



Disseminated Pyogranulomas in a Female Dromedary Camel: Hematobiochemical, Sonographic and Pathologic Investigations

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ABSTRACT

This report describes the clinical, hematological, biochemical, sonographic, and pathologic findings in a female camel with disseminated pyogranuloma. A 6-year-old, non-lactating and non-pregnant female dromedary camel was presented due to progressive weight loss during the last 5 months. The presenting complains in the case under investigation consisted of progressive weight loss with a body condition score of 2.0. Hematobiochemical panels indicated severe bacterial infection, hypoalbuminemia, hypoproteinemia, hyperglobulinemia, hyponatremia, hyperkalemia and renal impairment in the form of increased blood urea nitrogen and creatinine concentrations. Transabdominal sonography showed a large area of heterogenous echogenicity between the intestinal loops on the right abdomen; some parts were anechoic. There was no evidence of vascularization. Other areas were homogeneously isoechoic compared to echogenic intestines. Spots of calcification were imaged within the lesions. Similar areas of dissemination were imaged within the right renal parenchyma. Histopathological examination of the abdominal lesion revealed massive, disseminated pyogranulomas composed of chronic suppurative inflammation, including bacterial colonies and exudate rich in neutrophils, macrophages, and plasma cells. In conclusion, transabdominal sonography was valuable for localization, scanning and verification of pyogranuloma and its intra-abdominal dissemination. Histopathological examination of the biopsy specimen, however, is still the final diagnostic tool for disseminating pyogranulomas in camels.

Key words: Camel, Diagnostic imaging, Pathology, Pyogranuloma, Ultrasound.

INTRODUCTION

Pyogranulomatous inflammation is a chronic inflammatory process that is manifested mainly by predominance of neutrophils and macrophages together with giant and plasma cells (Giuliano et al. 2020). Granuloma is defined as a mass-forming lesion that involves always multiple organs and is formed due to chronic inflammation triggered by poorly degradable or

unidentified antigens (Naeem et al. 2021). Microscopically, granulomas can experience different morphologies, extending from necrosis until fibrosis. Therefore, the imaging appearance of granulomas are heterogenous such as malignancy (Naeem et al. 2021).

Intra-abdominal granuloma is rare in small animals. They can be found with feline infectious peritonitis or fungal disease or are caused by foreign bodies, such as retained surgical materials. Among 102 granulomas found

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in in cattle and buffaloes, the cause of 75 of them could be clarified. It was found that 70 granulomas were due to infectious nature; 5 were non-infectious and in 27 no definite etiology could be detected. Infectious causes included parasites in 37 cases, bacteria in 32 cases and fungus in 1 case. However, the non-infectious etiologies included lipid granulomas in 2 cases, neoplasia in 2 cases and renal calculi in 1 case (Uma et al. 2011).

Granulomas are induced by members of *Mycobacterium tuberculosis* complex group, *Echinococcus sp.*, *Schistosomes sp.*, and *Capillaria sp.* (Uma et al. 2011). *Nocardia sp.* cause opportunistic pulmonary, cutaneous and subcutaneous infections in domestic animals, wildlife, and humans which can progress to systemic disease characterized by suppurative to pyogranulomatous inflammation (Doyle et al. 2009). *Actinobacillus lignieresii* is invading adjacent soft tissues after the development of a penetrating wound in cattle and the infection is characterized by pyogranulomas containing sulfur granules especially in tongue (wooden tongue) (Margineda et al. 2013). *Corynebacterium pseudotuberculosis* in sheep and camels is a common pyogranulomatous pathogen and characterized by multiple disseminated pyogranulomas composed of central lamellated caseous necrosis surrounded with layer of neutrophils, lymphocytes and macrophages that encircled with fibrous capsule. Fungi and yeast infections such as Aspergillosis, Mucor and Candidiasis also caused pyogranulomatous lesions (Haridy et al. 2018). In addition, infection with *R. equi* may be taken in consideration in differentiating camelids with pyogranulomatous lymphadenitis, gastroenteritis, pneumonia and abdominal abscessations (Löhr et al. 2019)

Recently, ultrasound has been proved effective in early detecting and verifying different diseases affecting the dromedaries as well as scanning of the healthy camels (Tharwat 2024; Tharwat et al. 2024; Tharwat and Al-Hawas 2024). This report is describing the clinical, hemato-biochemical, ultrasonographic, and pathologic findings in a female camel (*Camelus dromedaries*) with disseminated intra-abdominal pyogranulomas.

