Bovine renal lipofuscinosis in a Tanzanian crossbred yearling male calf: A case report

ABSTRACT

Aim: Report a rare case of bovine renal lipofuscinosis (BRL) that was encountered incidentally at necropsy.
Presentation of the case: In June 2023 an yearling male calf was found dead in one of the dairy cattle farms in Mbeya city, Tanzania; after being sick for about a week. The owner requested a necropsy service to establish the cause of the death of the animal. Necropsy revealed significant gross pathological changes in a liver that was cooked-like and shrunken, with flabby consistence and large pale necrotic foci. Furthermore, dark blue discoloration of both kidneys with normal morphology was evident. Based on the history and gross pathological findings, the animal was diagnosed to have died from acute hepatitis. Differential diagnosis for kidney discoloration included hemachromatosis, renal hemosiderosis, BRL, and melanotic renal cell carcinoma (MRCC). After ruling out hemachromatosis, renal hemosiderosis and MRCC in the list of possible causes of kidney discoloration based on the lack of gross pathological findings, particularly hepatic fibrosis, pallor, and a mass of tumor tissue in the kidneys that are characteristic of hemachromatosis, renal hemosiderosis and MRCC, respectively; the cause of kidney discoloration was diagnosed as BRL.
Discussion: In this necropsy, the history and gross pathology suggested that the animal's death could be attributed to acute liver failure, which is one of the sequelae of acute hepatitis. Kidney discoloration was not considered an attribute factor to the animal's death because, with the exception of discoloration, the kidneys did not have gross pathological changes. Moreover, to date there has been no report of a clinical disease in cattle associated with BRL. However, BRL is an important disorder because it leads to condemnation of the affected kidneys as unfit for human consumption.
Conclusion: The case of BRL reported here was an incidental finding at necropsy, and is not associated with the death of the animal.

Keywords: *Dark blue discoloration, black kidneys, hemachromatosis, renal hemosiderosis, melanotic renal cell carcinoma*

1. INTRODUCTION

Bovine renal lipofuscinosis (BRL) is an incidental finding in cattle at slaughter [1, 2]. It is associated with brown to black kidney discoloration, which is condemned as unfit for human consumption [1, 3]. Grossly, the main characteristic is a brownish to dark brown discoloration of the kidneys in an apparently healthy animal [2, 4]. The discoloration affects the entire organ and both kidneys are equally affected to the same extent. The extent of discoloration varies. In some instances, it may be so intense that the kidneys appear dark blue [4]. This discoloration has led to the more common name "black kidney disease" [2, 4, 5].
Histopathology of "black kidneys" demonstrates no renal lesions and a preserved renal parenchyma. For histological sections stained with hematoxylin and eosin (H&E) stain, a

granular refringent pigment varying from light yellow to brown or red can be seen within proximal tubules. For histological sections stained with periodic acid Schiff (PAS) stain, pigment varying from deep purple to a light pinkish-purple can be seen within the proximal tubules [2, 3].

BRL has been reported as incidental findings in slaughter cattle for more than a century [3]. Initially, some studies identified the accumulation of melanin pigment as the cause of this condition. Others identified the accumulation of hemosiderin as the cause of the condition, and others identified the accumulation of lipofuscin pigment as the cause of the condition [3]. Since the 1960s, several studies have further classified this pigment as lipofuscin based on its staining and ultrastructural properties [2, 3], a view currently generally accepted.

Generally, lipofuscin pigment comes from the degradation of proteins and lipids that accumulate within cells, especially cells of the heart [2, 6, 7, 8], liver [2, 6], neurons [2, 6, 7, 8, 9], kidneys [6], dermal tissue [6, 8, 10] and skeletal muscle fibers [7] as part of the normal cellular aging process [2, 8, 10] or in association with multiple diseases or disorders [2].

According to reports from epidemiological and genealogical studies, the disorder has a genetic etiology with simple autosomal recessive inheritance in the Danish Red and Danish Holstein breeds [1, 3], but with incomplete penetrance of the genotype in Danish Holsteins [1]. The disorder has been reported in Danish Red, Danish Holstein, crossbred cattle [1, 3], Danish Jersey, Danish Red Holstein, Finnish Ayrshire, Norwegian Red, Jutland cattle, Summerntaler, Swiss Brown, Grauviel, Highland cattle, Danish Gelbvieh, Dexter, Salers, Aberdeen Angus, Galloway, Hereford, Piemontese, Blonde d'Aquitaine, Danish Shorthorn, Danish Charolais, Limousine, and Belgian blue breeds of cattle [1]. This paper reports a case of BRL encountered at necropsy of a crossbred yearling male calf in a dairy cattle farm composed of Friesian crosses, in Mbeya city, Tanzania.

