ELECTROENCEPHALOGRAPHY EVALUATION OF CEREBRAL BIOELECTRIC ACTIVITY IN DOGS WITH BABESIOSIS

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Abstract: *Canine babesiosis is a parasitic disease characterized by a cluster of clinical signs like: hemolytic anemia, jaundice, secondary nephritis, and occasionally neurological disorders and gastroenteritis.*
The aim of the current study is to describe short time electroencephalographic (EEG) changes in dogs with babesiosis presenting neurological signs.
EEG examination was performed on 6 dogs diagnosed with babesiosis and showing neurological signs (incoordination, paresis, paralysis, muscle tremor, nystagmus, loss of consciousness, tonic-clonic epileptic seizures and coma). EEGs were obtained via five subdermal stainless steel needle electrodes (F3, F4, O1, O2, Cz) placed as described by Redding (1978). The parameters used for each electroencephalographic recording were: sensitivity = 70μV/cm; time constant = 0.3 seconds; Hf = 70 Hz; Lf = 0.5 Hz; notch filter inserted; impedance of all electrodes < 10 kΩ.
The results of the present study revealed an EEG background activity characterized by the presence of the theta and delta rhythms, while alpha and beta waves were less encountered. In contrast with these the background activity showed an intersection of epilpeptiform interictal discharges (DIE) like: fast spike and atypical spike-wave complex in 2 cases, slow waves in 3 dogs and polyspikes just in one case.

Keywords*: babesiosis, electroencephalography, dogs, neurological signs*

INTRODUCTION

Canine babesiosis caused by different *Babesia* species is a parasitic disease with worldwide distribution and global significance. The severity of the disease depends on the species of *Babesia*, the presence of concurrent infections and the age and immune status of the host. (Irwin, 2009; Schoeman, 2009)

The most severe clinical and paraclinical findings in canine babesiosis are characterized by marked hemolytic anemia, severe acid-base abnormalities with frequent secondary multiple organ failure and complications such as acute renal failure (ARF), hepatopathy with marked jaundice, splenomegaly, hypoglycemia, acute respiratory distress syndrome (ARDS), gastroenteritis, additional immune-mediated red blood cell destruction (IMHA) and cerebral pathology. (Leisewitz et al., 2001, Keller et al., 2004, Jacobson, 2006)

Diagnosis of acute cases infected with *Babesia* species is based on the morphologic appearance of the parasite in the erythrocytes. (Solano-Gallego, 2011). Biochemical profile abnormalities are related both to the severity of the disease and the hypoxia degree. Common laboratory findings include elevation of liver enzymes such as alkaline phosphatase (ALP), alanine aminotransferase (ALT) and aspartate aminotransferase (AST) , hyperbilirubinemia -

more in the patients with marked icterus, hypoalbuminemia, electrolyte and acid–base abnormalities (mostly hypokalemia, hypercloremia and metabolic acidosis) (Schoeman, 2009, Furlanello et al., 2005).

The electroencephalography is a noninvasive test on electrical activity of the brain, trying to assess the impact of different neurological anomalies on electrical activity of the brain.

The aim of the present study was carried out to evaluate cerebral bioelectric activity in dogs with clinical babesiosis presenting neurological signs.

MATERIAL AND METHODS

The study was made on 6 dogs diagnosed with babesiosis and showing neurological signs (incoordination, paresis, paralysis, muscle tremor, nystagmus, loss of consciousness, tonic-clonic epileptic seizures and coma), that were presented to Internal Clinic of Faculty of Veterinary Medicine, Iasi.

In order to uniform the batches regarding the subjects' fatigue degree, the tests were performed at the same moment of the day and in identical environmental conditions.

The electroencephalogram was performed under general anesthesia, using medetomidine (Domitor, Pfizer) in a dosage of 0.03 mg/kg administered intramuscularly, in order to eliminate the artifacts triggered by the muscular contractions. After the anesthesia is installed, that is when the animal is no longer able to perform voluntary moves (in about 10-20 minutes after administration), the patients were put in sternal-abdominal decubitus.

The acquisition of the biopotentials was made with Neurofax electroencephalograph (Nihon Kohden) for 30 minutes. Needle electrodes were introduced subcutaneously according to Redding and Knecht model (1984), using five electrodes (Fig. 1): two frontals (F3, F4), one central (Cz) and two occipitals (O1, O2) used in bipolar montage, the reference electrode being placed on the nasal bone. Electrodes' nomenclature is similar to the one described by 10-20 system in human medicine (Aminoff, 2005; Nordli et al., 2011).

The parameters used for each electroencephalographic recording were: sensitivity: 70 μV, time constant: 0.3 seconds, filter pass – down of 70Hz, filter pass – up 30 Hz and electrode impedance < 10Ω.

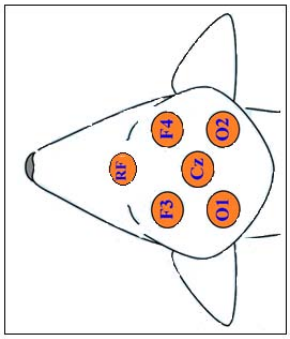

Fig.1 The electrodes positioned according to Redding and Knecht model (1984). F3 - frontal left, F4 - frontal right, Cz - vertex, O1- occipital left, O2 -occipital right, Rf-nose, between the eyes.

Recording sections were visually selected for analysis of background activity using Fast Fourier Transformation (FFT). Spectral bands were, 8.0-13.0 Hz for alpha, 13.0-30.0 Hz

for beta, 0.5-4.0 Hz for delta and 4.0-8.0 for theta activity. In order to minimize errors through different skull sizes, forms and thicknesses, the relative power of the spectral bands was calculated for every lead.

