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CASE REPORT
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Thromboembolism in a Bitch - Diagnosis by Infrared Thermography

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ABSTRACT

***Background*:** Thermography is a noninvasive, non-contact, painless, and non-ionizing imaging technique that records cutaneous thermal patterns generated by infrared emission of the surface. The surface heat is closely related to dermal microcirculation. Thromboembolism is responsible for important changes in the thermal pattern of the body surface due to physical obstruction of blood flow, being the main complication in immune-mediated hemolytic anemia. The aim of this paper is to report a dog with thrombus in his left forelimb secondary to idiopathic hemolytic anemia, whose diagnostic screening was performed through infrared thermography.

***Case*:** A 9-year-old mixed breed bitch was referred to a veterinary hospital with a history of emesis, diarrhea and dark-colored urine for 2 days. The complete blood count showed hypochromic macrocytic anemia (hematocrit [HTC] 28%, reference: 37 to 55%) with the presence of nucleated erythrocyte (14/100 leukocytes, reference: 0 to 5/100 leukocytes), polychromasia and spherocytes. Leukocytosis (28,300 mm³, reference: 6,000 to 17,000 mm³) by neutrophilia with left deviation and toxic granulations was also present, in addition to hemoglobinuria at urine exam. Therefore, treatment for immune-mediated hemolytic anemia (IMHA) was instituted. After 2 days, the animal returned with acute functional impairment of the left forelimb. Physical examination revealed that the limb was cold, without pulse, proprioception, reflexes, and deep pain. New blood analyses revealed decreased hematocrit (HTC 17%, reference: 37 to 55%), and increased total leukocyte number (57,000 mm3, reference: 6,000 to 17,000 mm³). Infrared thermography revealed an important temperature difference between the limbs, with the affected limb temperature considerably lower (31.3ºC) when compared to the contralateral limb (35.0ºC). Thermography showed the site of the thrombus in the medial portion of the limb (cephalic vein), where the catheter had been placed for fluid therapy. Due to the severity of the condition, the bitch was submitted to amputation surgery, which occurred without complications. The patient had a good response to treatment, with decreased signs of hemolysis and hypercoagulability. The medications were slowly withdrawn, and the clinical discharge occurred after 4 weeks.

***Discussion*:** In humans, thermography has been widely used in the assessment of thrombotic diseases, contributing to diagnosis, localization, and prognosis. In veterinary medicine, however, the use of this tool in the diagnosis of thromboembolism is still rare. The difference of 3.7°C between the affected and contralateral limb was objectively verified using thermography. A minimum difference of 2.4°C between limbs has high sensitivity and specificity for diagnosing thromboembolism and occurs due to the reduction in local blood flow. In the present case this tool was essential for the anatomical location of the thrombus, which was in the middle third of the forearm, and allowed an adequate surgical planning. It is known that the main complication of IMHA is thromboembolism. Its predisposing factors include venous stasis, endothelial damage, and hypercoagulability, being exacerbated by cage confinement, decubitus and presence of a peripheral venous catheter. The reported case corroborates at least one of these factors since it had a peripheral venous catheter in the left forelimb, which later showed absence of pulse, spinal reflexes, pain and proprioception. The thermography showed to be an objective, rapid and non-invasive tool to diagnose and precisely locate the thrombus, which allowed for adequate treatment and surgical planning for the case. To the best of our knowledge, this is the first report about use of thermography to diagnose thromboembolism secondary to immune-mediated hemolytic anemia in a dog.

Keywords: infrared imaging, hemolytic anemia, hypercoagulability, immunosuppression, temperature, female dog.

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INTRODUCTION

Thermography is a noninvasive, non-contact, painless, and non-ionizing imaging technique that records cutaneous thermal patterns generated by infrared emission of the surface. The image formed is based on a color scale corresponding to temperature, where cooler regions result in darker colors such as blue and green, and warmer areas are identified with lighter colors such as yellow, red and white [6].

The surface heat is closely related to dermal microcirculation which is controlled by the sympathetic section of the autonomic nervous system [3]. In medicine, it has been used for early identification of diseases that occurs changes in local blood flow, caused by inflammatory or obstructive processes [9], such as intervertebral disc disease, femoral arterial thrombosis, breast tumors, cranial cruciate ligament rupture and pain assessment [11].

