

Brucellosis as an Occupational Disease in the Republic of Macedonia

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Abstract

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Brucellosis, a bacterial disease caused by species of the genus *Brucella*, is an important zoonosis and recognized as an occupational disease. A high risk of infection with *Brucella* is associated with certain workplaces related to direct contact with infected animals or their products. Infection may occur by inhalation of infectious aerosols, conjunctival contamination, skin contamination, contact with laboratory cultures and tissue samples, and accidental injection of live vaccines.

Brucellosis is included as an occupational disease in the Macedonian List of Occupational Diseases, and diagnosis and verification of the occupational diseases, according to the national medical criteria, are realized at the Occupational Health Institute of R. Macedonia. According to the official health statistics, in the last two decades in Macedonia as an endemic region, a high incidence of human brucellosis has been registered, with more than 300 reported cases per year. In spite of a possible high occupational risk of infection with *Brucella sp* in the confirmed cases of disease, during 2008-09 just 12 cases of brucellosis (6 stockmen, 5 veterinarians and an agronomist) were confirmed as an occupational disease. These data suggest that human brucellosis is underdiagnosed and underreported as an occupational disease at national level.

An adequate management of brucellosis with a multidisciplinary approach should provide more accurate reported data in occupational epidemiology in the country.

There is a need to strengthen joint actions within the health care system, to promote an intersectoral collaboration and to support the successful realization of national control programme at the community level.

Introduction

Brucellosis is a bacterial disease caused by species the genus *Brucella*. It is an important zoonosis and the infection is generally transmitted to people by direct or indirect contact with infected animals or their products. Brucellosis can be recognized as an occupational disease in individuals who work directly in contact with animals.

Although brucellosis is present in many countries,

it is well controlled in most developed countries. Its incidence has been decreasing in countries that have been able to control the disease in animals. However, every year 0.5 million new cases are recorded, and most are caused by *B. sp.* [1]. Clinical disease is still common in the Middle East, Asia, Africa, South and Central America and the Mediterranean Basin. In endemic areas, the reported incidence ranges from less than 0.01 to more than 200 cases per 100,000 population [1]. Human brucellosis is the most common zoonosis in the

Republic of Macedonia and is still a serious problem, presenting with a high percentage of focal forms, relapses and therapeutic failures in infected persons [2].

In the last decade, according to the epidemiological data from different countries, an occupational exposure or direct contact with animals or animal products during professional practice related to the human brucellosis were reported with large variations from 18% [3] to more than 90% [4]. The data have shown that brucellosis as an occupational disease is still a present and future public health challenge.

Clinical features of human brucellosis as well as its long convalescence suggest that brucellosis is a significant medical, economic and social problem with public health impacts at individual and community levels.

The aim of this paper is to recognize the occupational exposure and its importance as one of the main sources for human brucellosis. On the other hand, the objective is to emphasize the public health point of view in an integrated, intersectoral and multidisciplinary approach in the prevention of brucellosis as an occupational disease, with particular focus on the Macedonian experience in this issue.

Workplaces and occupational exposure

A high occupational risk of infection with *Brucella* species is associated with specific workplaces where employees are working in direct contact with infected animals or their products. This includes certain workers, such as farmers, stockmen, shepherds, goatherds, abattoir workers, butchers, dairymen, veterinarians, laboratory workers, health care workers, and those involved in the processing of viscera, hides, skins and wool. The highest level of occupational risk is assumed at the workplaces where individuals are working with animals during abortion or parturition and during other contacts with infected animals, like shearing, dipping, examination, vaccination and treatment as well as during disinfection and cleaning of contaminated premises.

One should point out that the way of disease acquisition in many professionally exposed workers is almost impossible to determine, and quite often it is a result of not only one, but more risk activities (different entry portals at the same time).

The occupational risk in veterinarians is the highest during abortion or parturition of animals, their exami-

nation, insemination, vaccination, and treatment of animal diseases.

