



Diagnostic Exercise

From The Davis-Thompson Foundation*

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Answer Sheet

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Diagnosis:

1. Morphologic diagnosis: brain: Severe, diffuse, cortical congestion.
2. Cause: *Babesia bovis*
3. Associated clinical pathology finding: Regenerative anemia (macrocytic hypochromic), hemoglobinemia, bilirubinemia.

Typical Gross findings are those to be expected of a mixed intravascular and extravascular hemolytic crisis. Mucous membranes are yellow (icterus); the spleen is enlarged, with dry and fleshy appearance on cut surface; the liver is enlarged and may be stained with bile pigment (orange); the kidneys are variably dark red to brown; the urine is dark red to red-brown (hemoglobinuria); the serous surfaces of the abdominal cavity may be stained with hemoglobin; the bone marrow is markedly red; there is severe congestion of multiple organs; and some animals develop pulmonary edema. The most typical *postmortem* finding of *Babesia bovis* infection, however, is severe, diffuse congestion of the gray matter of the brain, which grossly is characterized by diffuse pink discoloration of the cerebral cortex (Fig.1, Fig.2). The affected brain is classically described as "cherry-colored".

Typical microscopic findings: Histologically, there is splenic congestion, erythrophagocytosis and hemosiderosis. The liver may present congestion, paracentral necrosis (due to anemia), hemosiderin accumulation in both hepatocytes and Kupffer cells, erythrophagocytosis, and variable canalicular cholestasis. There is also mild periportal lymphoplasmacytic infiltration and the sinusoids have mild to moderate numbers of circulating leukocytes. The kidneys present hemoglobinuric nephrosis and hemosiderin accumulation in tubular epithelium. The brain is severely congested, and cerebral capillaries are packed with parasitized and non-parasitized erythrocytes. Parasitized erythrocytes may also be seen in the vessels of many other organs. These erythrocytes contain 1 to 2 parasites that measure less than 1 μm each, stain faint blue in

routine sections, and are best demonstrated as small spherical bodies through Giemsa stains. These parasites can also be demonstrated in smear preparations of fresh brain tissue (Figure 4). Animals that die of peracute disease have necrosis of lymphocytes in germinal centers of lymph nodes and spleen.

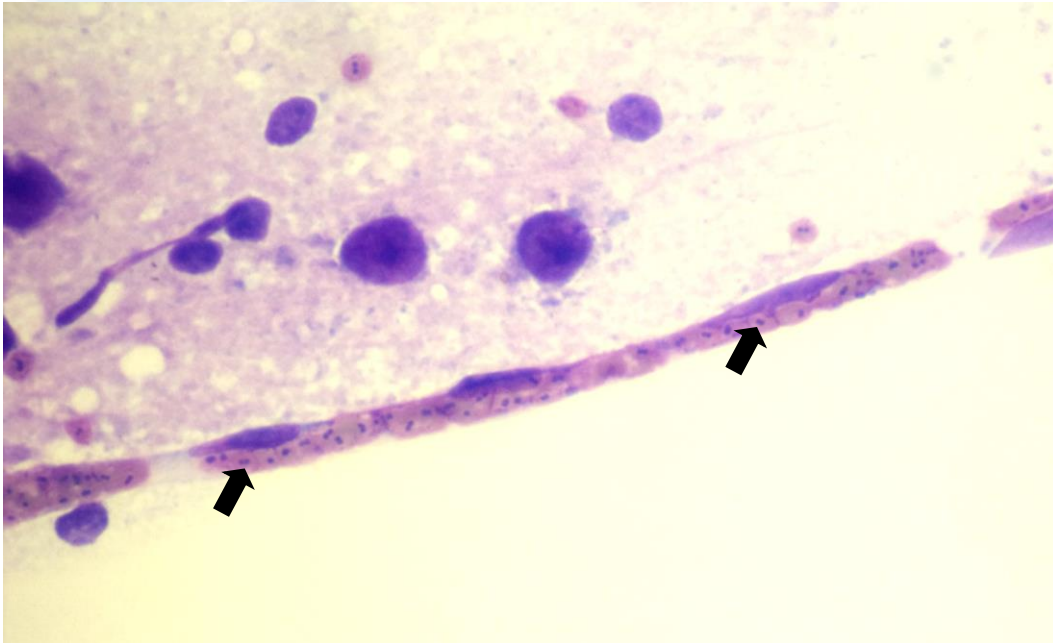


Figure 4. Brain (fresh tissue, smear preparation). Parasitized erythrocytes contain 1 to 2 parasites that measure less than 1 µm each (arrows). Diff Quick staining. Obj. 40X.

Discussion: Babesiosis is one of the main infectious causes of death in Brazilian cattle. The infection with this parasite is directly associated with intravascular hemolysis (which is responsible for the clinical anemia and hemoglobinuria) and indirectly responsible for extravascular hemolysis, which causes clinical jaundice and splenomegaly. It has been demonstrated that the infection of erythrocytes by *Babesia bovis* induces the production of autoantibodies against parasitized and non-parasitized erythrocytes, which justifies the occurrence of significant extravascular hemolysis. Once inside the erythrocyte, the parasite remodels the cellular surface, which changes the mechanical and adhesive properties and activates the complement by alternative pathway. Many aspects of the mechanisms of intravascular hemolysis, however, remain obscure. Furthermore, the disease caused by *Babesia bovis* is more complex than a simple hemolytic crisis. This idea is supported by the fact that many animals die before developing significant anemia. These animals have intense vasodilation, congestion of multiple organs and increased vascular permeability, and most die of circulatory shock. The vasodilation is due to the production of proteases by the parasite that activate plasma kallikrein (responsible for hypotension and activation of bradykinin). Many other aspects of the circulatory shock induced by *Babesia bovis* remain obscure. The macroscopic appearance of the brain of affected animals is caused by capillary congestion of brain vessels,

and is frequently responsible for clinical neurological signs. The congestion affects both gray and white matter, but is only grossly visible on the gray matter. The pathogenesis of the cerebral congestion observed in *Babesia bovis* infections has been compared to that of *Plasmodium falciparum* (causative agent of cerebral malaria) in humans. Additionally, a similar form of cerebral babesiosis has been described in cats and dogs infected with *Babesia* sp. in Africa. Bovine babesiosis is most common in adult animals, but may also occur in calves, mainly when there is failure on the transfer of maternal antibodies. In some peracute cases like the one presented here, the animal may not show clinical jaundice.

References and Recommended literature:

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