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Case Report
Wildlife Medicine

Bilateral perirenal fat necrosis in a sambar deer (*Rusa unicolor*)[1]

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ABSTRACT.- Bernardo A.C.M.R., Lima T.S., Fonseca S.M.C., Silva-Filho G.B., Bom H.A.S.C., Melo E.T., Silva J.P.G & Mendonça F.S. 2023. **Bilateral perirenal fat necrosis in a sambar deer (*Rusa unicolor*).** *Pesquisa Veterinária Brasileira 43:e07254, 2023*. Laboratório de Diagnóstico Animal, Universidade Federal Rural de Pernambuco, Rua Dom Manoel de Medeiros s/n, Dois Irmãos, Recife, PE 52171-900, Brazil. E-mail: fabio.mendonca@ufrpe.br

The gross and histopathological findings of perirenal fat necrosis in a sambar deer (*Rusa unicolor*) are described in a 6-year-old female deer that was necropsied after showing severe apathy, weight loss, recumbency, and death. At *post-mortem* examination, two large white to yellow, irregular, and encapsulated masses involving both kidneys were observed. Microscopically, these masses consisted of fat tissue presenting multifocal to coalescing areas of necrosis, diffuse infiltration of lymphocytes, macrophages, occasional plasma cells, and multinucleated giant cells. Multifocally, the necrotic sites were replaced by mineralization and fibrosis. The described condition has not been reported in deer and the exact mechanisms of development of perirenal fat necrosis remain to be determined. Massive fat necrosis has been reported in other animal species such as dogs, cats, pigs, goats, cattle, and whales (*Balaena mysticetus*). It is usually an incidental finding during *post-mortem* examination that needs to be differentiated from neoplasms originating from the adipose tissue, kidneys and adrenals, and disorders resulting from pancreatitis and obesity.

INDEX TERMS: Fat necrosis, adipocytes, mineralization, deer, *Rusa unicolor*.

RESUMO.- [**Necrose gordurosa perirrenal bilateral em cervo sambar (*Rusa unicolor*).**] São descritos os achados anátomo e histopatológicos da necrose gordurosa perirrenal em um cervo sambar (*Rusa unicolor*) fêmea de seis anos de idade que foi necropsiado após apresentar severa apatia, perda de peso, decúbito permanente e morte. Durante a necropsia foram observadas duas grandes massas brancas a amarelas, duras, irregulares e encapsuladas envolvendo ambos os rins. Microscopicamente, essas massas consistiam em áreas de necrose multifocais a coalescentes do tecido adiposo perirrenal, com infiltrado difuso de linfócitos, macrófagos e ocasionais plasmócitos e células gigantes multinucleadas. Multifocalmente, as áreas necróticas estavam substituídas por mineralização e fibrose. A compressão dessas massas no córtex renal foi associada à degeneração tubular renal leve a mínima. A condição descrita não foi relatada em veados e os mecanismos exatos de desenvolvimento da necrose da gordura perirrenal ainda precisam ser determinados. Necrose gordurosa maciça foi relatada em outras espécies de animais, como caninos, felinos, suínos, caprinos, bovinos e baleias (*Balaena mysticetus*). Geralmente é um achado incidental durante o exame *post-mortem* que precisa ser diferenciado de neoplasias originárias do tecido adiposo, rins e adrenais, e distúrbios decorrentes de pancreatite e obesidade.

TERMOS DE INDEXAÇÃO: Necrose gordurosa, adipócitos, mineralização, cervo, *Rusa unicolor*.