Laboratory workers with specific occupational exposure to contaminated specimens and *Brucella* cultures are also identified as an occupational group at high occupational risk. At particular workplace risk of infection with *Brucella* are the workers in laboratories where culturing of *Brucella* species is performed. *Brucella* aerosols could be generated by the handling of cultures and their inhalation, as in centrifugation when breakage of containers occurs and presents the highest risk. The processes of preparation and use of live vaccines, application of diagnostic procedures, and preparation of diagnostic antigens, are also characterized with high occupational risk.

Employees engaged in the processing of animal products, such as slaughtermen, butchers, meat packers, collectors of foetal calf serum, processors of hides, skins and wool, renderers as well as dairy workers may be exposed to *Brucella* species.

Workers performing their tasks at the workplace are generally infected by inhalation of infectious aerosols, contamination of conjunctivae, ingestion, skin contamination through cuts or abrasions, and rarely by contact with laboratory cultures and tissue samples, and accidental self-inoculation with live vaccines.

Clinical course of Brucellosis

Brucellosis is an acute or sub-acute febrile illness often characterized by an intermittent or remittent fever accompanied by malaise, anorexia and prostration, and which, in the absence of specific treatment, may persist for weeks or months. The acute phase may progress to a chronic one with relapse, development of persistent localized infection or a non-specific syndrome resembling the "chronic fatigue syndrome" [5].

Brucellosis as an occupational disease is usually associated with inability for work for a relatively long period, long and expensive treatment, slow recovery and very often relapses and possible serious sequelae in the musculoskeletal and nervous system.

Epidemiology

The global burden of human brucellosis remains enormous; it causes more than 500,000 infections per year worldwide [6]. In Europe, 1,033 human brucellosis

cases were reported in 2006 [7]. The annual incidence of human brucellosis in the U.S. is less than 0.5 cases per 100,000 persons; approximately 100 cases are reported annually [1]. In Mediterranean and Middle East countries the annual incidence of brucellosis in people varies from less than 1 to 78 cases per 100,000 [8]. The mean annual incidence rate for the population of the area of North-western Greece was 17.3 cases/100,000 inhabitants [9]. In Spain, brucellosis occurs in epidemic cycles and the peak was in 1984 with 22.7 cases per 100,000 population and a total of 596 cases were registered in 2004 (1.5 cases per 100,000 population) [10]. In 2004, 300 cases of human brucellosis were reported in Macedonia [11].

In the last few years, numerous epidemiological studies from different countries have focussed on the problem of occupational exposure related to human brucellosis. German studies from 2007 reported direct contact with animals or animal products during professional practice in 18% of all cases with brucellosis [3]. On the other hand, in a Greek study, more than 90% of all brucellosis cases referred to occupational exposure [4].

More than 60% of the patients with brucellosis from the Macedonian study [11] identified occupational exposure as one of the potential sources of infection.

A serological survey carried out in Bénin in exposed workers (workers in slaughterhouses and breeders) showed that the percentage of positive sera among exposed workers was 17.7% [12]. The study of the epidemiology of brucellosis in Granada province elaborated that the occupational group with the highest risk were veterinarians in whom the disease was 31 times more common than in the rest of the population [13]. In the study concerning some epidemiological aspects of the infection by *Brucella abortus* in high risk occupational groups in the microregion of Araguaína, Tocantins, Brazil, it was found that 4.1% of serums were positive among slaughterhouse employees, while the frequency of positive serums in rural workers was 8.1% [14]. The same study showed that individuals born in the countryside have a higher probability of being infected with *B. abortus* than those born in cities and a significant association was found between previous work in direct contact with production animals and seropositivity. Spinola and Costa in Salvador, Bahia, studied human brucellosis in 128 cold storage plant workers under the serological, occupational and clinic perspective. They reported a seropositivity of 10.6% [15]. Regarding rural workers, Ramos, et al, in a serological study conducted on 33 rural workers reported a prevalence of 21.1% [14].

Those differences in the reported data are related to the degree of endemicity, level of specific occupational risk, implementation of specific preventive and control measures, education, information, socioeconomics, density of cattle, sheep and goat herds, and eating habits.

