Tuberculosis in health professionals: a new perspective on an old problem*

Tuberculose em profissionais de saúde: um novo olhar sobre um antigo problema

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Abstract

The objective of this review was to contribute to the debate on the nosocomial transmission of TB among health professionals in a country where TB is endemic. Prior to 1900, there was no reason to believe that health professionals interacting with TB patients were more susceptible to becoming infected with the bacillus than was the general population. Between 1920 and 1930, various studies showed significant findings regarding the rates of positive tuberculin skin tests among students in the area of health care. However, most clinicians remained skeptical about the susceptibility of health professionals to becoming infected with TB. In the various locales where the treatment of patients with TB has been implemented, health professionals have been described as an especially predisposed population to becoming infected with and developing active TB. It is urgent that the scientific community and health professionals become mobilized, recognizing themselves as a population at risk of developing TB, and that actions be taken in order to minimize the potential risks of acquiring the disease at locales where patients with TB are treated.

Keywords: Tuberculosis; Cross infection; Health personnel.

Resumo

Este artigo tem o objetivo de contribuir para o debate sobre a transmissão nosocomial da TB em profissionais de saúde em um país onde esta é endêmica. Verificamos que até 1900 não se aceitava que os profissionais envolvidos no cuidado de pacientes portadores de TB pudessem ser mais susceptíveis à infecção pelo bacilo que a população geral. Vários estudos entre 1920 e 1930 apresentaram achados significativos nas taxas de conversão do teste tuberculínico dos estudantes da área de saúde, mas a maioria dos clínicos continuava se recusando a reconhecer a suscetibilidade dos profissionais de saúde em relação à TB. Nos diferentes locais onde o cuidado ao paciente com TB foi implantado, os profissionais de saúde são descritos como uma população especialmente exposta ao risco de contrair a infecção e adoecer. É urgente que a comunidade científica e os trabalhadores de saúde se organizem, que se reconheçam como uma população sujeita ao risco de adoecimento, e que ações se efetivem no sentido de minimizar os riscos potenciais nos locais onde acontece o cuidado a pacientes com TB.

Descritores: Tuberculose; Infecção hospitalar; Pessoal de saúde.

Introduction

The risk of contamination of professionals involved in the care of patients with TB, a problem long forgotten or minimized, returns to current discussion. The same controversy of the beginning of the past century brings up the following question: do health professionals present a higher risk of infection with *Mycobacterium tuberculosis* and of developing TB than does the general population?

The resurgence of TB epidemics worldwide has been partly attributed to difficulties of the governmental institutions and of the scientific community itself in dealing with the problem in a pertinent manner.[1]

Since TB has become endemic in some countries and emergent in others, new strategies had to be implemented, principally since, with the opening of international borders, TB has become a worldwide problem.[2]

In the various locales in which TB patient care has been implemented, health professionals are described as populations especially exposed

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to the risk of acquiring this infection and developing TB when in contact with individuals who have the disease.[3-5]

The objective of this review was to contribute to the debate on nosocomial TB transmission among health professionals in a country where TB is endemic.

Nosocomial transmission: historical context

The knowledge accumulated over the years allows us to know a little more about transmission and control of nosocomial infections in a more effective way than those proposed by our predecessors.

One of the first ideas described in the literature related to nosocomial infection dates back to the 17th century. At that time, Europe was divided regarding the idea of contagion. Italy, a defender of the contagiousness of the disease, created the Lucca Law in 1699 in order to protect its citizens. This law consisted of some control measures regarding public health: physicians were required to report ulcerative lesion of the lungs; authorities confiscated and burned the belongings of patients after their death; and hospitals were obliged to eject poor patients.[6]

However, it was only at the beginning of the 19th century that the idea of transmission was established. Despite the fact that the microscope had yet to be invented, the idea began to take hold. In this debate, data obtained through empirical observation were refuted with ideological arguments. Although there was a suspicion of the transmissibility of the epidemic diseases was suspected, the medical authorities thought it prudent to hide the risk of transmission, fearing that families would abandon their sick members.[7]