MATERIALS AND METHODS

Case presentation

A 6-year-old, non-lactating and non-pregnant female camel (*Camelus dromedaries*) was presented to Qassim University Veterinary Hospital, Saudi Arabia for investigation due to progressive weight loss during the last 5 months. Past history included that 2 other females suffered from the same symptoms in the same herd. All the 3 diseased cases were treated with different broad-spectrum antibiotics, anti-inflammatories, anthelmintics, fluid therapy and appetizers; however, no response was obtained. In spite of the intensive treatment, 2 females collapsed and therefore the 3rd diseased female was admitted to our clinic. Initially, the vital signs including rectal temperature, pulse and respiratory rates, inspecting visible mucus membranes and palpating superficial lymph nodes were carried out. Following, the heart, lungs and gastrointestinal tract were thoroughly auscultated. Owing to the relatively short period at the clinic, ethical approval

of the biopsy procedures by the experimental animal committee regulations of Qassim University were not applicable to this case. Despite this, written approval was obtained from the owner regarding the biopsy process.

Laboratory investigation of hematological and biochemical variables

Blood samples were collected on EDTA tube for estimating complete blood count and on heparin for investigating biochemical variables. The total and differential leukocytic count, erythrocytes, hematocrit, hemoglobin, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) were evaluated in the EDTA sample (VetScan HM5, Abaxis, California, USA). An automated biochemical veterinary analyzer (VetScan VS2, Abaxis, California, USA) was used to measure the plasma constituents of total protein, albumin, globulin, blood urea nitrogen (BUN), calcium, glucose, creatinine, total bilirubin, sodium, and potassium.

Sonography, biopsy, and histological examinations

Transcutaneously, the heart, lungs, pleurae, abdomen, liver, kidneys, and urinary bladder of the diseased animal were scanned ultrasonographically in the sternal position using a 3.5MHz sector transducer (SonoScape, Sonoscape Medical Corp., China). Slight sedation was obtained initially using, xylazine (2mL IV; 0.18mg/kg BW) together with infiltration of 10mL of procaine HCl as a local anesthetic solution. Following, the abdominal lesion was biopsied using an ultrasound-guided, free-hand technique using a 14G×170mm spinal biopsy needle (Kurita Co., Ltd, Tokyo, Japan). The specimen was then fixed at once in 10% neutral buffered formalin for 24h before being routinely processed and embedded in paraffin. For histopathological diagnosis, consecutive 5-µm-thick sections were cut with a microtome and stained with hematoxylin and eosin

RESULTS

The main presenting history included only progressive weakness for 5 months. Values of rectal temperature and pulse and respiratory rates were 36.5°C, 40/min, and 8/min, respectively. Primary physical examination showed that camel had an emaciation with a body condition score of 2.0 (scale 1 to 5) (Fig. 1).

Hematological parameters included white blood cell count 86000/µL (normal value 16.9±2.7×10⁹/L), neutrophils 82320/µL (normal value 9.8±3.0×10⁹/L), and lymphocytes 1310/µL (normal value 5.9±2.4×10⁹/L), hematocrit 25.41% (normal value 28.9±2.7%), RBCs 11.46×10⁶/µL (normal value 11.3±1.4 ×10⁶/µL), hemoglobin 13.4g/dL (normal value 16.0±2.3g/dL), MCV 22fL (normal value 25.5±1.5fL), MCH 11.7pg (normal value 14.7±2.4pg) and MCHC 52.9g/dL (normal value 57.6±9.0g/dL).