Brucellosis as an occupational disease in R. Macedonia – different aspects of the problem

Brucellosis as an occupational disease has serious public health consequences such as absenteeism, work disability, long rehabilitation and socio-economic implications.

Brucellosis is included in the new List of Occupational Diseases as an occupational disease [16] and the Macedonian List is harmonized with the EU List of Occupational Diseases from 2003, stipulated by the Pension and Disability Act. Additionally, a Rulebook on the Confirmation and Verification of Occupational Diseases has been published. This document contains specific conditions and medical criteria for each occupational disease which have to be fulfilled in order to verify the occupational characteristics of the disease. Diagnosis and verification of the occupational diseases, according to the national medical criteria, are realized at the Occupational Health Institute of the Republic of Macedonia, WHO Collaborating Center. When brucellosis is verified as an occupational disease, a special form is sent to the employer and to the Pension Fund in order to notify them and another one is sent to the Institute of Public Health for the purposes of registration of occupational diseases.

The Occupational Health Institute and its expert team are authorized for the preparation of expertise for medical verification of occupational diseases. In order to verify and to confirm that brucellosis is an occupational disease it is necessary to have evidence that a worker had been performing his tasks and duties at the workplace where contact with possibly infected animals and animal products was present (positive workplace history). Additionally, for the same purpose, brucellosis has to be diagnosed in its acute, subacute or chronic forms and diagnosis has to be verified by a doctor – a specialist in infectious diseases. Worker's contact with *Brucella spp.* has to be documented and verified. The data obtained from veterinary authorities should provide objective evidence about the presence of *Brucella spp.* in the animals

or animal products. Occupational exposure should be considered in the specific case when a worker during his workplace tasks and duties, had experienced a workplace contact with seropositive animals or animal products which were positive on cultures for *Brucella spp.* It is necessary to have evidence that the worker was present at the workplace in the same period and at the same place where *Brucella spp.* were found in the animals or animal products.

During the period 2008-009, 12 cases of brucellosis (6 stockmen, 5 veterinarians and an agronomist) were confirmed as cases of occupational diseases. According to the epidemiological and clinical studies concerning human brucellosis in Macedonia, brucellosis is underdiagnosed and underreported as an occupational disease.

In order to improve occupational epidemiology at a national level concerning data on human brucellosis some steps should be realized in different segments of the health care system in the country.

Closer collaboration between medical doctors from different disciplines (primary health care, infectious disease, occupational health) should be improved and should support the process of verification and confirmation of brucellosis as an occupational disease. Physicians should be aware of the possible occupational characteristic of the disease, especially in employees with evidence of occupational risk of infection with *Brucella*. The inclusion of brucellosis as an occupational disease in the differential diagnosis of the febrile patients who belong to high-risk groups could be very important from both the clinical and occupational health points of view. It is necessary to emphasize the difficulties and challenges for the doctor to confirm/exclude whether brucellosis in the patient is an occupational disease in an endemic region.

In the context of regular preventive medical examinations of workers at specific risk of infection with *Brucella spp.*, occupational health physicians should recognize early signs of the disease and should take over all measures of early intervention in affected workers. In the workers with confirmed diagnosis of brucellosis, within the medical procedure, the expertise for medical verification of the occupational character of the disease has to be prepared at the Occupational Health Institute of the Republic of Macedonia.

The new Law on evidence in health in Republic of Macedonia, 2009 [17] should be an additional and important step towards better future registration and

notification of the diseases, including brucellosis as an occupational disease.

Preventive measures

Good workplace practice, safe work, control and reduction of risks and protective measures should be implemented at any workplace with high occupational risk of infection with *Brucella spp.* [5].

The prevention must be based on the elimination of direct or indirect exposure to infected animals or their products. But, elimination of the disease from animals is often difficult to implement, especially in endemic regions as well as in developing countries. Therefore, the goal is to reduce the risk through personal hygiene, adoption of safe working practices, protection of the environment and food hygiene.

