseases that affect Brazilian primates. The second chapter was a case report describing a fatal case of low-frequency diseases in non-human primates. An adult male rhesus monkey, coming from the zoo and with no history of previous diseases, presented severe respiratory symptoms with dyspnea, coughing and sneezing. Due to the poor prognosis and non-responsiveness to treatment with anti-inflammatory and antibiotics, euthanasia was chosen. Macroscopically, the lung contained multiple round lesions, sometimes coalescing, yellow to gray, firm, measuring 2 to 5 mm; the kidney contained a rounded, elevated lesion on the capsular surface with a diameter of 0.8 cm, well delimited and white, when cut it was a firm white and rounded surface, limited to the cortical region. Microscopically, there were bronchiolitis and piogranulomatous and eosinophilic bronchitis characterized by multifocal lesions where they replaced and distended the adjacent lung parenchyma due to the large number of neutrophils, macrophages, eosinophils, less multinucleated giant cells, lymphocytes and plasma cells. In the renal cortex, a well-defined circular encapsulated neoplasm was noted, with free margins and densely cellular composed of uniform polygonal cells arranged in papillae supported by thin fibrovascular stroma, immunohistochemistry demonstrated primary malignant epithelial neoplasia. Through the necropsy examination, it was possible to observe two conditions considered low frequency in the rhesus monkey: bronchitis and bronchiolitis due to mites and unilateral renal adenocarcinoma.

Keywords: Primatology. Pathology. Public Health

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CONSIDERAÇÕES GERAIS

A taxonomia da ordem Primates é um tema continuamente discutido e em constate mudança (PISSINATTI *et al.*, 2010). A fauna de primatas brasileiros se destaca mundialmente por ser a maior em relação ao número de espécies (REIS; PERACCHI; ANDRADE, 2008). Os primatas neotropicais destacam-se morfologicamente pela presença de três pré-molares, nariz achatado com narinas abertas para os lados, cauda geralmente longa – em alguns gêneros apresenta-se preênsil (AURICCHIO, 2017).

O Brasil é um país de tamanho continental que contém três grandes centros de primatologia distribuídos em estados na Região Norte, Centro-oeste e Sudeste, além de centros menores em algumas instituições de pesquisa espalhadas pelas outras regiões do país (PISSINATTI *et al.*, 2010). Devido à proximidade filogenética dos primatas não humanos e humanos, pesquisas são realizadas para o estudo das condições crônicas ou agudas que afetam os humanos (LIN; FLYNN, 2012; ROCKX *et al.*, 2020). Dentre as numerosas espécies que habitam o país, poucas tem sido utilizadas na pesquisa científica (ANDRADE *et al.*, 2010).

O conhecimento a respeito das condições que afetam a saúde dos primatas de vida livre ou cativeiro é importante pois conhecer o *status* sanitário desses animais permite traçar medida para conservação da fauna brasileira, além da importância destes para a saúde pública no âmbito da Saúde Única, pois servem como sentinela para algumas doenças, como por exemplo a febre amarela (ROCKX *et al.*, 2020).

Estudos retrospectivos são importantes, pois permitem a determinação de quais enfermidades são mais frequentes em determinada região. No nordeste brasileiro, incluindo o Estado da Paraíba, são escassos os trabalhos que retratam o perfil anatomopatológico e epidemiológico de doenças que afetam os primatas não-humanos. Nesse contexto, e considerando a diversidade de espécies de primatas da fauna brasileira, faz-se necessário maiores estudos tratando do reconhecimento dessas doenças em primatas não-humanos, visando contribuir com diagnósticos futuros bem como a traçar estratégias de controle e prevenção das espécies.

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Capítulo 1

“A Retrospective Study of Wild and Captive Non-Human Primate Diseases in Brazil”

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Title Page

A Retrospective Study of Wild and Captive Non-Human Primate Diseases in Brazil

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Abstract

Brazil has the greatest diversity of nonhuman primates (NHP) globally, and in Northeastern Brazil, there are two endangered NHP species. However, the causes of death of these animals in wildlife, captivity, or apprehended from trafficking are still unknown. We retrospectively analyzed cases of NHP referred to the Veterinary Pathology Laboratory of the Federal University of Paraíba, Brazil between 2013 and 2020. Fifty four cases and nne different NHP species were identified. Parasitic (40%) and bacterial (27,3%) diseases were the most prevalent. On the other hand, neoplastic and viral diseases had one (1.8%) case each. Traumatic conditions were present in seven cases (12.7%), while multifactorial, electrocution, and idiopathic conditions were present in six (10.9%), two (3.6%), and one (1.8%) case, respectively. Among the parasites, *Molineus torulosus*, *Trypanoxyuris callihtricis*, *Platynosomum illiciens*, *Pneumonyssus simicola,* and *Dipetalonema gracile* were identified. Cases of infection by *Staphylococcus aureus*, *Salmonella* sp., *E. coli,* and *Clostridium* sp. were also diagnosed. Renal adenocarcinoma was the only neoplasia found, and the human herpes virus was responsible for the infection of a marmoset. The diversity of diseases identified in different Brazilian species and African species in captivity reinforces the need for studies aiming to identify diseases that affect native or exotic primates in Brazil.

Keywords Parasites, Bacterium, Neoplasia, Trauma, Monkey

Introduction

Viruses, parasites, bacteria, chemical and physical agents threaten the lives of non-human primates (NHP) and can have major ecological impacts (Strier et al. 2019). In addition, several other factors threaten free-living NHPs such as advancing agriculture, deforestation and illegal trade (Pessoa et al. 2014) The first step in understanding the influence that these

actions can have on free-living populations is to monitor the health of NHP through surveys of their main causes of death.

According to the National Center for Research and Conservation of Brazilian Primates (CPB) of the Chico Mendes Institute for Biodiversity Conservation of the Ministry of the Environment, Brazil has 139 primate species and subspecies, 21 of which occur in the northeast region (BRASIL 2012). In the state of Paraíba, there are four free-living species, namely the common marmoset (*Callithrix jacchus*), the capuchin monkey (*Sapajus libidinosus*), and two species that are included in the Official National List of Endangered Species of Fauna (Brasil 2014): the blonde capuchin (*Sapajus flavius*) and the red-handed howler (*Alouatta belzebul*)

Endangered NHP species in Paraiba State inhabit the coastal region and are found in some fragments of remnants of the Atlantic Forest, a region that is anthropized because of the sugarcane monoculture and urbanization (BRASIL 2019).

Humans and NHP can share different pathogens, which is why zoonotic and anthropozoonotic diseases deserve special attention especially in regions where the two populations live in close proximity. Diseases that affect free-living animals must be evaluated so that they can be avoided in captive animals and consequently avoid the spread of zoonoses (Andrade et al. 2010). Thus, knowing the conditions that affect these animals is crucial as this knowledge can be applied to public health, as an example serving as sentinel animals in the surveillance of yellow fever.

In this study, we aim to survey the diseases in non-human primates diagnosed at the Veterinary Pathology Laboratory of the Federal University of Paraíba and describe the macroscopic and histopathological aspects of the different presentations of these diseases.

Material and methods

We searched the collection of necropsy records for all primate pathology diagnoses from 2013 to 2020 at the Veterinary Pathology Laboratory of the Agricultural Sciences Center campus of the Federal University of Paraíba, located in the city of Areia, Paraíba, Brazil.

The animals had three origins: captivity, free-living (found dead and sent to the laboratory), or free-living but had public or private veterinary medical care before death. This study was authorized by the Biodiversity Authorization and Information System - SISBio, under number 70790-1.

Complete necropsies with histopathological evaluation were performed for each primate. Tissues from internal organs, central nervous system, and skin were fixed in 10%

formaldehyde. The samples were then conventionally processed, embedded in paraffin, cut to 4 µm, stained with hematoxylin and eosin (H&E) and analyzed under a light optical microscope. According to the evaluation on HE staining, sections were further analyzed by special histochemical stains. A microbiological culture or other tests were used according to clinical or pathological suspicion.

The individual records were gathered in a Microsoft® Office Excel 2003 spreadsheet (Microsoft, 2003) for classification and tabulation according to species, sex, age (newborn, young, adult, or elderly), pathological diagnosis, and cause of death. Diseases were classified into parasitic, bacterial, viral traumatic, multifactorial, and idiopathic.

Results

During 2013 and 2020, 54 neotropical or exotic NHP were submitted for necropsy. Among these, six cases were inconclusive due to the advanced state of decomposition of the animals, not being included in the classification of the diseases found. Nine different species of affected primates were identified (Table 1). Parasitic diseases were the most prevalent, comprising 22 (40%) cases, followed by bacterial diseases, with 15 (27.3%) cases, neoplastic and viral diseases having one (1.8%) case each. Traumatic conditions accounted for nine (16.4%), multifactorial six (10.9%) cases and idiopathic one (1.8%) case.