In 1847, Semmelweis first proposed the idea that the health professionals were vectors of disease transmission, and efforts were made to minimize the problem for the patients.[8] However, it was Florence Nightingale who brought measures for infection control to a prominent position Her ideas for changes in hospital architecture, such as the separation of patients by disease, as well as the improvement of the hygiene, food, and ventilation on the wards, permeate the principals of the nosocomial infection control measures used to date.[9] In 1865, Villemin, an English surgeon, obtained results proving the contagiousness of *M. tuberculosis* through experiments in rabbits.[10]

In 1880, with the new theories about transmission spreading throughout Europe, there was a revolution in health care and social issues, giving rise to two new classes of workers—visiting nurses and social workers—both composed of high-class bourgeoisie girls, who were considered virtually "immune" to the danger of transmission.[7] To underscore this idea, a study carried out in London in 1882 reported that TB constituted no risk of infection to the professionals involved in the care of patients with TB in a hospital.[11] Therefore, the control measures would not focus on these workers until much later.

It is of note that the TB sanatorium movement was gaining acceptance throughout Europe, and that health professionals played a fundamental role in this scenario. The idea of removal and isolation of TB patients gained strength between 1800 and 1900, driven by the health care movement of the 19th century. The widely disseminated concepts regarding the need for fresh air, the importance of a proper diet, together with rest and controlled exercise, formed the basis of that movement.[12]

Two trends were observed during the health care movement of the 19th century. Although patients were deprived of the conviviality of living with their families, the clustering of so many patients with the same pathology allowed researchers to gain a better understanding of the missing epidemiological links.[13] The natural history of the disease and the mechanisms involved could be better expressed, and the proposed treatments were faster and more efficaciously implemented.[7]

In this context, health professionals were given the important role of caring for these hospitalized patients who were subjected to extensive investigation in order to explain and control the epidemic. Various studies carried out between 1920 and 1930 reported significant data in 20 nursing schools and 30 medical schools in the United States in relation to the conversion rates of the students to positive tuberculin skin test results. However, the idea that professionals involved in the care of patients with TB could be more susceptible to the bacillus infection than is the general population was not accepted.[10,14-16]

In 1929, medical students were submitted to the tuberculin skin test in a research involving

449 individuals. Of these, 35.6% were reactive at the course admission. However, the percentage increased to 41% by the end of the third year and to 67.8% by the end of the last year of college. In fact, 50.2% of the students who were nonreactors in their first year of college became reactors by the end of the course. Values that were more alarming were observed for the students graduating in 1933 and 1936, of whom 57.7% and 77.9%, respectively, became reactors over the course of their studies.[17]

Between 1940 and 1960, the concept of occupational risk was delineated in the world panorama, and the appropriate authorities became aware of the problem. In this period, TB was recognized in the United States courts as a labor-related disease. The term occupational TB was used for the first time for professionals who were infected with the bacillus during their work in the sanatoriums.[18]

Various authors have demonstrated the considerable extent of *M. tuberculosis* transmission among medical students and health professionals.[19-21] A study published in 1968 evaluated three time frames in terms of the tuberculin skin test conversion rate among students at the teaching hospital studied: in the 1948-1951 period (in the era of sanatoriums, before the use of chemotherapy), the conversion rate was 66%; in the 1952-1958 period (chemotherapy was already available), the conversion rate was 21%; and in the 1959-1964 period (coinciding with the establishment of the routine ordering of a chest X-ray whenever a patient suspected of having TB was hospitalized at that facility), the conversion rate was 3.5%.[22]

There was no treatment for TB from the end of the 1920s and the beginning of the 1950s (a period during which the number of TB cases was on the rise). However, the strains existing at that time proved to be sensitive to the antibiotics that were then discovered: streptomycin in 1944; isoniazid in 1951; and pyrazinamide and rifampin in the 1970s. Through the use of these antibiotics, it was possible to control the epidemic.[2]

With the advent of new drugs, the sanatoriums were no longer considered necessary for the control of the disease. In 1972, the American College of Chest Physicians Committee on Tuberculosis prepared a report to facilitate the transition from sanatoriums to general hospitals fin terms of the admission of TB patients. In that report, it was explicit that the low contagiousness of the disease and the use of chemotherapy, which allowed the cure of 95% of cases, made it possible for TB patients to be treated as patients with any other disease. Some reference hospitals had be elected, and the professionals in those facilities had be trained.[23]

The world celebrated the cure of TB in the 1980s, with the advent of the short-term therapy regimen, a combination of isoniazid, rifampin and pyrazinamide, allowing patients to be treated at home with their families. In the subsequent years, a gradual decrease in the number of positive tuberculin skin test results was observed among these professionals, which was attributed to changes in the epidemiology of TB worldwide. It was then presumed that health professionals were no longer at risk.[7] However, it was revealed that the risk of tuberculin skin test conversion was 0.46% among nursing students,[24] and that the annual conversion rate was 2.2% and 5.6%, respectively, among health professionals aged below and above 50 years of age,[25] all these percentages being considered high when compared with the general population.