The personal protective equipment of employees in the workplaces with high occupational risk of brucellosis includes appropriate protective clothing (coat, rubber or plastic apron), rubber gloves and boots, eye protection, as well as protection of respiratory exposure. The work clothes should be disinfected after use (heat treatment, chemical disinfectants, etc.) and workers should wash their hands using a disinfectant solution and soap and water with special attention to superficial skin injuries.

It is also necessary to think about eye protection due to the possibility of conjunctival contamination. Respiratory contamination by inhalation of aerosols or dust derived from infected excreta or tissues should be prevented by use of adequate respirators with changeable antibacterial filters.

Adoption of safe working practices and protection of the working environment is a very important step in the reduction of the occupational risk of brucellosis. Certain workplaces and working operations with high occupational risks of infection with *Brucella spp.* require special protective measures and safe working practices.

Infected animals that are aborting or giving birth present specific occupational risks to **farm workers and animal attendants**. It is recommended that aborted fetuses, placenta and other infected organs and tissues should be collected in special containers and disposed by incineration. Contaminated premises, used vehicles and equipment should be adequately cleaned and disinfected. An additional problem in the adoption of

safe working practices could be nomadic or migratory working conditions of those workers.

Concerning **meat processing establishments and rendering plants**, it is important to emphasize that animals infected with *Brucella spp.* should be slaughtered at specially designated abattoirs and the staff adequately trained and equipped. Eating, drinking and smoking must be prohibited at the workplace. Full cleaning and disinfection of the premises and the equipment must be performed at the end of each working day.

Each **laboratory** should have written procedures about the use of equipment, disinfection of equipment and contaminated materials, handling and processing samples, spill containment and cleanup, and waste handling. Bio-safety level 3 is appropriate for handling *Brucella* cultures or infected membranes, foetal tissues and fluids.

Medical preventive measures include preventive medical examinations of exposed workers, performed by occupational health specialists, according to the national legislation. In the Republic of Macedonia, the new **Law on safety and health at work** [18] emphasizes that every employed worker should be under medical surveillance through periodic medical examinations every 18 months. This Law is an obligation for every employer who has to cover expenses for those examinations.

It is necessary to perform pre-employment medical examinations in individuals who are intending to work with animals or animal products in order to identify workers with diseases or disabilities and to detect vulnerable workers, such as young workers (under the age of 18 years) and pregnant women. On the other hand, regular periodical medical examinations should be performed on workers who are already working with animals or animal products. Within the periodical medical examinations serological tests should be included. The new staff should provide a baseline blood sample before starting work, while workers with manifested disease should be treated promptly and removed from further exposure (replacement, professional rehabilitation, pension, etc.).

Health promotion, education and training, and information should be the main components of brucellosis control programmes focussed on different target groups and vulnerable workers who need to be aware of the measures required to protect and improve their health.

It is important to stress that in the last decade, a special **preventive programme** focussed on various aspects of human brucellosis (including occupational exposure and high risk groups of exposed workers) has been promoted by the Ministry of Health of the Republic of Macedonia. This programme offers concrete preventive measures on different levels and shows the continuous efforts of the government of Republic of Macedonia to deal with brucellosis as a significant public health problem in the country.

Conclusion

Brucellosis is an important zoonosis, identified as an underdiagnosed and underreported occupational disease and represents a serious public health issue in endemic countries such as the Republic of Macedonia. There is a need to strengthen the joint actions within the health care system between health care workers from different profiles and disciplines (focussed on occupational health), between medical associations and organizations, the Medical Faculty-School of Public Health and the Ministry of Health, through implementation of specific protective, preventive and promotion measures, supported by new legislation.

Adequate management of brucellosis with a multidisciplinary approach should provide real epidemiological and reporting data on brucellosis as an occupational disease.

In order to provide good quality of life in the workers and productive work in the society it is necessary to promote intersectoral collaboration (health, public health, veterinary authorities and agriculture) as well as to support successful realization of the national control programme at the community level.

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