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Original Article

Evaluation of sensitivity and specificity of tuberculosis diagnostic tools among HIV positive patients: A cross-sectional study

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ABSTRACT

Background & Aim: Tuberculosis is the major cause of morbidity and mortality among HIV patients. Thus, early diagnosis of Tuberculosis among these patients is important. The purpose of the present study was to determine the Sensitivity, Specificity, PPV and NPV for tools of diagnosing TB among HIV patients referred to behavioral disorder counseling center of Shiraz city.

Methods & Materials: In this cross sectional study, 250 HIV+ patients in Shiraz were evaluated. For each patient, three sputum smears and a Chest X-ray and PPD was taken. Sensitivity, specificity, and positive and negative predictive values were determined based on the results of sputum cultures as a gold standard.

Results: Among 250 HIV+ individuals who entered the study, 8 (3.2 %) were diagnosed with tuberculosis. The sensitivity, specificity, PPV and NPV for chest x-ray were 62.5%, 96%, 38% and 98.7%, respectively. Also they were 62.5%, 98.7%, 62.5% and 98.7% for AFB 1, and 25%, 99.5%, 66% and 97.5% for AFB 2. Finally, these factors were 99.5%, 99.5%, 66% and 97.5% for AFB 3.

Conclusion: The prevalence of TB among HIV+ patients referring to the behavioral disease counseling center in Shiraz was lower than in other endemic areas of developing countries. The screening tools for diagnosis of tuberculosis included the chest x-ray and Acid Fast Bacilli and PPD test in order to find out the important role of detecting TB disease among HIV-infected people.

Introduction

The first approved case of HIV was reported from California, USA, in 1981 and now it accounts for a global health problem (1). The disease has caused 40 million deaths across the world (2). Tuberculosis is one of the most important causes of death among HIV+ patients (3-6). HIV-related recrudescence of tuberculosis is considered as a major health problem (7) and this co-infection is a great burden to the healthcare systems all over the world (8). TB/HIV co-infection contributes to about 400,000 annual deaths globally (9). According to the World Health Organization, about 7.8 million new cases of TB occur annually worldwide (10). On the other hand, HIV increases the risk of active TB (11, 12), so the 5% yearly probability of TB in a normal individual reaches 50% in HIV+ patients (13).

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Since 1990, HIV has increased the burden of TB and has become one of the most important causes of the TB recrudescence in many developing countries (14). Tuberculosis had been recognized as the most common single cause of mortality in developing countries for many years, and concurrently HIV infection has compounded this problem again (15). Since HIV / TB co-infection exacerbates the effect of each disease, the delay in diagnosis would have a huge impact on the increase of the mortality rate (16). The greatest TB mortality rate was reported in Asia and it was one death in every 30 seconds (17,18). In Iran, as in other Asian countries, the number of individuals who carry the disease is on the rise. It is anticipated that in 2015, this number will reach about 126,000 HIV+ patients (1), and this condition is the major risk factor for tuberculosis infection [19]. The incidence of TB in different parts of Iran is varied and the estimated mean value of 13.9 in 100000 has been reported in recent years (20). Given the importance of this co-infection, the purpose of the present study was to determine the Sensitivity, Specificity, PPV, and NPV for the chest x-ray and Acid Fast Bacilli for diagnosis of TB among patients referred to behavioral disorders counseling center of Shiraz.

Methods

Type of study: In this cross-sectional study, 250 HIV+ patients were evaluated for the diagnosis of active pulmonary TB among HIV positive patients in 2014.

Data Collection

250 HIV+ patients were selected to enter the study. After the PPD test, they underwent three times the direct sputum smear tests, a chest X-Ray, and a sputum culture.

In the first step, we applied the PPD test and injected 0.1 ml of the liquid into their forearm skin. If it was positive (more than 5 mm), the patients would be followed by some clinical assessment, CXR result (to evaluate by a physician), existing series of clinical symptoms and positive AFB tests. We distinguished the presence or absence of TB in the patients. Also for confirmation of the diagnosis, we used the result of sputum culture (18).

The infected persons were diagnosed according to the history, physical exams, and test results. The data collection was done by using a researcher-designed checklist after getting approved by the expert committee in the center. The collected data after coding entered the spss19 for analyzing.

