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REVIEW

Historical aspects of bovine tuberculosis in Britain

Ross G. Cooper

Division of Physiology, Faculty of Health, Birmingham City University, UK

Abstract: Bovine tuberculosis (TB) is spreading from infected badgers to cattle. The objective of the review was to consolidate the principal and important articles written on bovine TB in Britain over the last six decades. The criteria used in the current review for selecting articles were both theoretically and practically motivated and adopted from proposed criteria in The International Classification of Functioning, Disability and Health for the 19th century, 20th century, and 21st century. Data was classified according to a normal distribution with the 20th century expressing the greater readership. The results show that cattle infected with *Mycobacterium bovis* characteristically exhibit pulmonary infection and shed the bacterium in respiratory secretions. Badger to cattle transmission may be via inhalation of bacilli from contaminated grass infected with badger excretions. Therefore, questions concerning the necessity of badger culling should be addressed.

Key words: bovine, Britain, history, treatment, tuberculosis

INTRODUCTION

Of concern is the spread of bovine tuberculosis (TB) from badgers to cattle. In 1868, F. A. Chauveau demonstrated transmission of TB via the digestive tract of cattle, and in 1870 Gerlach showed that milk from TB infected cows could transmit the disease to other animals [1]. In 1882, Robert Koch advocated the identical nature of bovine tuberculosis in man, its associated transmissibility, and pronounced the risks of consuming unpasteurised milk [2]. In 1935, there was a national voluntary programme to eradicate bovine TB in the UK which became compulsory in 1950, principally because of concern about *Mycobacterium bovis* as a cause of the disease in humans [3]. The programme utilised intra-dermal tuberculin testing and slaughtering of reactors resulting in the disease being confined to a few localised areas in south-west England [3]. There has been a renewed interested in managing zoonotic risks to both humans and livestock [4]. Often, however, it is impossible to reduce prevalence by culling, particularly of wild-life, such as badgers. The presented study advocates ecological land management techniques that are beneficial to conservation in order to reduce the incidence of bovine tuberculosis in cattle [4].

The aim of the current review was to explore the literature pertinent to bovine TB and its historical consequences.

MATERIALS AND METHODS

The criteria used in the current review for selecting articles were both theoretically and practically motivated and adopted from proposed criteria in The International Classification of Functioning, Disability and Health- ICF, 2001. The criteria were as follows:

- Articles with internationally recognised impact factors were classified as follows: > 5 (Class A), 5-1 (Class B) and <1 (Class C). Where articles were not published in journals, e.g. health documents, classification was limited to point 2 below.
- Articles were rated (1 – excellent, 5 – poor) concerning relevance therein of impact of lifestyle, stress and/or environmental factor/s predisposing the contraction of TB among the British public.
- Criteria for selection of literature used included yes-no responses to: the appropriateness of methodology; adequacy of subject numbers; specificity of gender and/or age of subjects; and statistically significant response rates to survey questionnaires.
- The time frame used was 1963-2008, inclusive.
- A multi-factorial overview of the factors eschewed concerning the predisposition and contraction of TB were elucidated. It was presumed that collective articles detailing known factors of TB prevalence were not necessarily correlated with functionality and health.
- Compilation of materials for the review started with published literature or easily accessible academic research.
- The articles were accessible from on-line sources, including Google, PubMed and Medline. In instances where abstracts were merely cited, attempts were made to gain the full-text article via a Google search or inter-library loan.

Articles were categorised according to information discussed therein into 3 groups using the ICF criteria proposed above: 19th century; 20th century; and 21st century. In cases where there was an overlap of centuries, all divisions were counted. The data utilised in each time period followed a normal distribution in terms of readership rating and/or impact factor. It was anticipated that the 20th century expressed a greater readership. A statistical method was not utilised but rather a count of appropriate articles chosen was tabulated (Table 1).

Ethical approval was deemed unnecessary as there were no foreseen and met costs, experiments, nor conflict of interest implicit in the literature searches.

Corresponding author: Dr. Ross G. Cooper, Division of Physiology, Faculty of Health, Birmingham City University, 704 Baker Building, Franchise Street, Perry Barr, Birmingham B42 2SU, UK.
E-mail: rgcooperuk@yahoo.com

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Table 1 Selection results for articles of bovine TB infection in Britain

Time period	Total # journal articles	Inclusion #	Exclusion #
19th century	4	2	2
20th century	12	9	3
21st century	13	10	3
TOTAL	29	21	8

RESULTS

The criteria for rejection of an article included a rating of 4 or 5 (point 2, ICF criteria) and/or 2 or more no responses to selection criteria (point 3, ICF criteria). In cases where the title and authorship of the article were given, but the abstract unobtainable, the article was rejected. Results were summarised in Table 1.

19th century. Bovine tuberculosis. By the mid-1890s, the use of tuberculin was regarded as the best method for treating bovine TB in cattle, and in Britain calls were made throughout the 1880s and 1890s to included bovine TB under the 1869 Contagious Diseases (Animals) Act [5]. There were problems with identifying TB positive animals which fuelled fears that a large proportion of the national herd would have to be put down. There was a shift from prevention to the regulation of meat and milk, and tuberculin revived discussion on prevention and eradication [5]. Tuberculin received official support and recognition from the Royal Commission on Tuberculosis of 1896-1898 [5]. There were, however, concerns about the reliability of tuberculin, resulting in farmers becoming more cautious. The sub-cutaneous test was considerably time-consuming and failed to produce a substantive reaction in animals with the early stages of TB, and in animals exhibiting a raised temperature just before calving [5].