INTRODUCTION

Abdominal fat necrosis (AFN), steatonecrosis, or encapsulated fat necrosis refers to the process of saponification of adipose tissue as a result of enzymatic changes in adipocytes (Tharwat & Buczinski 2012). This lesion may result from nutritional, pancreatic disorders (Tani et al. 2017), traumatism of fat tissue, or may be idiopathic (Ortiz et al. 2018). In the pathogenesis of AFN, when associated with pancreatitis, the necrosis is attributed to the release of proteolytic and lipolytic enzymes

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from damaged pancreatic acini, and the degeneration of neutrophils recruited to the area (Uzal et al. 2016). Additional possibilities for the pathogenesis include the action of free radicals present in inflammatory responses or lipid-rich diets or vitamin E and Selenium poor diets, which have been also associated with the pathogenesis of this lesion (Wang et al. 2016). As a result of injury, adipose tissue becomes hemorrhagic and firm, which is followed by granulomatous inflammation, necrosis, mineralization, and fibrosis (Taboada et al. 2009).

In human beings, different spectra of the condition are described, such as the subcutaneous fat necrosis of newborns (Stefanko & Drolet 2019), breast (Vasei et al. 2019), and epicardial fat necrosis (Artunduaga et al. 2020). Hypercalcemia is an important factor associated with the occurrence of this lesion in children (Chesover et al. 2021), while in adults, radiotherapy or surgical trauma may contribute to its origin (Taboada et al. 2009). Furthermore, these masses can cause complications such as peritonitis (Samuel et al. 2013), or they can involve intestinal loops, promoting functional blockage of the ingesta (Biondi et al. 2017), similar to that occurs in horses with lipomas (Edwards & Proudman 1994). When immobile, the compression caused by the mass may cause ischemic necrosis in adjacent organs.

In domestic animals, AFN has been described in dogs, cats (Schwarz et al. 2000), cattle, sheep, goats, horses, and swine (Vitovec et al. 1975, Smith et al. 2004). In cattle, AFN has been more frequently associated with obesity and a high-energy diet (Tani et al. 2017) and in specific areas, AFN is more frequent in cattle grazing tall fescue grass. In wild species, the lesion has been reported in aquatic Caecilians (*Typhlonectes* sp.), whales (Sykes et al. 2006, Stimmelmayr et al. 2021), and Eld's deer (*Rucervus eldii*). However, its occurrence in other species of cervids is unknown. For this reason, the aim of this study was to report the pathological findings of perirenal fat necrosis in a sambar deer.

CASE REPORT

A 6-year-old female sambar deer (*Rusa unicolor*) from a private zoological collection, was necropsied after showing severe apathy, progressive weight loss, and permanent recumbency. Necropsy findings included two large masses in the abdominal cavity involving both kidneys. The first consisted of a 10cm x 5cm x 4cm long, weighing 292g and adhering to the right kidney. Adhering to the left kidney there was a mass measuring 17cm x 6cm x 4cm long, and weighing 384g. No other significant gross lesions were noted.

These masses were white to yellow, irregular, and encapsulated (Fig.1). On cut surface, the masses creaked and had a multilobed appearance, which varied from white to yellow, interspersed by black punctate multifocal areas and by focally extensive brown areas of calcification. In these areas, there was resistance to cleavage. On the cut surface, both kidneys' cortical regions had irregular edges and were reduced in size, secondary to compression (Fig.2). Fragments of the mass and kidney were fixed in 10% buffered formalin and routinely processed for histopathology. Tissues embedded in paraffin were sectioned into 3-4µm sections and stained with hematoxylin and eosin (HE) and Masson's trichrome (MT).

On histopathological examination, the lesions consisted of capsulated and multilobulated masses with multifocal to coalescing areas of necrosis, inflammation, fibrosis and mineralization of adipose tissue (Fig.3). The negative images of adipocytes were mostly anucleated, with irregular to lysed edges (steatonecrosis) (Fig.4), and multifocal to focally extensive areas of mature fibrous connective tissue proliferation (fibrosis) replacing and/or separating the fat necrosis, forming dense and well-delineated septa was noted (Fig.5). Also containing cellular debris, lipid clefts/crystals and an inflammatory infiltrate consisting of lymphocytes,