Statistical procedures

Considering sputum culture as a gold standard, we calculated the sensitivity and specificity, positive predictive value (PPV) and negative predictive value (NPV) of the PPD, chest X-Ray and AFB tests. We also used descriptive statistics such as simple proportions for data analysis. All data were analyzed by the team of investigators through the use of Statistical Package for Social Sciences (SPSS) software, version 19.0.

Results

Of the 250 participants in the survey, 12% had a positive family history of HIV while 82% cases had a negative history. Eight (3.2%) were diagnosed as TB+. Of those eight patients, 6 (75%) were male, 5 (62.5%) were younger than 40 years of age and 3(37.5%) were married, 3(37.5%) were single and 2(25%) were divorced. Furthermore, of eight patients with tuberculosis, five cases (62.5%) were infected via drug injection and three cases (37.5%) were infected by sexual contact. In addition, six (75%) of the patients were drug addicts, among whom 5 (83%) were addicted to opiates and 1(17%) was addicted to heroin. Three (37.5%) subjects had a history of respiratory diseases. The PPD test results were positive (more than 5mm) in 7 out of 8 patients and the chest x-ray images were consistent with TB diagnosis in five cases (62.5%). Five patients (62.5%) were positive by the first sputum smear, two patients (25%) by the second, and two patients (25%) were positive by the third sputum sample. Six patients (75%) were smeared positive and two (25%) were smear-negative pulmonary tuberculosis (more information presented in Tables 1 and 2.

Sensitivity, specificity, and positive predictive values were determined based on direct sputum smears and are presented in Table 3. Also, the efficacy of TB diagnosis tools compared between TB and non TB cases. The odds of positive results among TB cases in all tests was more than non TB cases. In Table 4 the results of the criteria for TB diagnosis in TB cases and non-TB cases have been compared:

Table 1. Important descriptive variables in total cases that entered this study

Variable	Total	Frequency	Percent
Sex	250		
Male		157	62.8%
Female		93	37.2%
Age	250		
15<		0	0
15-25		8	3.2%
26-45		174	69.6%
46-65		68	27.2%
CD4 Enumeration	250		
200>		94	37.6%
200-350		96	38.4%
350-500		27	10.8%
500>		33	13.2%
Transmission mode	250		
Injection		121	48.4%
Sexual		109	43.6%
Other ways		20	8%
Marital Status	250		
Single		67	26.8%
Married		108	43.2%
Divorced		50	20%
Widow		25	10%
Addicted	250		
Yes		147	58.8%
No		103	41.2%
History of other respiratory diseases	250		
Yes		54	21.6%
No		187	74.8%
unknown		9	3.6%
ART[a] treatment	250		
yes		135	54%
no		115	46%
Stage of disease	250		
clinical		52	20.8%)
nonclinical		198	79.2%
Smoking Yes	250		
No		107	42.8%
		143	57.2%

[a]. Antiretroviral therapy

Table 2. Important descriptive variables in TB positive cases in this study

Variable		Total	Percent
Sex	Male	6	66.6%
	Female	2	33.3%
Age	=<40	5	62.5%
	>40	3	37.5%
CD4	200>	1	12.5%
Enumeration	200-350	5	62.5%
	350-500	1	12.5%
	500>	1	12.5%
Transmission mode	Injection	5	62.5%
	Sexual	3	37.5%
Marital Status	Single	3	37.5%
	Married	3	37.5%
	Divorced	2	25%
Addicted	Yes	6	75%
	No	2	25%
History of other	Yes	3	37.5%
respiratory diseases	NO	5	62.5%
ART[b] treatment	Yes	2	33.3%
	No	6	66.7%
Stage of disease	Clinical	4	0.50%
	Nonclinical	4	0.50%
Smoking	Yes	5	62.5%
	No	3	37.5%
Type of TB	Smear-positive pulmonary TB	6	75%
	Smear-negative negative TB	2	25%

[b].Antiretroviral therapy

Table 3. Sensitivity, Specificity, PPV, NPV and sputum smear in HIV patients

Test	Sensitivity	Specificity	PPV[a]	NPV[b]
CXR[c]	62.5%	96%	38%	98.7%
AFB1[d]	62.5%	98.7%	62.5%	98.7%
AFB2	25%	99.5%	66%	97.5%
AFB3	99.5%	99.5%	66%	97.5%
PPD	87.5%	40%	46%	98.9%

[a]. Positive predictive value, [b]. Negative predictive value, [c]. Chest x-Ray, [d]. Acid Fast Bacilli