In the 13 (23.6%) cases of enteritis by *Molineus torulosus*, the primates affected were from the genus *Sapajus*, with seven *S. libidinosus*, four *S. flavius*, and two *S. appella*. Most animals were emaciated during necropsy, and one female from S. libidinosus had severe abdominal distention. The serosa of the small intestine, in the duodenum portion, had multiple pale nodules of 0.3-2 cm in diameter, sometimes coalescent. Millimetric ulcers in the intestinal mucosa have been described as contiguous nodules that have become transmural comprehensive to the mucosa and submucosa (Figure 1A). On cut section, the nodules were firm with a thick wall and a necrotic center. In four cases, we observed intralesional adult parasites grossly (Figure 1B). Microscopically, the lesion was characterized by granulomas that elevated the serous tunic and compressed the muscular tunic, with granulomas being composed of numerous epithelioid macrophages, eosinophils, degenerate, and viable neutrophils surrounding multiple transversal and tangential sections of adult nematodes and eggs (Figure 1C). In four cases, neutrophilic and lymphocytic pancreatitis was observed with intraductal nematodes and eggs associated with mild epithelial sloughing.

During necropsy of one (1.8% of cases) male *S. flavius*, two specimens of nematodes (*Dipetalonema gracile)* were observed in the abdominal cavity (Figure 1D). There was also an increase in mesenteric, mandibular, and tracheobronchial lymph nodes. Multiple small

nodules were seen in the spleen. Microscopy examination of lymph nodes and spleen revealed lymphadenitis associated with parasitism, characterized by a marked and diffuse inflammatory reaction, with edema, plasma cells, eosinophils, histiocytes, lymphocytes, and rare multinucleated giant cells, with obliteration of the organ's typical histological architecture. Microfilariae of approximately 125 µm in length were associated with this lesion.

In cases of enteritis associated with the presence of *Trypanoxyuris callithricis*, five (9.1%) *C. jacchus* were affected. During the necropsy, all marmosets were emaciated. The gut was distended, and the portion of the cecum and colon presented several nematodes in the intestine wall. The intestinal lumina revealed a large number of white nematodes with 2 to 6 mm in length (Figure 2A,B). Moreover, the intestinal wall was severely thin and reddish. Microscopically, all primates presented mild to moderate diffuse lymphocytic and eosinophilic enteritis with mild wall edema and diffuse moderate interstitial pneumonia and severe pulmonary edema.

Platynosomiasis was diagnosed in two (3.6%) *C. jacchus*. One animal was extremely thin with enophthalmos, while the other one presented jaundice. The liver ranged from intensely dark red to brownish (Figure 2C) and with moderately rounded edges. There were dark brown leaf-shaped flattened trematode parasites on the cut surface, identified as *Platynosomum illiciens*. Microscopically, the lesion was characterized by increased cellularity in the portal space and bile ducts, with moderate to severe proliferation of connective tissue, bile duct hyperplasia, and moderate to severe inflammatory cell infiltration, composed of a large number of lymphocytes, few plasma cells, and rare eosinophils (Figure 2D).

Pulmonary acariasis due to *Pneumonyssus simicola* infection was diagnosed in one (1.8%) elderly *M. mulatta*. This primate was markedly thin. During necropsy, multiple random nodules of 1 to 7 mm were observed in the lung parenchyma. These nodules were firm, grayish-yellow, and had a necrotic center, with the presence of mites. Histologically, the lesion was characterized by bronchiolitis and bronchitispiogranulomatous and eosinophilic , chronic, multifocal, marked, with bronchiectasis and arthropods inside bronchioles, with mite pigment.

Staphylococcus aureus infection affected 14 (25.5%) capuchins monkeys with pneumonia, four of which were *S. flavius*, five were *S. libidinosus,* and five were *S. apella*. All individuals were kept in captivity and presented reddish fluid in the thoracic cavity, with fibrinous exudate in the pleura and pericardium at necropsy. The lungs were diffusely red, with extensive areas of pulmonary consolidation (Figure 3A). Five of these animals had

multiple lung abscesses (Figure 3B,C). Abscesses in the right ventricular myocardium were observed in two monkeys. Suppurative vegetative endocarditis was found in one animal. Microscopically, there was pulmonary necrosis associated with areas of pulmonary congestion, in addition to alveolar edema and several aggregates of neutrophils in the lumen of bronchioles and alveoli. Numerous coccoid and basophilic bacterial aggregates were observed in areas of necrosis and neutrophilic infiltrate (Figure 3D). In the pleura, numerous accumulations of neutrophils, eosinophilic fibrillar material (fibrin), and cellular debris were observed.

The microbiological culture of lung and pleura samples from six primates resulted in the growth of *Staphylococcus*, compatible with coagulase-positive *S. aureus* found on the routine biochemical tests.

Pseudomembranous colitis affected one (1.8%) cub male of *Alouatta caraya* kept in captivity with a history of mother rejection. We noticed that the large intestine, mainly the colon, was diffusely dilated with serosa intensely congested during the necroscopic examination. The opening revealed a large amount of homogeneous, brown, cloudy, and thick fluid content. The mucosa was diffusely covered by pale brown to green material, easily removed when pulled (pseudomembrane). Beneath the pseudomembrane, the mucosa was diffusely red.

Microscopically, the large intestine presented a loss of villi and diffuse, marked necrosis extending to the submucosal layer. These areas were covered by several degenerated and non-degenerated neutrophils, numerous bacterial colonies, eosinophilic fibrillar material, and fewer erythrocytes (pseudomembrane). Pale basophilic bacteria, individually arranged and grouped, are rod-shaped up to 10 mm long, occasionally with a clear central vacuole (oval spores), sometimes mixed with shorter coconuts and bacteria in the form of gram-positive rods. Below the pseudomembrane, the epithelium was partially necrotic, with multifocal cellular infiltrate composed of a large amount of degenerated plasmocytes, lymphocytes, and neutrophils extending to the submucosa. A suggestive diagnosis of *Clostridium difficile* enteritis was made.

The only viral disease consisted of systemic infection by Human Herpes 1 (herpesvirus simplex 1) in a young female common marmoset kept in captivity. During the necropsy exam, multiple vesicles and ulcers were noted on the upper and lower lip and on the skin of the muzzle. In the tongue, we observed irregular ulcers ranging from 0.3 to 0.5 cm in diameter, and the dorsal surface of the tongue was covered with fibrin. There were similar lesions on the soft palate. Microscopically, lesions of the face and oral mucosa were

characterized by necrosis of the epithelium and multifocal areas of ulcerations, associated with intact and degenerate neutrophils. In the epidermis, there was ballooning degeneration with intranuclear inclusion bodies, vesicles, and pustules. In the brain, we found gliosis, perivascular inflammatory infiltrates composed of a large number of lymphocytes and fewer plasmocytes, vasculitis with 3 to 4 layers of inflammatory cells, fibrinoid necrosis of the wall of some arterioles, and diffuse congestion, associated with intranuclear inclusion bodies in neurons, astrocytes, and oligodendrocytes. Immunohistochemistry on fragments of the brain was performed with positive staining for antibody against herpesvirus simplex type 1 (HSV-1) antigen (polyclonal, DAKO Corporation, Glostrup, Denmark), in the 1 / 1,500 dilution.

The only case (1,8%) of neoplasia corresponded to a renal adenocarcinoma in a male *M. mulatta* kept in a zoo. Macroscopically, the lesion consisted of a, less than 1 cm, well delimited, white round nodule, extending from the subcapsular surface to the parenchyma. On cut surface, it was firm, with a regular white and rounded surface limiting the cortical region. Upon microscopic examination, a well-defined circular encapsulated neoplasm in the renal cortex was noted, with free margins and densely cellular composed of uniform polygonal cells arranged in papillae, supported by a thin fibrovascular stroma. Neoplastic cells had indistinct borders and small amounts of finely granular eosinophilic cytoplasm. The nuclei were round to oval, with finely speckled chromatin and 1-2 evident nucleoli. A low mitotic index (one mitosis per field of high magnification) was observed. Neoplastic cells were positive for CD-10 antibodies. Multifocally, the glomeruli showed slight segmental expansion of basement membranes and mesangial cells. There was mild multifocal glomerular sclerosis.

One (1.8%) free-living *Aotus trivirgatus* was affected by pelvic limb paresis. On necropsy, there were no significant changes; however, on histology, the myocardium showed an increase in cellularity among the cardiomyocytes, composed of a large number of lymphocytes and plasma cells and some neutrophils. Muscle fibers showed hypertrophy, and some were stunted or necrotic. In the kidneys, the glomeruli contained one or more of the changes described: mild to moderate thickening of the mesangial matrix and basement membranes by amorphous eosinophilic material (matrix); moderate hypercellularity, and podocyte hypertrophy. Multifocally, the tubules contained proteinaceous eosinophilic material. Tubular epithelial cells often contained brown-yellow pigment. There was a diffusion in the interstices of the cortical and medullary regions and increased cellularity composed of a moderate amount of plasma cells and lymphocytes.

