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Coinfection with Tuberculosis and HIV–1 in Male Prison Inmates

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Synopsis

An association between past exposure to tuberculosis (TB) and infection with human immunodeficiency virus type 1 (HIV–1) was investigated using a case-control design among a 6-week sample of 698 male inmates consecutively admitted to the Maryland State prison system. Based on Mantoux testing and measurement of anti-HIV–1, we found a positive but not significant association between HIV–1 and TB infection (odds ratio 2.4, 95 percent confidence interval 0.9–6.3). The power of the study to detect an association of this magnitude was 0.57. Of the entire intake sample, 1.3 percent were found to be coinfected with TB and HIV–1.

Some misclassification may have been present due to anergy or latent HIV–1 infection. The elevated risk of TB in coinfected inmates, coupled with the study results, suggest that the inmate screening process on entry to the prison should be modified to improve identification of coinfected people. Specifically, anergy testing should be added to the admission screening procedure, and appropriate voluntary anonymous HIV–1 antibody testing should be more widely available to inmates.

AFTER DECLINING steadily for three decades, the number of tuberculosis (TB) cases in the United States began to rise in 1986 (*1*). This increase was pronounced in the New York State prison system, which observed a fivefold increase in the TB incidence among inmates between 1976 and 1986 (*2*). These changes have been attributed in part to infection with the human immunodeficiency virus type 1 (HIV–1) (*1, 2*). A large body of epidemiologic evidence has linked acquired immunodeficiency syndrome (AIDS) and TB through case

Results of Mantoux and HIV–1 antibody testing for study sample, Maryland Division of Correction, 1987

Mantoux result	HIV–1 antibody result		
	Positive	Negative	Total
Positive	9	78	87
Negative	8	165	173
Total	17	243	260

NOTE: Odds ratio 2.4, 95 percent confidence interval 0.9–6.3.

reports, case series, linkage studies of AIDS and TB registries, and a prospective study (*3–7*). A high prevalence of persons seropositive for HIV–1 (*8*) has been found in seroepidemiologic studies of TB patients.

Cases of TB related to HIV–1 infection appear to result from reactivation of latent TB due to immunosuppression, rather than from primary TB infection (*7*). Since both AIDS and TB result from chronic infection with pathogenic agents, the asymptomatic period presents an opportunity for preventive intervention, particularly in the instance of TB (*9*). Asymptomatic persons who are infected with both TB and HIV–1 (or "coinfected") are probably at high risk for development of clinical TB. Despite different modes of transmission, literature review suggests that TB and HIV–1 infection have similar demographic risk profiles (males, black race, urban residence, low socioeconomic status).

Intravenous drug use has also been associated with both infections (*3*). Prison inmates are at high risk for infection with both TB (*3, 10–11*) and HIV–1 (*12*). Although many researchers have examined persons with clinical disease, no study has reported results of screening an asymptomatic high-risk population for coinfection with TB and HIV–1. This study was designed to determine the prevalence of such coinfection among State prison inmates, to compare it with the prevalence expected by chance, and to examine its association with certain demographic—age and race—and correctional characteristics—type of offense, sentence, and previous incarceration.

Methods

The setting is the Maryland State prison system of approximately 13,000 inmates, with 6,000 new admissions and releases per year. In January 1988, the population was 96 percent male, 72 percent black, and 76 percent between ages 18–35. This study was conducted in the male intake facility; because of the small numbers, females were excluded from this study. All inmates admitted to the prison system routinely received a medical history, physical examination, blood tests for syphilis and hepatitis B, and an intradermal Mantoux skin testing with 5 tuberculin units of purified protein derivative (PPD), unless they had received treatment for TB or had a documented positive skin test in the past. State medical personnel measured the induration in millimeters (mm) after 48–72 hours and recorded the results in the inmate's medical record. Persons with greater than 10 mm induration or a documented previous positive test were considered positive, evaluated with a chest radiograph, and offered preventive therapy for 12 months with isoniazid.