20th century. Bovine tuberculosis. In the 1970s, a strategy was initiated in which badgers were killed on farms where cattle were found positive to the tuberculin test [3]. If there was a routine system for monitoring all wildlife, the incidence of TB in wild animals would have been revealed, e.g. in rats, foxes, deer, waterfowl, raptors, pheasants and outdoor poultry. A comparison between possum and badger transmission has been published [6]. In 1901, Koch stated that bovine tuberculosis was not a significant threat to humans. Later, however, John McFadyean discounted Koch's assertion with the warning of TB's fatality following consumption of contaminated milk. A number of TB Orders were made from 1913-1946 proclaiming the removal of cattle affected by various forms of clinical TB [2]. In 1922, although the Ministry of Health introduced the Milk (Special Designations) Order which identified milk from tuberculin tested herds, by the mid-1930s there was a non-significant attenuation of infected milk [2]. In 1944, it was noted that bovine TB was a significant disease in Britain, and dairy marketing boards propitiated the problem by blocking attempts to enforce legislation for milk pasteurisation [7]. Progress only began to be made when the 1937 Agriculture Act empowered the Minister of Agriculture and Fisheries to spend money on the eradication of the disease and providing cash incentives for voluntary eradication based on tuberculin testing and removal of reactors. Weybridge bovine PPD provided enhanced discrimination between TB and non-TB cattle than the Weybridge human PPD when used together with avian PPD in comparative tuberculin tests [8]. In 1950, a compulsory eradication plan was launched, and in 1960 all of Britain became subject to compulsory tuberculin testing and destruction of positive animals. There was widespread introduction of pasteurised milk [2]. Cattle infected with *Mycobacterium bovis* characteristically exhibit pulmonary infection and shed the bacterium in respiratory secretions [9]. Badger-to-cattle transmission may be via inhalation of bacilli from contaminated grass infected with badger excretions. Cattle prefer to graze along the edges of fields and are thus sometimes likely to graze grass in badger latrines and scent marking areas [10]. Culling of these animals may potentiate immigration into culled areas, disruption of territoriality, increased ranging and mixing between badger groups [11].

In the early 1920s, the MRC's support for tuberculin saw legislative attempts to stop its transmission through milk [5]. In order for milk to qualify as Grade A it had to come from herds tested twice yearly. All cattle reacting to TB were removed and any additions to the herd had to pass a tuberculin test. Studies for the established Joint Tuberculosis Committee focused on 2 main areas, including the refinement of testing procedures and the pursuit of pure tuberculin [5].

21st century. Bovine tuberculosis. There has been some concern over the impact of badger culling on the spread of TB to cattle [12]. The authors are concerned that the culling was unlikely to control cattle TB. Indeed, if badgers were to be culled such an enterprise would be resisted by the public, and concerns raised over the ecological impact [13]. The authors advocate the safety of intra-muscular injection of BCG vaccines in badgers. Badger culling increases the risk of badger-to-badger transmission, and cattle-to-badger transmission is influenced by cattle testing regimes [14]. Other vectors include the bank vole (*Clethrionomys glareolus*) of strains identical to those found in badgers and cattle on the same farm [15]. The authors suggest that it is unlikely that other small mammals were able to harbour the disease to levels synchronous with infective transmission. The clonality of this group of organisms suggests that population structures of this bacterium are dominated by reductions in diversity as a consequence of population bottlenecks or selective sweeps, because entire chromosomes are fixed in the population [16]. The risk of intra-human transmission cannot be ignored, especially considering the increasing numbers of cattle herds [17]. For certain, the continued consumption of unpasteurised milk, retail sales of the like, and occupational exposure to infectious aerosols from TB-infected animals and carcases is of concern [17]. Follow-up of human contacts should be limited to those with close contact with herds infected with bovine TB, and cattle with visible pulmonary lesions or evidence of udder infection [18]. Children on such farms should be administered BCG prior to entry into junior school [18]. The development of effective vaccines in farmed cattle and deer is essential to judge the control of TB [19]. An anonymous paper published in 2000 proposed a number of discussion points which are summarised here: adequate staffing and resources; public health law; organisational needs; measure of control in hospitals; healthcare worker protection; control in prisons; protection from exposure; incidence in the homeless; contact tracing; management in schools; screening of new immigrants; outbreak contingency investigation; and BCG vaccination and management of positive reactors in schools [20]. A study in the West Midlands revealed a rise in the number of human *Mycobacterium bovis* TB in 2005, and detection of a cluster of 6 epidemiologically-linked patients from 2004-2006 [21]. Approximately 20% of patients with *Mycobacterium bovis* infection in the UK were aged 15-44 years [21].

CONCLUSION

Assuming the association between badgers and bovine TB, the Department for the Environment, Food and Rural Affairs (DEFRA) (UK) should liaise closely with veterinarians to prevent the spread of the infection. Impacts on human health are un-questionable. Between 1993-2003, the commonest cause of infection was consumption of unpasteurised dairy products (49%) and exposure to cattle (37%) [21]. The use of rapid DNA fingerprinting enabled a more precise identification of the location in which transmission occurred [21]. The development of *Mycobacterium bovis* infection in the patients studied was possibly due to a number of host factors, including HIV, diabetes mellitus, and the use of alcohol and steroids [21]. Additionally, such environmental factors as prolonged and repeated contact in a confined space with poor ventilation, dark environments, noise resulting in shouting, and smoke resulting in coughing, were contributory factors [21].

Conflict of interest. None recorded.

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