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Observations on the incidence of herds with non-visible lesioned tuberculin test reactors in south-west England

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SUMMARY

The herd incidence of confirmed *Mycobacterium bovis* infection in cattle in the south-west of England has been approximately ten times that of the remainder of England and Wales; this greater incidence has been attributed to infection from badgers. The incidence of herds with only non-visible lesioned tuberculin test reactors, from which *M. bovis* was not isolated, has also remained higher in the south-west region.

The incidences of these latter unconfirmed incidents were compared in parishes in the south-west region in which *M. bovis* in cattle had been confirmed, and those where *M. bovis* had not been confirmed, for the period 1979–83. This analysis was carried out both for those parishes in which herds had been subjected to annual tuberculin testing and for those subjected to biennial tuberculin testing. The incidence of unconfirmed incidents was significantly higher in parishes in which confirmed incidents had occurred, and this difference was found in both the annual and biennially tested parishes. The relative risks for the incidence of unconfirmed incidents in annually and biennially tested parishes were 1·89 and 2·56, respectively. The incidence of unconfirmed incidents in biennially tested parishes was lower than in annually tested parishes.

The incidence of non-specific tuberculin test reactor herds was estimated from tuberculin test results in the eastern region of England during a period when tuberculosis was not confirmed in cattle. A comparison of this incidence and that of unconfirmed incidents in the south-west region suggests that approximately 70% of the unconfirmed incidents in the south-west were related to exposure to *M. bovis*.

The results of the analyses indicate that unconfirmed incidents cannot be completely ignored in epidemiological analyses and studies of bovine tuberculosis in the problem areas of the south-west region of England.

INTRODUCTION

The incidence of confirmed *Mycobacterium bovis* infection in cattle herds in the south-west region of England has been approximately ten times that in the remainder of Great Britain (Evans & Thompson, 1981; Wilesmith, 1983).

Since 1971 this increased risk of infection has been attributed to exposure to infected badger populations (Muirhead, Gallagher & Burn, 1974; Report, 1979; Little *et al.* 1982; Wilesmith, 1983).

The incidence of herds with only non-visible lesioned tuberculin test reactors from which *M. bovis* was not isolated (unconfirmed incidents), has also remained higher in the south-west region than in other areas.

The objective of this study was to examine the incidence of unconfirmed incidents in those parishes in the south-west region in which *M. bovis* in cattle had been confirmed, and those where *M. bovis* had not been confirmed, in order to determine whether there was an association between confirmed and unconfirmed incidents. The proportion of unconfirmed incidents which were due to non-specific reactions was also estimated from a comparison between the incidence of unconfirmed incidents in south-west England with that in eastern England where tuberculosis had not been confirmed in cattle during the time considered.

MATERIALS AND METHODS

Tuberculin-testing regimes

The tuberculin testing regime in operation in the south-west region of England has previously been described (Wilesmith, 1983). In summary, herds are subjected to a routine tuberculin test annually, bienially or trienially, the frequency being dependent on the perceived risk of infection.

Definition of herd infection status

Cattle herds in the south-west region in which tuberculin test reactors were found during the 5 years, 1979–83, were classified as confirmed or unconfirmed incidents. Confirmed incidents were those in which *M. bovis* was isolated from reactors and/or visible lesions of tuberculosis were found at post-mortem examination. Unconfirmed incidents were defined as herds with only non-visible lesioned tuberculin test reactors, from which *M. bovis* was not isolated.

Classification of parishes

Parishes in each of the seven counties in south-west England were categorized according to the frequency of tuberculin testing (annual, biennial and triennial) during the period 1979–83. These three categories were further subdivided by whether a confirmed incident of tuberculosis had occurred in the parish during the period 1972–83.

Calculation of incidence rates

The number of herds at risk in each of the six categories of parish, in each county, was derived from the June 1983 agricultural census supplemented by information from Animal Health Office records. The incidence of unconfirmed incidents

Table 1. *Incidence of unconfirmed incidents of tuberculosis in the south-west region, 1979–83, in annually and biennially tested parishes*

	Parish type			
	Annual testing		Biennial testing	
	No confirmed herd incidents 1972–83	Confirmed herd incidents 1972–83	No confirmed herd incidents 1972–83	Confirmed herd incidents 1972–83
Number of unconfirmed incidents *1979–83	29	171	105	67
Number of herds at risk	1298	4054	15311	3841
Incidence of unconfirmed incidents 1979–83 (%)	2·23	4·22	0·68	1·74
Number of parishes	139	217	1158	160

* Herds with reactors to the tuberculin test but no lesions of tuberculosis and *M. bovis* not isolated.

(1979–83) in each parish category was calculated as the percentage of the herds at risk which experienced such an incident.

Observed incidences of unconfirmed incidents (1979–83) were also calculated, in the same way, for each of the counties in the eastern region of England: Cambridgeshire, Bedfordshire, Essex, Hertfordshire, Norfolk and Suffolk, where herds are tested every 3 years: *M. bovis* infection had not been found in these counties in either cattle or badgers during the 5 years of the study and it was therefore assumed that the tuberculin reactions which did occur, were not associated with tuberculosis.

Statistical analyses

Measures of association between the incidence of unconfirmed incidents and the occurrence of confirmed infection were estimated by relative risks (Kleinbaum, Kupper & Morganstern, 1982).

The statistical significance of the difference between incidence rates was assessed using the chi square test, as described by Fleiss (1973), for a pre-specified total sample size.

Population attributable risks (MacMahon & Pugh, 1970) were calculated to estimate the impact of potential exposure of *M. bovis* on the incidence of unconfirmed incidents in annually and beinnially tested areas in the south-west region.