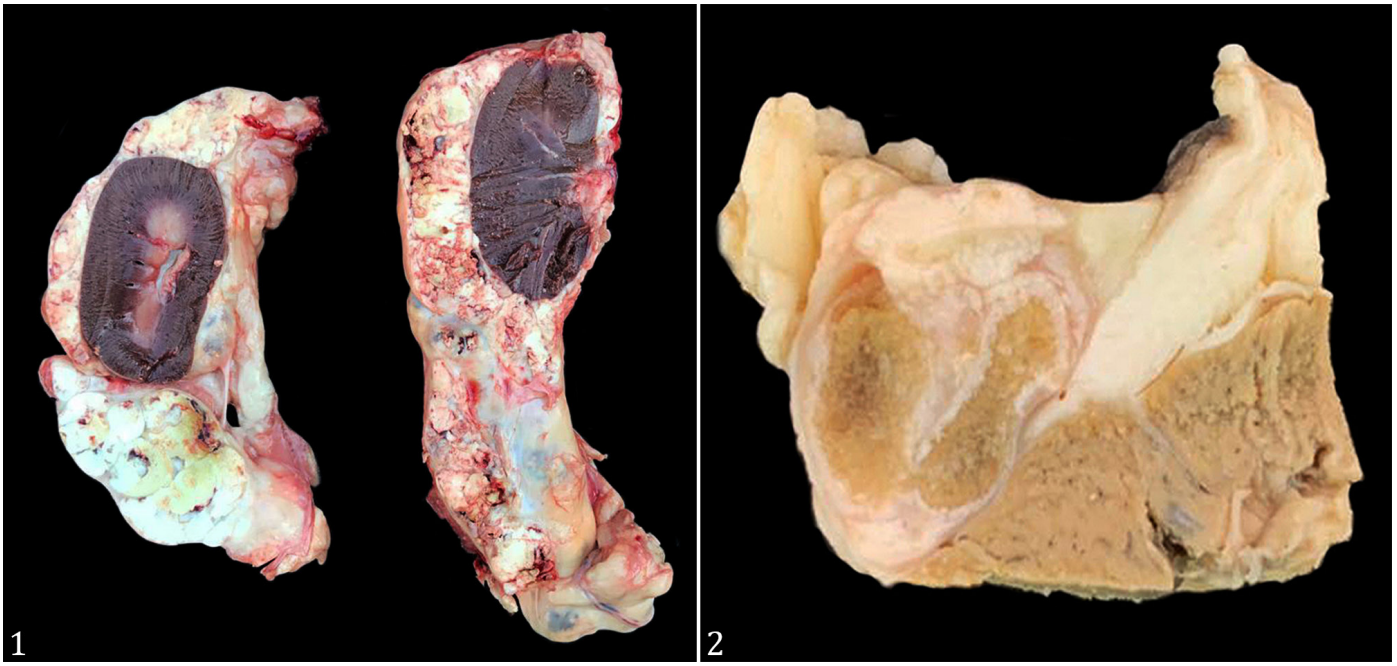

Fig.1-2. Bilateral perirenal fat necrosis in sambar deer (*Rusa unicolor*). (**1**) The kidneys are completely surrounded by a firm, white-to-yellow fat, forming multiple concentric nodules. (**2**) Formalin-fixed tissue showing the cut surface of perirenal fat. The mass contains multiple irregular firm areas separated by fibrous septa.

macrophages, occasional plasma cells and multinucleated giant cells (granulomatous steatitis) (Fig.6). Occasionally, close to the areas of inflammation, there were intensely reactive fibroblasts associated with the deposition of immature collagen fibers, in addition to intralesional multifocal amorphous and basophilic (mineralization) areas. In MT, there was marked staining of capsular and intralesional collagen fibers, excluding evidence of chondroid metaplasia. Microscopically, at the subcapsular surface, especially in the areas close to the renal capsule and the mass, there was mild to minimal epithelial tubular degeneration and multifocal areas of lymphocyte and plasma cell infiltration.

DISCUSSION

The diagnosis of AFN was based on pathological and histological findings which were similar to previous reports (Wolfe et al. 1998, Tharwat & Buczinski 2012). To the authors' knowledge, this is the first description of AFN in this species of cervid, which was characterized by severe replacement of adipose tissue by varying degrees of inflammation, hemorrhage, necrosis, and mineralization. Given the chronic nature of the condition and the anatomical location, the diagnosis was only possible during the necropsy, so it was not possible to associate it with the patient's previous clinical condition.

