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Bovine Babesiosis: A potential threat to cattle health

Jyoti Kumari[1], Sonam Bhatt[2], Sudhanshu Kumar[1], Anil Kumar[3], Ajit Kumar[4]
[1]M.V.Sc Scholar, Department of Veterinary Medicine, Bihar Veterinary College, BASU, Patna
[2]Assistant Professor, Department of Veterinary Medicine, Bihar Veterinary College, BASU, Patna
[3]Associate Professor, Department of Veterinary Medicine, Bihar Veterinary College, BASU, Patna
[4]Associate Professor, Department of Veterinary Parasitology, Bihar Veterinary College, BASU, Patna
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Introduction

Babesia genus was named after pathologist Victor Babes who discovered this organism first in red blood cells of cattle in 1888 in Romania, later Smith and Kilborne in 1893 demonstrate that the organism was transmitted by *Boophilus annulatus* to cattle.

Bovine babesiosis is a tick-transmitted disease affecting cattle and buffalo, caused by species of the genus *Babesia*, an obligate intracellular protozoan that invades and destroys red blood cells, leading to considerable mortality and morbidity in cattle. The disease is globally distributed and can occasionally infect humans. Its acute form is marked by fever, intravascular hemolysis resulting in progressive anemia, jaundice, hemoglobinuria, and splenomegaly, while the chronic form leads to anemia and variable weight loss. As one of the most widespread parasites globally, babesiosis is the second most common blood borne parasitic disease after trypanosomiasis. The economic impact on the cattle industry is substantial, with losses from mortality, reduced milk and meat production, and the costs associated with tick control. Synonyms for the disease include Texas fever, Redwater disease, Piroplasmosis, and Tick fever.

Etiology

Babesia bovis, Babesia bigemina, B. divergens and B. Major are most important *Babesia* species to cause bovine babesiosis where *B. bovis and B. bigemina* are most common species in tropical and subtropical areas while *B. divergens and B. major* are important species in temperate zones.

Epidemiology

The likelihood of a disease relies on the animal's age, breed, and immune system. Young animals are less likely than adults to contract babesiosis because of inverse age resistance to *Babesia* caused by passive transfer of maternal antibodies via colostrum. *Bos indicus* breeds are more resistant to babesiosis than *Bos taurus* as a result of evolutionary relationship between *Bos indicus* cattle, *Boophilus* species and *Babesia.*

Pathogen factor- Strain *B. bovis is* more pathogenic than *B. bigemina* & *B.divergens*. They also undergo rapid antigenic variation to survive the host immune system.

Environmental factor- the greatest incidence of bovine babesiosis occurs after the peak of tick populations as higher temperature increases tick activity.

Geographical distribution-Bovine babesiosis is distributed worldwide and can be found wherever the tick vector exists.

Transmission

Disease is transmitted solely by infected ticks, which acquire the Babesia infection from infected animals and pass it on to healthy animals during blood feeding. Various species of ticks are involved in transmission such as *Ixodes ricinus, Rhipicephalus (Boophilus).* Transmission to host occurs when larvae in case of *Babesia bigemina* while nymph and adult feed in case of *Babesia bovis.* Transovarian transmissions are found in ticks.

Life cycle

When tick sucks blood, the infective stage of *Babesia* sporozoites enters into the host. By binary fission *Babesia* multiplies in erythrocytes, this replication eventually results in gametocytes which are ingested by vector tick. In tick gut, these gametocytes conjugates and multiplies by binary fission then migrate to various tissues such as salivary glands where further development takes place and in ovary which leads to transovarial transmission.

Clinical sign

The clinical sign differs with the age of the animal, strain of the parasites and the species involved. In acute phase, there is high fever (41-42 °C), anorexia, ruminal atony, elevated respiratory rates and heart rates, muscle tremors, depression, constipation followed by diarrhea (pipe stem), rough hair coat, abortion in pregnant animals, red colored urine (hemoglobinuria) which is characteristics clinical features of babesiosis, hence it is named as red water disease. Mucus membranes are initially red but become pale as diseases progress due to breakdown of red blood cells. In Chronic phase, there is emaciation, edema, anemia, and jaundice. CNS disturbances such as incoordination, excitability, stiff gait, convulsion, and coma can also occur. Postmortem lesions include enlarged terry red spleen, swollen dark colored kidney enlarged yellow color liver, generalized anemia and jaundice, myocardial ecchymoses, brain congestion or petechiae may also be seen.

Diagnosis:

Disease can be diagnosed by

- History taking and clinical findings
- Blood smear examination: Identification of the *Babesia* by microscopic evaluation of blood smears collected from peripheral blood (Fig.1). This is a traditional method of identifying the agent by direct microscopic examination of blood smear stained with Giemsa or Romanowsky stain which is used for mainly dection of parasite for acute infection but failed to do in chronic infection.
- In vitro culture- This method is used to detect the presence of carrier infection of *Babesia* species. In vitro cultivation of *Babesia* basically consists of a red blood cell suspension from a bovine donor and a chemically defined culture medium supplemented with 40% adult bovine serum.
- Detection of babesia species in tick-Babesia parasites can be identified in *Rhipicephalus (Boophilus)* microplus engorged females by looking for kinetes in light microcopies of tick-hemolymph. Techniques based on DNA samples were developed to find Babesia in cattle and ticks.
- Animal inoculation-Carrier or long-term infected cattle can be identified by subinoculating infected blood into splenectomized calves for *B. bovis* and *B. bigemina* isolation.
- Serological testing like ELISA, IFAT, CFT: IFAT (IFAT- Indirect Fluorescent Antibody Test) is a widely used test that combines high sensitivity of florescence microscopy with strict specificity of immunological techniques. Antibodies to *B. bovis*, *B. bigemina*, and *B. divergens* are found by using different ELISA versions. The CFT reaction depends on the presence of complement fixing antibodies; the IgM immunoglobulin is the most crucial isotype. According to the description, a crude suspension of parasites was helpful in the implementation of a sensitive CFT in order to identify antibodies to *B. bovis* in serum.
- Molecular method (PCR assay) - Because of the relatively small number of parasites present in peripheral blood, babesia infections are difficult to detect. DNA-based molecular methods, therefore, have been developed such as PCR used to amplify millions of copies in vitro from a single DNA fragment to detect the presence or absence of a small DNA sequence.