Table 4. Comparison of patients and non-patient in criteria for diagnosing of TB

Diagnostic modality	Total Positive cases	TB cases N=8	NON-TB cases, N=242	PV	OR (95%CI)
CXR	8	4	4	0001/0	58(10-319)
AFB1	5	2	3	009/0	26(3.7-188)
AFB2	2	1	1	112/0	3.43(0.786-15)
AFB3	3	2	1	003/0	80(6.827-1011)
PPD	152	7	145	0/154	4.6(0. 56-38)

Discussion

The major source of TB transmission is pulmonary infection with positive direct sputum smear test. The incidence of tuberculosis should be determined separately in two groups; a) the direct sputum smear-positive pulmonary TB cases, and b) the negative sputum smear ones. The latter may be sub-classified further to patients with positive sputum culture, patients without positive sputum culture and patients with extra pulmonary TB disease. One study conducted on 800 TB-infected US prisoners disclosed that 152 of them were TB-negative prior to entering prison (21). One-third of HIV positive patients worldwide are also TB-positive. The prevalence of the TB disease among HIV+ patients is 21-34 times greater than those not infected by HIV (21). TB/HIV Co-infection will augment clinical course of both diseases. In 2011, 43000 HIV^+ patients died of tuberculosis. A study in Kermanshah, a city in the west of Iran, confirmed that 68% of the patients with Tuberculosis had sustained HIV infection (21). Lifestyle and intravenous drug use in jails and rehabilitation centers were among the most important factors of the co-infection (21). In the present study, tuberculosis was diagnosed in 8 (3.2 %) HIV+ patients, while this prevalence was 11.7% in a study conducted by Mansoori et al in Kermanshah (22). In a study by Pollack et al, the prevalence of latent TB was determined to be 14.9% in London (23). Besides, in a study by Shah et al the prevalence of TB among HIV-positive patients was 7% in Ethiopia (24), and in Moore's study, it was 7.2% in Uganda (25). Furthermore, in our study, most TB positive patients were younger than 40 years old just as in Mansoori's study. As far as marriage is concerned, the number of married patients was higher in our research than in Mansoori's study (69% vs 37%). In the present study, positive smears were found only in 75% of confirmed pulmonary patients, while the incidence was 80% in Mansoori's study (22). In the present study CD4 count in 62% of the patients was above 200. Our finding was similar to the one in Pollack's study where (similar to that of Shah) the CD4 count was greater than 250 in most of the patients. Christopher's study in Nigeria indicated that the prevalence of TB among HIV positive patients was 33.9%, and the mean CD4 count in TB/HIV-co infected patients was 150.6 cells/mm^3, while the mean CD4 count in HIV patients without TB co-infection was 276.4 cells/mm^3 (26). In another study by Surendra India, the prevalence of active TB among HIV patients was 33.2% amongst whom 79.9% had the CD4 count of less than 200/µl at diagnosis (27). A study by Rabirad et al contained 71 HIV infected patients, 28.2 percent were diagnosed with pulmonary tuberculosis. 74% of the patients had CD4 less than 200 ml per mm (3, 28).

In our study, sensitivity and specificity of PPD for diagnosis TB were 87.5% and 40%, respectively. Therefore, this test can have an important role in the diagnosis of TB among HIV+ cases. In a study by Simsek et al (2010) the sensitivity of PPD test among non-HIV cases was 38.3 % (29). Hence, this test had higher sensitivity in HIV+ cases. The sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of CXR in our study were 62.5%, 96%, 38% and 98.7%, respectively, but these factors were 100%, 23.2%, 33.0% and 100%, respectively, in the study by Muyoyeta et al (30). The sensitivities of

AFB in the samples were different from each other and the third sample (AFB3) had the most sensitivity and specificity: 99.5% and 99.5%. In Odubanjo's study, AFB microscopy showed a diagnostic specificity of 71.6% and a sensitivity of 74.5%. So, diagnosis of tuberculosis in HIV cases is very important for the prevention of mortality in these patients, and the tests such as PPD, chest x-ray, and AFB which played important roles in detecting the disease should be more considered.

Conclusion

Screening tools for diagnosis of tuberculosis included the chest x-ray and Acid Fast Bacilli and PPD test in order to find out the important role of detecting TB disease among HIV-infected people.so this tests can very beneficial in early diagnosis of TB among HIV positive cases.

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Conflict of Interests

Authors have no conflict of interests.

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