BOVINE TUBERCULOSIS IN THE HISTORICAL ASPECT OF ITS ERADICATION IN POLAND BETWEEN 1882 AND 1975

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Abstract

Tuberculosis (TB) is a chronic pulmonary disease caused by different representatives of *Mycobacterium*. The fight against bovine TB has been implemented within the framework of the 'One Health' concept. 'One Health' is based on cooperation between broad medical professions, including medicine and veterinary medicine to prevent prevalence of zoonotic diseases. Analysing the development of these disciplines throughout history, we can say that they common origin. Up to the second half of the 18th century, it was often the same people treating both humans and animals. Veterinary medicine diverged from medicine in the second half of the 18th century, after the first veterinary schools were established. However, it occurred that some diseases affecting humans and animals required close cooperation between medicine and veterinary medicine. At first, the link between human and cattle TB has not been made. Due to the chronic nature of TB, it usually took quite long between contact with the sick animal or its products and the onset of the disease. But, after Robert Koch attributed the origin of the disease to mycobacteria, the progress has been made in identification of the pathogenicity of human and bovine TB. Effective measures of limiting spread of TB had to combine treatment of infected people with eliminating the reservoirs of the germ, which were and are animals. Due to coordinated efforts within 'One Health', about a hundred years later, many countries were announced as TB-free.

Keywords

veterinary history, history of medicine, tuberculosis, bovine tuberculosis, Robert Koch

Bovine tuberculosis (bTB) is an infectious, chronic bacterial disease of cattle caused by members of *Mycobacterium* genus (predominantly *M. bovis*). In cattle it's respiratory disease with rare clinical signs. It can be spread to humans and other animals by direct contact or consumption of contaminated, unpasteurized milk. When the direction of the transmission is from infected cattle to susceptible human, then TB is classified as a direct zoonosis. In the reverse scenario (transmission from infected human to susceptible cattle), it is called anthropozoonosis. The prevalence of TB in animals and humans dates back to ancient times. The skeletons of reptiles from the Mesozoic period, as well as fossil mammals bear traces of tuberculous infection. Archaeological and archaeozoological studies indicate that tuberculosis was a frequent cause of illness and death among people inhabiting the present areas of Egypt, Peru, and Chile [1].

The development of molecular biology and its application in diagnostic techniquesallowed for the precise identification of the infectious agents present in the fossil samples. DNA analysis of mycobacteria collected at archaeological sites unambiguously confirmed that humans were infected not only by *Mycobacterium tuberculosis* but also by *Mycobacterium bovis*, which is infectious agent characteristic to cattle[2]. The microbes from humans and animals were cross-contaminated during the domestication process of the cattle. Based on the current theories, the tuberculosis emerged in humans and was passed on to ruminants[3].

Intraspecies transmission of mycobacteria between humans and animals became more significant with the introduction of the factory farming. Cattle herds have constituted the reservoir of mycobacteria and therefore pose a high risk of the disease transmission towards humans. Therefore, from the very beginning of the development of medical science, tuberculosis has aroused particular interest. It was first known by the Greek name *phthisis* and then by Latin *tuberculosis*, which means tubercle, the most characteristic lesion, developing during the disease.

For many centuries, the fight against TB has been difficult. The disease took a deadly toll on both humans and animals. The problem of cross-contamination was enhanced by the consumption of the contaminated animals products (meat and milk), resulting in further spread of the disease. The cause of TB was discovered by Robert Koch in 1882 [4]. Initially, it was thought that tubercle bacilli in animals were not dangerous to humans, which led to the development of the so-called dualistic theory [7]. Quite soon, in 1899, this theory was proved to be incorrect, driven by the vast medical documentations on the lesions caused by TB in animals and humans. In the same year, at the first International Congress on Tuberculosis, held in Berlin, Bollinger defined the conclusions, which turned out to be fundamental for further medical and veterinary work on TB. The most critical observation was that the bovine mycobacteria are pathogenic to humans and can cause both pulmonary TB and the non-pulmonary form of the disease. The researcher noted that primary foodborne infection was possible in both adults and children, with the main sources being unpasteurized milk, both raw and sour, as well as cream, butter, and cheese [8].

Since then, the efforts of medical and veterinary scientists towards preventing and treating TB have been combined. Attribution of TB spread in humans through unspateurized milk meant that one infected cow, producing several litres of milk a day, could contaminate several dozen people with *M. bovis*. These observations led scientists to determine the percentage of infected cows. It was obvious, that eradicating TB needed not only improvement in the living conditions and treatment methods in humans, but also required drastic reduction of the mycobacteria in their largest reservoirs, i.e. the cattle herds. While research on TB in humans was focused primarily on treatment, while in animals the approach was to monitor the degree of infection in the cattle population and to eliminate animals that came into contact with the pathogen. For the successful anti-tuberculosis campaign, the diagnostic test had to be developed. It was accomplished by Robert Koch, who obtained the substance, later named tuberculin by Prof. Odo Bujwid. Tuberculin was initially treated as a drug, but its ineffectiveness in treating TB eliminated it from therapy. Still, the tuberculin remained in use, but as diagnostic tool.   The estimation of the incidence of tuberculosis in cattle using tuberculin made it possible to take radical steps and introduce planned and structural measures aimed at TB eradication [7].

