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Canine Babesiosis: An Overview

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Abstract

Canine Babesiosis is one of the most common, globally existent, fast spreading tick-borne diseases of haemoprotozoan origin caused by different species of Babesia. The clinical signs appear as a result of hemolysis due to presence of the organism within the erythrocytes. But some species of Babesia may also trigger immune mediated component to anaemia along with severe inflammatory reaction resulting to morbidity and mortality in animals. The various species of Babesia are *B. canis, B. vogeli, B. microti, B. rossi* and *B. gibsoni*. Canine Babesiosis occurs mainly due to two forms of Babesia namely Large form and small form. Within large form *Babesia canis* is reported and in small form *B. gibsoni* is the main causative agent. In this article the taxonomy, geographical distribution, transmission, clinical signs, diagnosis, treatment and prevention on canine babesiosis is discussed.

Keywords: Babesia; Ticks; Treatment.

Introduction

In the year 1888, Dr. Victor Babes, a Romanian physician, was the first to observe microorganisms in the erythrocytes of sheep and cattle showing the symptoms of haemoglobinuria [1]. Later these micro-organisms were named *Babesia ovis* and *Babesia bovis* respectively. In 1895, not long after the observation in ruminants, the same type of observations ie. *Babesia* spp. for the first time in dogs came into light in Italy [2]. Currently this protozoan disease is prevalent in various parts of the world.

Canine babesiosis was formerly known as Canine piroplasmosis. The *Babesia* spp. is mainly transmitted by hard ticks. An important phase of life cycle of *Babesia* spp. ie. sexual conjugation and sporogony takes place within the intestinal lumen followed by haemocoel of the ticks. Ultimately a blood meal transmits the sporozoites from the tick's salivary gland to a new host wherein the protozoan life cycle is completed by asexual replication or merogony within the erythrocytes where the parasites remain as merozoites.

Taxonomy and morphology

The *Babesia* genus belongs to the order *Piroplasmida* in the phylum *Apicomplexa* and can be seen as a non-pigmented pear or signet ring shaped organisms in the mammalian erythrocytes. The large forms of *Babesia* (2.5-5.0 µm) consists three species viz., *B. canis*, *B.vogeli and B. rossi* and the small forms (1.0–2.5 µm) comprising of the. *B. gibsoni, B. conradae* and *B. microti* like piroplasms [3] (Figure 1 & 2).

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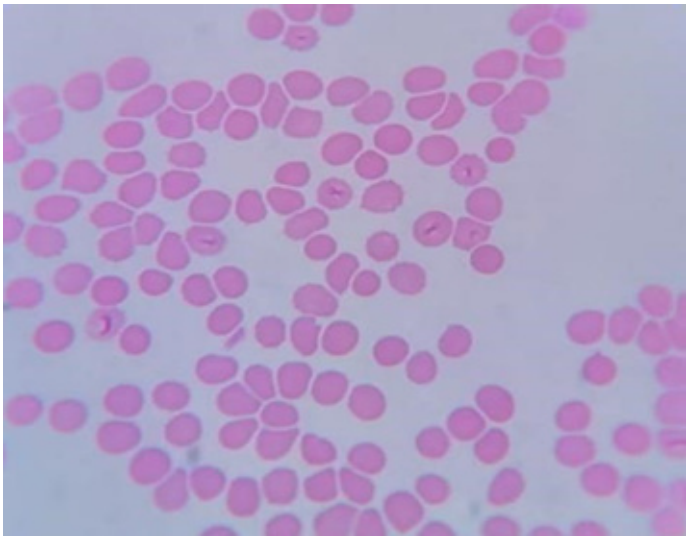

Figure 1: Babesia canis (Large form).

