

Epidemiological and economical impact of tuberculosis in an adolescent girl in Lausanne (Switzerland)

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Summary

Patients with pulmonary tuberculosis (TB) can infect people in their environment but children and adolescents are rarely contagious. A recent case of an adolescent girl in Lausanne, however, proved to be infectious and required extensive contact tracing.

Subjects and methodology: The source case was a 15-years-old adolescent girl of African origin. Upon her arrival in Switzerland in 1994 the tuberculin skin test was 14 mm. The patient did not receive preventive treatment. She developed smear-positive pulmonary tuberculosis in May 1999. Contact tracing identified contacts in the surrounding population. The contact persons were divided into 3 groups according to their proximity. The first group consisted of close family and friends, the second of classmates and teachers and the third of more distant contacts. Costs were also evaluated.

Results: Of the 53 people examined, 24 (45%) were infected and required treatment. Eight out of 9 cases (88%) were infected in the first group (including another case of culture-positive pulmonary tuberculosis). Fourteen out of 33 cases (42%) in the second group and 2 of 11 (18%) to the third group. Passing from one proximity group to the next decreased the relative risk of infection 4 fold.

The costs of contact tracing and treatment are estimated at over CHF 24 000.

Conclusions: (1) Pulmonary TB can be contagious even in adolescents. (2) Subdividing contacts into proximity groups allows for better targeting of the people to be screened. (3) Contact tracing and the high costs involved could have been avoided if the patient had received preventive chemotherapy upon her arrival in Switzerland.

Key words: tuberculosis; adolescents; contact tracing

Introduction

The prevalence of tuberculosis in children and adolescents is low in our country. In 1998, out of 596 cases of tuberculosis confirmed by cell culture, only 3 involved children under the age of 10 years, and 32 involved patients between the ages of 10 and 19 years. Only 5.8% of the cases occurred in subjects under 20 years of age [1]. The number of persons contaminated by contagious subjects is unknown, but it is assumed that clinical tuberculosis may develop in about 10% of contaminated patients, usually within 2 years of infection [2]. Among 43 children hospitalised with TB in Switzerland, 18 (42%) had the active disease (5 with positive culture) and 25 (58%) were infected but asymptomatic. Contact tracing led to the discovery of 3 unsuspected cases of pulmonary TB [3].

This article presents a rare case of contagious TB in an adolescent girl, the results of contact tracing within contact circles, and the cost induced by failure to identify the case and treat it preventively.

Source case: In April 1999, a smear-positive pulmonary TB was diagnosed in a 15-year-old adolescent girl born in Angola where she had received BCG immunisation during childhood. She arrived in Switzerland in 1994 without a history of TB contact but a positive tuberculin skin test of 14 mm. At that time, no investigation was performed and the patient did not receive preventive chemotherapy. During the winter of 1998-1999 she developed a chronic cough followed by hemoptysis in April 1999. The chest X-ray revealed an infiltrate with cavities in the left apical region. The sputum smear revealed acid fast bacilli identified as *M. tuberculosis* sensitive to the four main antituberculous drugs. The patient was treated with isoniazid, rifampin, pyrazinamide, and ethambutol for 2 months followed by isoniazid and rifampin during 4 months. Clinical and bacteriological course were favourable.

Methodology

The physicians in charge of the patient (Hôpital de l'Enfance, Lausanne) notified the case to the cantonal health officer. The health officer ordered that contacts be traced to identify and treat those infected. In the Vaud Canton, contact tracing is carried out by the Ligue Pulmonaire Vaudoise (LPV) and the Dispensaire Antituberculeux. A nurse from the LPV established the list of contacts and informed the school authorities and the doctors in charge of each contact to insure the evaluation and follow-up of the entire group. All persons identified were requested to undergo a tuberculin skin test with 2 TU of RT23 Berna (bioequivalent to 2 TU RT23 Copenhagen or to 5 TU of PPD-S). According to the current Swiss guidelines, tuberculin skin tests are considered to be clearly positive if equal or superior to 15 mm, dubious if between 10 and 14 mm (requiring repetition of the test 2 months later), and negative if less than 10 mm. An increase in size by 5 mm between the first and second test is considered to be suggestive of a primary infection.

In each person with a positive skin test was given a chest X-ray was performed to rule out pulmonary disease. All infected contacts with a normal chest X-ray received a six-month preventive chemotherapy with isoniazid.

We studied the patient's records and divided them into 3 proximity groups: Group 1: people living under the same roof and close friends; group 2: classmates and teachers; group 3: occasional contacts, other schoolmates.

We counted the number of infected cases in each group and calculated the relative risk for each proximity group.

