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Review Article

Tick-Borne Diseases and Gastric Ulcer in the Donkey

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ABSTRACT

Clinical research on donkeys needs to be in continual development because they require specific diagnostic and therapeutic approaches. Unfortunately, donkeys are still considered to be small horses. Some update about donkey diseases is here provided on the basis of current knowledge, personal publications, and experiences. Several chronic diseases are not currently enough clear about the consequences they can have in donkeys. Epidemiology and clinical presentation of piroplasmiasis and other tick-borne diseases (TBDs) show some differences between horses and donkeys. Nonspecific clinical presentation of *Babesia caballi* and *Theileria equi* infection seems to be common in donkeys, and clinical pathology alterations persist after natural infection. Nevertheless, donkeys seem to be less sensitive to *Borrelia burgdorferi* infection. Clinical monitoring for TBDs should be recommended because donkeys represent a risk both for transmission to other animals (as unapparent carriers) and for their own health and performances. A high prevalence of equine gastric ulcer syndrome (EGUS) in donkeys with no clinical signs of this disease has also been found. This suggests that subclinical forms of EGUS may be more common in donkeys than was previously thought, but it is routinely overlooked. The results indicate that this syndrome could be present in apparently healthy donkeys. Several peculiarities of donkey are present in respect to horses. Disease presentation can be very different, and also epidemiology of infectious and noninfectious disease needs to be specifically studied for donkeys, to identify control plans to decrease incidence and consequences, especially for the discussed subclinical diseases.

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1. Introduction

Interest in the welfare and diseases of donkeys is constantly increasing in several countries. Despite this, clinical research on donkeys needs to be in continual development because they show different reactions compared with horses in many conditions, including infectious diseases, and need specific diagnostic and therapeutic approaches [1–4]. Their current popularity is also due to their use as pets, in addition to other use depending on geographical differences, such as recreational purposes, sports

activities, donkey-assisted therapy, and as pack/draught animals or meat production [4].

Some update about donkey diseases is here provided on the basis of current knowledge, personal publications, and experiences. The discussion is mainly focused on those diseases that are able to change the normal physiology of the donkey despite none or minimal clinical appearance. It is notorious as donkey can show sign of diseases and pain in a different way compared with other equine as horses [4,5]. Unfortunately, donkeys are still considered to be small horses, despite several studies showed physiological, behavioral, and pharmacological differences between these species [1–7]. Well-known diseases from the epidemiological, diagnostic, and therapeutic point of view in horses are not currently enough clear about the consequences they can have in donkeys.

In the light of these considerations, it is important to study in detail of those diseases that could only appear subtly in the donkey due to their stoicism in manifesting certain symptoms, to trace the path of a new line of research, providing information on their effects on health, welfare, working performance, and production.

Animal welfare/ethical statement: The authors state that the work has been carried out in accordance with the EU directive 2010/63/EU for welfare of animal experiments and with all the current legislation.

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2. Tick-Borne Diseases in Donkey

Among the infections transmitted by ticks that may affect donkeys, those caused by *Theileria equi* and *Babesia caballi* (order piroplasmida) are of major importance; however, the infections by *Anaplasma phagocytophilum* and *Borrelia burgdorferi* s.l. that are described in association with clinical onset in horses could not currently find suitable findings in donkey species.

Basing on the high prevalence rates of infection by *B. caballi* and *T. equi* recovered both at Immunofluorescence Antibody Test (IFAT) and polymerase chain reaction (PCR) tests in Italian horses [8–13], in 2014, we performed an epidemiological survey to assess the seroprevalence of tick-borne pathogens (TBPs), mainly piroplasm protozoans, affecting the Italian donkeys [14].

One hundred twenty-two adult donkeys were selected and submitted to blood collection. Antibodies against *T. equi*, *B. caballi*, *A. phagocytophilum*, and *B. burgdorferi* s.l. were detected by IFAT, while the presence of pathogens by using specific PCR protocols. Forty-eight (39.3%) animals tested positive for *T. equi* while 58 (47.5%) tested positive for *B. caballi* antibodies; nine animals (7.4%) were found positive for antibodies against *A. phagocytophilum*, whereas negative results were obtained for *B. burgdorferi* s.l. Twenty-three (18.8%) donkeys resulted to be positive to *Babesia/Theileria* spp. PCR assays. Neither *A. phagocytophilum* nor *B. burgdorferi* PCRs tested positive.

The study showed a high exposure of Italian donkeys to piroplasm protozoans confirming the results obtained in previous surveys performed in donkey populations from other European countries, for example Turkey, Spain, and also in China which showed a seroprevalence ranging from 17% to 93% for *B. caballi* and from 10% to 47% for *T. equi* [15–17]. Basing on our results, donkeys seem to have a scant exposition to *B. burgdorferi* s.l. infection. This could account for the absence of *B. burgdorferi* s.l. infection in the donkey population investigated or, alternatively, a scant susceptibility of donkeys to the *B. lusitaniae* the *Borrelia* species detected in the studied areas in horse populations [18].