Blood chemistry panel showed albumin 1.6g/dL (normal value 4.2±0.4g/dL), total protein 7.5g/dL (reference range 7.9±0.4g/dL), globulin 5.8g/dL (normal value 3.7±0.5g/dL), BUN 50mg/dL (normal value 17±10.0mg/dL), glucose 71mg/dL (normal value 61±19mg/dL), calcium 9.5mg/dL (normal value

8.6±0.7mg/dL), creatinine 4.6mg/dL (normal value 1.3±0.2mg/dL), sodium 147 mmol/L (normal value 163±2.0 mmol/L), potassium 4.3 mmol/L (normal value 3.8±0.2 mmol/L) and total bilirubin 0.6mg/dL (normal value 0.8±0.3mg/dL).



Fig. 1: A 6-year-old female dromedary camel with disseminated Pyogranulomas. She was admitted with a history of progressive weight loss during the past 5 months.

Transabdominal sonography showed a large area of heterogenous echogenicity between the intestinal loops on the right abdomen; some parts were anechoic. There was

no evidence of vascularization. Others areas were homogenously isoechoic compared to echogenic intestines. Spots of calcification were imaged within the lesions. Similar areas of dissemination were imaged withing the right renal parenchyma (Fig. 2). No other sonographic abnormalities were detected on either abdominal or thoracic examinations.

Histopathological examination of the prepared specimen revealed massive, disseminated pyogranulomas composed of chronic suppurative inflammation including bacterial colonies and exudate rich in neutrophils, macrophages and plasma cells (Fig. 3).

DISCUSSION

Granulomas are a primary immunodeficiency condition and is often detected in the digestive system, urinary bladder and skin, and it is generally known as chronic granulomatous disease (CGD). The condition is categorized histologically as pyogranulomas formed mainly of organized collection of macrophages and neutrophils (Sacco et al. 2023). Despite of that patients with CGD always have different fungal and bacterial infections (Marciano et al. 2015), pyogranulomas are often sterile. CGD pyogranulomas are, therefore, characteristic of hyperimmune conditions which result frequently in inflammatory bowel disease, autoimmunity and poor wound healing (Dinauer 2019).

