Utility of the Lateral Chest Radiograph in the Evaluation of Patients With a Positive Tuberculin Skin Test Result*

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Study objectives: In the United States, chest radiographs are performed on patients with positive tuberculin skin test (TST) results. It is not known whether, in addition to a single posteroanterior radiograph, a lateral chest radiograph is clinically indicated or cost-effective. We sought to determine the utility of the lateral chest radiograph in evaluating TST-positive adults.

Design: Cross-sectional study.

Setting: Tertiary-care hospital.

Patients: Adults with positive TST results.

Measurements: Findings on posteroanterior radiographs alone were compared to posteroanterior and lateral chest radiographs.

Results: In 2 of 535 cases (0.4%), lateral chest radiographs revealed a calcified granuloma not visible on posteroanterior radiographs. This finding did not alter patient management. In all other cases, lateral radiographs only confirmed findings seen on posteroanterior chest radiographs.

Conclusion: Treatment altering findings were always visible on posteroanterior radiographs alone. These results suggest that lateral chest radiographs are not useful in evaluating adults with positive TST results.

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Key words: chest radiograph; screening; tuberculosis

Abbreviations: ATS = American Thoracic Society; CDC = Centers for Disease Control and Prevention; CI = confidence interval; LTBI = latent tuberculosis infection; mSv = millisievert; TST = tuberculin skin test

Tuberculosis screening is central to the control of Mycobacterium tuberculosis transmission in the United States. The recommended practice for evaluating tuberculin skin test (TST)-positive patients includes routine screening by chest radiography to rule out clinically active tuberculosis or to detect the presence of fibrotic lesions suggestive of old tuberculosis. In a recent joint statement, the American Thoracic Society (ATS) and Centers for Disease Control and Prevention (CDC) recommended the use of a single posteroanterior radiograph for all TST-positive adults and children > 5 years of age. In fact, no study has compared the sensitivity of posteroanterior and lateral chest radiographs to posteroanterior chest radiographs alone in the evaluation of patients with a positive TST result. Therefore it is unclear if a posteroanterior and lateral chest radiograph or a single posteroanterior chest radiograph is required for screening purposes. In the setting of limited health-care resources and budgetary constraints in tuberculosis control programs, elimination of the lateral chest radiograph in routine screening of TST-positive patients could have a substantial economic impact and could lead to a significant reduction in radiation exposure. The present study was designed to evaluate the additional benefit of routine-screening lateral chest radiographs in an urban population of high-risk, TST-positive subjects.

Materials and Methods

Patients

All adult patients who were seen at the Boston Tuberculosis Control Program Clinic at Boston Medical Center for a positive TST result between January 2000 and March 2000 were included in the study. The Boston Tuberculosis Control Program Clinic serves an inner-city population with a high case load of recent immigrants who are targeted for TSTs based on ATS/CDC guidelines. Patients undergoing screening at this clinic routinely undergo posteroanterior and lateral chest radiographs as part of...
their medical evaluation. Pregnant women, who routinely undergo posteroanterior radiographs alone and patients < 18 years of age were excluded. The study was approved by the institutional review board of Boston Medical Center.

Measurements

Posteroanterior and lateral chest radiographs were independently reviewed by an attending radiologist (P.C.) and an attending pulmonologist (A.W.O.). The readers assessed for the presence of lesions suggestive of tuberculosis infection. Posteroanterior radiographs were first read alone and then later reread together with the lateral radiograph. If there was a discrepancy in the reading of chest radiographs by the primary readers, a third independent reader (an attending radiologist) reread the radiographs, with the final interpretation reached by consensus. All abnormalities were recorded, and it was determined using the ATS/CDC guidelines whether subsequent treatment of tuberculous infection in individual patients was altered based on lateral chest radiograph findings.

