Effectiveness of Tuberculin Skin Test Screening in a Rural Family Practice

Jennifer T. Cornell, Paul S. Frame, MD, and Peter Franks, MD
Cohocton, New York

Tuberculin skin tests were performed on 1,146 patients out of an active patient population of 3,112 patients over a ten-year period in a rural western New York State family practice. There were 19 new positive tuberculin reactions and six cases of active tuberculosis discovered in the population. All but two of the patients with new positive tuberculin reactions and all of the patients with new cases of active tuberculosis were members of at least one of the following high-risk groups: (1) contact with an individual with active tuberculosis, or a positive family history of the disease; (2) immigrants to the United States; (3) a history of alcohol abuse; (4) having lived in an institutional setting; (5) health care personnel; and (6) having signs and symptoms of tuberculosis (cough, anorexia, weight loss, positive chest roentgenogram). All new cases of active tuberculosis were diagnosed because of symptoms. No asymptomatic person with a positive tuberculin test developed active disease during the study period. The positive predictive value of using risk factors to prescreen for the tuberculin skin test was 16 percent. The negative predictive value of not screening people without risk factors (because they will have a negative tuberculin test) was 99.8 percent.

The prevalence of tuberculosis in the United States has been decreasing since the 19th century. Despite this decline, tuberculosis is still a significant health problem. In 1982 there were 25,520 cases of tuberculosis in the United States, a case rate of 11/100,000 population. In New York State the case rate was 12.8/100,000.[1] In 1982 the National Center for Health Statistics reported 1,980 deaths caused by tuberculosis.[2]

Tuberculin skin tests have been widely used to screen for tuberculosis since 1950. With the decrease in the prevalence of tuberculosis, the effectiveness of skin testing for routine tuberculin screening has been questioned. The American

From the Tri-County Family Medicine Program, Cohocton, and the Department of Preventive, Family, and Community Medicine, University of Rochester School of Medicine and Dentistry, Rochester, New York. Requests for reprints should be addressed to Jennifer Cornell, Box 389, University of Rochester School of Medicine, 601 Elmwood Avenue, Rochester, NY 14642.

Thoracic Society recommends that populations with a disease rate greater than that seen in the United States, or with a rate of tuberculin sensitivity greater than 1 percent in children aged under 5 years, should be considered for routine tuberculin screening.[3] The Center for Disease Control stated in 1971 that screening should be discontinued for school children if they have a low prevalence of positive reactions.[4] Both groups recommend routine screening of populations that have a high risk of being infected with tuberculosis.

In contrast, the American Academy of Pediatrics[5] advises routine tuberculin screening for children at 12 months of age and annually or biannually thereafter. They do state that in areas with an exceedingly low prevalence of tuberculosis, the physician may elect to widen the intervals between routine screening. Frame and Carlson[6] in 1975 recommended tuberculin screening of adults every ten years. Kraut et al determined that even though the conversion rate for positive skin tests was less than 1 percent in their urban pediatric clinic, routine screening was still effective because it identified a significant number of children with unsuspected tuberculosis infection.[4]

There are thus no widely agreed-upon guidelines for tuberculin screening. Because of this controversy, this study was initiated to determine (1) the occurrence of active tuberculosis and tuberculin sensitivity in a rural western New York State family practice, (2) the effectiveness of the practice's current routine tuberculin screening program, and (3) whether a more efficient protocol for tuberculosis detection could be developed.

Methods

Tuberculin skin tests have been used for routine screening at the Cohocton office of Tri-County Family Medicine since 1974. Routine tests are recommended for children at age 1 year and 4 years, and for adults every ten years.[6,7] Cohocton is located in rural western New York State and has a predominately lower middle-class population of 1,000 people. The practice population has been stable at about 3,000 patients for the past ten years. About 17 percent of patients are lost to the practice each year and are replaced by new patients. What proportion of the community gets its care from this office is not known. The office is staffed by one board-certified family physician, a registered physician's assistant, a nurse, and two clerical personnel.

An audit of all the charts of active patients in the Cohocton practice was conducted in May 1984. This audit was used to determine the age and sex distribution of the practice and to identify patients who had had a tuberculin skin test performed or who at one time had active tuberculosis. From this general chart audit two subgroups of charts were reviewed in greater detail. Information obtained from the charts was cross-checked against a computerized diagnostic coding system.