2. PRESENTATION OF THE CASE

On 12 June 2023 an yearling male calf was found dead in the morning in one of the dairy cattle farms in Mbeya city, Tanzania. According to the animal attendant, before death the animal was recumbent with decreased appetite for seven consecutive days and was treated with oxytetracycline and multivitamin. Unfortunately, the prognosis was poor, so the animal died. The owner requested a necropsy service to establish the cause of the death of the animal. Necropsy was carried out using standard procedures described previously [11]. Gross pathological findings included a cooked-like shrunken liver with flabby consistence and large necrotic foci (Figure 1). Dark blue discoloration of the kidneys was also evident. The discoloration affected the entire kidneys and both kidneys were equally affected to the same extent (Figures 2 and 3). However, the kidneys had normal gross morphology, that is, normal size and texture (consistence). Based on the history and gross pathological findings, the animal was diagnosed to have died of acute hepatitis.

Differential diagnosis for kidney discoloration included hemochromatosis [12], renal hemosiderosis, renal lipofuscinosis, and melanotic renal cell carcinoma (MRCC) [13]. Renal hemosiderosis is a disease in which hemosiderin is deposited in the renal cortex as a form of iron overload. It is a complication of chronic intravascular hemolytic states such as hemolytic anemia, paroxysmal nocturnal hemoglobinuria, and mechanical hemolysis from the prosthetic cardiac valve [14]. Hemochromatosis is a disease characterized by an accumulation of iron in the liver and other organs, including the kidneys [15] that leads to tissue damage, particularly the liver [16]. A carcinoma is a type of cancer that forms solid tumors. Like other types of cancer, carcinomas are abnormal cells that divide without control.

Carcinomas form in epithelial cells, which line the outer surface of the skin and the cover and lining of organs and internal passageways, such as the gastrointestinal tract [17].

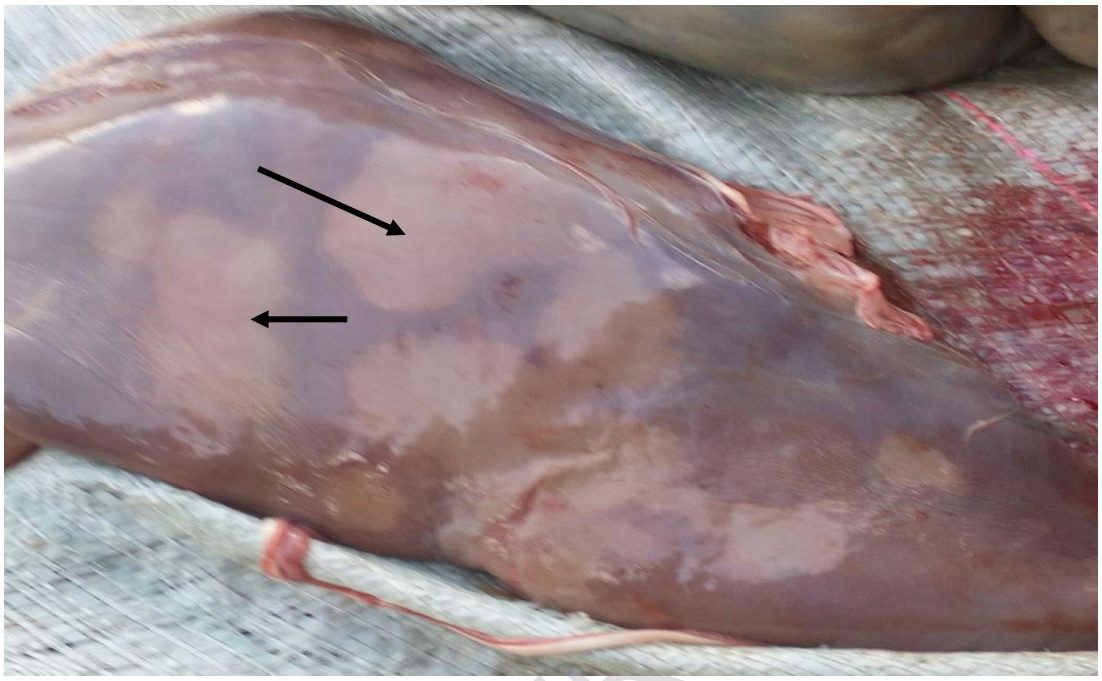

Fig. 1. An image of a cooked-like shrunken liver showing large pale necrotic foci (arrows).

