Mycobacterium bovis

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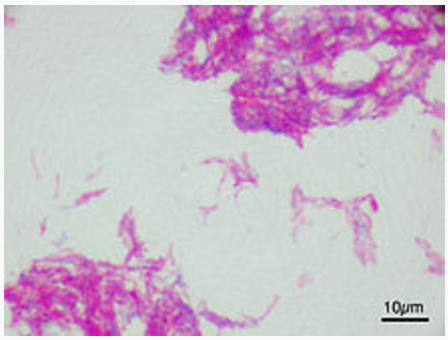
Mycobacterium bovis (*M. bovis*) is a slow-growing (16- to 20-hour generation time) aerobic bacterium and the causative agent of tuberculosis in cattle (known as **bovine TB**). It is related to *Mycobacterium tuberculosis*—the bacterium which causes tuberculosis in humans—*M. bovis*, and can jump the species barrier and cause tuberculosis in humans and other mammals.[2]

Mycobacterium bovis



Attenuated strain of *M. bovis* used in the Bacillus Calmette-Guérin vaccine

Scientific classification

Kingdom:	Bacteria
Phylum:	Actinobacteria
Order:	Actinomycetales
Suborder:	Corynebacterineae
Family:	Mycobacteriaceae
Genus:	*Mycobacterium*
Species:	***M. bovis***

Binomial name

Mycobacterium bovis

Karlson & Lessel 1970,[1] ATCC 19210

Contents

Pathogenesis

Lesions consistent with bovine tuberculosis on the lower jaw and lung of a wild boar

During the first half of the 20th century, *M. bovis* is estimated to have been responsible for more losses among farm animals than all other infectious diseases combined. Infection occurs if the bacterium is ingested.

M. bovis is usually transmitted to humans by consuming raw, infected cows milk, although it can also spread via aerosol droplets. Actual infections in humans are nowadays rare in developed countries, mainly because pasteurisation kills *M. bovis* bacteria in infected milk. In the UK, cattle are tested for the disease as part of an eradication program and culled if they test positive. Such cattle can still enter the human food chain but only after a government veterinary surgeon has inspected the carcass and certified that it is fit for human consumption. However, in areas of the developing world where pasteurisation is not routine, *M. bovis* is a relatively common cause of human tuberculosis.[3]

Bovine TB is a chronic infectious disease which affects a broad range of mammalian hosts, including humans, cattle, deer, llamas, pigs, domestic cats, wild carnivores (foxes, coyotes) and omnivores (common brushtail possum, mustelids and rodents); it rarely affects equids or sheep.[4][5] The disease can be transmitted in several ways; for example, it can be spread in exhaled air, sputum, urine, faeces and pus, so the disease can be transmitted by direct contact, contact with the excreta of an infected animal, or inhalation of aerosols, depending on the species involved.

Epidemiology and control

New Zealand

In New Zealand, the common brushtail possum is a presumed wildlife vector for the spread of *M. bovis*. The Biosecurity Act 1993, which established a National Pest Management Strategy, is the legislation behind control of the disease in New Zealand. The Animal Health Board (AHB) operates a nationwide programme of cattle testing and possum control, with the goal of eradicating *M. bovis* from wild vector species across 2.5 million hectares – or one quarter – of New Zealand's at-risk areas, by 2026 and, eventually, eradicating the disease entirely.[6]

The TB-free New Zealand programme is regarded as "world-leading".[7] It has successfully reduced cattle and deer herd infection rates from more than 1700 in 1994 to fewer than 100 herds in July 2011. Much of this success can be attributed to sustained cattle controls reducing cross-infection and breaking the disease cycle. For example, at Hohotaka, in New Zealand's central North Island, control work from 1988 to 1994 achieved a sustained mean reduction of 87.5% in the density of TB-infected possums. As expected, annual TB incidence in local cattle herds consequently declined by a similar amount (83.4%).[8]

Possums are controlled through a combination of trapping, ground-baiting and, where other methods are impractical, aerial treament with 1080 poison.[9]

From 1979 - 1984, possum control was stopped due to lack of funding. In spite of regular and frequent TB testing of cattle herds, the number of infected herds snowballed and continued to increase until 1994.[10] The area of New Zealand harbouring TB-infected wild animals expanded from about 10% of the country to 40%.