Thromboembolism is responsible for important changes in the thermal pattern of the body surface due to physical obstruction of blood flow, being the main complication in immune-mediated hemolytic anemia. The mechanism of this condition is still unknown, but some hypotheses are the increase in the concentration of procoagulant factors, the decrease in the concentration of anticoagulant and fibrinolytic factors, the presence of disseminated intravascular coagulation, increased platelet activity, and the presence of antiphospholipid antibodies [2]. The aim of this paper is to report a case of one bitch with thrombus in his left forelimb secondary to idiopathic immune-mediated hemolytic anemia (IMHA), whose diagnostic screening was performed through infrared thermography.

CASE

A 9-year-old mixed breed spayed bitch was referred to a Veterinary Hospital with a history of emesis, diarrhea, and dark-colored urine for two days. There was no recent history of medication. On physical examination, hyperthermia (rectal temperature 39.6°C), increased capillary filling time (3 s), dehydration estimated at 7%, tachypnea, hypocorated mucous membranes and presence of fluid in intestinal loops at abdominal palpation were observed. Support treatment has initialized with fluid therapy[1] [lactate ringer solution] through venous access in the left forelimb, associated with ondansetron[2] [Nausedron® - 0.3 mg/kg, i.v.], metronidazole[3] [15 mg/kg, i.v.] and glucose *bolus*[4] [300 mg/kg, i.v.], as well as dipyrone[5] [25 mg/kg, s.c.].

The complete blood count showed hypochromic macrocytic anemia (HTC 28%; ref. 37 to 55%) with the presence of nucleated erythrocyte (14/100 leukocytes; ref. 0 to 5/100 leukocytes), polychromasia and spherocytes. Leukocytosis (28,300 mm^3; ref. 6,000 to 17,000 mm^3) by neutrophilia with left deviation and toxic granulations was also present, and platelet count was within the reference values. Among biochemical analyses only the serum alkaline phosphatase (ALP) was altered (391.4 IU/L; ref. 20 to 156 IU/L). There was hemoglobinuria at urine exam. The dog was tested to leishmaniosis, ehrlichiosis, borreliosis, anaplasmosis, and dirofilariasis, being negative to all antigens. Therefore, treatment for IMHA was instituted with prednisone[6] [Prediderm® - 2 mg/kg, v.o., BID] and metronidazole[7] [Flagyl® - 15 mg/kg v.o., BID], and scheduled return within 7 days.

After 2 days, the animal returned with acute functional impairment of the left forelimb. Physical examination revealed that the limb was cold, without pulse, proprioception, reflexes, and deep pain. New blood analyses revealed decreased hematocrit (HTC 17%; ref. 37 to 55%), and increased total leukocyte number (57,000 mm^3; ref 6,000 to 17,000 mm^3) compared to the 1st exam, being only the platelet count within the reference values. Therefore, adjustment of prednisone[6] doses was made [4.4 mg/kg, v.o., BID] and added cyclosporine[8] [10 mg/kg, v.o., BID], acetylsalicylic acid[9] [Aspirina® - 0.5mg/kg, v.o., BID], and sodium enoxaparin[2] [Hemofol® - 0.8 mg/kg, s.c., QID] to the treatment. Echocardiogram and abdominal ultrasound were performed and showed no alterations.

Infrared thermography[10] (Flir One Pro® model) was performed on the forelimbs of the animal to evaluate and possibly detect the site of the thrombus (Figure 1). After acclimatization for 15 min in a temperature-controlled environment (25ºC), the images were taken 30 cm away from the regions of interest, with the camera kept at a 90º angle for capture. The thermal resolution of the thermograph was > 0.07ºC, accuracy of ± 1% and resolution of 4,800 pixels. The patient's own contralateral limb was used as control.

There was a significant temperature difference between the limbs, and the affected limb temperature was considerably lower (31.3ºC) when compared to the contralateral limb (35.0ºC) (Figure 1). Thermography