An association between the different wards of a hospital and tuberculin skin test conversion was observed in two important studies. In the first,[26] high conversion rates were found in the medical, pediatrics and surgery wards; intermediate conversion rates were found in the gynecology and obstetrics wards; and low conversion rates were found in the radiology and psychiatric wards. In the second, the conversion rate was found to be higher among residents in pulmonology (5.65%) than among those in the field of infectious and parasitic diseases (1.19%).[27]

With the visible decrease in the infection rate in the United States and Europe, TB was no longer of high interest to the funding agents, and the resources dedicated to its control were dramatically reduced. In cities such as New York, the resources for TB control were reduced from 40 million to 4 million in early 1990.[28]

The American experience clearly showed a decrease in the cases of TB. In 1953, there were 84,304 new cases, compared with 22,255 in 1984. However, from 1984 onward, the curve modified, and there was an increase of more than 18% in the number of cases. Between 1986 and 1991, cases of TB/HIV co-infection resulted

in reactivation of the latent TB infection, bringing those patients inside the hospital walls once more.[1]

The advent of HIV set off a new epidemic of TB of worldwide proportions, with strains resistant to drugs traditionally used in the TB treatment. Rapidly, new articles were published, proclaiming our frailty in the face of the epidemic.[29-32]

In 1990, the Centers for Disease Control and Prevention (CDC) released a guide on the prevention of TB transmission in health care facilities, with special focus on problems related to the hospitalization of TB patients with HIV. Some of the measures proposed in the document have already implemented, and others, especially those related to cost-effectiveness, are still under debate. In addition to being the first official document that truly recognized the problem of nosocomial transmission, proposing protection measures, it set forth the following objectives: a) the prevention of the generation of viable bacilli through early identification and appropriate treatment of individuals with active TB; b) the use of engineering methods to control the circulation of aerosols containing *M. tuberculosis*; c) the use of personal protective equipment, such as masks, in order to reduce the inhalation of aerosols containing *M. tuberculosis* in the contaminated air; d) surveillance of the individual health care facilities, in order to avoid *M. tuberculosis* infection and TB.[33]

Recent studies have been assertive in relation to the risk of exposure of students in health sciences and health professionals involved in patient care. Various studies published in the 1990s discussed the problem of TB in the AIDS era.[33,34] One of those studies demonstrated tuberculin skin test conversion rates of 15% among health professionals who had previously tested negative and became positive after their exposure to patients with TB/HIV, recognizing the high risk of infection in this population.[29] Another author warned that, during outbreaks, the conversion rate can range from 33% to 50%, according to data from the USA.[35] Corroborating these findings, it has been found that there is a significant increase in nosocomial transmission, especially among patients with TB/HIV co-infection and health professionals, when the standards established by the CDC are not rigorously observed.[5,36]

One meta-analysis addressed contact with patients and tuberculin skin test conversion. The authors reported that there were few studies in the area, and that the results of those studies were inconclusive. According to the same authors, two studies demonstrated statistically significant differences between health professionals who had been in contact with TB patients and those who had not, whereas three other studies observed no statistical difference.[37]

The issue in Brazil

In Brazil, the 19th century was replete with alarming numbers related to TB, which was responsible for one third of the deaths reported. The ineffective treatments were conducted at the Santa Casa Sisters of Mercy Hospitals, where the "phthisic" patients were hospitalized in the same wards with the other patients. Prior to the proclamation of the Brazilian Republic, there was no program against TB, and TB control measures were restricted to official reports, the medical literature and newspapers reports.[7]