That possums are such effective transmitters of TB appears to be facilitated by their behaviour once they succumb to the disease. Terminally ill TB possums will show increasingly erratic behaviour, such as venturing out during the daytime to get enough food to eat, and seeking out buildings in which to keep warm. As a consequence, they may wander onto paddocks, where they naturally attract the attention of inquisitive cattle and deer. This behaviour has been captured on video.[11]

United Kingdom

In the 1930s, 40% of cattle in the UK were infected with *M. bovis* and there were 50,000 new cases of human *M. bovis* infection every year.[12] According to DEFRA and the Health Protection Agency, the risk to people contracting TB from cattle in Great Britain today is very low. The HPA has said that three-quarters of the 440 human cases reported to the HPA between 1994 and 2006 were aged 50 years and above and only 44 cases (10%) were known to be non-UK born.

Badgers (*Meles meles*) were first identified as carriers of *M. bovis* over 40 years ago in 1971, but the report of an independent review committee in 1997 (The Krebs Report) concluded that while there was 'strong circumstantial evidence to suggest that badgers represent a significant source of *M. bovis* infection in cattle... [h]owever, the causal link... has not been proven'.[13] In essence, the contribution of badgers 'to the TB problem in British Cattle' was at this point a hypothesis that needed to be tested, according to the report. The subsequent Randomised Badger Culling Trial [14] (designed, overseen and analysed by the Independent Scientific Group on Cattle TB, or ISG [15]) examined this hypothesis by conducting a large field trial of widescale (proactive) culling and localised reactive culling (in comparison with areas which received no badger culling). In their final report,[16] the ISG concluded: "First, while badgers are clearly a source of cattle TB, careful evaluation of our own and others' data indicates that badger culling can make no meaningful contribution to cattle TB control in Britain. Indeed, some policies under consideration are likely to make matters worse rather than better. Second, weaknesses in cattle testing regimes mean that cattle themselves contribute significantly to the persistence and spread of disease in all areas where TB occurs, and in some parts of Britain are likely to be the main source of infection. Scientific findings indicate that the rising incidence of disease can be reversed, and geographical spread contained, by the rigid application of cattle-based control measures alone." On 26 July 2007, the Minister of State, Department for Environment, Food and Rural Affairs (Defra) (Lord Rooker) said "My Lords,

we welcome the Independent Scientific Group's final report, which further improves the evidence base. We are carefully considering the issues that the report raises, and will continue to work with industry, government advisers and scientific experts in reaching policy decisions on these issues."[17]

In the UK, many other mammals have been found to be infected with *M. bovis*, although the frequency of isolation is generally much less than cattle and badgers. In some areas of South-West England, deer, especially fallow deer due to their gregarious behaviour, have been implicated as a possible maintenance host for transmission of bovine TB,[18][19] a disease which in the UK in 2005 cost £90 million in attempts to eradicate.[20] It has been argued that in some localised areas, the risk of transmission to cattle from fallow deer is greater than it is from badgers.[18][19]

The main reason that Defra requires infected or suspected cattle to be culled is to meet EU regulations for the export of meat and dairy products to other Member states. There is no ethical or veterinary reason why infected animals cannot continue to live out their lives until the normal age for slaughter. All meat and dairy products can still be sold into the human food chain, providing the relevant carcass inspections and milk pasteurisation have been applied.[21] [22]

Spread of the disease to humans by domestic pets became evident in March 2014 when Public Health England announced two people in England developed bTB infections after contact with a domestic cat. The two human cases were linked to nine cases of bTB infection in cats in Berkshire and Hampshire during 2013. These are the first documented cases of cat-to-human transmission.[23]

In a 2010 opinion piece in *Trends in Microbiology*, Paul and David Torgerson argued that bovine tuberculosis is a negligible public health problem in the UK, providing milk is pasteurized. Bovine TB is very rarely spread by aerosol from cattle to humans. Therefore, the bovine tuberculosis control programme in the UK in its present form is a misallocation of resources and provides no benefit to society. Indeed, there is even very little evidence of a positive cost benefit to the livestock industry, as few studies have been undertaken on the direct costs of bovine TB to animal production. Milk pasteurisation was the single public health intervention that prevented the transmission of bovine TB to humans, and there is no justification for the present test and cull policy in the UK.[24]

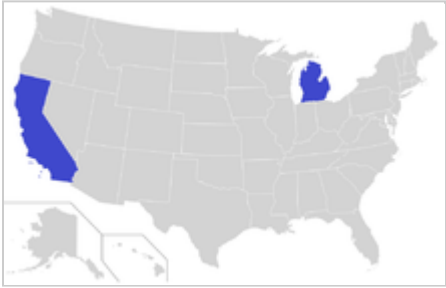
In July 2010 the 2nd issue of the discussion document 'Bovine TB, Time for a Rethink' [25] was published by Rethink Bovine TB, an independent research group. The paper considers current policy in England and Wales. It proposes an alternative solution that is both practical and cost effective. In the paper evidence is drawn from Defra and the work by Professors Paul and David Torgerson.[24]