The newborn's respiratory distress syndrome was identified in one (1.8%) neonate female of the species *S. libidinosus*. Macroscopically, the lung was firm, dark red and a large

amount of translucent liquid/serous content flowed through the cut. Microscopically, the lungs were congested with airway lumen filled with hyaline material and surrounded by a discrete mononuclear inflammatory infiltrate.

Among the five (9.1%) cases of gastric dilation, the affected species were three *S. libidinosus,* one *S. sciureus,* and one *C. jacchus*. Macroscopically, all had abdominal distention; the stomach was markedly filled with gas and compressed the abdominal and thoracic viscera (Figure 4A). In addition to the gas, there was a yellowish pasty content (Figure 4B), and the mucous membranes were hyperemic. Microscopically, we found a necrotic lesion of the epithelium, causing loss of the apical epithelium of the gastric glands, with increased cellularity composed of a moderate amount of lymphocytes, plasma cells, and fewer neutrophils, with a moderate amount of basophilic bacillary organisms (bacteria) in the crypt and inside the glands.

Electrocution affected two (3.6%) free-living females of the species *C. jacchus*. External lesions were characterized by severe focal necrosis (Figure 5A, B), with loss of epithelium and muscle and bone exposure with carbonization in the right forearm limb's distal region. In another case, there was severe focal necrosis with loss of epithelium, muscle, and medial and distal phalanges together with the exposure of the proximal phalanges of the third and fourth digits of the right pelvic limb. We also observed severe focal necrosis of the right hand. Microscopically, there was moderate diffuse interstitial pneumonia and severe edema.

The seven (12.7%) deaths caused by trauma were characterized by mechanical action, with blunt wounds being the most common cause. The affected animals were six *C. jacchus* and one *A. belzebul*. The most affected sites were the cranial, thoracic, and pelvic limbs. In the cranial region, subcutaneous edema and hemorrhage were the most common injuries, followed by multiple calvaria fractures (Figure 5C). In the chest region, the most common injuries were rib fracture and rupture of intercostal musculature. In the pelvic and thoracic limbs, the injuries found were abrasions, and in the case of *A. belzebul,* there was still a fracture of the proximal phalanx of the fifth digit of the right hand (Figure 5D).

Discussion

Our results demonstrate a wide variety of diseases found in different species of non-human primates in Northeast Brazil. Infectious agents were the most common, followed by bacterial agents and physical agents (trauma and electrocution).

Parasitic illnesses are the most common diseases affecting NHP, whether free-living or captive (Verona 2008; Strait et al. 2012). Identifying primate parasites are significant to guide the diagnosis of animals that die (Verona 2008). Nematode infection has historically been

common in many New World primate species (Cogswell 2007; Strait et al. 2012; Bacalhao et al. 2016). In the present study, nematode parasitosis was identified as the primary lesion found in primates, especially in capuchin monkeys.

Molineus torulosus infestation was found in several animals, both as an incidental finding or causing extensive lesions. These parasites belong to the order *Strongylida*, superfamily *Trichostrongylidae*, and mainly affect free-living animals (Deinhardt 1967; Cosgrove et al. 1968). All animals in the study came from the wild or were seized from the illegal trade. Histologically, the lesion is described as having an intense granulomatous inflammatory response, surrounded by proliferating fibrous connective tissue (Strait et al. 2012), as observed in the present study. One case presented gastric dilation concomitant to *Molineus* infection; in the other primates, the most critical finding was associated with malnutrition. Among the species of the genus *Molineus*, only *M. torulosus* is pathogenic, causing hemorrhages and necrotic ulcers in the intestinal wall (Durette-Desset et al. 2001), as found in many of the present cases. There is no effective treatment for diseases so far, with sanitation and consistent management being the most appropriate to prevent them.

The intense parasitosis by *Trypanoxyuris callithricis* was also responsible for severe malnutrition in marmosets. In these cases, in addition to weight loss, the animals developed pulmonary edema due to hypoproteinemia because of the high parasitic load. *T. callithricis* are oxyurids that infect primates of the *Callithrix* genus. Although there is little information about the biology or clinical effects of these parasites, cases of rectal prolapse and death associated with the presence of *Trypanoxyuris* sp. have already been described (Valença et al. 2000; Amato 2002; Baker 2018). These data emphasize the need to investigate the consequences of this parasite on the animal's organism and the conservation of the species in free life.

Two free-living *C. jacchus*, both males, were diagnosed with hepatic parasitosis by *Platynosomum* sp. Infections of these parasites have also been described in platyrrhins and catarrhines, with fewer records for the latter. Although there are descriptions of two species (*P. amazonenses* and *P. marmoseti* in callitrichids), recent studies suggest that these two species are synonymous with *P. illiciens* (Pinto et al. 2017). Hepatocellular carcinoma and progressive weight loss are findings described in concomitant conditions with infection by *Platynosomum* sp (Sousa et al. 2008; Díaz-Delgado et al. 2018). In the case investigated, severe jaundice and cachexia were the conditions found during the necropsy. As in the macro evaluation, microscopic findings are variable and depend on the degree of infestation. In the microscopic evaluation, mononuclear infiltrates (lymphocytic and plasmacytic), ductal

hyperplasia, cholestasis, and fibroplasia findings are expected, together with sections of the parasite (Sousa et al. 2008; Díaz-Delgado et al. 2018). The treatment indicated is praziquantel (Baker 2018).

We found only one old-world primate, which was kept in a zoo. The animal was a rhesus monkey affected by progressive weight loss that culminated in cachexia. The histopathological evaluation confirmed infestation by *Pneumonyssus simicola*, a mite that colonizes the respiratory tract of primates of the *Macaca* genus. With the advent of ivermectin, the incidence rate of this disease has become low, but some cases are still described (Johnson et al. 2017). The complete life cycle of this parasite is still unknown, but the literature suggests that all stages can be found in the lungs (Innes et al. 1954). Death from pulmonary acariasis is currently rare (Johnson et al. 2017), but its presence often results in severe lung injuries characterized by multiple random, yellowish, and slightly elevated nodules. Due to the similarity with the tuberculosis lesion, the differential diagnosis must be taken into account (Lowenstine and Osborn 2012). Histologically, the lesion is characterized by bronchiolitis, peribronchiolitis, lobular pneumonitis, collapse or alveolar consolidation and, sometimes, bronchiolectasis, with intralesional mite and brown to black pigment.

Infection with *Dipetalonema gracile* occurs in different species of Brazilian primates (Muniz-Pereira et al. 2009). In the present study, the infection occurred in the species *S. flavius*, which, to our knowledge, has not been reported to date. Adults of these filarial nematodes are often found in the cavity (Garner 1967; Esslinger and Gardiner 1974). In this case, in addition to the parasite's presence in the cavity, we observed histologically an infectious process in the mesenteric, mandibular, and tracheobronchial lymph nodes caused by the migration of the microfilaria.

Bacterial diseases can be significant causes of morbidity and mortality in colonies of non-human primates. In the present study, they were responsible for respiratory and enteric conditions.

Bacterial pneumonia caused death in three primate species, with *Staphylococcus aureus* being isolated from six animals. Some animals had been frozen for more than two months; thus, the isolation was not feasible. *S. aureus* has already been isolated from systemic infections with pulmonary involvement, with possible primary infection in other places, such as skin lacerations, surgical wounds, osteomyelitis, endocarditis, enteritis, and use of internal catheters (Wood et al. 1978; Silverman et al. 1997; Taylor and Grady 1998). In the present study, the animals contained skin lesions, resulting from fights with other monkeys in the enclosure. Many of these animals were obtained from illegal animal dealers, so they were

subjected to stress and had difficulty adapting in screening centers. *S. aureus* is a bacterium also isolated from oral lesions (Gaetti-Jardim Jr et al. 2012), proving that the oral cavity can be an important source of infection for other animals, from bites during fights and attacks. This bacterium has also been isolated in the respiratory tract of *Saguinus oedipus*, *S. fusicollis* (Deinhardt et al. 1967). Several staphylococci were recovered from abscesses, ascitic fluid, eye secretions, fistulas, heart, nasal cavity, and trachea of clinically ill owl monkeys (Weller 1994). Individual infections due to staphylococci have been reported in non-human primates. One monkey died of bronchopneumonia of which *Staphylococcus* spp. has been isolated (Deinhardt et al. 1967). The results show that pneumonia and pleuritis deserve attention in captive primates in Brazil.

High rates of morbidity and mortality have been reported in captive non-human primates due to enteric diseases, with diarrhea being one of the leading medical conditions found in these animals (Lopes et al. 2010; Brady and Carville 2012). Several species of bacteria can cause enteritis in both animals and humans. For instance, the species *Clostridium difficile* causes enteritis mainly in the colon region with the formation of the pseudomembrane. Histologically, lesions with the characteristic of 'volcano' are formed, and the disease's induction is probably dose-related. However, the reasons for bacterial overgrowth, except that caused by administration of oral antibiotics, are still not understood (Brady and Carville 2012). In the present case, pseudomembranous colitis occurred in an *A. caraya* puppy with a history of rejection by the mother. However, we were unable to isolate or detect the toxin; however, the macro and micro findings are highly suggestive of pseudomembranous colitis associated with *C. difficile* infection.