Among the infected people who received a preventive treatment, we evaluated the compliance with the treatment. The criteria for compliance were regular patient attendance and request for medical prescriptions at each visit.

The costs were evaluated including those of the source case's hospitalisation and those of ambulatory treatment and medication of the source case and contacts.

Results

Fifty-three people were identified as having had a contact with the source case during the two months prior to the diagnosis. Among the contacts, 24 people (45%) were considered to have been infected, including one case of smear-negative, culture-positive pulmonary TB (figure 1).

In the first proximity group, 9 contacts were tested and 8 (88%) were infected. The patient's father had a tuberculin skin test of 11 mm in April 1999 but did not come to the control 2 months later and was therefore not retested or treated. He was considered as potentially infected. The patient's cousin was found to have a smear-negative, culture-positive pulmonary TB due to *M. tuberculosis* with the same RFLP typing as the index case. Among the other close contacts, 6 were infected and asymptomatic and received preventive chemotherapy.

Among the other contacts (groups 2 and 3), the rate of infection was considerably lower (figure 2).

Passing from one group to the next decreased by 4 times the risk of being infected. A similar proportion of persons in each group had received prior BCG immunisation (4 in group 1, 12 in group 2 and 4 in group 3).

Of the 53 contacts identified, 26 were of African origin (15 infected), 8 from ex-Yougoslavia (mainly Kosovo) (4 infected), 2 of Turkish origin (1 infected), 5 of Iberian origin (2 infected), 6 of Swiss origin (1 infected) and 2 Italians (non infected). Among the 4 contacts of unknown nationality, none were infected.

The compliance rate with the preventive treatment among the patients to whom it was prescribed was 64% (6/6 in group 1, 7/14 in group 2 and 1/2 in group 3). The patient with the culture-positive pulmonary TB interrupted her treatment after 2 months and left the country. One infected person has returned to Kosovo and was considered non compliant. Furthermore, one non infected

Figure 1
Global results of contact tracing by proximity groups.

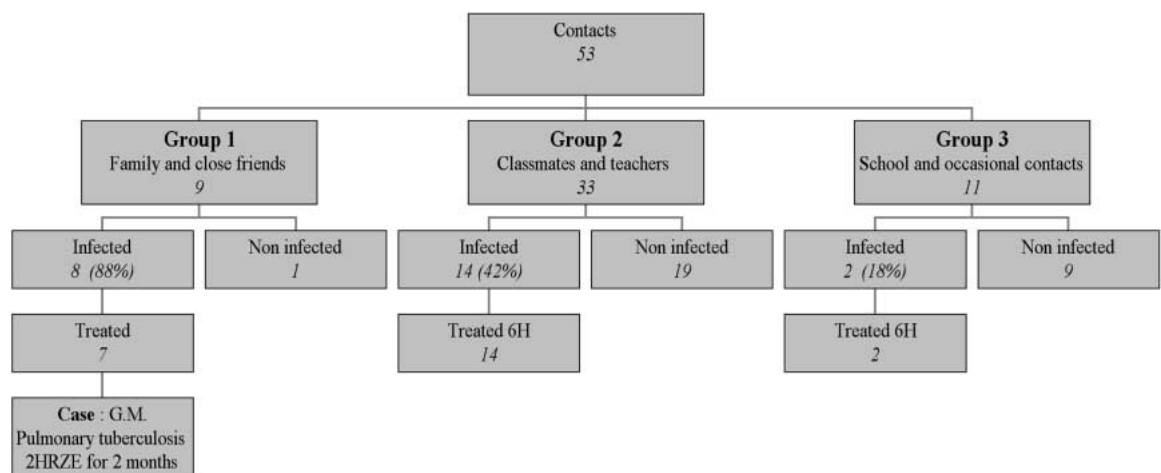


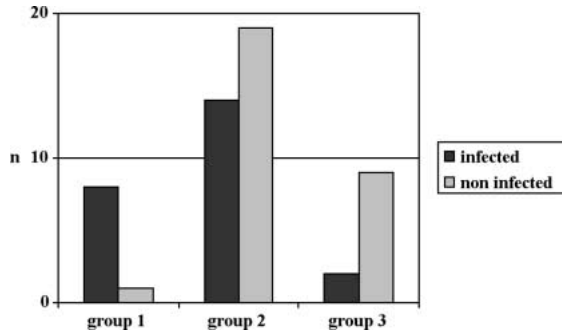
Table 1

Cost estimation of treatment of the index case and contact tracing (all figures are given in CHF).

	cost of hospitalisation	cost of outpatient follow-up	cost of treatment	total cost
Source-case	8000	1000	2000	11 000
Case of secondary tuberculosis (2 months)	–	500	700	1200
Infected contacts	–	11 000	1000	12 000
Total	8000	12 500	3700	24 200

Figure 2

Number of infected and non infected contacts by proximity group.



contact (a classmate) refused the second tuberculin skin test 2 months later. One adult changed medication due to the side effects of isoniazid.