In March 2012, think tank the Bow Group published a target paper urging the Government to reconsider its plans to cull thousands of badgers to control bovine TB, stating that the findings of Labour's major badger culling trials several years prior were that culling does not work. The paper was authored by Graham Godwin-Pearson with a foreword by singer Brian May and contributions by leading tuberculosis scientists, including Lord Krebs.[26][27][28]

United States of America

M. bovis infections in cattle herds in the United States is not common. *M. bovis* is endemic in white-tailed deer (*Odocoileus virginianus*) in the northeastern portion of Michigan and northern Minnesota, and sporadic import of the disease from Mexico. Only the white-tailed deer has been confirmed as a maintenance host in the Michigan outbreak of bovine tuberculosis, although other mammals such as raccoons (*Procyon lotor*), opossums (*Didelphis virginiana*), and coyotes (*Canis latrans*) can serve as spill-over and dead-end hosts.[30] The fact that white-tailed deer are a maintenance host for *M. bovis* remains a significant barrier to the US nationwide eradication of the disease in livestock. In 2008, 733,998 licensed deer hunters harvested approximately 489,922 white-tailed deer in attempts to control the disease spread. These hunters purchased

more than 1.5 million deer harvest tags. The economic value of deer hunting to Michigan's economy in the drive to eradicate TB is substantial. For example, in 2006, hunters spent US$507 million hunting white-tailed deer in Michigan.[31]



As of the end of 2013, the USDA has accredited cattle herds in all US states except for Michigan and California as being free from bovine TB.[29]

Global

The disease is found in cattle throughout the globe, but some countries have been able to reduce or limit the incidence of the disease through a process of 'test and cull' of the cattle stock. Most of Europe and several Caribbean countries (including Cuba) are virtually free of *M. bovis*. Australia is officially free of the disease since the successful BTEC program, but residual infections might exist in feral water buffalo in isolated parts of the Northern Territory. In Canada, there are affected wild elk and white-tailed deer in and around Riding Mountain National Park in Manitoba. To improve control and eliminate bovine TB, the Canadian Food Inspection Agency (CFIA) has split Manitoba into two management areas: The Riding Mountain TB eradication area (RMEA), the area where the disease has been found and the Manitoba TB Eradication Area (MTEA), the rest of the province outside RMEA where the disease has not been found.[32] The disease has also been found in African buffalo in South Africa.

Mycobacterium bovis can be transmitted from human to human; there was an outbreak in Birmingham, England in 2004,[33] and from human to cattle,[34][35] but such occurrences are rare.

In Mexico, the disease is prevalent and rising among humans.[36]

Treatment

See: Tuberculosis treatment

M. bovis is innately resistant to pyrazinamide; therefore, the standard treatment is isoniazid and rifampicin for 9 months. However, most cattle with TB are culled.

See also

- Agriculture
- Christopher Morcom
- Badger culling in the United Kingdom
- Veterinary medicine

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External links

- TB free New Zealand (http://tbfree.ahb.org.nz/) - TB control programme in New Zealand
- Bovine TB information on Department of Conservation website (http://www.doc.govt.nz/publications/conservation/threats-and-impacts/animal-pests/the-use-of-1080-for-pest-control/3-why-we-use-1080-for-pe

st-control/3_1-possums-as-reservoirs-of-bovine-tuberculosis/) - The use of 1080 for pest control in New Zealand - Possums as reservoirs of bovine tuberculosis
- Information about bovine TB on 1080: The Facts website (http://www.1080facts.co.nz/bovine_tuberculosis_TB) - Facts about how 1080 poison is used to control bovine TB in New Zealand
- Background on immunology and testing for Bovine TB (http://www.surefarm.co.uk/background-immunology-tb/) - The background on immunology and testing for Bovine Tuberculosis.
- *Mycobacterium bovis* in African wildlife (http://www.awp.eduwikis.co.za/index.php/Mycobacterium_bovis/) *Mycobacterium bovis* in African wildlife

Categories: Tuberculosis | Acid fast bacilli | Mycobacteria | Zoonoses | Foodborne illnesses | Bovine diseases | Wildlife diseases | Bacteria described in 1970
