BABESIOSIS

('Piroplasmosis', 'Tick Fever', Redwater Disease)

Synonyms: In Cattle : Redwater Fever; Texas Fever
In Horses: Biliary Fever
In Dogs: Tick Fever, Malignant Jaundice

INTRODUCTION:

Babesiosis is caused by intraerythrocytic protozoan parasites of the genus *Babesia*. Transmitted by ticks, babesiosis affects a wide range of domestic and wild animals and occasionally people. Two important species in cattle—*B bigemina* and *B bovis*—are widespread in tropical and subtropical areas and are the focus of this discussion.

Babesia, were first described in 1888 by **Babes** in Roumania. However, they were not recognized as important pathogens until 1893 when Smith and Kilbome reported them to be the cause of "Texas cattle fever".

Organisms of the genus Babesia parasitize the erythrocytes of a wide range of vertebrate hosts, namely, cattle, buffaloes, sheep and goats, pigs, horses, and dogs and cats. They **multiply in the erythrocytes by binary fission**, giving rise to Two or Four daughter individuals. Blood-sucking ticks act as intermediate host-vectors in which the parasites reproduce.

Babesiosis is characterized by Fever and intravascular Haemolysis causing a syndrome of anaemia, haemoglobinaemia, and haemoglobinuria.

AETIOLOGY

Babesia sp. are relatively host-specific. There is considerable variation in the severity of disease caused by the different Babesia species and strain. In cattle, severity of infection also depends on the breed. *Bos indicus* (i.e., Zebutype cattle) breeds are relatively resistant (than European cattle) because of their resistance to heavy infestations with ticks. The disease may have a seasonal incidence if the tick population varies with climate.

Of the several species that affect cattle, *B. bigemina* and *B. bovis* are the most prevalent and important. In equine babesiosis, *B. caballi* is reportedly less pathogenic than *B. equi.* In canine babesiosis, *B. gibsoni* principally occurs in India.

Babesia	Animals Affected	Transmitted By Tick
B. bigemina	Cattle, zebu, buffalo, deer	*Rhipicephalus / Boophilus microplus*

B. bovis	Cattle, buffalo, deer	*Ixodes ricinus*
B. caballi	Horse, donkey, mule	*Rhipicephalus evertsi, Dermacentor & Hyalomma*
B. equi	Horse, mule, donkey, zebra	*Rhipicephalus, Dermacentor & Hyalomma*
B. canis	Dog, wolf, jackal	*Rhipicephalus sanguineus*
B. gibsoni	Dog, wolf, fox, jackal	*Hemophysalis bispinosa*
B. divergens	Cattle	
B. felis	Domestic cat, wild cat, lion, leopard	
B. major	Cattle	
B. argentina	Cattle	
B. motasi	Sheep, goats	
B. ovis	Sheep, goats	
B. trautmanni	Pig, warthog	

Domestic animal-wise classification of Babesia sp. is as follows:

Cattle	*B. bigemina, B. bovis, B. argentina, B. divergens, B. major*
Buffaloes	*B. bigemina, B. bovis*
Sheep and goats	*B. motasi, B. ovis*
Horses	*B. caballi, B. equi*
Dogs	*B. canis, B. gibsoni*
Cats	*B.felis*
Pigs	*B. trautmanni*

Babesia occurs in circulating erythrocytes as **pyriform (pear-shaped) or ovoid (egg-shaped) bodies**, usually in **pairs, or multiples** thereof. They can be divided into two groups based on their size:

1. The Larger group *(B. bigemina, B. major, B. caballi, B. motasi, B. canis, B. trautmanni),* measuring 4-5 µm long by 2-3 µm wide; and
2. The Smaller Group *(B. bovis, B. argentina, B. ovis, B. gibsoni, B. felis, B. divergens, B. equi)* , which are 1-2 µm long and about 0.5 µm wide.

Babesia are easily differentiated from Plasmodium sp. by the absence of haemoglobin-derived pigment. Babesia completely catabolize haemoglobin, whereas Plasmodia retain the brownish pigment (haemozoin).

TRANSMISSION

The main natural vectors of *B bigemina* and *B bovis* are **Ixodid Ticks** (eg. ***Rhipicephalus*** Ticks also k.a ***Boophilus*** spp.) in which transmission also occurs

transovarially. In *Rhipicephalus* spp ticks, the blood stages of the parasite are ingested during engorgement and protozoa undergo sexual multiplication in the replete female, and the Sexual stage is followed by Schizogony that results in production of elongated, motile, club-shaped bodies, called **VERMICULES**. These migrate to tissues of tick, especially Ovary and further undergo asexual multiplication producing more Vermicules. In ovary, vermicules invade eggs & continue to multiply in tissues of Hatched larvae. When larvae first feed, the vermicules enter the Salivary acini, and within few days, form the **Infective Sporozoites**, that are incoculated into the new hosts. Transmission to the host occurs when larvae (in the case of *B bovis*) or nymphs and adults (in the case of *B bigemina*) feed.

Contaminated needles and surgical instruments can transmit the infection physically.

