Tuberculin reaction in children and affecting factors

Sukriye Ece Dervisoglu Abay, MD
Family Physician
Gudul General Hospital

Selcuk Mistik M.D. Assistant Professor
Erciyes University Medical Faculty
Department of Family Medicine
Correspondence address:

Selcuk Mistik M.D. Assistant Professor
Erciyes University Medical Faculty
Department of Family Medicine
38039
Kayseri
Turkey
Tel: +90 532 3438450
Fax: + 90 352 4375285
E-mail: smistik@erciyes.edu.tr

First Published Chest Medicine On-Line 16th September 2005

Abstract

Objective: The aim of this study was to define the Annual Infection Risk (AIR) of tuberculosis in Turkey.
Methods: We have compiled data from school screening and immunisation programs, conducted by health centres in Mamak, Ankara. We screened 1069 students from 13 primary and high schools.
Results: Five hundred and forty two of 1069 students were girls (50.7%), and 527(49.3%) were boys. All of the children were classified into age groups as 474 (44.3 %) students in 7-8 years (first grade, primary school), 436 (40.7 %) students in 11-12 years (fifth grade, primary school), and 159 (14.8 %) students in 17-18 years (last /eleventh grade, high school. Of the male students, 448 (85 %) had 0- 10mm, 76(14.4 %) had 10-20mm, and only 3(0.6 %) had over 20 mm positive skin test. 461 (85 %) girls had 0-10mm, 75 (13.8 %) of girls had 10-20mm, and 6 girls (1.1 %) had over 20mm positive PPD reactions.
Of the1069 children, 239 (22.3 %) were found to have never been in vaccinated. Eighteen of them (7.6 %) had Mantoux reaction over 10mm. Upon examination of the distribution of PPD reaction with respect to age groups, it is seen that 435 students (91.7 %) had over 10mm or smaller reactions in 7-8 age group; 34 students (79.5 %), in 11-12

age group; and 127 students (79.8 %), in 17-18 year age group. Numbers of students and their percentages with over 10 mm PPD reaction in each age group are 39 (7.8 %), 89 (20.4 %), and 32 (20.1 %).
Eight hundred and forty-seven (79.2 %) were found to have been born at hospital, and 222 (20.9 %), at home. Of these 847 students born at hospital, 189 (22.3 %) had no scar. 438 (51.7 %) of them had one scar, 215 students (25.3 %) had two scars, and 5 (0.5 %) had three scars. Distribution of scar counts among students born at home was as follows in the same order; 50 (22.5 %), 104 (47.2 %), and 4 (0.9 %). 80 students who have chronic illness were detected. Of the 80 students, 69 (86.2 %) had gave 10 mm or smaller reaction, the remaining 11 (13.7 %) had gave 10 mm or greater reaction. Distribution of reactions in the students who do not have chronic disease, 840 (85 %) and 149 (15 %) respectively.
Conclusions: Our study found the prevalence as 7.6%. Although it appears slightly better, this value places Turkey between countries with low prevalence (2 %) and those with intermediate prevalence (14%) according to the classification of IUAT.

Keywords: Tuberculin reaction; children; affecting factors

Introduction

Pulmonary tuberculosis still affects millions of people in the developing world, in spite of effective and safe anti-tuberculosis drugs and drug regimes. According to World Health Organisation (WHO) 90 million new tuberculosis cases will occur all over the world between 1990 and 2000.[1] Studies declared that tuberculosis is the leading infectious disease that causes morbidity in adults in the world. If prevention of tuberculosis continues to be inadequate, it is estimated that some 30 million people will die of tuberculosis .[2]

The most effective way of solving the tuberculosis problem and protection against it in a society is treating all detected patients successfully. Hence, effectively managed patients lose their infectivity, and as a result infection sources are decreased, and the

infection chain is broken in this society. In order to be successful at least 70% of patients must be treated effectively.

Both developed and developing countries make use of annual infection risk (AIR) as the most important parameter in evaluating prevention programs. The annual risk indicates the probability for a non-infected individual to become infected in a year. It depends on only PPD results, and another factor, which increases its reliability, is that it is not affected from defects in registration. It is not affected from failure in drug regimen either.[3] Positive tuberculin skin test is an indicator of primary tuberculosis infection. Primary tuberculosis is the infection that occurs in a person with no prior immunity.[4] There are two techniques for performing tuberculin skin test: Mantoux test, and the multiple punction tests. Mantoux test is the most safest and standardised one. It is performed by the injection of 0.1ml.of-purified protein derivatives (PPD) to the back of forearm, and the diameter of indurations is measured 48 to 72 hours after injection.[5] There are many factors that have influence on the tuberculin reaction: ones regarding the host, the tuberculin and the way it is applied.[6] There are many occasions where Mantoux test is accepted as positive when it is 5mm., 10mm., and 15mm. In countries where there is high risk of tuberculosis infection, a PPD test of 10mm. or more is considered to be a tuberculosis infection.[7]

In Turkey only two studies have been done to found an AIR. According to their results, AIR shows an increase instead of decrease (between 1977 and 1985).