The histological findings observed in this case indicate that the lesion was chronic in which moderate to severe fibrosis and mineralization, and mild infiltration of lymphocytes, plasma cells, macrophages, and multinucleated giant cells were noted (Uzal et al. 2016). However, in the current case, the cause of death was not determined. AFN is usually an incidental finding during *post-mortem* examination (Uzal et al. 2016) and was not associated with the loss of condition and death of this sambar deer. Nevertheless, AFN can be fatal if it obstructs the intestines or compression of the ureters (Herzog et al. 2010).

In cattle and small ruminants, the specific etiology of abdominal fat necrosis remains little understood. However,

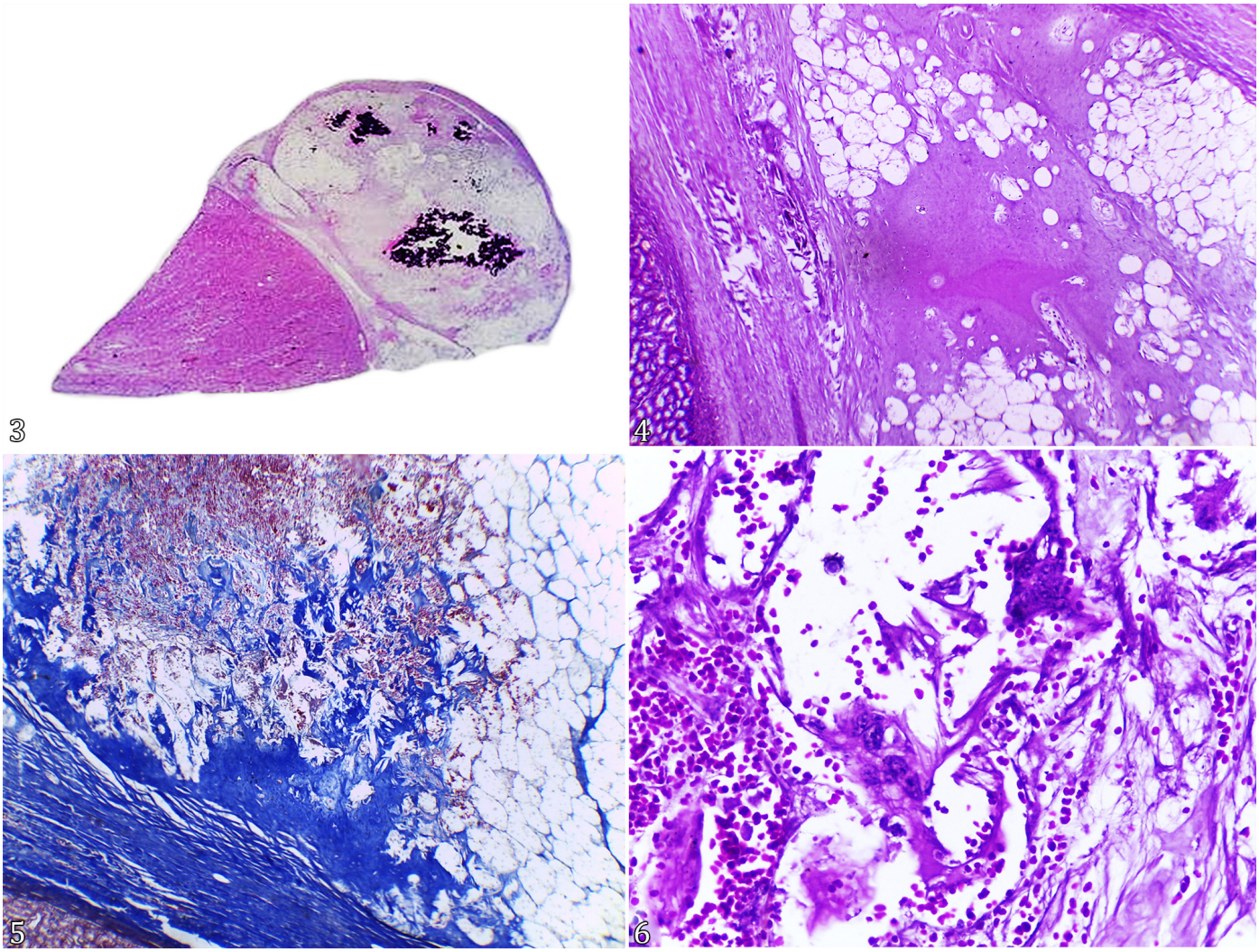

Fig.3-6. Bilateral perirenal fat necrosis in sambar deer (*Rusa unicolor*). (**3**) Subgross view of perirenal fat necrosis. Note the mass with multifocal areas of mineralization adhered to the capsular surface of the kidney. Deposition of calcium salts (saponification) is evident. (**4**) The fat necrotic mass is separated from the renal tissue by a thick fibrous capsule. The mass exhibits a marked reduction in mature adipocytes, with random necrosis and fibrosis. HE, obj.10x. (**5**) A remarkable connective tissue dissecting the adipocytes and hemorrhage is noted with the staining. MT, obj.10x. (**6**) Granulomatous inflammation, hemorrhage, and increased connective tissue. HE, obj.40x.

this condition can be multifactorial, which may include disturbances of lipid metabolism, vitamin E deficiency, pancreatitis, and toxicity of tall fescue infected with high levels of the endophyte *Neotyphodium coenophialum* (Smith et al. 2004, Wang et al. 2016). It is also believed that fescue toxicosis can cause AFN in the deer (Wolfe et al. 1998). In a study, five adult female Eld's deer (*Rucervus eldii*) died due to large masses of necrotic abdominal fat constricting the ureters, causing hydroureter and hydronephrosis. The herd from which these deer originated was maintained on pastures consisting primarily of tall fescue, samples from which were subsequently confirmed