Between August 6 and September 18, 1987, the excess serum available after routine serologic testing was collected for all entering male inmates. The serum was placed in a vial labeled only with a prisoner identification number. The prisoner identification number was linked to the prison management information system to obtain demographic and correctional information. Mantoux skin test results were abstracted from the medical record. Persons diagnosed with TB or AIDS were excluded from the sample. A sample was selected; cases were defined as all inmates with a positive reaction to tuberculin, and controls were a systematic sample by prison identification number of nonreactive inmates at the ratio of two controls per case. The prisoner identification number on the serum specimen and the other information were linked and replaced by a study number prior to serologic testing.

The serums from the sample group were screened for anti-HIV–1 using enzyme-linked immunosorbent assay (ELISA) (DuPont, Wilmington, DE) and Western blot (Biotech Research Laboratories, Rockville, MD) techniques. Stratified Mantel-Haenszel techniques were used to analyze the data (*13*). The protocol was approved in advance by the Committee on Human Volunteers, Johns Hopkins University School of Hygiene and Public Health.

Results

A total of 698 male inmates were admitted during the study period; 693 (99 percent) had results of the Mantoux testing available. Eighty-eight (12.7 percent) inmates were found to have positive Mantoux tests. Of the 88 cases, 87 (99 percent) had serums available for testing; of the 176 controls, 173 (98 percent) had serums available. Nine of the cases (10.3 percent) and eight controls (4.6 percent) had serologic evidence of HIV–1 infection (see table). The nine coinfected inmates represent 1.3 percent of the intake sample. Case-control analysis found a positive but not statistically significant association between HIV–1 and TB infection (odds ratio 2.4, 95 percent confidence interval 0.9–6.3), which was not affected by stratification by other available variables (age, race, urban residence,

type of offense, length of sentence, and previous incarceration). The power of the study to detect an association of this magnitude was 0.57. All of the coinfected inmates were over 25 years of age, eight (89 percent) were black, and six (67 percent) were urban residents.

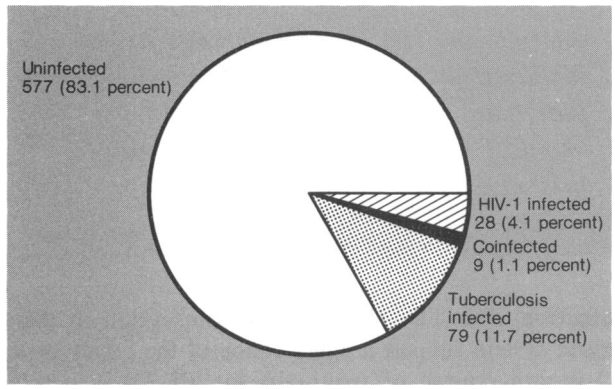
Discussion

Although the association between HIV–1 and TB is not statistically significant, these findings have serious implications for correctional policy. The 1.3 percent prevalence of coinfection with TB and HIV–1 among incoming inmates, applied to an annual turnover of 6,000 inmates, could represent 78 coinfected persons per year who could be identified using the screening tests employed in this study. A larger study would be required to determine if there is a true association between HIV–1 and TB in this population.

The 12.7 percent prevalence of TB infection is lower than that reported in prisons in the mid-1970s (*10, 11*) but comparable to a recent report from New Mexico (*14*). The prevalence of HIV–1 antibody in this Maryland prison population has been 7 percent for each of the past 3 years (*12*); these results are consistent (6.5 percent seropositive). The prevalence of HIV–1 infection is not available for the full sample because of the case-control design. To estimate this, we used two different assumptions. First, we applied the HIV–1 seroprevalence of the TB negative controls (4.6 percent) to the remainder of the intake sample, and assumed that those without samples were negative for antibody to HIV–1. This results in a total of 37 (4.0 percent of total) inmates seropositive for HIV–1, of whom 24 percent have been exposed to TB (see figure). Using the 7.0 percent seroprevalence of prior studies (*12*) yields a more conservative estimate of 18 percent coinfection among HIV–1 infected inmates.