Regarding *A. phagocytophilum*, the low seroprevalence (7.4%) indicates a moderate circulation of this TBP among donkeys in the considered area; this finding agrees with a previous epidemiological survey conducted on 100 donkeys in southern Italy, detecting a prevalence rate of 6% [19]. The positive rate is lower than those observed in horse populations reared in the same investigated areas (ranging from 13% to 17%) [20–22] suggesting that the infection by *A. phagocytophilum* occurs more frequently in horses compared with donkeys in Italy, as recently observed in other European countries for example Sweden and Denmark [23,24].

The risk factors associated with piroplasmosis in our study, resulted to be advanced age and outdoor housing. These results agree with previous studies conducted on horses and are consistent with a high exposure to tick bites [9,25–27].

The presence of different strains even within the same geographical locality, established by the molecular characterization of *T. equi* isolates, suggested different sources of introduction, likely driven by horses rather than donkeys [14].

Piantedosi et al [28] performed a survey on piroplasmosis infection in Italian donkeys and found similar positivity percentages at IFAT. As in the study we performed, in this article the authors found no symptomatic donkeys. The unique exception was represented by an active reproductive male that showed symptoms of the acute form of the disease, representing the first report in Italy of such clinical presentation.

Equine piroplasmosis is endemic in tropical and temperate areas and occurs as acute, subacute, chronic, and not evident forms, the latter being the most frequent. Animals surviving the acute phase may remain seropositive carriers with low levels of parasitemia,

condition that occurs more frequently in *T. equi* infections [29]. In horse species, clinical presentation of overt disease is commonly associated with *T. equi* infections. Infections with *B. caballi* often remain latent but can be sometimes exhibited as anemia accompanied with other clinical signs associated with the disease. Hyperacute, acute, subacute, and chronic forms of the disease have been described. Clinical signs of the disease may include varying degrees of inappetence, pyrexia, dependent edema, hemoglobinuria, anemia, reduced work efficiency, weight loss, and abortion in mares [29–31].

It is important to highlight that horses infected with *T. equi* or *B. caballi* in both endemic and nonendemic regions, as most of the Italian regions are, act commonly as not evident carriers without appreciable clinical signs of disease [29]. In Italy, the rarity of clinical disease observed in horses was consistent with the nature of the disease in an endemic setting, where equids over time have developed protective immunity [30].

Piroplasmosis of donkeys is an underestimated disease for the prevalence of chronic/asymptomatic forms attributable both to the strong state of premonition, typical of the animals living into endemic areas and to the natural resistance of this animal species. However, in the rare cases in which symptomatic forms are observed, the clinical expressions are different from those commonly detected in acute or subacute forms of horse piroplasmosis, that is, prevalent signs such as anorexia, apathy and intestinal motility disorders (constipation), and splenomegaly rather than alterations of the hematological profile are present [32].

Since nor systematic studies have been reported about the symptoms associated with piroplasmosis occurring in Italian donkeys after natural infection and neither on the effect on animal health status (e.g., blood analysis) of IFAT or PCR positives, we performed a clinical study on the same areas of the previous epidemiological survey to investigate those specific aspects [2].

One hundred thirty-eight donkeys were enrolled. IFAT to detect immunoglobulin G antibodies against *T. equi* and *B. caballi* and PCR to detect *Babesia* spp. and *Theileria* spp. DNA were done. Clinical examinations, hematological analyses, and serum bilirubin evaluation were also performed, and results were compared in respect to positive or negative status.

A seroprevalence of 40.6% and 47.8% was found for *T. equi* and *B. caballi*, respectively. PCR results showed that 17.4% of the animals tested positive for *T. equi* and 3.6% for *B. caballi*.

Clinical examination allowed to verify that 12 donkeys (8.7%) had clinical signs consistent with chronic forms of the disease. The symptoms included signs as anorexia, depression, pale mucus membrane, and poor body condition score. The only symptom related to piroplasmosis was slight icterus, detected in six donkeys. Differently from the previous study performed on horses in Italy [30], no acute forms of the disease were found. Despite the very not specific clinical presentation, 58 donkeys had hematological and serum bilirubin alterations, and 56 (96.6%) of them were IFAT and/or PCR positive. Changes in erythrocyte number, packed cell volume, hemoglobin concentration, mean corpuscular hemoglobin, platelets number, and total bilirubin were significantly associated with both positive and symptomatic animals. Therefore, from this second survey, it can be deduced that piroplasm protozoans have a significant effect that is predominantly subclinical in donkeys, and knowledge of its real consequences, especially on performances and production, requires further investigations [2].

Despite the scant perception of practitioner about the prevalence and clinical significance of the donkey piroplasmosis, effective antivectorial protective measures are advisable, due to the side effects that pharmacological treatment with imidocarb dihydrochloridato may induce in this animal species [33]. In fact, therapeutic schemes are derived from horse practices and are not

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