to be infected with an endophytic fungus. A retrospective study of deaths in this herd revealed a sharp increase in the incidence of abdominal AFN (Wolfe et al. 1998). Yet rabbits fed with high levels of raw soybeans, a lipase-rich plant, develop high serum lipase levels and can present AFN of perirenal fat which can be prevented by cooking the soybeans (Papp & Williams 1970).

Renal involvement is identified as the second major site of AFN in cows (Tharwat & Buczinski 2012) and both gross and microscopic findings described here were similar to previous reports (Reed & Evans 2010, El-Sebaie & Khaleel Abd Elghaffar 2015), although the renal damage observed had been more severe. However, no construed ureters, hydroureter, and hydronephrosis were observed in the current case, as reported before (Wolfe et al. 1998). It is important to emphasize that AFN masses can be also observed in the omentum where usually they compress the abomasum, small intestine, and spiral colon and obstruct the birth canal (Tharwat & Buczinski 2012), but these alterations were not observed.

The cause of fat necrosis reported here remained undetermined. Pancreatitis was ruled out because it was not observed microscopically. No fescue grass, raw soybeans, or soybeans byproducts were given to the deer. However, other toxic factors can not be ruled out. Unfortunately, it was not possible to provide ancillary exams for disturbances of minerals or disturbances of lipid metabolism. For these reasons, nutritional or disturbances of lipid metabolism could not be discarded.

Possible differential diagnosis for AFN includes lipomas, angiolipomas, and liposarcomas which may exhibit nodular-cystic fat necrosis (Hurt & Santa Cruz 1989). Given possible pancreatic involvement, acute pancreatitis and pancreatic carcinoma (Hurt & Santa Cruz 1989) should be considered in the differential diagnosis of AFN.

CONCLUSION

Abdominal fat necrosis (AFN) is an incidental finding during *post-mortem* examination. This condition needs to be differentiated from neoplasms originating from the adipose tissue, kidneys, and adrenals.

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