After the proclamation of the Brazilian Republic, the "Leagues against Tuberculosis" were created. This movement was inspired by the sanatorium movements in Europe and the United States and was composed of various physicians, many of whom became phthisiologists because they had contracted TB. The problem of TB was taken over by the State in 1920, with the creation of the National Public Health Department, where the dispensaries and the visiting nurses were instituted, rebuilding the European experience in methodology as well as in the risk of transmission to these professionals.[38,39]

However, few studies addressed nosocomial transmission in Brazil. One study was carried out in the 1970s at the Institute for Medical Treatment of Civil Servants, in the city of São Paulo. In that study, the researchers concluded that the chance of developing the disease was four times higher for employees of the hospital than for the general population.[13]

Even after the CDC guidelines were disseminated in 1990, the Brazilian National Ministry of Health, through the Tuberculosis Control Guidelines,[40] established activities aimed at the search for and treatment of cases, as well as the adoption of the standards for the vaccination with BCG. However, no position was taken regarding the health of the worker.[41]

In 1997, in the national capital of Brasília, the National Pulmonology Health Care Council of the Brazilian National Ministry of Health and the Brazilian Thoracic Association discussed controversial points in TB control. Approximately 70 professionals of the area were heard, and the 1 Brazilian Consensus on Tuberculosis was created. In relation to nosocomial transmission, the text incorporates principally the American recommendations, in which the control measures are divided into three categories: administrative measures; environmental control (or engineering control) measures; and respiratory protection measures.[40-42]

Among the recommendations described, the topic of biosafety and respiratory isolation came to be a growing concern due to the increase in TB morbidity and mortality. The text denounced the fact that the control measures were not developed systematically in the country and that, when those existed, they were partial and without impact measurement.[40]

After the analysis of the studies on the prevalence of reactivity to the tuberculin skin test and the development of the disease in professionals, some authors defend the idea that TB be considered an occupational disease, and that professionals involved in its care have the right to compensation and a health hazard allowance.[39]

Despite the different profile of TB in Brazil, that is, of mostly community transmission, recently, in Brazil, this elevated TB transmission rate was also observed in medical schools, university hospitals, prisons and psychiatric clinics.[42-49]

In a study carried out at the Federal University of Rio de Janeiro Clementino Fraga Filho University Hospital, a tuberculin skin test conversion rate of 9.2% was found among health professionals. These data are higher than those found in a slum in Rio de Janeiro (approximately 4%).[49]

In 1997, it was found that 39.4% of the 178 nursing students of the Federal University of Espírito Santo were reactors to the tuberculin skin test, 25.35% being strong reactors and 14.04% being weak reactors. Of those, 33.3% were in their first year of college and had therefore had no contact with TB patients in college. However, of this percentage, 42% reported belonging to another professional category (nursing/laboratory technician/assistant). Students with positive tuberculin skin test results presented a 2.28 times greater chance of having had contact with a TB patient than did those who had negative tuberculin skin test results.[14]

In the period between February of 1994 and September of 1997, a survey on the tuberculin skin test was carried out in order to evaluate the professional risk of TB infection in a general hospital in Rio de Janeiro.[44] Of the 1,250 health professionals who participated in the first phase of the study, 649 (52%) presented positive tuberculin skin test results (induration > 10 mm). The health professionals over 30 years of age presented a lower risk of tuberculin skin test conversion (RR: 0.37, 95% CI: 0.23-0.89; p = 0.01), whereas belonging to the medical or nursing professional category conferred a significantly higher risk (RR: 4.21, 95% CI: 1.17-8.94; p = 0.03).[44]

Another similar study, comprising 4,419 health professionals working in four hospitals, was carried out in three Brazilian states between 1999 and 2000. The rate of positive tuberculin skin test results was 63.1% and the conversion was 8.7% (10.7 per 1,000 individuals/month). The risk factors associated with positive tuberculin skin test results were nosocomial exposure to TB patients, the professional category of nursing and a lack of biosafety measures implemented in the hospital.[46]