The strength of this study is the lack of selection bias on the basis of disease status because of the consecutive blood collection made possible by the blinding techniques. Two potential sources of misclassification in this study are anergy and the time lag before development of antibodies to HIV–1. Both would decrease the strength of the association between TB and HIV–1 infection and cause underestimation of the true prevalence of coinfection. Anergy is characterized by false-negative skin tests, but its prevalence and time course in HIV–1 infection is poorly understood. It has been reported in AIDS-related active TB (*5, 6*). People who are incubating HIV–1 infection may not have antibodies for 2–14 months (*15, 16*). Indeed, Ranki and coworkers reported that five of nine patients who had latent HIV–1 infection developed anergy or reduced response to PPD during the 6–14-month period before seroconversion

Tuberculosis and HIV–1 infection status at intake of 693 inmates to a State prison



(*16*). We are unable to assess the magnitude of potential misclassification in this study.

The elevated risk of TB in coinfected inmates suggests that the inmate screening process on entry to the prison should be modified to improve identification and treatment of coinfected persons. In particular, inmates who are both anergic and HIV–1 infected need to be managed as if they are positive reactors to tuberculin. Routine Mantoux testing should be continued for all incoming prisoners. TB transmission by aerosolized droplets is of particular concern in an institutional setting where outbreaks can occur (*10, 11*). Additional anergy testing may be necessary at intake, to prevent untreated TB-infected inmates from entering the general prison population. Changing the definition of a tuberculin reactor for HIV–1-infected persons to those with 5 mm induration could reduce misclassification and should be investigated; the present data are unable to address this problem. Chest radiography should continue for those who have positive Mantoux tests and should be added for anergic inmates. This will lead to evaluation and treatment of possible TB cases before entry to the general prison population. The rate of anergy will determine the added burden of these tests.

These data, coupled with Centers for Disease Control (CDC) recommendations, support the availability of voluntary HIV–1 antibody testing for inmates. At the time of the study, testing was only available for "medical indications," for example, to determine the length of treatment for a person with an active case of TB. The CDC currently recommends investigation of HIV–1 risk factors for Mantoux positive persons, with voluntary HIV–1 antibody testing of those who admit to risk factors (*9*). Chemoprophylaxis is indicated for coinfected people of any age for a total of 12 months. Preventive therapy with isoniazid is now recommended for all inmates "at high risk of TB (including those with HIV infection)" (*17, 18*). The significant prevalence of

'In particular, inmates who are both anergic and HIV–1 infected need to be managed as if they are positive reactors to tuberculin. Routine Mantoux testing should be continued for all incoming prisoners.'

infection with TB, HIV–1, and coinfection in this prison system support a continuation of the policy of a 12-month course of isoniazid for all TB-infected inmates who have not been treated previously. Inmates who refuse chemoprophylaxis are segregated; this ensures a high rate of compliance. These data also support the need for ensuring timely TB casefinding and contact investigation in correctional institutions where persons at risk for coinfection reside.

If Maryland adopts these recommendations, 5 percent to 10 percent of all incoming male inmates in the State might require HIV–1 antibody testing. The number tested would depend on the prevalence of positive Mantoux tests and the consent rate for HIV–1 antibody testing. Careful attention to ethical and confidentiality considerations should be maintained. It is difficult to maintain confidentiality of sensitive information in a correctional setting. Consequently, inmates may be more likely to comply with voluntary testing if it can be established by or coordinated with anonymous testing programs that are independent of nonmedical correctional staff. These recommendations will protect the person, the prison population, and ultimately the public.

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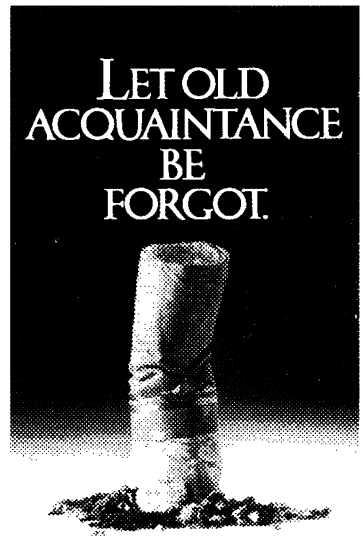

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