Eradication of tuberculosis in world is rendered difficult by migration from developing countries, increased population, and increased HIV infection in last ten years, which itself is a risk factor for tuberculosis.[8]

The aim of this study was to define the AIR of tuberculosis. We also aimed to investigate a correlation between PPD results and BCG scar counts, and the socio-cultural dimension of tuberculosis in our study.

Materials and Methods

We have compiled data from school screening and immunisation programs, conducted by health centres in Mamak, Ankara. We surveyed 1069 students from 13 primary and high schools. They are all screened by PPD skin testing which was performed at schools. 5 TU PPD was injected to dorsal forearms of children by trained health staff. Doctors inspected results 72 hours later. Results were categorised as 0-10mm, 10-20mm and over 20mm. According to BCG scar count at the deltoid part of left arm, children were grouped as non-scarred, one-scarred, two-scarred and three-scarred. Their weight and height were taken as well to group them into the growth percentile of Turkish children to see the effect of malnutrition. This classification covered 910 primary school students.

Information on general health, personal and socio-economic condition, demographic data and the history of contact with infected person were obtained from parents by a questionnaire. The questionnaire included the following items: height, weight, number of siblings, which child of the family is the child in order, the childhood diseases that the child has been infected before, presence of any chronicle diseases, the presence of permanently used drugs, the use of any drugs in the past three months. The number of BCG scars and the PPD results are recorded on the questionnaire. In addition to the personal questions, some questions about the family are asked as well in the

questionnaire. These are the age, education level, smoking status, and chronic use of any medications, occupation, and alcohol consumption, the history of tuberculosis disease of both the mother and the father. The final question on the questionnaire was the presence of persons taking anti-tuberculosis drugs either at home or amongst the relatives. The questionnaire is performed by face- to- face interview with the parents. The relation between PPD results and chronic illness or the medications was also evaluated.

Results

Five hundred and forty two of 1069 students were girls (50.7%), and 527(49.3%) were boys (Table I). Of the male students, 448 (85 %) had 0- 10mm, 76(14.4 %) had 10-20mm, and only 3(0.6 %) had over 20 mm positive skin test. 461 (85 %) girls had 0-10mm, 75 (13.8 %) of girls had 10-20mm, and 6 girls (1.1 %) had over 20mm positive PPD reactions.

All of the children were classified into age groups as 474 (44.3 %) students in 7-8 years (first grade, primary school), 436 (40.7 %) students in 11-12 years (fifth grade, primary school), and 159 (14.8 %) students in 17-18 years (last /eleventh grade, high school) (Table II).

Of the1069 children, 239 (22.3 %) were found to have never been in vaccinated. Eighteen of them (7.6 %) had Mantoux reaction over 10mm. Table II, which shows BCG scar counts with respect to age groups, reveals that 177 students (37.3%) in 7-8 years age group had no scars.

Upon examination of the distribution of PPD reaction with respect to age groups, it is seen that 435 students (91.7 %) had over 10mm or smaller reactions in 7-8 age group; 34 students (79.5 %), in 11-12 age group; and 127 students (79.8 %), in 17-18 year age

group. Numbers of students and their percentages with over 10 mm PPD reaction in each age group are 39 (7.8 %), 89 (20.4 %), and 32 (20.1 %). The relationship between PPD results and BCG scar count is shown in Table III.

Of the 198 students whose weights are in less than 10 % percentile, 168 students (84.8 %) had smaller than 10 mm PPD, whereas the remaining 30 (15.1 %) had over 10mm. On the other hand, these percentages were found to be 85.9 % and 14.1%, respectively among 871 students whose weights are in above 10 % percentile. Similarly, 286 pupils (89 %) below the 10% height percentile level gave less than 10 mm reaction while 35 pupils (10.5 %) gave over 10mm reaction in the same group. As for those above the 10 % percentile, the percentages were 87.3 % and 12.7 %, respectively.

The students were also classified into two groups as these born at home and those born at hospital, and the two groups were correlated with BCG scar counts. Of the 1069 students, 847 (79.2 %) were found to have been born at hospital, and 222 (20.9 %), at home. No reliable information could be obtained from mothers as to the birth weights of subjects.

Of these 847 students born at hospital, 189 (22.3 %) had no scar. 438 (51.7 %) of them had one scar, 215 students (25.3 %) had two scars, and 5 (0.5 %) had three scars. Distribution of scar counts among students born at home was as follows in the same order; 50 (22.5 %), 104 (47.2 %), and 4 (0.9 %). 80 students who have chronic illness were detected. Of the 80 students, 69 (86.2 %) had gave 10 mm or smaller reaction, the remaining 11 (13.7 %) had gave 10 mm or greater reaction. Distribution of reactions in the students who do not have chronic disease, 840 (85 %) and 149 (15 %) respectively.