Two studies carried out in the city of Vitória, located in the state of Espírito Santo, evaluated the prevalence of positive tuberculin skin test results among professors in the health sciences area. In the first study, the tuberculin skin test conversion was 10.5% per year (95% CI: 3.63-17.43; p = 0.035), whereas the conversion rate for the general population in Brazil is 0.5% per year. These results indicate that nursing students are a risk group for TB infection. Among the factors studied, only the use of the NIOSH95 mask was associated with protection against infection (RR: 0.2). There was no statistically significant difference between the students who had positive tuberculin skin test results and those who had negative test results in relation to their knowledge of TB or the existence of specific conditions for the hospitalization of patients with TB.[50] In the second study, there was a significant difference between the frequency of reactivity to the tuberculin skin test among nursing students (20.3%) and among medical students (18.4%) in comparison with that seen

among economics students (6%; p < 0.001). As expected, the medical and nursing students had greater knowledge of TB than did the economics students (p < 0,001). These data suggest that the incidence of the *M. tuberculosis* infection among nursing and medical students in the state of Espírito Santo, where TB is highly endemic, is no different from that seen in countries with low TB endemicity.[51]

In another study, carried out between 2002 and 2006, 25 new cases of health professionals with TB were reported. Of those, 8 (32%) were nursing technicians, 4 (16%) were doctors, 3 (12%) were nurses, 2 (8%) were radiology technicians, and 8 (32%) were professionals from other categories. The predominant clinical form was the extrapulmonary form, with 12 cases (48%), followed by the pulmonary form, with 11 (44%), and the combination of the two forms, with 2 (8%). The proportion of health professionals diagnosed with TB in the studied period was 2.53%. The results of that study indicate the need to incorporate the biosafety norms recommended by the TB control program into the practices of health care facilities.[52]

Finally, a new facet has presented itself in relation to the risk of the health professionals. In 2004, the Brazilian National Health Ministry, following the guideline of the Brazilian National Tuberculosis Control Program in relation to the "horizontality" of the fight against TB, through the expansion of its activities to all the services of the Unified Health Care System, emphasized the integration of primary health care through the Family Health Strategy and, specifically, the integration of the Community Health Agent Program (CHAP), as a means of widening the access to diagnosis and treatment of TB throughout Brazil.[53] In TB control, it is basically expected that these new professionals will be capable of identifying, through home visits in the community, those individuals who present cough three or more times a week (respiratory symptoms) and will refer such individuals to health care facilities for TB investigation (active search). In addition, it is expected that they will instruct the family and the community, monitor patient ingestion of medication (supervised treatment) and organize meetings with the members of the community.[53]

With this new intervention, we put the CHAP representatives in direct contact with TB patients and, again, did not reflect upon the risk of infection and developing TB.

With this perspective, a study was conducted in Cachoeiro de Itapemirim, a city fully covered by the Family Health Program and one of the eight priority cities in the state of Espírito Santo, which showed that the CHAP representatives have a six times greater chance of being infected with *M. tuberculosis* than do their home controls. In that sample, of the 30 CHAP representatives investigated, 8 presented positive tuberculin skin test results and, of those 8, one was diagnosed with TB.[54]

Final considerations

The risk of nosocomial transmission of *M. tuberculosis* varies principally according to the local prevalence of TB and to the effectiveness of the infection control program at the institution.[43] Patients with pulmonary or laryngeal TB are the principal sources of transmission, although some infections have been reported after the manipulation of extrapulmonary sites.[54-56] Failures in the recognition, isolation and management of TB patients are important determinants of nosocomial outbreaks. Patients with multidrug-resistant TB, inadequately treated with Regimen I, can remain infected for long periods, increasing the risk of TB transmission.[43]

In Brazil, recommendations for the use of TB control norms have recently been published.[57] However, no effective action has been adopted in Brazil, due to the lack of specific legislation to guide the managers of the institutions, as well as lack of actual implementation of these measures. In addition, there are few recommendations for TB control in closed communities, such as prisons, nursing homes, mental health and psychiatric clinics, in Brazil.[58]

It is of note that, in Brazil, the disease has always been a public health problem; however, biosafety measures are not yet a part of the scope of the TB programs.[2] Any measures aiming to combat the transmission of TB should take into account the institution as a whole, whether a health institution or not, and should be implemented accordingly to the type of institution and the risk of the transmission of the TB bacillus.

The scientific community and the health workers should organize immediately, and recognize themselves as a population subject to the risk of developing the disease, actions should

be implemented in order to minimize the potential risks in the locales where the treatment of TB patients takes place.

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