Infections caused by viruses pose a potential threat to the health of NHP, whether free-living or from laboratory colonies, zoos, and screening centers (Wachtman and Mansfield 2012; Megid 2014; Romano 2014). As the transmission of viruses between species can have devastating consequences, direct contact between different species of NHP must be avoided (Hunt et al. 1973). In Brazil, the rabies virus, human herpesvirus 1, and the yellow fever virus stand out due to their importance in public health (Megid 2014; Romano 2014). Human herpesvirus 1 (HHV1) is a common cause of infection in humans. On the other hand, infection of New World species results in a lethal disseminated disease (Araújo et al. 2016). In our investigation, a systemic infection by human herpesvirus 1 in an illegally raised marmoset was confirmed, which had a history of sharing food with humans.

Neoplasms in non-human primates are rare, with case reports and surveys in small numbers (Miller 2012). At present, this diagnosis was made in only one animal, possibly

because most of the animals were young, free-living adults or were apprehended from the illegal trade. An incidental papillary-type renal adenocarcinoma was diagnosed in an elderly rhesus monkey. The exact age of the animal was not obtained, but we were able to speculate that she had lived in captivity for many years. Recent studies in primate colonies demonstrate that the primary neoplasms reported are those from the endocrine and digestive systems (Simmons and Mattison 2011; Miller 2012). Neoplasms that affect the urinary system are not frequent, with metastases being more common than primary neoplasms and malignant ones more frequent than benign ones. One hypothesis for the increase in cases described may be related to longevity in captivity (Lowenstine 1986; Miller 2012).

Information on diseases in *Aotus* sp. are less common than those from other primates, such as the rhesus monkey, capuchin monkey, and marmosets. The reason for this is that *Aotus* sp. are not investigated in biomedical research. Spontaneous kidney disease and diseases that affect the heart are described as the most common causes of morbidity and mortality reported in the owl monkey, although the etiopathogenesis, in most cases, remains unknown (Hunt et al. 1976; Chalifoux et al. 1981; Aikawa et al. 1988; Gozalo et al. 1992; Rajendra et al. 2010). Nephrotic syndrome, glomerulonephropathy, and interstitial nephritis have been observed, and infection by *Plasmodium* sp., *Trypanosoma* sp. and dietary factors have been proposed as possible causes (Hunt et al. 1976; Aikawa et al. 1988). Cardiomyopathy is common in elderly night monkeys and is a significant cause of death (Gozalo et al. 1992; Rajendra et al. 2010). The infectious causes that may cause myocarditis in *Aotus* sp. are *Trypanosoma cruzi* and *Toxoplasma gondi* (Sousa et al. 1974; Sullivan et al. 1993; Wachtman and Mansfield 2008; Sasseville et al. 2012).

Gastric dilation syndrome is a condition that can be caused by several factors, such as abdominal trauma, changes in diet, use of antibiotics, use of anesthetics, surgical trauma, stress conditions, rapid ingestion of large amounts of food or foreign objects (Markowski 1947; Leigh 1960; Soave 1978; Stein et al. 1981; Pissinatti et al. 1986). This condition's appearance is generally acute, and the animals usually present abdominal distension, weakened, and sometimes curved, where discomfort is evident. An interesting fact in the present study was a case of molineiasis and gastric dilation in a female of free-living *S. libidinosus*. In some cases, we performed bacterial culture and isolated *Salmonella* sp., *E. coli*, and *Clostridium* sp. in primates of the *Sapajus* genus.

Spontaneous respiratory disorders in newborns are poorly described in the literature, but some experimental models are useful for studying human conditions (Coalson et al. 1982; Hessler et al. 1985). The newborn's respiratory distress syndrome is a known condition, which

can be caused by pulmonary surfactant deficiency and can be due to fetal immaturity (premature births) or metabolic disorders (Lowenstine and Osborn 2012). In the present case, the newborn was found dead on the floor of the enclosure, and the examination did not evidence any blunt injury. The lungs were heavy, red, and firm. Microscopically, the airways were filled with hyaline material and surrounded by a discrete mononuclear inflammatory infiltrate.

Deaths from trauma can be caused by different types of energy (e.g., mechanical, physical, and chemical) and a myriad of causes (e.g., hammer, knife, automobile, electricity, and UV rays) (França 2017). Blunt trauma in animals is a common cause of accidental injuries and is the most common cause of non-accidental injuries (Reisman 2018). In the present study, the blunt injuries suggest that a great force was applied to the animals, mainly in the cranial region, suggesting that the injury may have been caused by being hit by a car, although the event was not witnessed. However, this hypothesis may be correct because the animals were located close to highways and public roads. Running over is among the leading causes of threat to Brazilian primatology fauna (Secco and Bager 2014). Natural or artificial electricity can act as damaging energy, with electrocution being the result of artificial electricity (França 2017). The lesions change according to the high or low voltage current. Wild animals can be exposed to high voltage electricity in power lines (França 2017; Viner 2018). The etiology of death by an electric current is justified by pulmonary, cardiac, and cerebral death, and these causes vary according to the intensity of the current (França 2017).

The species *C. jacchus* was most frequently submitted to necropsy, followed by *Sapajus libidinosus*. The most common etiologic agents were *Molineus torulosus* and *Staphylococcus aureus*, both in *Sapajus* sp., followed by *Trypanoxyuris callitricis*. *Trypanoxyuris callitricis* is also an important pathogen for *C. jacchus*. Blunt trauma and electrocution were also important causes of death in primates in northeastern Brazil, mainly free-living C. jacchus. The research also revealed the unprecedented diagnosis of *D. gracile* in *S. flavius*.

This work confirms the need for a continuous study of diseases that affect NHP and points out the need to investigate the impacts that may be caused on the conservation of wild and captive species.

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Table 1. Species of non-human primates submitted for necropsy between 2013 and 2019 at the Pathology Laboratory of the Federal University of Paraíba, Paraíba, Brazil, according to species, sex and age group.

Species	**Quantity**	**Sex**		**Age Group**
		Male	**Female**	**Infant | Young | Adult**
Callithrix jacchux	24	9	15	0 | 5 | 19
Sapajus libidinosus	10	6	4	1*| 1 | 8
Sapajus apella	5	2	3	0 | 0 | 5
Sapajus flavius	4	2	2	0 | 0 | 4
Aotus trivirgatus	1	1	0	0 | 0 | 1
Macaca mulatta	1	1	0	0 | 0 | 1
Saimiri sciureus	1	0	1	0 | 0 | 1
Alouatta caraya	1	0	1	1 | 0 | 0
Alouatta belzebul	1	1	0	0 | 0 | 1