The costs for the treatment of the index case and contact tracing, including preventive therapy of the infected contacts, are indicated in the table 1.

Discussion

On rare occasions tuberculosis among children and adolescents may be contagious. A recent case of infectious pulmonary TB disease in a 9-year-old child was responsible for a 20% infection-rate among contacts (56 cases out of 276 contacts) [4]. The young girl described in this paper infected a larger proportion of contacts (24/53 or 45%), with one case of secondary pulmonary tuberculosis in a cousin living under the same roof. This difference may be partly explained by the age of the source cases and the fact that our patient was 15 years of age at the time of diagnosis. Indeed, adolescents are more likely to produce sputum and to transmit the bacillus than younger children. According to a retrospective study of 4607 children aged 0 to 4 years and 1615 adolescents aged 15 to 19 years, the lungs are the main site of infection (71 to 82%) and 24% of adolescents have cavities [5].

We assumed that the smear positive index case, who was symptomatic for several months before diagnosis, was the source of contamination of the second case of tuberculosis, who was asymptomatic at the time of diagnosis and positive only in cell culture.

The limit above which a tuberculin skin test is interpreted as being positive and indicative of infection requiring treatment varies between studies and countries. The latest ATS/CDC recommendations consider any test above 5 mm in a person in contact with a case of TB as indicative of infection, regardless of history of BCG immunisation [6]. However, in countries with a high prevalence of TB and where a large proportion of adults and children have been immunised, the definition of a positive skin test may be different. In subjects with a BCG scar, it is impossible to distinguish between infection and immunisation. In Switzerland, it is

usual to consider 10 mm in unvaccinated adults and 15 mm in vaccinated persons as indicative of a possible infection. The current Swiss guidelines recommend the preventive treatment of immigrants born in a country with a high incidence of tuberculosis in children less than 15 years old with a tuberculin skin test equal or greater than 11 mm and young adults, 15 to 25 years of age, if the skin test is equal to or greater than 18 mm [7]. This restricts the preventive treatment to cases with the highest risk of reactivation. Preventive therapy can be extended to other subjects with documented exposure to tuberculosis or very young children (1 child was younger than 1 year of age in our study). In our case, in spite of prior BCG immunisation, a preventive treatment should have been considered at entry in Switzerland, when the child was aged 10 years, or at least a close follow-up of the tuberculin reactivity.

A history of contact with a case of infectious TB is far more important for the indication of treatment than the history of previous BCG immunisation and the size of the tuberculin skin test [7–10]. In our group, the history of prior BCG immunisation did not influence the decision to treat or not.

The distribution of contact cases in 3 groups confirms the importance of duration and proximity of contact with the source case, which has to be determined by a precise history [11]. Indeed, close contacts in Group 1 had the highest incidence of infection with 88%. The relative risk of infection is different in each group and decreases 4 fold between groups 1 and 2 and between groups 2 and 3 (odds ratio of 0.4). Therefore, the contact tracing should concentrate on close contacts and extend the search to further circles only if the results among close contacts demonstrate an infection

rate higher than expected in the local population. This procedure allows for the rapid examination of the persons more at risk and avoids the unnecessary testing of remote contacts. There is, however, a selection bias which becomes more important in the distant contact groups. Furthermore, we cannot exclude that some contacts have been infected prior to the contact with the index case or by environmental mycobacteria, but this would not explain the difference between the proximity groups.

The costs of contact tracing and treatment could have been avoided in this case if the tuberculin skin test done on the source case's arrival in Switzerland had been interpreted correctly, and if preventive chemotherapy had been prescribed according to current guidelines.

A study done in Lausanne on 250 patients, mainly of foreign origin, showed a compliance rate with preventive therapy of 76% [12]. In another study done on migrants in Switzerland, the compliance rate was 68% [13]. In our group, the compliance rate with preventive therapy (excluding the secondary case of tuberculosis) was close to this (64%, 12 out of 22 cases).

The costs induced by this case of TB and contact tracing are difficult to estimate. The first reason is the inaccessibility of some data (in particular the costs of treatment prescribed by the family doctors) which we had to extrapolated from existing data. The second reason is the difficulty of estimating the time spent for the global follow-up of the patients, the intervention of each professional and the complexity of co-ordination to guarantee effective contact tracing and treatment.

In conclusion, contrary to common belief, an adolescent can transmit TB infection to a large number of people in his/her environment. Hence, the search for infected contacts and their treatment is essential to prevent further dissemination of the tubercle bacillus in the population.

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