Charts of patients who had had active tuberculosis were reviewed for the age at which they developed tuberculosis, how they were diagnosed, and the treatment they received. Complications from drug therapy and other coexisting diagnoses, such as lung cancer, smoking, emphysema, or alcoholism, were recorded. Old cases of tuberculosis were defined as any disease that occurred before 1974. New cases were diagnoses made in Cohocton between 1974 and 1984. The incidence of active tuberculosis was defined as one tenth of the total number of new cases of active tuberculosis diagnosed during the ten-year study period divided by the number of active patients in the Cohocton practice.

Charts of all patients with positive tuberculin reactions were reviewed to determine when the tuberculin skin test had been administered, at what age, and whether the reaction was new or old. Old converters were defined as anyone who had a positive tuberculin test prior to 1974. A new converter was defined as a patient who had not previously had a skin test or who had previously had a negative reaction and converted during the study period. The approximate period prevalence of tuberculin sensitivity was determined to be the total number of new positive reactions divided by the total number of people who received a skin test during the study period.

Charts of both groups were reviewed for the presence of tuberculosis risk factors as defined by the American Thoracic Society. These risk factors included (1) persons who had contact with an individual with active tuberculosis or who had a family history of the disease, (2) persons with a history of alcohol abuse, (3) persons living in a long-term residential institution such as a nursing home or developmental center, (4) first-generation immigrants, and (5) health care personnel, especially those at risk for exposure.[8,9] Some of these groups, including food handlers, child care workers, and workers in nursing homes and extended care facilities, are required by law in many states to have tuberculin tests.

In addition, a systematic review of every tenth family chart was completed. All family members within the chart who had received a tuberculin test were reviewed. The patient's age at the time of the tuberculin test, results of the test, reason for administering the test, and the presence of risk factors were recorded.

The tuberculin skin tests administered were either purified protein derivative (PPD) or old tuberculin tine test. Tests were administered by the nurse to the volar surface of the forearm. PPD tests were given by injection 0.1 cc of PPD containing 5 US tuberculin units into the skin, creating a wheal of 6 to 10 mm. The PPD used was Tubersol, distributed by Squibb/Connaught. The tine tests were old tuberculin distributed by Lederle Laboratory. In general, young children received tine tests, and all others received PPD tests.

All patients who received a skin test were given a card instructing them to report back to the office if a raised or reddened area was noticed within 48 to 72 hours, or to mail the card back if no reaction was apparent. A positive result consisted of an area of induration of 10 mm or more in diameter. The diagnosis of a positive reaction was determined by the physician.

Results

There were 3,122 active patients in the Cohocton practice, 1,146 of whom received tuberculin skin tests. A total of 33 patients were tuberculin sensitive, 14 old reactors and 19 new reactors. Thirteen patients had a history of active tuberculosis. Of those patients six were diagnosed during the study period, and seven had previous histories or active tuberculosis. There were no positive skin reactions or new active cases of tuberculosis in patients younger than 14 years of age. The occurrence of both conditions increased with age (Table 1). Five men (0.4 percent) and one woman (0.06 percent) had active tuberculosis. Twelve men (2.5 percent) were new tuberculin reactors compared with seven women (1 percent), even though 649 women (37.9 percent) were screened compared with 487 men (34.7). The period prevalence of new tuberculin sensitivity in the population was 1.7 percent. The incidence of new active tuberculosis was 0.02 percent.

Of the 33 patients who were tuberculin sensitive, 10 of 14 old positive reactors and 17 of 19 new positive reactors belonged to at least one or more of the high-risk groups. Of the new tuberculin reactors 6 had family contacts, 4 were alcoholics, 3 were immigrants, 3 were health workers, 4 presented with symptoms, and 2 had no risk factors present. All patients with old positive reactions had a history of either alcohol abuse or institutionalization and had a chronic cough. Twelve of the 13 patients with active tuberculosis belonged to a high-risk group. Four of the patients with new active tuberculosis were alcoholic, and the other two had reactivated old disease.