RESULTS

The incidences of unconfirmed incidents from 1979–83 in annually and biennially tested parished are shown in Table 1. Triennially tested parishes have been excluded because the small number of parishes, and herds, in which confirmed incidents had occurred precluded the intended analysis.

The incidence of unconfirmed incidents in both annually and biennially tested parishes was higher in parishes in which confirmed incidents had occurred than in those without confirmed incidents. The difference in the incidence of unconfirmed

incidents was significant at the 0·1% level for annually tested parishes ($\chi^2 = 10·19$) and for biennially tested parishes ($\chi^2 = 179·3$). The relative risk for the incidence of unconfirmed incidents in annually and biennially tested parishes were 1·89 and 2·56, respectively.

The incidence of unconfirmed incidents in biennially tested parishes was lower than in annually tested parishes. This difference was evident in each of the seven counties of the south-west region except Wiltshire where no herds are tested biennially.

The observed incidences of unconfirmed incidents in counties of the eastern region during 1979–83 ranged from zero to 0·24% of herds.

DISCUSSION

The intradermal tuberculin test, using a variety of tuberculins and test sites, has been used successfully to control bovine tuberculosis throughout the world. It has been recognized in all control programmes that there will be herds with reactors where subsequent post-mortem and laboratory examinations fail to confirm infection. The question then arises as to whether the reactions are due to undisclosed *M. bovis* infection or to other causes. It was estimated that herds in parishes where *M. bovis* had been confirmed in cattle are approximately twice as likely to experience unconfirmed incidents as herds in other parishes. The attributable risks provide estimates of 40·1% and 23·4%, for annually and biennally tested areas, of those unconfirmed incidents which are associated with exposure to *M. bovis*. The potential sources of exposure for these herds were infected cattle and badgers. The former is the less likely source as transmission of infection to contiguous herds has been rare (Wilesmith, 1983). Badgers are therefore the most probable source of infection.

The geographical distribution of unconfirmed incidents in cattle and *M. bovis* infection in badgers was not compared as information about the geographical distribution of infection in badgers is incomplete. This is because the information is restricted to the results of laboratory examination of badgers sampled for diagnostic purposes from and around farms where infection has been confirmed in cattle, badgers caught during the course of control operations, and badgers found dead and submitted by members of the public.

An alternative explanation for the higher incidence of unconfirmed incidents in the south-west than the rest of England would be that the exposure to causes of non-specific reactions was higher. However, there was no evidence that this was the case. An investigation into the bovine tuberculosis problem in West Cornwall looked at this possibility but refuted it (Report, 1972). Similarly, veterinary investigations in the rest of the south-west region have failed to reveal any evidence to suggest that causes other than *M. bovis*, are more common in the south-west than the rest of England. The causes of non-specific reactions in cattle have been the subject of a number of reviews (Paterson, 1956; Karlson, 1962; Worthington, 1967; Stuart, 1984). They include *M. avium* and *M. paratuberculosis*, skin tuberculosis, atypical or anonymous mycobacteria, and infections and diseases which produce a connective tissue or granulation response. The latter include infection with *Nocardia* species, *Actinobacillus* species, *Actinomyces bovis*, *Cory-*

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nebacterium pyogenes and *Brucella abortus* and fascioliasis. None of these conditions are considered more prevalent in the south-west than the rest of England.

The true rate of non-specific test reactor animals or the incidence of herds with such animals is not known in Great Britain, but the observed incidence of unconfirmed incidents in the eastern region provides some estimate of the latter. This observed incidence is not directly comparable with the annually and biennially tested areas in the south-west because of the differences in the frequency of testing. Some allowance can, however, be made for this. Sensitization to tuberculin as a result of skin tuberculosis or atypical mycobacteria are usually only transitory (Crawford, 1936; Gotink & van Ulsen, 1953; Corner, 1981). There is also some evidence in Great Britain that non-specific reactions, sufficient to classify an animal as positive to the current tuberculin test, are frequently short lived. An examination of the results from 1979–80 of retesting single reactors, disclosed in herds with no risk of infection with *M. bovis*, revealed that animals were positive on retesting, after an interval of 60 days, in only 32 (15·9%) of the 201 herds in which retests were made (Wilesmith, unpublished).

If all non-specific reactions to the tuberculin test are assumed to be transitory then the expected rate of unconfirmed incidents, during the 5 year study period, in annually tested areas, could be three times the maximum observed incidence in the eastern region where testing is triennial, ie 0·72%, and in biennially tested areas one and a half times the observed incidence, i.e. 0·36%. The former represents a mean annual herd incidence of 0·14% which would be realized on annual testing. Therefore, if no geographical variation in the risk of non-specific reaction exists then, from the expected incidence of unconfirmed incidents, 39 (19·5%) of the 200 unconfirmed incidents in annually tested areas and 69 (40·1%) of the 172 unconfirmed incidents in biennially tested areas are likely to be unrelated to exposure to *M. bovis*. These percentages are considerably less than those suggested by the attributable risk values of 59·9 and 76·6% for annually and biennially tested areas. The latter are likely to be the least accurate because, as indicated above, the infection status of the badger population in an area could not be used to classify herds fully as to their potential exposure to *M. bovis*.

This comparison of the south-west and eastern region indicates that approximately 70% of the unconfirmed incidents in annually and biennially tested areas would be prevented if control measures were successful. Also, it indicates that unconfirmed incidents cannot be completely ignored in epidemiological analyses and studies of bovine tuberculosis in the problem areas of the south-west region of England.

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