* Neonate

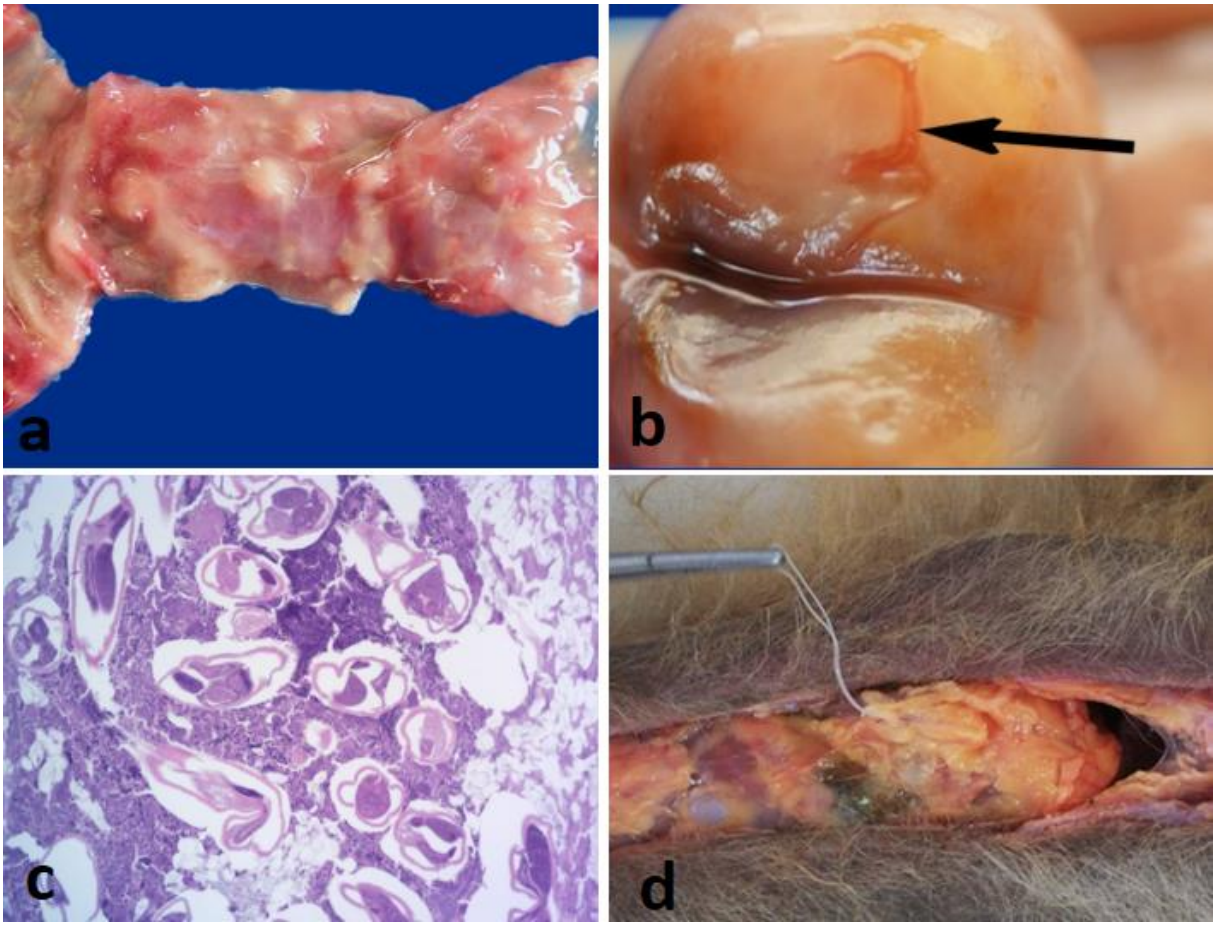

Fig. 1 Parasitic diseases of the genus *Sapajus* sp.: **a** intestinal serosa containing multiple parasitic granulomas of *Molineus torulosus*. **b** adult nematode (*Molineus torulosus*) within the granuloma (arrow) **c** sections of nematodes (*Molineus torulosus*) surrounded by cellular debris, a large number of viable and degenerative inflammatory cells (Hematoxylin and eosin, 10x). **d** *Dipetalonema gracile* observed in the abdominal cavity

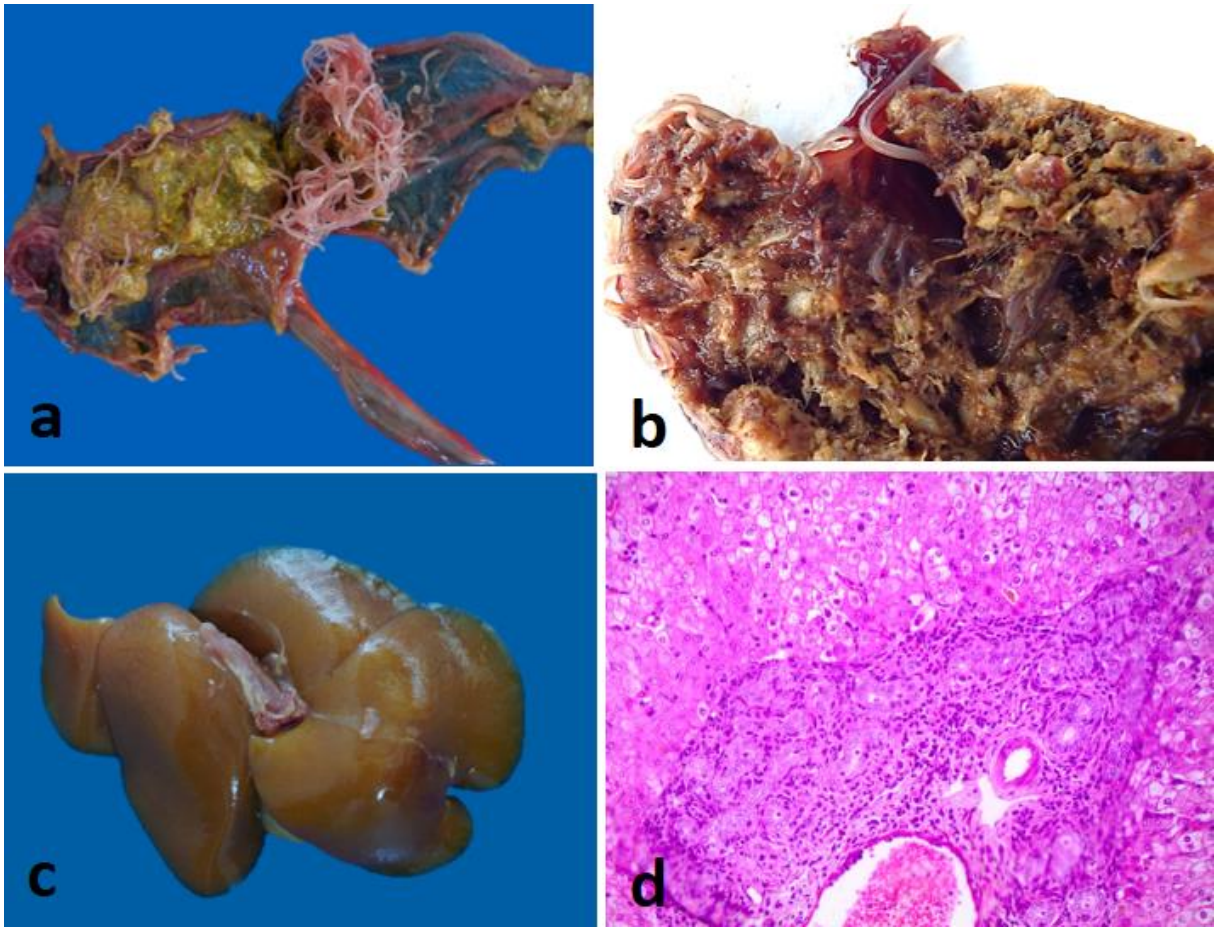

Fig. 2 Parasitic diseases of common marmoset (*Callithrix jacchus*): **a** large amount of Trypanoxyuris callithricis in the large intestine **b** greater detail of Trypanoxyuris callithricis in the intestinal lumen. **c** brown liver parasitized by Platynosomun illiciens. **d** severe diffuse periportal hepatitis with periportal fibrosis (Hematoxylin and eosin, 20x)