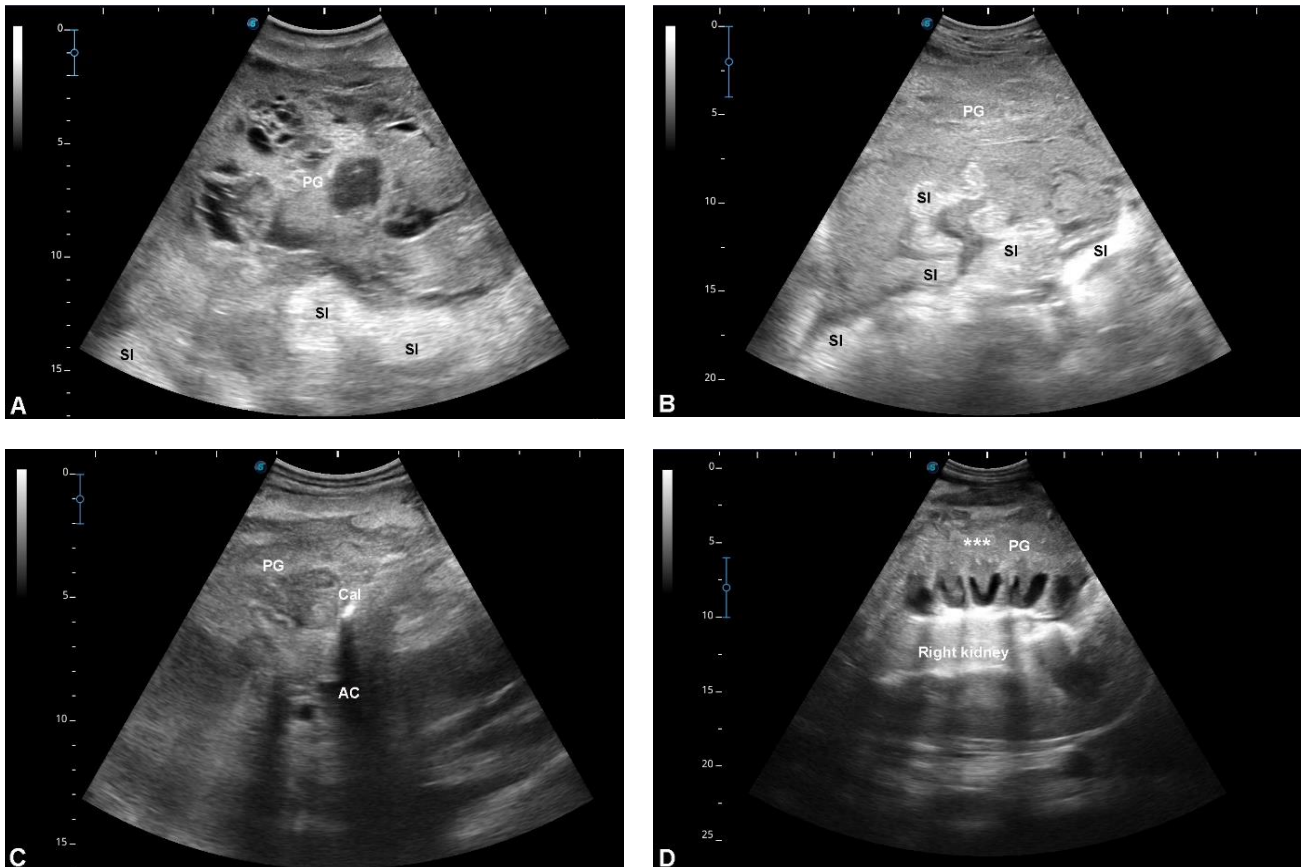


Fig. 2: Ultrasonographic findings in a 6-year-old female dromedary camel with disseminated pyogranulomas (PG). A large area of heterogenous echogenicity between the small intestinal loops (SI) on the right abdomen were imaged; some parts are anechoic (A). Other areas were homogenously isoechoic compared to echogenic intestines (B). Spots of calcification (Cal) with distal acoustic shadowing (AC) were imaged within the lesions (C). Similar areas of dissemination (***) were imaged withing the right renal parenchyma (D).

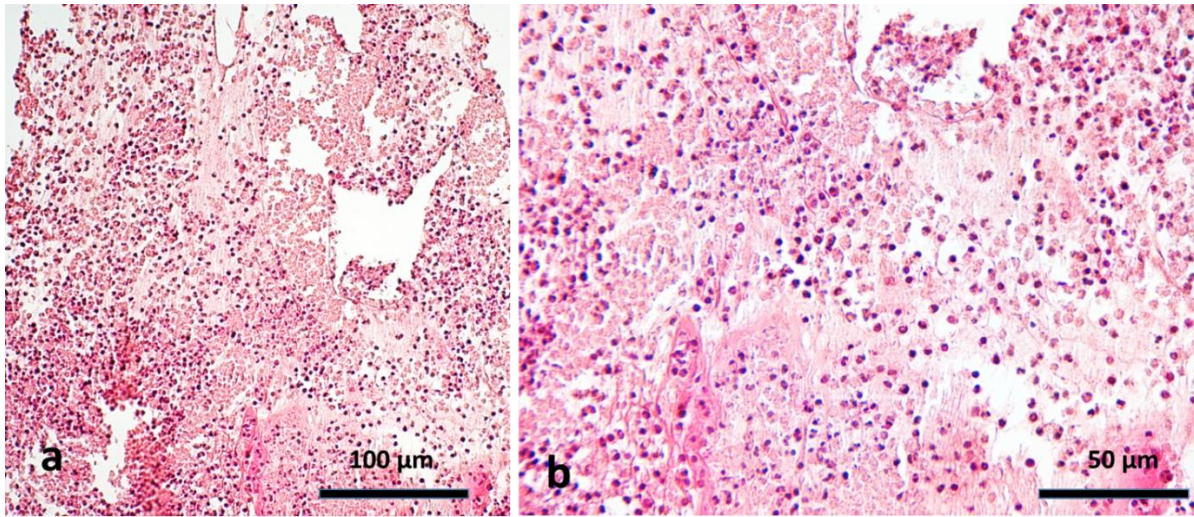


Fig. 3: The histopathological findings of biopsy revealing massive, disseminated pyogranulomas composed of neutrophils, macrophages, and plasma cells (H&E).