All six new cases of tuberculosis were symptomatic when diagnosed. Of the patients with these new cases, one had a positive tuberculin reaction and two had negative reactions at the time they presented with symptoms. One of the reactivated cases never had a tuberculin test performed, while the other had a positive tuberculin reaction and a negative chest roentgenogram three years prior to the recurrence of active tuberculosis. This same patient had a positive tuberculin reaction and positive chest roentgenogram at the time of diagnosis. The remaining patient with active tuberculosis was never screened. This patient's tuberculosis was found as a complication of lung cancer. Furthermore, no patient who had a new positive skin test went on to develop active

Table 1. Age Distribution of Positive Tuberculin Reactors and Active Cases of Tuberculosis

Age (years)	Total Patients in the Population	Patients Tuberculin Tested	Patients With a New Positive Tuberculin Test* No. (%)	Patients With Old Positive Tuberculin Sensitivity	New Active Tuberculosis Cases** No. (%)	Old Active Tuberculosis Cases
0-14	746	311	0 (0)	0	0 (0)	1
15-34	946	249	2 (0.8)	2	1 (0.01)	4
35-50	738	330	9 (2.7)	4	1 (0.01)	1
51+	692	252	8 (3.2)	8	4 (0.06)	1
All Ages	3122	1146	19 (1.7)	14	6 (0.02)	7

*Prevalence
**Incidence

tuberculosis, even though only three of the new tuberculin converters received chemoprophylaxis.

The charts of 90 patients receiving tuberculin tests were reviewed, and only two showed a positive reaction. Seven of the 88 patients without tuberculin sensitivity belonged to a high-risk group. Fifty-seven patients (63 percent) screened were under the age of 35 years. Fifty-six patients (62 percent) screened were women. Fifty-six of the skin tests in this group were done for routine screening purposes. Twenty were requested for school or work physical examinations. In 11 charts the reason for doing the test was not recorded. Two tests were done because of symptoms.

In this systematic sample, if only persons with risk factors had received tuberculosis tests, the sensitivity for tuberculosis reactivity would be 89 percent and the specificity would be 92 percent. The positive predictive value for tuberculin reactivity in this group is 16.0 percent. Conversely the negative predictive value of not tuberculin testing persons without risk factors would be 99.8 percent.

Discussion

This study showed that almost all positive tuberculin reactors (90 percent) would be identified if only high-risk populations were screened. This observation is especially relevant in the pediatric age group. No positive tuberculin reactions or new active cases of tuberculosis were observed among children aged less than 14 years.

These results support the recommendation of the Center for Disease Control[4] and the American Thoracic Society[3] for screening only at-risk populations. The results contradict the suggestion of Kraut et al,[4] the recommendations of Frame and Carlson,[6] and the American Academy of Pediatrics.[5]

Screening only high-risk persons for tuberculin sensitivity, however, creates practical problems for the physician. An accurate database must be kept on all patients. Furthermore, the connection between the presence of a risk factor for tuberculosis and the need for tuberculin screening must be made consistently. Linking specific risk factors and screening is not always easy to do in the private practice environment where the physician may be preoccupied with other matters.

That none of the six new cases of active tuberculosis in this study were detected by screening while the patients were asymptomatic is disturbing. Only one of the six new cases of active tuberculosis was discovered as a result of a patient having a positive tuberculin reaction prior to presentation with symptoms. This one positive reaction occurred three years prior to the active disease.

Two of the six patients had negative tuberculin tests at the time of diagnosis. All of the patients with active tuberculosis were detected because of symptoms. This observation is supported by Edwards,[10] who stated that 80 percent of new clinical cases of tuberculosis are diagnosed because of symptoms. A possible explanation for this phenomenon is that the very patients most likely to get tuberculosis are those least likely to be involved in a periodic health maintenance program. If screening is to be successful, a special effort will need to be made to involve the at-risk population.

If screening for a disease is to be justified, it must meet screening criteria including: (1) the condition must be significant, (2) it must have an asymptomatic period, (3) effective treatment must be available, (4) treatment in the asymptomatic period must be better than waiting to treat when symptomatic, (5) acceptable tests must be available to detect the condition in the asymptomatic period, and (6) the incidence of the condition must justify the cost and effort of screening. Tuberculosis fulfills criteria 1, 2, 3 and 5, but in this population failed criterion 6 and possibly criterion 4.

These results do not support the practice of routine skin tests for tuberculosis in this population with a 1.7 percent prevalence of tuberculin sensitivity. Screening of high-risk groups is indicated, including those who have had (1) contacts with an individual with active tuberculosis or persons with a positive family history of the disease, (2) those who are recent immigrants to the United States, (3) those who have a history of alcohol abuse, (4) those who have lived in an institutional setting, and (5) those who are health care personnel. Routine screening of food workers, child care workers, and nursing home staff is often required by law and should be continued.

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