Statistical Analysis

Values were expressed as the mean ± SD. Interreader reliability was tested with statistics, using SPSS software (SPSS; Chicago, IL); 95% central confidence intervals (CIs) were calculated using the methods of Bayes and Laplace.2

Results

During the study period, 576 patients > 18 years old were evaluated. Seven patients (1%) were excluded because they were pregnant; in 34 patients (6%), radiographs could not be located for analysis, leaving 535 evaluable cases (93%). Patient age averaged 39 ± 15 years (mean ± SD), and 52% were women. The results of the readings are presented in Table 1. Interreader agreement was high (κ = 0.92). The lateral chest radiograph revealed an additional finding not visible on the posteroanterior chest radiograph in only 2 of 535 cases. In both cases, the finding was a calcified granuloma, which did not alter patient management. In all other cases, the lateral radiograph served only to confirm the reading on the posteroanterior radiograph. Overall, posteroanterior radiographs were read as abnormal in 81 cases (15%); findings included fibrosis (n = 59), granuloma (n = 11), consolidation or cavity (n = 6), pleural disease (n = 2), and calcified lymph nodes (n = 3) [Table 2].

Discussion

Lateral chest radiographs are frequently obtained in the evaluation of patients with latent tuberculosis infection (LTBI), as determined by a positive TST result. Although the ATS/CDC recommendations advocate the use of a single posteroanterior radiograph in all adults and children > 5 years of age, these guidelines are not based on previously reported studies.1 To our knowledge, this is the first study to evaluate the role of the lateral chest radiograph in adults with LTBI, and the results show that the addition of a lateral chest radiograph has no added benefit to a single posteroanterior radiograph.

In this study, the lateral chest radiographs showed a finding not detected on posteroanterior radiographs in only 0.4% of cases. This is not surprising because postprimary tuberculosis most commonly affects the apical-posterior segments of the upper lobes or the superior segments of the lower lobes, areas that can be well visualized on the posteroanterior radiograph. There was very high interreader agreement in chest radiograph interpretation. Even so, as reader 1 reported a higher number of abnormal lateral radiographs with normal posteroanterior radiographs (0.9%; 95% CI, 0.41 to 2.16) compared to reader 2, based on 95% CIs it is statistically possible that lateral radiographic abnormalities not detected on the posteroanterior radiograph could be present in as many as 1 in 46 cases. Such a discrepancy, however, would have little impact on disease control or cost efficacy, because all abnormal lateral radiographs showed only a calcified granuloma.

According to the recommendations from the ATS/CDC,1 patients with LTBI and a chest radiograph

<table>
<thead>
<tr>
<th>Table 1—Case Detection Rate and Reader Agreement</th>
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<tbody>
<tr>
<td>Posteroanterior Radiograph Findings</td>
</tr>
<tr>
<td>Variables</td>
</tr>
<tr>
<td>Normal, No. (%)</td>
</tr>
<tr>
<td>Reader 1</td>
</tr>
<tr>
<td>Reader 2</td>
</tr>
<tr>
<td>Consensus*</td>
</tr>
</tbody>
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*In all cases for each reader, the only abnormal finding on the lateral chest radiograph was a calcified granuloma when the posteroanterior radiograph was normal.

†Differences in interpretation were resolved by consensus with a third independent reader.
Table 2—Abnormal Findings on Chest Radiographs

<table>
<thead>
<tr>
<th>Findings</th>
<th>Posteroanterior Abnormal Radiograph, No.</th>
<th>Lateral Abnormal Radiograph, No.</th>
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</thead>
<tbody>
<tr>
<td>Fibrosis</td>
<td>59</td>
<td>0</td>
</tr>
<tr>
<td>Granuloma</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>Consolidation</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Cavitation</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Calcified lymph nodes</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Pleural disease*</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>81</td>
<td>2</td>
</tr>
</tbody>
</table>

*Without evidence of fibrosis.

demonstrating calcified granulomas do not require specific treatment regimens as compared to patients with LTBI and a normal chest radiograph. Therefore, no clinically relevant findings that would alter treatment were detected on lateral chest radiographs in this study. While we cannot completely exclude the possibility of finding a clinically relevant abnormality on a lateral chest radiograph in patients with positive TST result, using 95% CI for the study sample size, this would occur in < 0.6% of the subjects. Thus this is the first study to provide support for the current recommendation to use a single posteroanterior radiograph alone in the evaluation of patients with positive TST results.