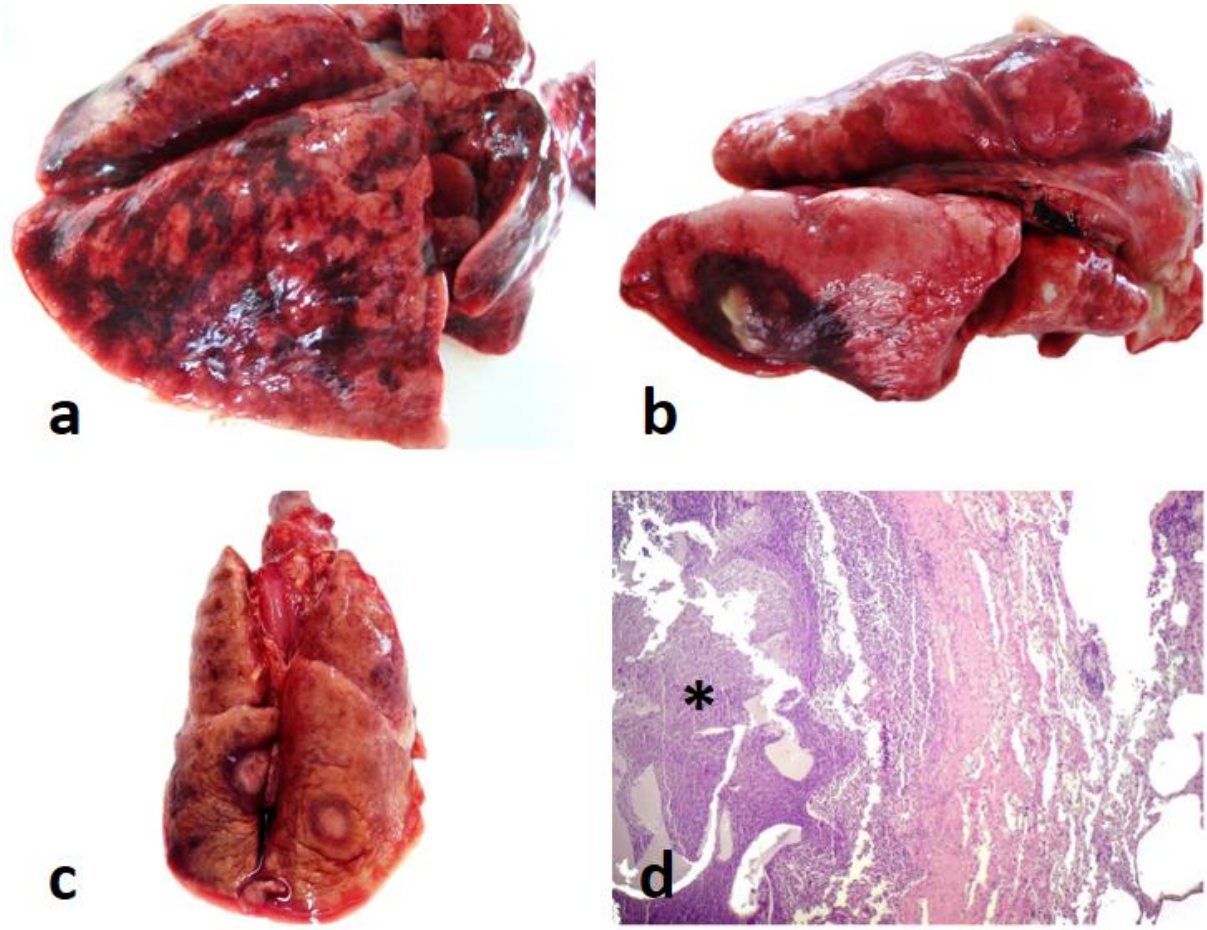

Fig. 3 Pneumonia in capuchin monkeys (Sapajus sp.): **a** diffusely red lungs with extensive areas of pulmonary consolidation. **b** lung showing abscess surrounded by a hyperemic halo. **c** multifocal distribution of lung abscesses surrounded by a hyperemic halo. **d** lung abscess with necrotic center (*) associated with basophilic bacterial aggregates, surrounded by numerous healthy and degenerate neutrophils and a fibrous connective tissue capsule (Hematoxylin and eosin, 10x)

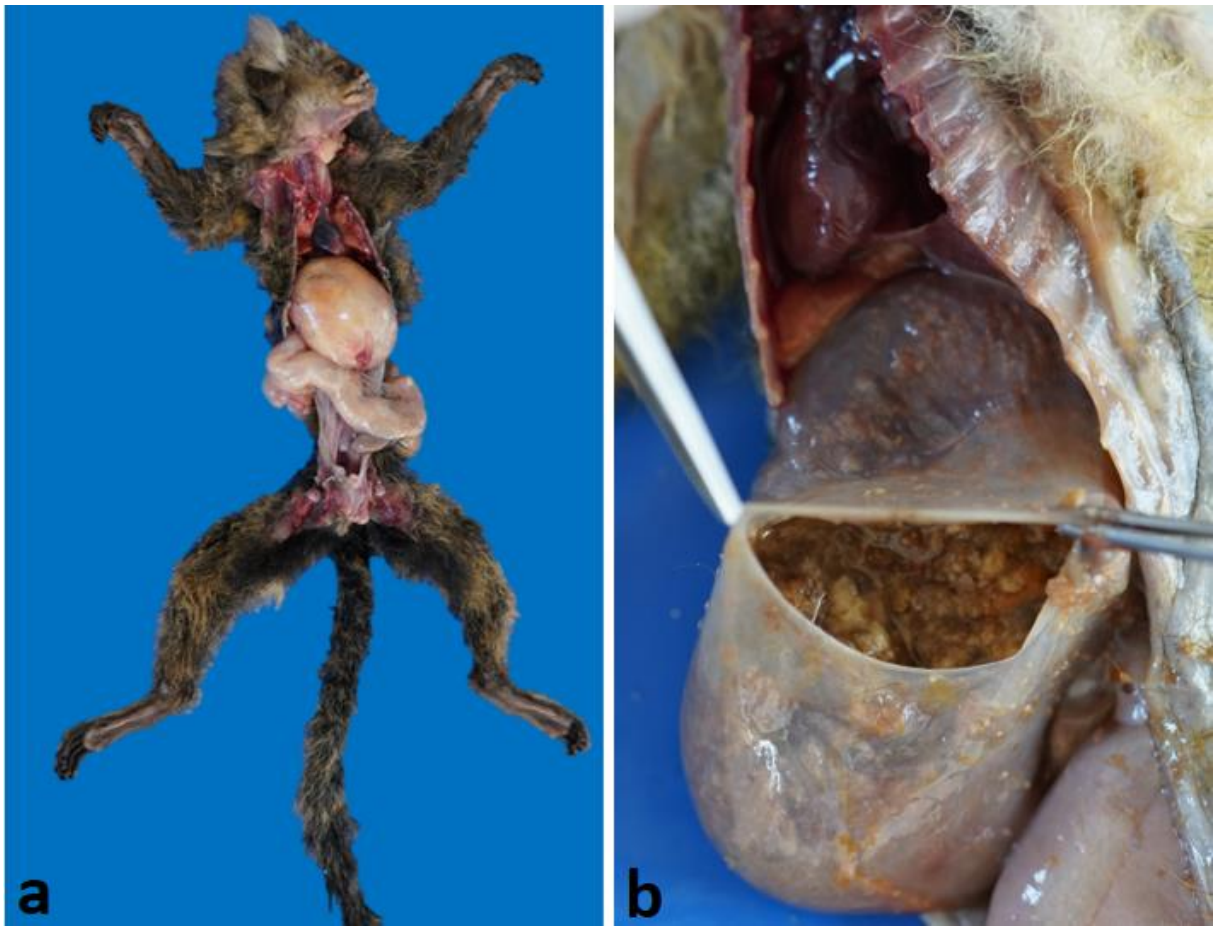

Fig. 4 Gastric dilation in neotropical primates: **a** common marmoset stomach (*Callithrix jacchus*) markedly filled compressing the thoracic organs. **b** yellowish pasty content makes up the stomach contents in a squirrel monkey (*Saimiri sciureus*)

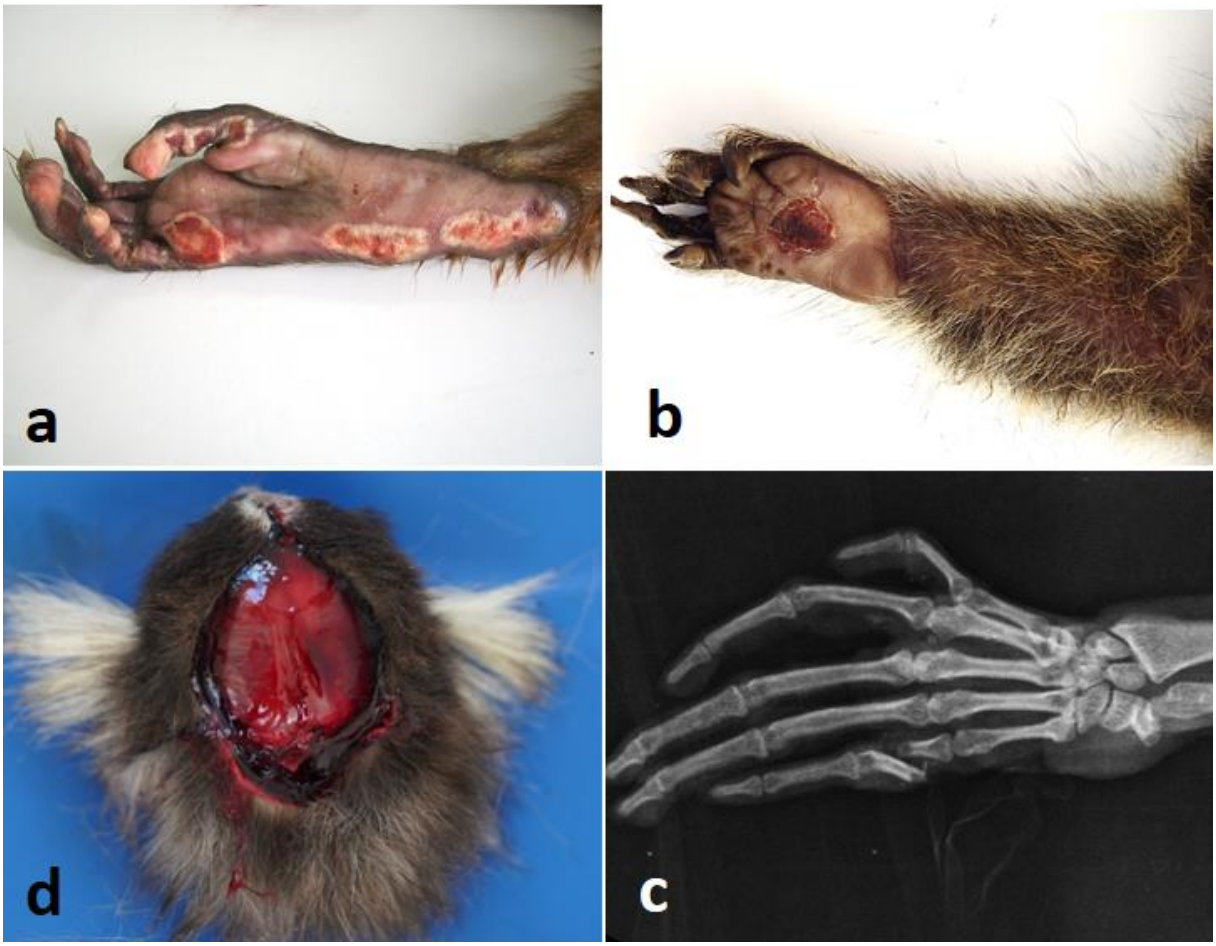

Fig. 5 Traumatic injuries in neotropical primates: **a** numerous foot ulcers in capuchin monkeys (*Sapajus apella*). **b** Epithelial necrosis in common marmoset (*Callithrix jacchus*). **c** cranial hemorrhage in common marmoset (*Callithrix jacchus*) due to blunt injury. **d** fracture of the proximal phalanx of the fifth finger of the howler's right hand (*Alouatta belzebul*)

Capítulo 2

"Acaríase pulmonar e adenocarcinoma em macaco-rhesus *Macaca mulatta* (Zimmermann, 1780) de zoológico"

Este artigo foi submetido à revista Acta Scientiae Veterinariae com fator de impacto 0.321 e Qualis B1.

