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Seasonal occurrence of canine babesiosis is influenced by local climate conditions

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Abstract

Global warming and its effect on local climate conditions is one of the presumed underlying causes for changes in temporal and spatial distribution of vector-borne diseases. In Europe, canine babesiosis is transmitted by *Dermacentor reticulatus*. This hard tick species is observed to spread to new endemic areas. Within these new areas, specific local climate conditions may be responsible for sudden seasonal onset and termination of occurrence of this disease in dogs. From 2000 to 2006, 343 confirmed cases of canine babesiosis were documented at the Veterinary University of Vienna and in the Laboratory for Veterinary Diagnostic (INVITRO, Vienna). Estimated week of infection was analysed for mean air and soil temperature, relative humidity, and precipitation for each case. For seasonal start in spring, a sudden rise of air temperature up to 12 °C and defrosting of soil were essential. In autumn, the seasonal start was associated with a drop of temperature below 17 °C. Termination of occurrence of canine babesiosis, independent of season, correlated either with a sudden drop of temperature ($\Delta T > 9$ °C) with concurrent heavy rain, persistent drought, or with air temperature above 20 °C (spring/summer) or below 5 °C (autumn/winter). Relative humidity and precipitation did not have a major influence on the incidence of canine babesiosis at all. Global climate changes and adaptation of ticks to new environmental conditions introduce vector-borne diseases into new areas.

Keywords: *Babesia canis*; *Dermacentor reticulatus*; Dog; Infection; Weather conditions

Introduction

Canine babesiosis is a seasonal disease in Europe caused by *Babesia canis*, an intracellular protozoan parasite of canine erythrocytes. It is transmitted to dogs by the hard tick *Dermacentor reticulatus*. Canine babesiosis was endemic in the Mediterranean area and eastern Europe for a long time until it became evident in Central Europe in the recent three decades. Introduction of infected ticks to Central Europe by dogs transported from southern European countries were documented since 1975 (Hinaidy and Tschepper, 1979). Isolated spots of occurrence of *D. reticulatus* in Central Europe in the 1950s spread to large areas over Hungary, Poland, Austria, and Germany (Zahler and Gothe, 1997; Sréter et al., 2005; Dautel et al., 2006; Zygner and Wedrychowicz, 2006). Single autochthonous cases of canine babesiosis were documented in the Netherlands

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(Matjila et al., 2005) and in Switzerland (Sager et al., 2005). Extending geographical distribution of vectors and rising incidence of vector-borne diseases may correlate directly to a global change in climate and atmospheric composition (Randolph, 2004) as well as to changes in human land cover, globalisation of trade and transport, the spread of alien species of plants and animals, human health, and technology (Sutherst, 2001). Studies on the correlation of epidemiology of animal babesiosis, tick activity, and environmental conditions have been conducted in several animal species (Martinod and Gilot, 1991; Yeruham et al., 1998; Corson et al., 2004).

Adult *Dermacentor* are well known to tolerate low temperatures and low humidities, although warm and humid conditions are preferred for development and reproduction (Zahler et al., 1996; Heile et al., 2006). Questing for preferred hosts (canine, wild boar, ruminants) starts after moulting from the nymphal to the adult stage at the end of summer. Activity is reduced or ceases during cold winter months while snow covers the tick habitat. Reactivation and reproduction appear to start immediately after melting of snow and a few warm days in the spring (Zahler and Gothe, 1997).

The typical biannual pattern of occurrence of canine babesiosis in Central Europe is assumed to be influenced by specific local climate conditions. This study demonstrates the local climate conditions in Central Europe during the seasonal occurrence of canine babesiosis, which may be applied as an index for tick activity.

Materials and methods

In the period from 2000 to 2006, 343 cases of canine babesiosis were documented by confirmation of the infectious agent in blood smears of dogs (Fig. 1). History of tick infestation and the presence of a given dog in an endemic area 1–2 weeks (incubation period) prior to diagnosing babesiosis were terms for the study. All dogs were infected in the eastern part of Austria or in Hungary near the Austrian border. Cases were counted on a weekly basis.

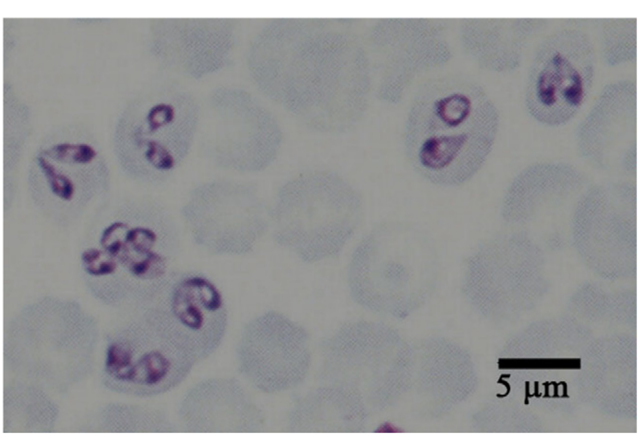

Fig. 1. Canine blood smear with intracellular *Babesia* spp.

Climate data were measured every 15 min at a meteorological station (Adcon, A730MD) located nearby Vienna (Raasdorf, operated by the Institute of Agronomy and Plant Breeding, BOKU – University of Natural Resources and Applied Life Sciences, Vienna).

The station was equipped with sensors for measuring air temperature (2 m above ground level) and soil temperature, relative air humidity, and precipitation.

Mean daily air temperature, minima and maxima of temperature, mean soil temperature, and mean relative humidity were related weekly with the number of cases of canine babesiosis 2 weeks later. To get more detailed information from these data, cases were classified by similarities of climate variables (temperature values and relative humidity) using the linkage between groups method with squared Euclidean distances. For classification, a hierarchical cluster analysis was performed using SPSS v. 14 (SPSS Inc., Chicago, USA). Generated groups defined by cluster analysis can be interpreted by the mean values of the variables integrated in the cluster analysis (Tables 1–3). This method was chosen to analyse the correlation of certain environmental conditions (climate data) and a known event (cases of babesiosis).

The first cluster analysis generated 3 groups differing in the mean values of air temperature, minimal temperature (T_{min}), and maximal temperature (T_{max}). Classifying cases by air temperature and relative humidity as well as soil temperature and relative humidity analysis resulted in 5 clusters each. For each of these groups, the frequencies of canine babesiosis were determined and described biannually. The spring/summer season was defined from February 1 to July 31 and the autumn/winter season from August 1 to January 31 the following year.

For further analysis, sudden onset times of canine babesiosis were defined as a rise of up to 3 clinical cases per week and termination times as a drop of 4 cases within 2 weeks. Climate data were checked for sudden change of temperature (air and soil), relative humidity, and rain 1–2 weeks (incubation period) before clinical diagnosis of canine babesiosis by descriptive methods.

Results

Biannual distribution of canine babesiosis resulted in 126 cases in the spring/summer season versus 217 cases in the autumn/winter season cases (Fig. 2).

Three well-distinguishable groups were generated regarding mean air temperature during the time of