PATHOGENESIS

The pathogenic effects relate more directly to erythrocyte destruction. With virulent strains a hypotensive shock syndrome, combined with generalized nonspecific inflammation, coagulation disturbances, and erythrocytic stasis in capillaries, contribute to the pathogenesis.

The main pathogenic effect of Babesia is **Intravascular Haemolysis, Hemoglobinuria** and associated **Haemolytic Anaemia** which could be acutely fatal due to anoxia. In longer surviving animals, there are ischaemic changes in skeletal and heart muscle.

When an animal becomes infected, protozoa multiply in the Peripheral vessels *(B. bigemina, B. ovis),* or in the Visceral vessels *(B. bovis).* The multiplication reaches a peak with the development of clinically detectable haemolysis. The haemolysis results in prolonged anaemia, jaundice, and haemoglobinuria. Death is due to anaemic anoxia.

Babesia bovis is immunosuppressive for cattle. Animals that recover from acute babesiosis are resistant to further clinical disease. This immunity has been considered to be a form of Preimmunity. The most common feature of many protozoan infection was premunition. **Premunition** is a term used to describe resistance that is established after the primary infection has become chronic. It is effective only if the parasite persists in the host. In other words, premunition is a form of immunity that is dependent on the continued presence of parasite in the host.

CLINICAL SIGNS

B bovis is a much more virulent organism than *B bigemina*. The acute disease generally runs a course of ~1 week.

- Fever, listlessness, anorexia - **Hemolytic Anaemia**, **Jaundice**, **haemoglobinuria (Red water)**, and **Ascites**.
- In cattle, the disease is characterized by an acute onset of high fever (1060 F), anorexia, depression, weakness, cessation of rumination, and a fall in milk yield.
- Ataxia and incoordination
- The brick-red conjunctivae and mucous membranes soon become extremely pale due to severe Hemolytic Anaemia.
- In the terminal stages, there is severe jaundice and the **urine is dark red to brown in colour (Hemoglobinuria)**. Coma may appear prior to death.
- Pregnant animals usually show Abortion.

Many severely affected animals die suddenly at this stage, after an illness of only 14 hours. In those that survive, the febrile stage lasts for about a week and the total course about 3 weeks. Animals that survive recover gradually from the severe emaciation and anaemia. In other species (like Dogs etc), signs are mostly same as in cattle.

GROSS LESIONS

- Postmortem examination of animals died from babesiosis shows the blood to be thin and watery, and the plasma is red-tinged.
- The subcutaneous, subserous, and intramuscular connective tissue is oedematous and yellow. Fat is similarly affected.
- A swollen Liver with an enlarged gallbladder containing **Thick,** granular, **Dark Green Bile.**
- Icteric discoloration is clearly seen in all organs.
- The spleen is usually enlarged 4-5 times the normal size, and its parenchyma pulp is **Dark Red.** Lymph nodes are usually enlarged.
- The Urinary Bladder contains red-coloured urine.

The **Microscopic Lesions** are characteristic of

- Severe haemolytic anaemia.
- Haemoglobinuric Nephrosis,
- Centrilobular and Paracentral Necrosis of the Liver
- Oedema, excessive fluid in the peritoneal, pericardial and pleural cavities, and serosal haemorrhages are usual findings.
- Babesia can be demonstrated in large numbers in capillaries, both free in the lumen and present in packed erythrocytes. The organisms may be associated with small thrombi, foci of haemorrhage and necrosis.

Diagnosis

- Clinically, jaundice with haemoglobinuria and fever are suggestive of babesiosis.
- The diagnosis is confirmed by identification of Babesia in blood smears/films where organism is seen to be within RBCs, almost always as Single or as Pairs, often arranged in characteristic angle with their Narrow-ends opposed. Typically they are Pyriforms – but may be round, elongated or cigar-shaped. So, Confirmation of diagnosis by microscopic examination of Giemsa-stained blood or organ smears is essential. From the live animal, thick and thin blood smears should be prepared, preferably from capillaries in the **ear or tail tip**. Smears of heart muscle, kidney, liver, lung, brain, and from a blood vessel in an extremity (eg, lower leg) should be taken at necropsy.

  Microscopically, the species of *Babesia* involved can be determined morphologically, but expertise is required, especially in *B bovis* infections in which few organisms are **present**. *B bovis* is **small,** with the parasites in paired form at an **obtuse angle** to each other and measuring ~1–1.5 × 0.5–1 µm. *B bigemina* is **larger** (3–3.5 × 1–1.5 µm), with paired parasites at an **acute angle** to each other. Single forms of both parasites are also commonly seen.
- The antibodies can be detected by Haemagglutination, Agglutination, Complement Fixation, Fluorescent Antibody, and Microplate Enzyme Immunoassay (EIA) and ELISA tests.
- Molecular detection methods are confirmative, like PCR and real-time PCR assays capable of detecting extremely low parasitemias.

DIFFERENTIAL DIAGNOSIS

- Anaplasmosis
- Trypanosomiasis
- Theileriosis
- Bacillary haemoglobinuria
- Leptospirosis
- Eperythrozoonosis
- Rapeseed poisoning
- Chronic copper poisoning