CASE REPORT

Acaríase pulmonar e adenocarcinoma renal em macaco-rhesus *Macaca mulatta* (Zimmermann, 1780) de zoológico.

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Abstract

Background: Rhesus macaques (Macaca mulatta - Zimmermann, 1780) are old world primates that naturally inhabit most of southern Asia. Because they are widely used in biomedical research and kept in zoos, the rhesus monkey has described several conditions that are identified as a cause of death or associated with aging. Hence the importance of studying and describing diseases that may affect this species, whether they are of an infectious, neoplastic or metabolic nature. The objective of this work is to describe a case addressing the clinical and pathological aspects of fatal pulmonary acariasis in a zoo rhesus monkey, in addition to a primary malignant renal neoplasia.

Case: An adult male rhesus monkey, coming from the zoo and with no history of previous diseases, signs of general weakness, lethargy, lack of appetite. Due to poor prognosis and

non-responsiveness to treatment, euthanasia was chosen. Macroscopically, the lung contained multiple round lesions, sometimes coalescing, yellow to gray, firm, measuring 2 to 5 mm; the kidney contained a rounded and elevated lesion on the capsular surface, 0.8 cm in diameter, well delimited and white, when cut it was a firm white, rounded surface, limited to the cortical region. Microscopically, there were bronchiolitis and piogranulomatous and eosinophilic bronchitis characterized by multifocal lesions where they replaced and distended the adjacent lung parenchyma due to the large number of neutrophils, macrophages, eosinophils, less multinucleated giant cells, lymphocytes and plasma cells. In the renal cortex, a well-defined circular encapsulated neoplasm was noted, with free margins and densely cellular composed of uniform polygonal cells arranged in papillae supported by thin fibrovascular stroma, immunohistochemistry demonstrated primary malignant epithelial neoplasia.
Discussion: Although in the past the presence of mites in the lung (Pneumonyssus simicola) was considered a finding in almost 100% of rhesus monkeys captured in the wild, the introduction of therapeutic and sanitary measures during quarantine made the identification and active pulmonary infection rare. Histologically, the lesion caused by the mite is quite characteristic, although some descriptions have slight variations. The presence of fragments of the chitinous exoskeleton associated with inflammatory cells is consistent with treated animals, whereas the active infection is characterized by the presence of intact mites surrounded by eosinophilic granulomatous inflammation with black pigments Some reviews on neoplasms in primates show that the digestive and endocrine systems are the most affected and that neoplasms in the kidney are rare and among these metastases are more common than primary neoplasms. Among the neoplasms that affect the kidneys, those of malignant epithelial origin are more frequent, being the carcinoma or renal adenocarcinoma. Macroscopically, adenocarcinoma is characterized by being a round to oval neoplasm, pale to yellowish, may have a reddish center depending on its size. Microscopically they are classified as papillary, tubular and solid, and there may be more than one pattern in the same tumor. There is no clinical sign or characteristic clinical pathological change. The diagnoses are usually made during necropsy and through histopathology. Through the necropsy exam, it was possible to observe two conditions considered low frequency in the rhesus monkey: bronchitis and bronchiolitis by mites and unilateral renal adenocarcinoma in a zoo rhesus monkey
Keywords: Pneumonyssus, neoplasia, immunohistochemistry, primate.

INTRODUTION

Primatas não humanos são animais amplamente utilizados como modelos experimentais para diversas condições, assim desenvolvendo importante papel nas pesquisas através do estudo de doenças, questões de saúde humana e estratégias de prevenção além do importante papel na conservação de ecossistemas [38, 41]. Decorrente a proximidades genéticas surgem preocupações quando novos patógenos podem ameaçar a vida dos primatas, como na pandemia do Sars-Cov-2 [21].

Os macacos-rhesus *Macaca mulatta* (Zimmermann, 1780) são primatas do velho mundo que habitam naturalmente a maior parte do sul da Ásia e possuem uma taxonomia complexa [17,45]. Dentre as espécies de primatas não humanos utilizados na pesquisa biomédica eles têm bastante destaque pois possuem maior quantitativo de animais em relação

ao número total [3, 22] e possuem uma grande importância pois foi devido a estudos com essa espécie foi possível criar vacina contra a pólio e estudos estão sendo realizados para o desenvolvimento de uma vacina contra a covid19 [20, 42].

Por serem amplamente utilizados nas pesquisas biomédicas e mantidos em zoológicos o macaco-rhesus tem descrito diversas condições que são apontadas como causa de morte ou associado ao envelhecimento [35, 43, 44]. Surge daí a importância de se estudar e descrever doenças que venham a acometer essa espécie sejam elas de natureza infecciosa, neoplásica ou metabólica [33].

Objetiva-se com esse trabalho descrever um caso abordando os aspectos clínicos e patológicos da acaríase pulmonar fatal em um macaco-rhesus de zoológico, além de uma neoplasia primária renal maligna.

CASE REPORT

Um macaco-rhesus adulto, macho, proveniente do Parque Zoobotânico Arruda Câmara, João Pessoa, Paraíba, Brasil sem histórico de doenças pregressas apresentou sinais de fraqueza geral, letargia, inapetência. Devido ao prognóstico ruim e a não responsividade ao tratamento com anti-inflamatório e antibióticos foi optado por eutanásia [4].

No exame de necropsia foi possível observar que o pulmão estava com múltiplos nódulos amarelo pálidos, firmes, medindo 2 a 5 mm de diâmetro, que distribuíam por todo o parênquima com os lobos craniais sendo mais afetados. Ao corte os nódulos estendiam-se da superfície pleural para o parênquima pulmonar. No rim foi possível observar massa arredondada e elevada superfície capsular com 0,8 cm de diâmetro, era bem delimitada e de cor branca, ao corte era firme superfície regular branca e arredondada limitando-se a região cortical. Amostras de rim e pulmão coletadas, foram fixadas em formalina tamponada a 10%, processadas convencionalmente, embebidas em parafina, cortadas em seções de 4 μm e coradas com hematoxilina e eosina[1] no Laboratório de Patologia Veterinária da UFPB.

Microscopicamente o pulmão continha uma bronquiolite e bronquite piogranulomatosa e eosinofílica caracterizada por lesões multifocais que distendiam a paredes bronquiolares decorrente do grande número de neutrófilos, macrófagos, eosinófilos, menos células gigantes multinucleadas, linfócitos e células plasmáticas (Figura 1A). Por vezes o epitélio bronquiolar era reduzido ou ausente e ocasionalmente hiperplásico e poucas regiões. Multifocalmente no lúmen ou na parede dos bronquíolos era possível observar seções transversais de artrópodes adultos (Figura 1B). Multifocalmente foram observados múltiplos agregados de macrófagos que continham material birrefringente intracitoplasmático de marrom dourado a preto finamente granular (pigmentos de ácaros). Dentro dos alvéolos

circundantes, haviam numerosos macrófagos alveolares, misturados com eosinófilos, linfócitos, células plasmáticas, fibrina, hemorragia e edema.

No córtex renal notou-se neoplasma circular bem delimitado, encapsulado, com margens livres e densamente celular composto por células poligonais uniformes dispostas em papilas suportadas por fino estroma fibrovascular (Figura 1C). As células neoplásicas possuíam bordas indistintas e pequenas quantidades de citoplasma eosinofílico finamente granular. Os núcleos são redondos a oval, com cromatina finamente pontilhada e 1-2 nucléolos evidentes. Baixo índice mitótico (1 por campo de grande aumento). Multifocalmente, os tufos glomerulares estavam expandidos por discreto espessamento segmentar de membranas basais e células mesangiais (glomerulonefrite). Alguns glomérulos estavam atrofiados (esclerose glomerular multifocal). Os anticorpos CD10 monoclonal $(56C6)^2$ foram usados para análise imuno-histoquímica (Figura 1D).