Fig. 2. An image of a right kidney showing dark blue discoloration of the kidney surface.

Fig. 3. An image of a left kidney showing dark blue discoloration of the kidney surface.

Based on gross pathology, the disorder was diagnosed as renal lipofuscinosis (black kidneys). The diagnosis was made after ruling out renal hemosiderosis, hemochromatosis, and MRCC in the list of possible causes of kidney discoloration based on the absence of gross pathological findings characteristic of each of these diseases. Renal hemosiderosis was ruled out because the dead animal was not anemic; this was indicated by a lack of pallor. Anemia is a consistent characteristic feature of hemosiderosis [14, 18, 19, 20, 21, 22]. Hemochromatosis was excluded due to the lack of liver fibrosis, a gross pathological finding involving the liver that has been consistently reported in cases of hemochromatosis [12, 15, 23, 24, 25, 26, 27]. MRCC was ruled out because the kidneys were grossly free of tumor tissue, which is a characteristic feature of renal cell carcinoma [28, 29, 30, 31, 32] and other types of cancer. Due to budget limitations, histopathology could not be performed to confirm the diagnosis.

3. DISCUSSION

Generally, BRL is a rare disorder in cattle that has been reported to occur incidentally during meat inspection after slaughter of cattle found to be clinically healthy during antemortem inspection [1, 2, 3, 4]. Unlike previous reports, this article reports a case of BRL encountered at necropsy which revealed a shrunken, cooked-like liver with flabby consistence and large pale necrotic foci, and dark blue discoloration of both kidneys. Renal hemosiderosis, hemochromatosis, MRCC, and BRL were considered for differential diagnosis of the dark blue discoloration of the kidneys. Based on gross pathology, the discoloration was diagnosed as BRL after ruling out renal hemosiderosis, hemochromatosis, and MRCC due to lack of pallor, liver fibrosis, and tumor tissue, respectively; which are gross pathological findings characteristic of each of these diseases.

Although in addition to a cooked-like shrunken liver with flabby consistence and large pale necrotic foci, BRL was also evident at necropsy, the pathological changes found in the liver were found to be more significant. Therefore, based on history and gross pathology, the animal was diagnosed to have died of acute hepatitis. The animal's death could be attributed to acute liver failure, which is one of the sequelae of acute hepatitis [33, 34, 35, 36, 37]. BRL was not considered an attribute factor to animal death because, except for discoloration, the kidneys did not have pathological changes (had normal gross morphology). In addition to that, to date, there has been no report of a clinical disease in cattle that is associated with BRL.

In this necropsy, both kidneys were found to have dark blue discoloration and equally discolored to the same extent. These findings are consistent with similar findings previously reported [4]. The normal gross morphology of the discolored kidneys reported here is in agreement with similar incidental findings by Rude et al. [3] at meat inspection where cattle kidneys with dark brown to black discoloration due to the deposition of lipofuscin pigment were found to have normal gross morphology. Furthermore, the finding is in agreement with a previous incidental finding by Lund and Olsen [38] at surgery of a human patient in which the kidneys with diffuse dark brown discoloration due to the deposition of lipofuscin pigment in the epithelium of the proximal tubules were found to have normal gross morphology. These findings suggest that renal lipofuscinosis does not seem to have had any harmful effect on kidney morphology and functions.

BRL is a rare disorder in cattle that has been reported in Holland, Germany, Sweden, Norway [4] and Denmark [3, 4]. Tanzania has been importing heifers, bulls and semen from Europe and the United States for breeding purposes [39, 40, 41]. Having a genetic etiology, this case of BRL could be associated with the importation of animals and semen from countries affected by BRL. To my knowledge, this is the first report of BRL in Tanzania and the African continent at large.

4. CONCLUSIONS

Based on the gross pathological findings, it is concluded that a case of BRL reported here was an incidental finding at necropsy. The finding is not associated with the death of the animal.

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