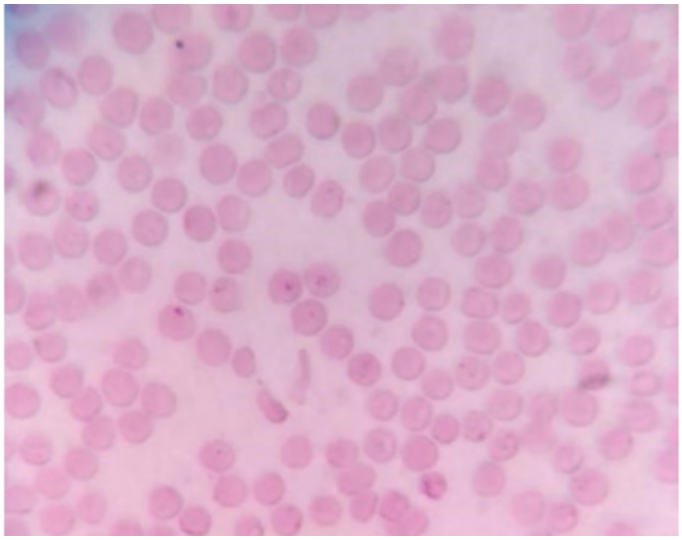

Figure 2: Babesia gibsoni (Small form).

Geographical distribution and transmission

Canine Babesiosis is clinically significant haemoprotozoan disease of dogs which is distributed world-wide including India. The disease appears during the whole year period with frequent outbreaks in the spring and autumn. The disease is transmitted through tick bites. Trans-stadial and trans-overial both transmission may occur and the ticks remain infective for several generation. Babesiosis can also be transmitted by blood transfusion. Recently proven that trans- placental transmission occur from dam to offspring [4]. *B. gibsoni* can also be transmitted by dog bites [5].

The species of *Babesia* transmission by vectors and their geographical distribution is given in the table below [6,7].

Species	Vector	Geographical Distribution
Babesia canis	*Dermacentor reticulatus*	Europe
B. vogeli	Rhipicephalus *sanguineus*	Tropical and subtropical region
B. rossi	*Haemophysalis elliptica*	South Africa
B. gibsoni	*Haemophysalis sp.*	Asia, North America, Northern and Eastern Africa and Europe
B. microti	*Ixodes hexagonus Ixodes canisuga*	France, Croatia, Italy, Portugal, Serbia, Spain and Sweden

Clinical signs

In general clinical signs of canine babesiosis are dependent on species, breed, age, immune status of animal and concurrent disease [8]. The disease can be classified as complicated and uncomplicated forms [9]. Uncomplicated forms can be categorized by haemolytic anaemia accompanied with inappetance to complete anorexia, increased pulse rate, heart rate, palor mucous membrane, pyrexia and in some case epistaxis is detectable. Complicated form characterized by Systemic Inflammatory Response Syndrome (SIRS) and Multiple Organ Dysfunction Syndrome (MODS), both of which are cytokine mediated phenomenon [10,11]. Both uncomplicated and complicated Babesiosis appear to be the result of host inflammatory responses [12,13]. The immunological response plays the most important role in pathogenesis of canine babesiosis. This parasite initiates the mechanism of antibody mediated cytotoxic destruction of circulating erythrocytes. Autoantibodies are directed against components of the membranes of infected and uninfected erythrocytes which causes intravascular and extravascular haemolysis.

Diagnosis

Microscopical examination

Most commonly used diagnostic method is direct microscopical examination of thin blood smear as it is cost effective, feasible and conclusive method. For microscopic examination, blood is collected from ear vein and a thin smear is made. It is then heat fixed and Giemsa staining is done following the standard protocol. In positive cases pear-shaped piroplasms are detected and the differentiation of species is done on the basis of size and appearance inside the erythrocytes [14].

Haematological findings

Haematological changes also examined in canine babesiosis. Whole blood is collected into the EDTA vial for blood cell parameters detection. There is mild to moderately regenerative normocytic and normochromic anaemia because of haemolysis. Haematological examination revealed elevated haemoconcentration, higher lymphocytes, monocytes and eosinophil count. Neutrophil counts are usually normal to decreased and left shifts are seen. Thrombocytopenia is a hallmark sign of this disease [15] and is usually severe in the acute phase of infection [16].

Biochemical profile

The serum sample is analysed for examination of biochemical profile. Total protein, albumin, Albumin/Globulin ratio, glucose level are reduced [17]. Liver enzymes such as ALP, ALT, AST and bilirubin level are also elevated with marked icterus due to cellular damage to the hepatic cells [18]. Urea and creatinine levels are also increased. Increased level of ALP may be occurs due to damage or abnormal function of the biliary system. This might be due to liver or kidney involvement. Serum potassium is reduced, especially in the icteric cases. Azotemia is present in dehydrated cases and in those with acute renal failure [19]. The changes may be occurs due to hepatopathy and immune haemolytic anaemia which is caused by the organism.