The relation between the number of household members and Mantoux test results was in consideration. Of the total of 362 students who were from households of less than 5

people, 57 students (15.7%) were detected as having over 10 mm reaction, whereas this number was found to be 103 (14.5 %) for students living in more crowded families. Of the 1069 students, 588 (55 %) with their families migrated from other cities of Turkey. The PPD positive in the migrated students group was 14.6 % and it was 15.6 % in non-migrated one.

The relation between the PPD result and the contact history with a tuberculosis-infected adult, which is the most important parameter for diagnosing tuberculosis at children, is shown in table IV.

The PPD results were found to be negative (≤ 10 mm) for 131 students (83.9 %) out of 156 students with a contact history with a tuberculosis bearing adult. The number of students with positive (> 10 mm) PPD results was determined to be 25 (16.1%) in this group. Of the 913 students without a contact history with an adult tuberculosis patient, 778 (85.2 %) gave negative PPD reaction while the test results were positive for remaining 135 students (14.8 %).

Discussion

If over 10 mm is considered positive, then the positive rates are 14.9% (8) for girls and 15% (79) for boys; so there is not a meaningful relation between Mantoux reaction and sex. As the number of household members increases, the indurations becomes greater. The sensitivity of PPD to BCG vaccination (and possibly immunity against tuberculosis if the immune system of the host is strong) depends on the quality and variation of BCG used, on the number of vaccinations, on the age, nutritional and immune condition of the person vaccinated, and on the time passed since last vaccination.[9] Repeated vaccination causes larger indurations.[10] It has been observed that the tuberculin sensitivity following revaccination was higher with respect to the first vaccination.[11]

It is commonly accepted that reactions larger than 10-15mm in diameter are rarely encountered after vaccination, and that tuberculin reactivity disappears rapidly in a couple of years.[12] Some authors suggest that a PPD over 12 mm regardless of the BCG time indicates tuberculosis infection in vaccinated persons.[11,12] Results concerning BCG vaccination and tuberculin indurations are usually based on a single vaccination. More than one BCG vaccination is suggested for children in developing countries like Turkey; it makes sense that tuberculin indurations, accepted as indication for tuberculosis infection, differ in children vaccinated once, twice, or three times.

Ildirim et al found in their study that the rate of children with 0-10 mm PPD indurations was 89 % among those with no BCG scar whereas it was determined to be 92.4 % in this study.[13] On the study carried out in Bursa, the ratio of children with 0-10 mm indurations in those with one scar was found to be 64% while this rate is 89.5 % in our study.[13] As the rate of two scarred children with the same indurations size, it is 71 % in our study, and 31 % in the other. Finally, when children with three scars are compared in the two studies, our rate of 42 % differs widely from 5 % found in the other study (Table IV).

A similar study was carried out in the United Arab Emirates (UAE) in 1994.[5] In this study in which a total of 785 students were screened, 428 students (54.5 %) were detected to have BCG scars, and no scars were detected in 357 children (45.5 %). Of the 1069 students screened in our study, 239 (22.3 %) had no BCG scar, and the remaining 830 (77.6 %) were detected to have BCG scar.[14] This finding shows that the vaccination program in Turkey runs much better and organised.

In the study carried out in the UAE by Bener et al, the prevalence was computed as 8 % based on group of subjects.[5] Our study found the prevalence as 7.6%. Although it

appears slightly better, this value places Turkey between countries with low prevalence (2 %) and those with intermediate prevalence (14%) according to the classification of IUAT. Infection should be prevented and vaccination programs should be enhanced in addition to continuing efforts to treat active tuberculosis patients effectively.

We found in our study that 177 (37.3 %) of the primary school first grade students and a total of 62 students (20.5 %) from the fifth grade and the last year of high school had no scar. Some students do not go to school on days of vaccination either because most is afraid of injection or they are sick or because of other reasons. Supposing an 80 % immunisation rate for BCG, the rates found in this study are quite high.

Although the study carried out in UAE found no relation between the family size and Mantoux reaction, in our study we detected higher positive PPD among children from crowded families.[14] Our conclusion that the size of PPD indurations increases with increasing age is in agreement with the this study. While 14 % of the primary school children had over 10mm indurations, the rate was found to be 20.1 %for high school last year students. We had different results than the other study on the effect of gender as well. The UAE study did find a meaningful relation between sex and positive PPD reaction while the ratio of students with over 10 mm reactions was the same (15 %) for both sexes in our study.[14] The picture we had when we look at the education level of parents we interviewed: 90.3 % of mothers either never went to school or were primary school graduates, and the percentage of fathers was 76 %. Many still think that tuberculosis is an incurable disease that should not be disclosed.