The benefit of routine lateral chest radiographs in hospitalized adults has previously been questioned. However, the only previous study to address the role of the lateral chest radiograph in evaluating tuberculous infection studied children aged 6 months to 12 years who had suspected tuberculosis or were recent close contacts of active tuberculosis infection. Interestingly mediastinal adenopathy, not seen on posteroanterior radiographs, was detected on lateral chest radiographs in approximately 10% of patients. In contrast, we noted no cases of mediastinal adenopathy in our cohort of TST-positive adults, presumably reflecting the low incidence of mediastinal tuberculous lymphadenitis in immunocompetent adults. To reflect clinical practice, where screening chest radiographs are ordered prior to evaluation by medical professionals, we studied an unselected urban population of adults screened using ATS/CDC guidelines and did not assess for potential comorbidities that might alter the risk or presentation of tuberculosis. In view of these data, our results may not apply to children < 18 years old or to cohorts of patients at high risk for mediastinal tuberculosis, such as those infected with HIV. Even so, the prevalence of posteroanterior chest radiograph abnormalities in this study is comparable to other studies of similar populations, and thus we believe these results can be applied to screening programs nationwide. If additional comorbidities exist, a lateral radiograph to evaluate for mediastinal disease can be subsequently obtained at the discretion of the examining physician. We emphasize that our results do not apply to other diseases such as malignancy and nontuberculous mycobacterial infection, where lateral chest radiograph is considered an important addition in the diagnostic evaluation.

Prior investigations of cost-effectiveness of tuberculosis screening programs either do not specify which chest radiograph modality was used or estimate costs based on posteroanterior and lateral radiographs. To assess the national impact of omitting the lateral chest radiograph from the evaluation of adults with LTBI, we performed an informal telephone survey of all state health departments in the United States. Twenty-two departments (44%) indicated that they routinely obtain a posteroanterior and lateral chest radiograph in TB screening (data not shown). There is no national surveillance or data collection system for persons with LTBI, but a prior study estimated that in 1991 alone 500,000 of 5.2 million patients screened for LTBI required follow-up examination including chest radiography. Given the frequency of TSTs across the nation, elimination of the lateral chest radiograph would have a substantial economic impact for tuberculosis screening programs. In our clinic alone, elimination of the lateral chest radiograph saves $18 per case. Thus, eliminating lateral chest radiographs would save approximately $72,000 per year given an annual case load of 4,000 radiographs. These figures do not include the cost of storing and destroying radiographs.

In addition to cost containment, eliminating lateral chest radiographs in tuberculous screening would reduce radiation exposure in the screened population. At our medical center, a lateral chest radiograph exposes a patient to approximately 0.12 millisievert (mSv) [12 millirem] of ionization radiation. This compares to an average annual dose of 3.6 mSv (360 millirem) radiation from natural sources such as radon and cosmic radiation. It is not yet possible to accurately quantify the risk of such a small exposure to radiation. Nevertheless, the International Commission of Radiologic Protection has estimated that an effective dose equivalent of 0.12 mSv would lead to five additional malignancies in 1,000,000 individuals exposed, and recommends that all exposures be kept as low as is reasonably achievable. It would seem prudent therefore to minimize any unnecessary radiation exposure. Our results show that lateral chest radiographs in patients with LTBI represent an unnecessary additional radiation exposure.

Recent studies have shown that chest CT scanning provides increased sensitivity in the diagnosis and
follow-up of selected patients with active tuberculosis. CT scans using low doses of radiation have not been studied in patients with LTBI. In other populations, the increased sensitivity of chest CT scanning is tempered by a high incidence of nonspecific findings. Thus, it would be difficult to justify the cost and radiation exposure of chest CT scans in all patients with LTBI.

**CONCLUSION**

In summary, we have shown that in a typical urban population of patients with a positive TST result, findings consistent with active tuberculosis or fibrotic disease are always visible on the posteroanterior radiograph and that the lateral chest radiograph added no information that altered subsequent management of tuberculous infection. These results provide evidence that a policy of screening adults with LTBI using only a posteroanterior radiograph can be implemented without a significant effect on disease control.

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**REFERENCES**