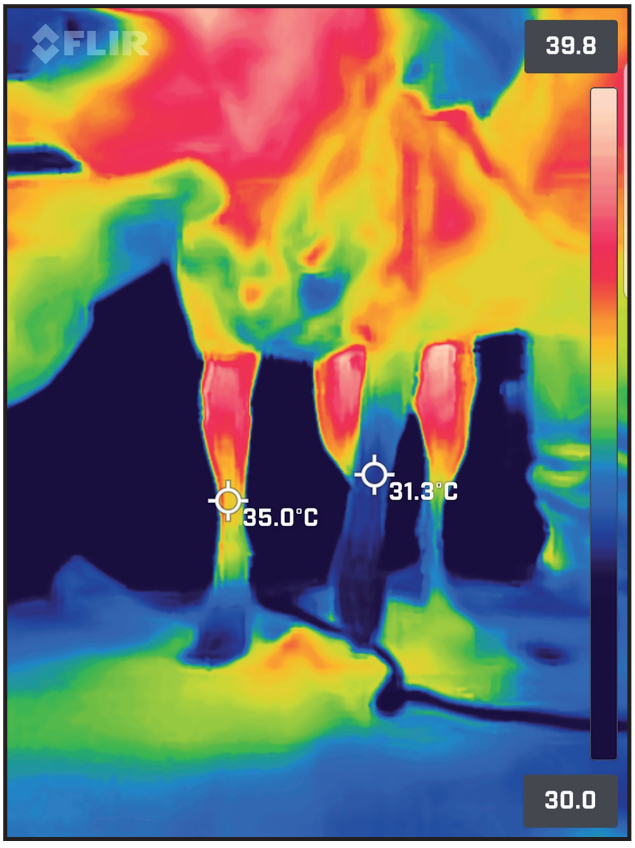

Figure 1. Thermographic image with two points demonstrating the temperature difference between forelimbs with (31.3°C) and without thromboembolism (35.0°C).

Figure 2. Left forelimb (medial) with cephalic vein thrombus (arrows). Dissection performed after surgical amputation procedure.

showed the site of the thrombus in the medial portion of the limb (cephalic vein), where the catheter had been placed for fluid therapy. Due to the severity of the condition, the dog was submitted to amputation surgery, and the use of anticoagulants was suspended for 24 h before the procedure. Surgery had no complications and after removed, the affected limb was dissected, and it was possible to observe the presence of thrombus (Figure 2).

The patient had a good response to treatment, with new blood tests requested after 5 days of therapeutic protocol had been altered. An improvement was observed referring to hemolysis and hypercoagulability of the blood, so that the medications were slowly withdrawn, and the animal was followed at least 2 times a week until clinical discharge which occurred after 4 weeks of treatment.

DISCUSSION

In humans, thermography has been widely used in the assessment of thrombotic diseases, contributing to diagnosis, localization, and prognosis [4]. In veterinary medicine, however, the use of this tool in the diagnosis of thromboembolism was performed only in a dog with thrombus in a femoral artery related to breast cancer [5], and in cats with thromboembolism in the abdominal aorta [8]. Thus, this is the 1st study that used thermography to diagnose thromboembolism secondary to immune-mediated hemolytic anemia in a dog.

The method conventionally used for diagnosing thromboembolism is nuclear scintigraphy and contrast angiography [5,7]. These, however, are invasive techniques, not being indicated in critically ill patients, differently to thermography, that is non-invasive and allows the execution without sedation or contact [1].

The difference of 3.7°C between the affected and contralateral limb was objectively verified using thermography. A minimum difference of 2.4°C between limbs has high sensitivity and specificity for diagnosing thromboembolism [8] and occurs due to the reduction in local blood flow.

Similar to previous study [5], which used thermography for the anatomy location of thrombus in the femoral artery of the right pelvic limb, in the present case this tool was essential for the anatomical location of the thrombus, which was in the middle third of the

forearm, and allowed an adequate surgical planning. The main difficulties found in thermography studies are those related to the patient (such as fur size) and environmental factors such as temperature, humidity, and air movement [10]. In studies where multiple animals are evaluated, these factors must be controlled. In this case, the dog was acclimated to a room at 25ºC for 15 min. In addition, the contralateral limb was used for comparison purposes.

It is known that the main complication of IMHA is thromboembolism. Its predisposing factors include venous stasis, endothelial damage, and hypercoagulability, being exacerbated by cage confinement, decubitus, and presence of a peripheral venous catheter [12]. The reported dog corroborates at least one of these factors since it had a peripheral venous catheter in the left forelimb, which later showed absence of pulse, spinal reflexes, pain, and proprioception.

The diagnosis of thromboembolism in the thoracic limb of a dog with hemolytic anemia was performed with the aid of thermography, which identified a difference of 3.7ºC between the affected and healthy limbs. The thermography showed to be an objective, rapid and non-invasive tool to diagnose and precisely locate the thrombus, which allowed for adequate treatment and surgical planning for the case.

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Declaration of interest. The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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