Use of Mycobacterial Smears in the Diagnosis of Pulmonary Tuberculosis in AIDS/ARC Patients*

Natalie C. Klein, M.D., Ph.D.† Frederick P. Duncanson, M.D.;† Theodore H. Lenox III, M.D.;† Africa Pitta, M.D.;‡ Steven C. Cohen, B.A.;§ and Gary P. Wormser, M.D.¶

Pulmonary tuberculosis in AIDS/ARC patients is an increasing problem. To assess the utility of acid-fast smears of pulmonary secretions in this patient population, we evaluated 38 AIDS/ARC patients with culture-positive pulmonary infection. A control group consisted of 57 non-AIDS/ARC patients, who also did not belong to an AIDS risk group, diagnosed during the same period. The number of culture-positive sputum samples evaluated per patient was similar in both groups (3.82±3.11 AIDS/ARC vs 4.47±2.83 control group). Significantly fewer AIDS/ARC patients, 45 percent, however, had a positive acid-fast smear compared with the control group, 81 percent (p<0.001).

*Mycobacterium tuberculosis* (MTB) infection in human immunodeficiency virus (HIV)-infected patients is often a challenging diagnosis owing to atypical chest x-ray film patterns, prominent extrapulmonary manifestations, negative tuberculin skin tests, and the presence of concomitant opportunistic infections. Since the presumptive diagnosis of pulmonary tuberculosis (TB) is often made on the basis of a positive sputum acid-fast bacillus (AFB) smear, we evaluated the sensitivity of AFB smears for the diagnosis of pulmonary TB in AIDS/ARC patients in comparison with a control group.

**MATERIALS AND METHODS**

We retrospectively reviewed charts, chest film reports, and laboratory reports from all patients whose pulmonary secretions grew MTB between Jan 1, 1985, and March 31, 1987, at Metropolitan Hospital Center, New York, a large urban hospital serving East and Central Harlem and the South Bronx.

AIDS was defined according to the 1985 CDC surveillance definition. ARC was defined according to Killen. In all cases, the diagnosis of AIDS/ARC either preceded the diagnosis of TB or followed the diagnosis of TB within a two-month period.

The initial sputum smear submitted was positive in only 29 percent of the AIDS/ARC group compared with 61 percent of control subjects (p<0.01). Further, ≥5 negative smears were found in 60 percent of the evaluable AIDS/ARC patients compared with just 13 percent of control subjects (p<0.01). More extensive findings on chest roentgenograms were not associated with a significantly higher yield of smear positivity in the AIDS/ARC group. We conclude that acid-fast smears on sputum specimens are a relatively insensitive test for pulmonary tuberculosis in AIDS/ARC patients.

The diagnosis of pulmonary TB was made by the presence of one or more positive expectorated sputum or bronchoalveolar lavage (BAL) cultures. No sputum specimens were obtained by nebulized hypertonic saline solutions. MTB was identified based on: growth of acid-fast organisms on Lowenstein-Jensen medium and/or Middlebrook 7H 11 medium, niacin production, nitrate reduction, and demonstration of loss of catalase activity after heating to 68°C.

Acid-fast smears were performed using a standard concentration method. An equal volume of 4 percent NaOH solution was added to the specimen. The NaOH-specimen was shaken for 20 min. Twenty milliliters of NaOH-specimen was mixed with 50 ml of phosphate buffer (pH 6.8). The specimen was centrifuged at 2,000 to 3,000 × g for 20 min. After centrifugation, the supernatant was discarded and the pellet resuspended in 1 to 2 ml of phosphate buffer. One slide per specimen was prepared and stained using the Kinyoun method. Slides were examined for 3 to 5 minutes with an average of 300 high-power fields per slide being reviewed for AFB by one of two laboratory technicians. The results of smears evaluated in this study were from pulmonary secretions that grew MTB. All culture-positive specimens submitted within six weeks of the initial positive culture were included in the evaluation. The x² test and Student’s t test were used to compare demographic data and study results.

**RESULTS**

Pulmonary TB was diagnosed in 115 patients over the 27-month study period. There were 38 cases in patients with AIDS or ARC and 57 in non-AIDS/ARC patients, who were also not members of AIDS risk groups (control group). Twenty additional TB patients were not known to have AIDS/ARC but belonged to AIDS risk groups. Since their HIV status was unknown but may well have been positive, this last group of patients was excluded from most analyses. The characteristics of the study population are shown in Table...
The mean age of the AIDS/ARC group was 40.2 years, and 92 percent were men. Heterosexual IV drug abusers (IVDA) composed the largest risk group (74 percent), followed by gay/bisexual men (11 percent). The control group members had a mean age of 47.2 years, and 61 percent were men. There was no significant difference in mean age between the two groups, but there were significantly more men in the AIDS/ARC group (p<0.01).