Further studies have confirmed that occurance of tuberculosis in humans and cattle are associated. Interestingly, based on data collected in Poland, such association was more pronounced in areas where human TB was at the later stages of the epidemiological transition, but the number of infected cattle was considerably high. Epidemiological characteristics of TB, even more than epizoonotic and economic ones, stimulated widespread efforts at TB eradication. The occurrence of zoonotic TB in humans, caused by both bovine and human mycobacteria, was also confirmed [9], which confirmed that TB was not only a zoonosis but also anthroposoonosis. Possible two-way transmission of mycobacteria greatly increased the danger of its spread among human and animal populations. Therefore, the efforts to control tuberculosis in humans and cattle had to be synchronized. Beginning of the close cooperation between the veterinary and public health services initiated what is now known as the 'One Health' approach to preventive health care.

Due to the large scale of the TB problem, its solution included systemic regulations that were part of the state's health policy. During the period of the Partitions of Poland (over XIX century), different legal regulations were in place, but all of them paid particular attention to bovine TB. After Poland regained independence in 1918, the Polish veterinary administration standardized the legislationregarding the eradication of infectious animal diseases, including TB, posing a particular threat to human health. The first legal act introducing provisions exclusively concerning veterinary protection of the animals against infectious diseases was the Ordinance of the President of the Republic of Poland on the eradication of contagious animal diseases, dated to 22 August 1927 (Journal of Laws of the Republic of Poland No. 77, item 673). The Article 20 of the ordinance listed 17 infectious diseases, which were by law subjected to reporting and control. The list included open TB of the horned cattle (lungs, udder, uterus, and intestines). Implementation of those provisions facilitated the eradication of the bovine TB in Poland. In the beginning, the participation in this process was voluntary, but after 1959 the campaign to eradicate TB was made obligatory. The most intensive efforts towards TB eradication in Poland took place from 1959 to 1975. Finally, in December 1975, Poland was declared a bovine TB-free country [7].

Since then, the incidences of bovine TB have been monitored, with several outbreaks recorded in Poland every year [5]. The contaminated animals are culled and tested to confirm TB. The European Food Safety Authority (EFSA), represented in Poland National Mycobacteria Laboratory in Warsaw, releases annual reports on human TB caused by *M. bovis.* Fortunately, there have been no records in Poland on people infected with *M. bovis*, which allows to assume that the preventive efforts of the veterinary services to contain TB in cattle, have been successful so far [6]. This was undoubtedly influenced by the work carried out continuously until 1975 and official eradication of the bovine TB in Poland [7].

In the process of TB eradication, there have been few methods developed, including: the Bang method, the Ostertag method, and the American method. They provided framework, rather than the template, that could be adjusted to the local environmental, economic, and administrative conditions [10]. In the early days of bovine BT control, attempts were made to introduce prophylactic and therapeutic procedures to immunize or cure cattle (when the disease occurred). This approach, as rational as it was in the case of human medicine, turned out to be missused by the veterinary medicine. The lack of implementation of the radical solutions in Poland in the beginning of the 20th century led to the perpetuation of the disease among cattle and prolonged its subsequent eradication by about 25 years. The countries, which promptly decided on taking the radical measures of removal of TB-infected individuals from the herds (Denmark, Finland and Switzerland), officially eradicated TB in the 1950s. It's worth mentioning that Professor Odo Bujwid had advised early on that the radical method of culling diseased animals was the most effective one. He demonstrated that restrictive measures introduced it in his Czudec estate near Rzeszów (Poland), allowed for TB reduction from 75% to 5% in only two years. However, at that time it was impossible to cover the whole country with the compulsory disease control due to poor economic conditions, which finally delayed the process of eradication by two decades [11].

In the field of TB diagnostics, there were not much improvement over the years and tuberculin remained the golden standard since its invention up to now. I This way, tuberculin became the longest-used diagnostic agent in veterinary medicine. However, there were some modifications in the methods of tuberculin production as well as in reading of the tuberculin test. . The main focus of research on tuberculin was overcoming the non-specific reactions, which in the early days of use overestimated the percentage of cattle suspected of having TB. Great hope was placed on serological diagnosis of TB, due to its high specificity. But, due to much more complicated procedure (compared with tuberculin skin test), remained mostly in use to provide confirmation to the positive tuberculin tests. In regard to TB treatment, it proved not only uneconomical but, above all, posed a danger to healthy animals. When individuals with inactive tuberculous remained in herds, under unfavourable conditions could become active foci of infection, thus posing a threat to the remaining individuals in the herd. This confirmed that the method of choice in containing TB in cattle was to eliminate diseased animals [7].

Polish scientists contributed significantly to the study on TB . Professor Odo Bujwid collaborated with the major scientists in the field, Robert Koch and Ludwig Pasteur. In regard to TB control, Bujwid's scientific connection with Koch could not be overestimated. He was the first to use the name tuberculin when referring to the famous diagnostic preparation invented by Koch. Moreover, Bujwid improved the tuberculin production technology, which resulted in its better use in infield practice. He was also a precursor of the industrial production of tuberculin in Poland and the Austro-Hungarian Monarchy. The second large contribution of Prof. Bujwid to combat TB in Poland was in the area of TB diagnosis and application of the radical methods of clearing the herds of the infected animals [12]. The methods first appliedby Prof. Bujwid on the limited territory of several estates ,(Bang's method with modifications), were later introduced with minor changes in the programme of bovine TB obligatory eradication in Poland in the 1950s. Among the scientists working on TB after World War II, Professor Juliusz Brill should be particularly recognized. He was the author of the national programme for the eradication of bovine TB, which ultimately led to Poland being declared TB-free. This was achieved in a relatively short period of 15 years [7].

In conclusion, human and bovine TB was a major public health threat in the 20th century. The combination of the two fields of medicine and veterinary medicine significantly reduced the incidence of this disease in both human and animal populations. This joint effort did not end in 1975 but has continued to the present day to control the incidence of TB.

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