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Risk factors for bovine tuberculosis persistence in beef herds of Southern and Central Spain

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ABSTRACT

In order to assess risk factors related to bovine tuberculosis (bTB) persistence, a case–control study, comparing persistent versus transient bTB infected beef farms from Central and Southern Spain, was conducted. Farms were matched by herd size and geographical location (county). A questionnaire administered by personal interview was conducted on 150 herds (80 controls and 70 cases) from Andalucia and Castilla La Mancha regions. The questionnaire included questions related to the personnel involved in routine diagnostics, structure of the farm and of the herd, management, presence of other domestic species and of wildlife reservoirs.

According to the results of our study, farms with large pasture areas and bTB infected neighbors had more difficulties in eradicating the disease, and therefore, were more likely to suffer a persistent bTB infection. The odds of bTB persistence were between 1.2 and 5.1 (i.e., 95% confidence interval of the OR) times higher in those herds that had a neighbor infected herd. Farms with large pasture areas had odds between 1.2 and 12.7 (i.e., 95% confidence interval of the OR) times higher of having a persistent bTB episode than farms with small pasture areas.

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1. Introduction

Bovine tuberculosis (bTB) is a chronic infectious disease of cattle (including all *Bos* species, and *Bubalus bubalus*) and bison (*Bison bison*) caused by any of the disease-causing mycobacterial species within the *Mycobacterium tuberculosis*-complex (Anon., 2013a).

The eradication of bTB has been an important issue over years due to its public health relevance and high economic impact in livestock production. Control programs, mainly based on the slaughter of animals positive to the tuberculin skin test (Reviriego-Gordejo and Vermeersch, 2006), have substantially reduced or nearly eradicated the disease from farm animals in many industrialized countries (EFSA, 2012). However, bTB is still widespread in Africa, Central and South America, parts of Asia and some Middle

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East countries (OIE, 2009). In Europe, despite the intensive eradication efforts applied over years, bTB continues to be present in countries such as the United Kingdom, Ireland, Spain, Greece, Portugal or Italy (EFSA, 2012). In Spain, the herd prevalence has been substantially reduced: from 11.1% in 1986 to 1.3% in 2012 (Anon., 2013b). However, in the last years, the decline has only been moderate: from 1.6% in 2007 to 1.3% in 2012. This slow progress poses a serious challenge for the achievement of a national official tuberculosis free (OTF) status.

In Spain, just recently, different studies have attempted to study bTB epidemiology in domestic animals (Alvarez et al., 2012; Allepuz et al., 2011; Rodríguez-Prieto et al., 2012; Martínez-López et al., 2013), but just one of them evaluated factors related to bTB persistence at farm level (Martínez-López et al., 2013). These authors found that previous bTB history, herd size, extensive production systems and a high number of fenced big game estates in the neighborhood of the farm were related to bTB persistence in farms from an area of South-Central Spain. The persistence of bTB in some cattle herds poses an important challenge to the eradication program, and therefore, improving the body of knowledge regarding those factors related to bTB persistence at herd level should be useful for disease management activities.

In addition to the limited knowledge about factors related to bTB persistence in Spanish cattle herds, most of the published bTB risk factors studies conducted in different countries did not discriminate between transient and persistent infections. The analysis of the causes of persistent infections has received little attention (Brooks-Pollock and Keeling, 2009; Wolfe et al., 2010), and differences on the factors that determine both situations might exist (Reilly and Courtenay, 2007). Persistent infections might be the result of the presence of infected but undetected cattle as a consequence of the lack of sensitivity of the test (De la Rua-Domenech et al., 2006) or due to the lack of good veterinary practice (Humblet et al., 2011). Moreover, *Mycobacterium bovis* could persist in the farm environment (Courtenay et al., 2006; Fine et al., 2011) or in other domestic reservoirs such as goats (Napp et al., 2013; Zanardi et al., 2013). Also, persistence of bTB within a farm may be the result of re-infections due to repeated contact with local wildlife or domestic reservoirs.

The aim of this study was to improve the understanding of bTB epidemiology in Spain by assessing which herd factors could be related to bTB persistent infections.

2. Materials and methods

2.1. Area of study

The study was conducted on farms from Southern and Central Spain (Andalucia and Castilla La Mancha). These areas were selected because of their higher risk of persistence as compared to the rest of the country (Allepuz et al., 2011).

2.2. Study design

A case–control study on beef farms matched by herd size and geographical location (at county level) was designed to detect Odds Ratio differences of 2.5, with a 95% level of confidence, 80% of power, and assuming exposure of 20% for the controls. A sample size of 200 (100 controls and 100 cases) was calculated.

2.3. Bovine TB eradication program in Spain

According to Council Directive 64/432/EEC, the Spanish bTB eradication program is based on testing of cattle and culling of positive animals. Moreover, cattle movement restrictions are implemented on infected herds in order to prevent the introduction of infected animals into free herds. Herds are classified as bTB free if no positive animals are detected within the herd in at least two consecutive follow-up herd tests, and as non-bTB free if at least one positive animal is detected. In each herd test, all animals older than 6 weeks of age are tested with the single intradermal test (SIT). In particular cases, where cross-reactions with other mycobacteria are suspected, single intradermal comparative cervical test (SICCT) may be used. In bTB free herds where positive animals are detected for the first time, the confirmation of bTB infection is carried out by tissue culture. Non-bTB free herds are tested at least 3 times per year. bTB free herds located in local veterinary units (i.e., counties) with prevalence higher than 3% are tested twice a year, otherwise they are tested once a year (Anon., 2013b).

2.4. Case–control definition and selection of farms

Case farms were defined as those farms in which bTB persisted for at least 5 consecutive years between 2002 and 2011, and control farms consisted of farms that achieved the elimination of the infection within a period of 1–2 years also between 2002 and 2011. Case farms were randomly selected among those that met the inclusion criteria, and control farms were matched to case farms based on herd size and location. For each case farm, given the herd size, and its location, provided by the regional governments of Andalucia and Castilla La Mancha, we first selected all the possible control farms for each case farm (i.e., same county and difference on herd size lower than 100 animals) and among them, we randomly selected one control for each case.

2.5. Questionnaire survey

An epidemiological questionnaire including potential risk factors for bTB persistence, based on existing literature, was designed. We included questions related to routine diagnosis (such as changes in personnel in charge of testing), structure of the farm (pasture area, number of holdings, etc.), structure of the herd (number of animals by age, breed, etc.), presence of other domestic species in the farm (goats, pigs, etc.), management (origin of purchased animals, feeding practices, etc.), wildlife reservoirs, health status of the herd and history of cases in people (full questionnaire available upon request). The

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