Table 2 summarizes the results of acid-fast smears in the two groups. Only 45 percent of patients with AIDS/ARC had a positive AFB smear compared with 81 percent of the control group (p<0.001). The initial sputum smear was positive only 29 percent of the time in the AIDS/ARC group compared with 61 percent in the nonrisk group patients (p<0.01). In the AIDS/ARC group, there was a total of 140 positive pulmonary secretion cultures, of which 51 (36 percent) were smear positive, compared with 255 positive cultures, with 180 (71 percent) smear positive in the nonrisk group (p<0.001). The number of sputum samples that were culture-positive per patient, 3.82±3.11 in the AIDS/ARC group compared with 4.47±2.83 in the control group, was not, however, significantly different.

The rate of positivity of the first sputum smear was similar for the AIDS/ARC group regardless of the chest radiographic appearance (Table 3).

Table 4 shows the frequency of negative smears in AIDS/ARC patients compared with the control group. Seventy-nine percent of the AIDS/ARC patients had at least one negative smear, compared with only 56 percent of the control group (p<0.05). Of those patients who had at least five specimens submitted, significantly more patients in the AIDS/ARC group (60 percent) had five or more negative smears than in the control group (13 percent) (p<0.01).

**DISCUSSION**

The number of cases of TB in several major urban areas has increased markedly since 1981 with the advent of AIDS. At least in part, this may be attributable to overlapping of both infections in the same patient population. Further, patients with HIV infection frequently have atypical presentations of pulmonary TB. Cavities are infrequent in this group of patients. More commonly, there is hilar adenopathy; localized infiltrates, often involving the middle or lower lobes; or diffuse infiltrates, either miliary or interstitial. In one series, 35 percent of patients with...
Table 4—Frequency of Negative Sputum Smears in AIDS/ARC Patients Compared with a Control Group

| No. of Negative Smears | % AIDS/ARC (No. Evaluate) | % Non-AIDS/ARC (No. Evaluate) | Significance
|------------------------|---------------------------|-------------------------------|--------------
| ≥1                     | 78.9 (38)                 | 56.1 (57)                     | p<0.05       |
| ≥2                     | 78.3 (23)                 | 37.8 (45)                     | p<0.01       |
| ≥3                     | 68.4 (19)                 | 27.5 (40)                     | p<0.01       |
| ≥4                     | 58.8 (17)                 | 18.9 (37)                     | p<0.01       |
| ≥5                     | 60.0 (15)                 | 12.9 (31)                     | p<0.01       |

*p<1.0.

HIV infection and TB had no pulmonary infiltrates seen on pretreatment roentgenograms.4

In view of the absence of cavitary disease in most patients with HIV infection, it is not surprising that sputum AFBs are often negative.3,4 In our series of 38 patients with AIDS/ARC and culture-proved pulmonary TB, only 45 percent had a positive AFB sputum smear compared with an 81 percent rate among 57 control patients who did not have AIDS/ARC and were outside known high-risk groups (p<0.001). Of the 15 AIDS/ARC patients with numerous sputum samples submitted, 60 percent had ≥5 negative smears compared with only 13 percent of 31 control subjects (p<0.01). In our study the rate of sputum smear positivity was low, even in patients with multilobar involvement or cavitation. The explanation for this observation is unknown. A large number of patients must be evaluated to establish the validity of this finding.

The percentage of patients with positive sputum smears in our patient population, 45 percent (17/38), which consisted principally of IVDAs with AIDS/ARC, is somewhat higher than that of Louie et al,5 who found 31 percent (5/16) among a mixed group of gay/bisexual men and IVDAs, and somewhat lower than that found by Pitchenik et al,6 67 percent (8/12), among predominantly HIV-positive Haitians. The latter study, however, must be interpreted with caution, as there were only 12 patients of whom three were considered by the authors as possibly not infected with HIV. These three patients had roentgenographic and clinical findings (including upper lobe disease, cavities, and tuberculin reactivity) similar to TB in non-HIV-infected patients and had only a weakly or moderately positive ELISA test for HIV antibody. No confirmatory HIV antibody test, such as Western blotting, was done for any of the ELISA-positive specimens in this study.

The 81 percent positivity rate for sputum smears observed in our study among non-AIDS and nonrisk group members is similar to the 74 percent positivity rate reported by Kim et al8 among 977 patients with pulmonary tuberculosis treated at the Blue Ridge Sanatorium in Charlottesville, Va, between 1974 and 1978. As in our study, Kim et al8 evaluated numerous sputum samples per patient (minimum of three) and used a concentration technique. Sputum smear positivity in other non-AIDS patient populations has varied widely, with rates as low as 22 percent, and is likely to be directly dependent on the smear technique used, the number of sputum samples examined, the extent of pulmonary involvement, and the presence or absence of cavities.9-13

Tuberculosis and HIV infection often coexist in endemic areas for these diseases. Acid-fast smears on sputum specimens are a relatively insensitive diagnostic test for pulmonary tuberculosis in this patient population.

REFERENCES