Treatment

- The choice of drug for treatment of bovine babesiosis is- Diminazene which is administered to cattle once at dose rate of 3.5 mg/kg, IM. Diminazene aceturate as well as Diminazene diaceturate both salt are used as babesicides , these came in different brand names like Berenil, Nilberry, Prozomin etc.

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- Second drug used as babesicides is Imidocarb. Imidocarb is administered once at @ dose rate of 1.2 mg/kg body weight SC. Imidocarb, when administered at a dose of 3 mg/kg, protects carrier animals from babesiosis for approximately four weeks. Additionally, it has the potential to remove *B. bovis* and *B. bigemina* from carrier animals.

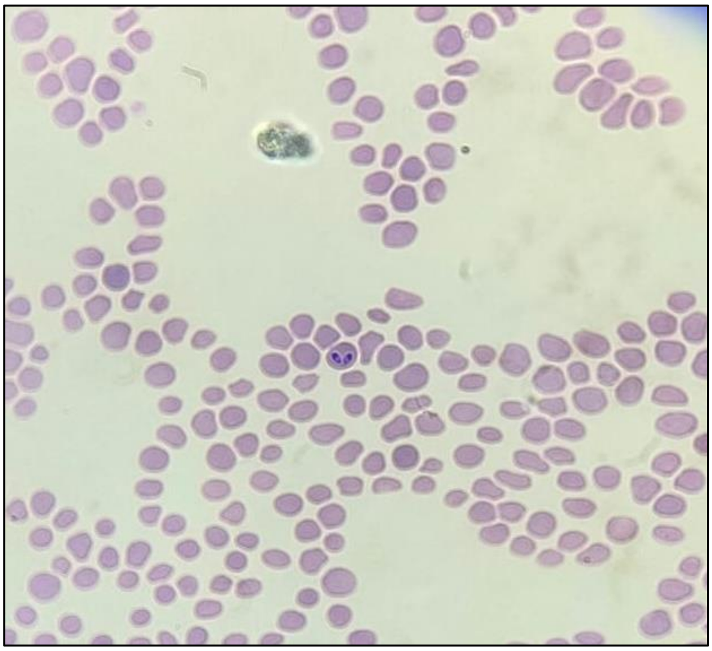

Fig. 1. Blood smear examination showing *Babesia* piroplasm (Red arrow)

- Triclosan, Nerolidol, Artesunate, Gossypol, Atovaquone are some of newly categorized drug which shows efficacy against different strain of bovine babesiosis however further studies are needed and research is going on regarding these novel drugs.
- In addition to babesicidal drugs, supportive treatment is also recommended. This may include the use of anti-inflammatory drugs, corticosteroids, and fluid therapy. In very anemic animals, blood transfusions are needed to save the lives of cattle.

Prevention and Control

Bovine babesiosis can be controlled by tick management, immunization, anti-babesia drugs or all of these.

- **Tick control-** Tick population can be reduced by acaricides or management practices, which can lower transmission rates.
  - ➢ Tick control acaricidal agent's organochlorines, organophosphates, formamidines (eg. Amitraz) synthetic pyrethroids (Permethrin, flumethrin), phenyl pyrazoles, fluazuron and macrocyclic lactones are currently used. These acaricides can be applied as dipping, spraying or pour on, dusts on animal body.

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- ➢ Dipping should be supplemented by spraying for intensive tick control or to eliminate tick present between toes, in ears or under the tails as these ticks missed out when only dipping is used. By using high pressure sprayers which provide mist to reach every part of animal's body acaricides can be applied as sprays.
- ➢ In pour on topical solution surfactants is mixed with acaricides to spread over the animal's body. In dust bags acaricides is mixed with powder. Ivermectin is a systemic acaricide which is introduced into the host's blood to kill ticks as they feed on the treated animals and provide excellent control up to 2-3 months.
- ➢ Rotational grazing and pasture treatment can reduce the tick burden by disrupting the tick lifecycle.

- **Vaccination-** Immunization against *Babesia* species can complement tick control efforts, reducing the severity of infections and the need for frequent acaricide use. Live attenuated vaccines are mainly used for vaccination against bovine babesiosis. Argentina, Australia, Brazil, Israel, South Africa, and Uruguay are some of the countries where live attenuated *Babesia* parasite strains have been used. On limited basis killed vaccines are also used, research is going on to make suitable subunit vaccine against *Babesia.*

Conclusion

In conclusion, controlling bovine babesiosis requires a holistic, integrated tick management approach that combines chemical, biological, environmental, and immunological methods. Sustainable tick control will reduce disease incidence, enhance livestock productivity, and minimize the economic impact on the cattle industry.

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