DISCUSSION

As lesões causadas pelo ácaro são bastante marcadas sendo múltiplos nódulos firmes branco a amarelo por vezes coalescendo espalhados pelo parênquima pulmonar. Vale ressaltar que macroscopicamente a lesão causada pelo ácaro deve ser diferenciada da lesão de tuberculose, apesar desta última ser mais firme com superfície de corte mais densa [47].

Histologicamente a lesão causa pelo ácaro é bastante característica apesar de algumas descrições terem pequenas variações [25, 31]. A presença de fragmentos do exoesqueleto quitinoso associado a células inflamatória é condizente com animais tratados, já a infeção ativa é caracterizada pela presença de ácaros intactos circundados por inflamação granulomatosa eosinofílica com pigmentos pretos [43]. Apesar da ênfase em descrever a ausência de formação de células gigantes [14, 25], trabalhos mais recentes as descrevem, assim como o encontrado nesse relato [2, 24, 26, 31]. Os pigmentos pretos presentes na lesão não são encontrados em animais livres dos ácaros, apesar dos esforços sua origem exata ainda não é definida porém pode estar relacionada a excreção do parasito [7, 25, 26].

Infecções fatais associadas a presença do ácaro foi descrita em macaco-rhesus (*Macaca mulatta*), macaco-japonês (*Macaca fuscata*), macaco-de-cauda-de-porco-do-sul (*Macaca nemestrina*), Chimpanze (*Pan* spp.), douc-de-canelas-vermelhas (*Pygathrix nemaeus*) [23, 24, 26, 36, 46].

O diagnóstico *ante mortem* de infecção subclínica ou massiva pelo ácaro é desafiador, pois exames de imagem, como o raio-x, e hematológicos são de pouco valor [19, 25, 39].

A eficácia do tratamento para a acaríase pulmonar já foi tema bastante dicutido, pois estudos com compostos arsênicos e organofosfatos mostraram não ser tão eficazes, porém com o advento de drogas a base de ivermectina o tratamento se torna eficaz [16, 28].

Assim como em humanos, as neoplasias e doenças proliferativas possuem relevante morbimortalidade e estão relacionadas ao envelhecimento nos animais, porém ainda são escassos dados epidemiológicos a respeito de tais desordens em populações de primatas a respeito da incidência e sua relação com idade e carcinogênese por exemplo, existindo alguns relatos pontuais e revisões que têm demonstrando grande importância dessa condição nos primatas [32, 40, 44, 49].

Apesar da incidência de neoplasia de primatas ser baixa, através de estudos com primatas mais velhos foi possível observar relatos surgindo. [27]. Nos macacos-rhesus o surgimento de neoplasias ocorre por volta dos 20 anos, porém pode ocorrer em animais mais jovens [44].

Algumas revisões sobre neoplasias em primatas mostram que o sistema digestório e o endócrino são os mais afetados e que neoplasias no rim são raras e dentre estas as metástases são mais comuns que os neoplasmas primários [9, 10, 40, 44]. Dentre as neoplasias que acometem os rins as de origem epitelial malignas são mais frequentes, sendo o carcinoma ou adenocarcinoma renal descrito em *Siimiformes* e *Prosimii* [8, 34, 40].

Macroscopicamente o adenocarcinoma é caracterizado por ser uma neoplasia redonda a oval, pálida a amarelada, pode possuir centro avermelhado dependendo do tamanho. Podem se apresentar como uma lesão elevada à superfície capsular ou se localizar mais internamente e ser observada apenas após o corte do parênquima renal. Comumente é uma alteração unilateral única porém, apesar de incomum, as metástases, tumores bilaterais ou múltiplos focos no mesmo rim já foram relatadas [5, 29, 37].

Microscopicamente são classificados em papilar, tubular e sólido, podendo haver mais de um padrão no mesmo tumor [11, 27]. Não há um sinal clínico e nem alteração clinico patológica característica [11, 27, 37]. Os diagnósticos geralmente são feitos durante necropsia e através da histopatologia. [27, 29, 44].

Através do exame de necrópsia foi possível observar duas condições de consideradas de baixa frequência no macaco-rhesus a bronquite e bronquiolite por ácaro e adenocarcinoma renal unilateral em um macaco-rhesus de zoológico.

MANUFACTURERS

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Declaration of interest.

Os autores informam que não há conflitos de interesse. Os autores são os únicos responsáveis pelo conteúdo e redação do artigo.

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LEGENDS

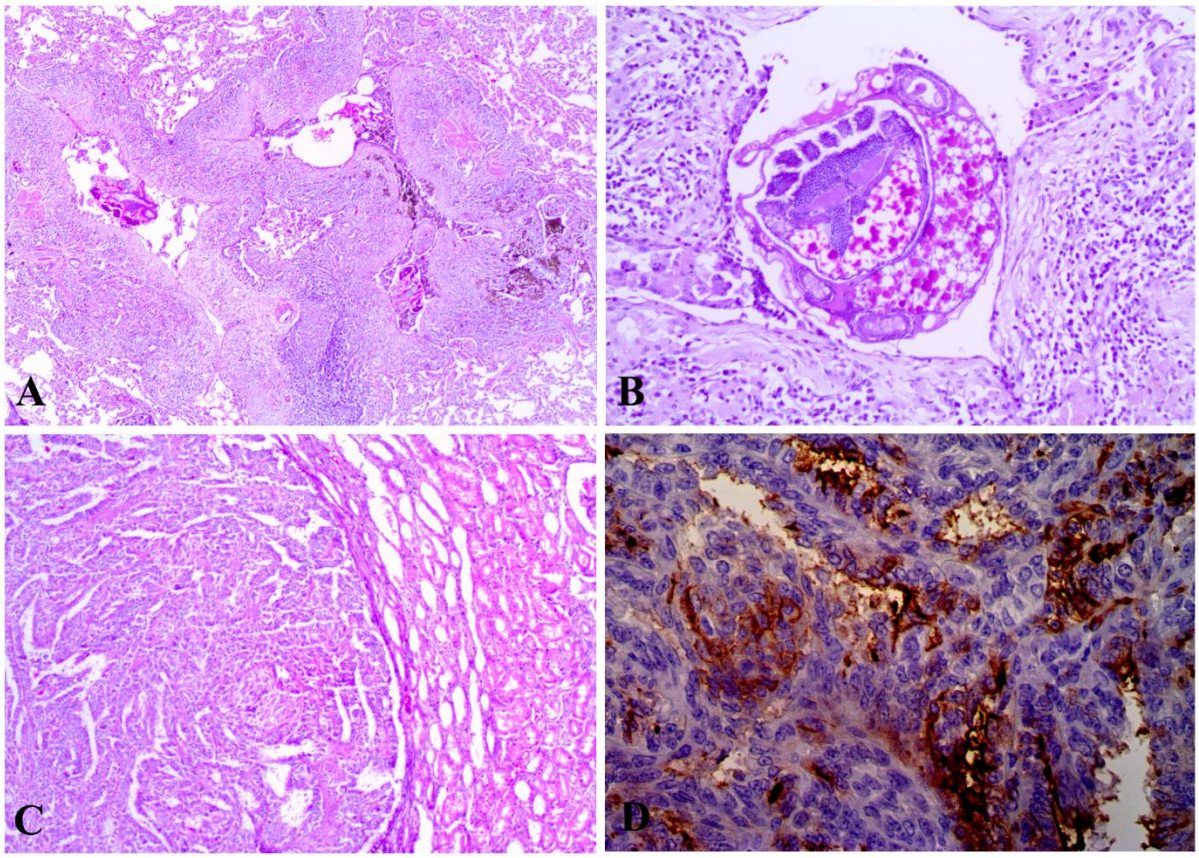

Figure 1. Acaríase pulmonar e adenocarcinoma renal em macaco-rhesus. A- Paredes bronquiolares distendidas decorrente grande número de células inflamatórias associada a presença de ácaro. B- Seção transversal de *Pneumonyssus* simicola no interior de bronquíolo que apresenta perda de epitélio. C- Micrografia demonstrando neoplasma circular bem delimitado disposto em papilas suportadas por fino estroma fibrovascular. D- Marcação marrom intensa de células de origem epitelial pelo anticorpo CD10.

CONSIDERAÇÕES FINAIS

Diversas são as doenças que acometem os primatas não humanos e a grande variedade encontrada nesse trabalho demonstra isso. Como esses animais podem ser carreadores patógenos e alguns podem ser zoonoses, o monitoramento das enfermidades que acometem esses animais é de grande importância tanto para a conservação das espécies como para a manutenção da saúde única. As doenças parasitárias assim como cita a literatura foi a mais frequente juntamente com as doenças bacterianas. Além disso foi possível descrever condições raras como acaríase pulmonar fatal e infecção por *Dipetalonema gracile* em *S. flavius* de vida livre.

Estre trabalho reforça a necessidade de estudos contínuos para o monitoramento das condições que afetam a saúde de primatas não humanos sejam de vida livre ou cativeiro.