Serological test

For confirmatory diagnosis of canine babesiosis serological test is done. Active infection can be confirmed by increasing

antibody titers detection. The serological method, indirect fluorescent antibody test (IFAT) and enzyme linked immuosorbent assay (ELISA) are highly sensitive for *B. gibsoni* but moderately specific to *B. canis* due to antigenic cross- reaction [20].

Molecular techniques

Polymerase Chain Reaction (PCR) offers a practical and non-invasive means to detect and differentiate infections with various Babesia spp. and also provides a sensitive tool for assessing treatment outcomes. Different molecular techniques are used for the identification and differentiation of the various species of Babesia viz., semi-nested PCR [21], reverse line blotting [22,23], and PCR- restriction fragment length polymorphism analysis [24]. Moreover, sequencing of 18S rRNA and Internal Transcribed Spacer-1 (ITS-1) have also been used for molecular phylogeny studies of this parasite [25].

Treatment

The treatment of babesiosis involves the removal of parasite from the body, correction of anaemia along with supportive treatment. Diminazene aceturate, imidocarb dipropionate and trypan blue are effective against large form of babesiosis. Diminazine aceturate @3.5 mg/kg body weight is administered subcutaneously or intra-muscularly but it has some toxic adverse effects with severe neurological signs [26]. Imidocarb dipropionate @6.6 mg/kg body weight 14 days apart is also widely included in treatment protocol and is injected intra-muscularly [26,27]. Administration of Imidocarb may cause pain at the injection site and reveals cholinergic signs like salivation, vomition, diarrhoea, lacrimation, nasal drip etc. Cholinergic side effects may be controlled by administration of atropine sulfate @0.04 mg/kg body wt. subcutaneously. Trypan blue @10 mg/kg wt. one dose administered intravenously followed by diaminazine or imidocarb 1 week later was earlier used and is still being used in some parts of the world [6].

In the case of *B. gibsoni,* Diaminazine aceturate, satisfactory results are not obtained as the drug is unable to remove the parasite completely. It is treated with combination of three drugs consisting of Doxycycline @5 mg/kg body wt. orally twice daily, Clindamycin @25 mg/kg body wt. orally twice daily and Metronidazole @15 mg/kg body wt. orally twice daily or Doxycycline @ 7-10 mg/kg body wt. orally twice daily, Enrofloxacin @ 2-2.5 mg/kg body wt. orally twice daily and Metronidazole @ 5-15 mg/kg orally twice daily [28]. Amphotericin B has been shown activity against *B. gibsoni* but it caused oxidative red blood cell damage *in-vitro* and kidney damage *in-vivo* [28].

Buparvaquone @5 mg/kg body wt. intramuscularly repeated after 48 hours in combination with Azithromycin @10 mg/kg body wt. once daily orally for 10 days [27,29]. But the side effect of this treatment protocol was found to be allergic reaction and itching which can be controlled by Dexamethasone @0.5 mg/kg body wt. intramuscularly along with Chlorpheniramine maleate @0.5 mg/kg intramuscularly. The other combination is Atovaquone @13.3 mg/kg body wt. thrice daily orally for 10 days in combination with Azithromycin @10 mg/kg body wt. once daily orally for 10 days [30].

Prevention

As it is a tick-borne disease so tick control is the most important factor. Regular examination of dogs to remove the tick is important for protection of animals from babesiosis. Various types of topical products e.g. tick control spray, shampoo, powder are recently available in market to control the ticks. Ivermectin @0.2 mg/kg body weight subcutaneously at 1 week interval is effective to get rid of ticks from the body of host. The use of amitraz impregnated collars give satisfactory result to control the *Babesiosis* infection in endemic areas. Awareness of the owners regarding tick control helps in eradication of the disease as early as possible.

In Europe a vaccine is available against *B. canis* having 70-100 % of efficacy. Recently a bivalent vaccine is derived from soluble parasite antigens *from B. canis* and *B. rossi* which helps to reduce the duration and severity of infection [28]. Although the vaccination doesn't prevent the infection but it blocks the initiation of pathogenic processes involved in the pathogenesis of the diseases.

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