The complaints presented in the case under investigation were vague and non-specific, consisting only of progressive weight loss with a body condition score of 2.0 on a scale of 5.0. To the best of the authors' information, this case is the first that reports the clinical, hematobiochemical, ultrasonographic, and pathologic findings in a female Arabian camel (*Camelus dromedaries*) with abdominal disseminated pyogranuloma. On the other hand, hematobiochemical panels indicated severe bacterial infection, hypoalbuminemia, hypoproteinemia, hyperglobulinemia, hyponatremia, hyperkalemia, and renal impairment in the form of increased BUN and creatinine concentrations. The causes of intra-abdominal granulomas are variable, so the ultrasonographic examination and needle aspiration of soft tissue masses were recommended to confirm their presence (Choi et al. 2010).

Sonography has been reported effective for the detection of various intra-abdominal disorders (Tharwat et al. 2023; Tharwat and Al-Hawas 2024). It was also proved that ultrasound is valuable in dromedary camels for assistance in antemortem diagnosis of abdominal masses (Sadan et al. 2024). In the present case, abdominal ultrasonography showed a large region of different echogenicity within the intestines and some areas were either anechoic or isoechoic. Chronicity of the lesion was also marked by the presence of focal calcification. In addition, disseminated lesions were imaged within the right renal parenchyma. The biopsied specimen also showed the presence of neutrophils, macrophages, and plasma cells together with bacterial colonies. Regarding the etio-pathological differentiation of the granulomas, most of them are epithelioid in nature, followed by eosinophilic granulomas, and finally suppurative (Uma et al. 2011).

Pyogranulomas are more common than granulomas in animals due to the existence of several higher pyogenic bacteria and fungi causing pyogenic granulomas. In camels, caseous lymphadenitis with multiple disseminated caseated abscesses in internal organs is frequently observed (Aljameel et al. 2014). Actinobacillosis was also recorded in camels, but Splendore-Hoeppli bodies were

not observed in the biopsy of the present case (Tuteja et al. 2015). As pyogenic granulomas are either caused by one pathogen or sometimes multiple pathogens and, on the other hand, could be sterile and caused by metabolic factors, the etiology has limited significance. Because the clinical and sonographic findings misled the authors to preliminary diagnosis as malignancy, the authors did not deliver the biopsy for bacteriological examination.

In another report, pyogranulomas were detected ultrasonographically as hyperechogenic masses. The procedure is also used to collect an aspirate using ultrasound guidance for cytological examination that usually confirms the presence of macrophages and neutrophils (Yuki and Hirano 2010). In dogs with intestinal pyogranuloma, abdominal sonography revealed the presence of hypoechogenic mass in the small intestines (Papazoglou et al. 2010). Ultrasonographic examination is essential to differentiate and determine the origin and the appearance of the lesions. However, the definitive diagnosis of intraabdominal masses always requires fine needle aspiration or biopsy procedures (Mattoon and Nyland 2002).

Conclusion

Imaging diagnosis using ultrasonography and fine needle aspiration results could confirm intra-abdominal granuloma. Transabdominal sonography was valuable for the localization, scanning, and verification of pyogranuloma and for its dissemination into the right renal parenchyma. It was also valuable in sampling of a biopsy specimen from the lesions. Histopathological examination of the biopsy specimen, however, is still the final diagnostic tool for disseminating pyogranulomas in camels.

Conflict of interest: The authors declare that there is no conflict of interest.

Author's Contribution

MT: Practical work, writing manuscript draft, editing, and revising the manuscript. HM, practical work, editing and revising the manuscript. MH and AAA:

Histopathological work, editing and revising the manuscript. MM: Editing and revising the manuscript. All authors revised and approved the manuscript for publication.

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