The visual analysis of the electroencephalographic tracks presumed the recording of the electroencephalographic pattern (any EEG characteristic activity), marking the background activity (any EEG activity that represents the frame where a normal or abnormal pattern appears), all the paroxysmal activities (spike, poly-spikes, sharp slow waves, wave-spike complexes, bursts of slow waves and spikes), as well as possible artifacts.

RESULTS AND DISCUSSIONS

The results of the present study revealed a modified EEG background activity in all dogs, characterized by the presence of the theta and delta rhythms, while alpha and beta waves were less encountered. All 6 dogs were presented an intersection of epileptiform interictal discharges (DIE) like: fast spike and atypical spike-wave complex in 2 cases without clinical epileptic seizures, slow waves in 3 dogs and poly-spikes just in one case (Fig.2).

At 2 dogs that died it was observed an increased reduction over EEG traces. In their case, it was noticed brain death characterized by the exclusive presence of amplitudes below 2μV. Generalized slow waves suggest a bilateral disturbance of brain function common in diffuse encephalopathy. When is observed an attenuation of EEG activity, the etiology of brain disorders cannot be determined, but is considered to be associated with a diffuse slowing and poor reactivity to somatosensory stimulation (Tatum, 2014).

At 2 dogs, EEG recorded an ictal period. (Fig.3) One dog was presented a Burst-suppresion (EEG activity characterized by rhythmic discharges with increased voltage alternating with periods of brain inactivity). This type of EEG activity may occur after administration of large doses of anesthetics or sedatives, hypothermia and coma. The presence of tissue hypoxia may lead to a poor prognosis. (Niedermeyer, 2009, San-juan 2009, Bauer 2013).

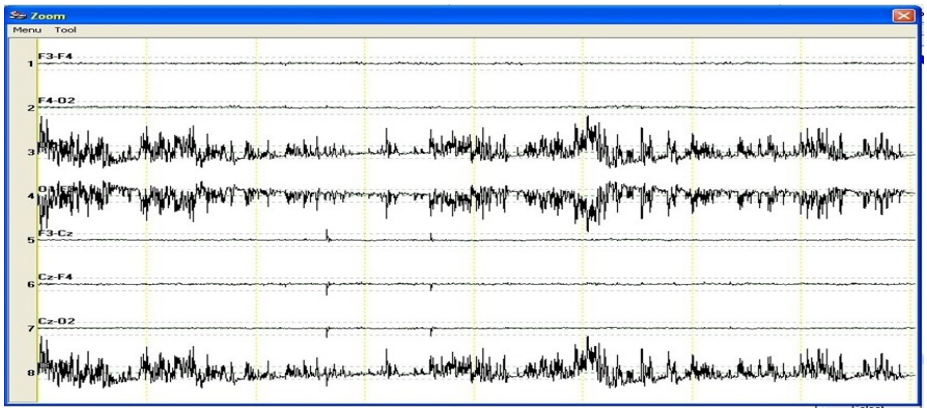

Fig.2 EEG of a Bordeaux Dog, 3 years old. Peaks at Cz derivations and hypervaulted beta at O1 derivations. Background activity more subdued.

The important causes of hypoxia include anemia, hypotensive shock, vascular stasis by sludging of erythrocytes, excessive endogenous production of carbon monoxide, and parasitic damage to hemoglobin (Ayoob et al., 2010; Taboada, 2006). The central nervous system, kidney and muscle are the organs most affected by tissue hypoxia (Jacobson, 2006). Hypoxia is thought to be more important than hemoglobinuria in damaging the kidneys of dogs with babesiosis (Lobetti et al., 1996; Mathe et al., 2007; Ayoob et al., 2010).

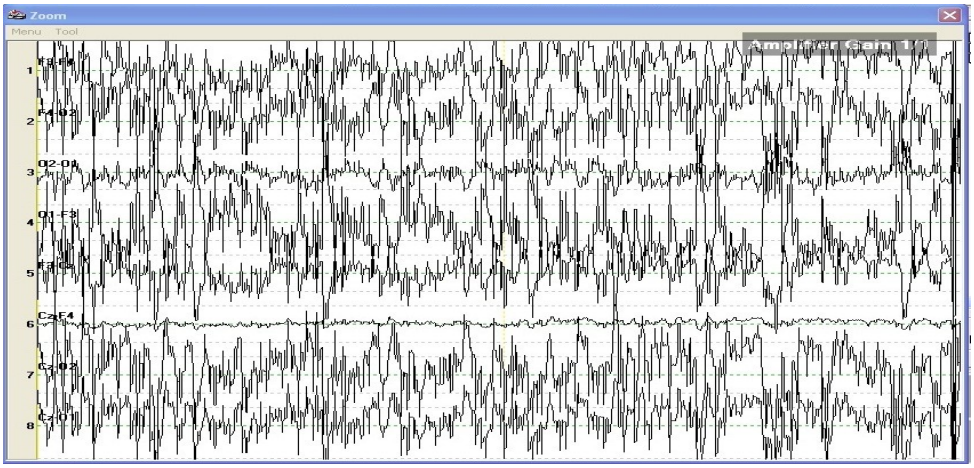

Fig.3 EEG of a German Shepard, 3 years old, generalized tonic-clonic crisis

Neurologic complications result from sludging of parasitized erythrocytes in CNS capillary beds, with congestion and macroscopic and microscopic hemorrhages. Another cause of neurological signs is severe hypoglycemia (Birkenheuer, 2014).

Thus, taking into account the previously stated, in the EEG of brain activity appears a cluster of anomalies which occur in hepatic and renal failure, hypoxia, cerebral edema, hypoglycemia or cerebral hemorrhages.

CONCLUSION

Examining the cerebral behavior of the dogs with babesiosis presenting neurological signs, the EEG showed epileptiform discharges in all patients.

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