In final conclusion, people should be provided with the kind of information that is consistent with their understanding and level of education. They should be made aware

of the protection of vaccination, and that every child should have and get administered a vaccination program must be emphasised to parents.

References

1. Dolin, P.J., Raviglione, M.C., Kochi, A.(1994) Global tuberculosis incidence and mortality during 1990-2000.WHO Bulletin,72-213.

2. Çöplü, L. (1998) Tuberküloz artıyor mu? Hacettepe Tıp Dergisi. 29,2,44-48.

3.Kocabaş, A. Tuberküloz tedavisinde sorunlar. (1991) Kocabaş, A.(ed).Tüberküloz kliniği ve kontrolü. Çukurova Üniv. Basımevi Adana.315-333.

4.Güler, N. (1996) Çocuk tüberkülozuna güncel yaklaşım. Ang Ö ve Uzun M.(ed).Tüberküloz tanı, direnç, tedavi. Türk Mikrobiyoloji Cemiyeti Yayını no:26, 27-42.

5.Badger, T.L., Breitwieser, E.R., Muench, H. (1963) Tuberculin tine test: multiple-puncture intradermal technique compared with PPD-S, intermediate strength (5TU). Am Rev Respir Dis 87,338.

6.Cheng, T.L., Miller, E.B., Ottolini, M., Brasseux, C., Rosenquist, G. (1996) Tuberculosis testing: Physician attitudes and practice. Arch Pediatr Adolesc Med. 150, 682-685.

7.Committee on Infectious Diseases. (1996) Update on tuberculosis skin testing of children. Pediatrics. Vol 97 No:2 ,282-283.

8.Çelenk, M. (1994) Tüberküloz epidemiyolojisi. T Klin Tıp Bilimleri Dergisi. Tüberküloz özel sayısı,14,6.

9.Cohn, D.L. (1997) Use of Bacille Calmette-Guerrin vaccination for the prevention of tuberculosis: renewed, interest in an old vaccine. Am J Med Sci. Jun 313 (6), 372-376.

10.Wong, G.W.K. and Oppenheime S.J. (1994) Childhood Tuberculosis. Clinical Tuberculosis, edited by PDO Devies, published by Chapman and Hall. London,211-223.

11.Pell, J., and Copewell, S. (1996) An audit of BCG immunization and tuberculin skin testing in Scotland Scottish BCG Study Group. Health Bull.Edinb. Nov.54(6),490-494.

12.Committee on Infectious Diseases. (1994) Screening for tuberculosis in infants and children Paediatrics 93,131.

13.İldirim, İ., Hacımustafaoğlu, M., Ediz, B. (1996) Tüberkülin endurasyonuyla BCG aşı sayısı arasındaki bağlantı. Pediatr Enfeks Hast Derg. 1,11-14

14.Bener, A., Uduman, S., Bin-Othman, S.A. (1996) Factors associated with tuberculin reactivity among children in United Arab Emirates. Respir Med.90,89-94.

Table 1. PPD Results with respect to sex

	PPD RESULTS							
SEX	0-10		10-20		> 20		TOTAL	
	n	%	n	%	n	%	n	%
BOY	448	85.0	76	14.4	3	0.6	527	100.0
GIRL	461	85.1	75	13.8	6	1.1	542	100.0

χ^2=0.98 P>0.05

Table 2. BCG Scar count with respect to age

	BCG SCAR COUNT									
AGE	0		1		2		3		TOTAL	
GROUPS	n	%	n	%	n	%	n	%	n	%
7-8	177	37.3	287	60.5	9	2.0	1	0.2	474	100.0
11-12	46	10.6	165	37.8	222	51.0	3	0.6	436	100.0
17-18	16	10.0	91	57.2	49	30.9	3	1.9	159	100.0

χ^2=325.09 P<0.000

Table 3. PPD Results with respect to BCG scar count

	PPD RESULTS							
BCG SCAR	0-10		10-20		>20		TOTAL	
	n	%	n	%	n	%	n	%
0	221	24.3	16	10.6	2	22.2	239	22.3
1	486	53.5	55	36.4	2	22.2	543	50.8
2	199	21.9	76	50.3	5	55.6	280	26.2
3	3	0.3	4	2.7	0	0.0	7	0.7
TOTAL	909	100.0	151	100.0	9	100.0	1069	100.0

χ^2=73.42 P<0.000

Table 4. PPD Results with respect to the contact history with a tuberculosis-infected adult

	PPD RESULTS							
HISTORY	0-10		10-20		> 20		TOTAL	
	n	%	n	%	n	%	n	%
Presence	131	84.0	23	14.7	2	1.3	156	100.0
Absence	778	85.2	128	14.0	7	0.8	913	100.0

χ^2=0.49 P>0.05