

Full Length Research Paper

The validity of the diagnostic methods in predicting pulmonary tuberculosis

Sulhattin Arslan^{1*}, Levent Özdemir², Yeltekin Demirel³ and Ibrahim Akkurt¹

¹Department of Chest Diseases, Faculty of Medicine, Cumhuriyet University, 58140 Sivas, Turkey.

²Department of Public Health, Faculty of Medicine, Cumhuriyet University, 58140 Sivas, Turkey.

³Department of Family Doctor, Faculty of Medicine, Cumhuriyet University, 58140 Sivas, Turkey.

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In our study, we aimed to determine the validity of diagnostic methods for tuberculosis. Eighty-one people suspected to have tuberculosis were included in the study. The validity of the applied methods for the diagnosis of tuberculosis tuberculin skin test (TST), sputum smear, and used in diagnostic chest X-ray findings (CXR), clinical features and history were evaluated as culture was considered the reference test. Included in the study of 81 people (54 males 27 females) mean age was determined as 45.04 ± 18.69 . The most sensitive diagnostic methods were detected as clinical and sputum smears (89 and 86%). The sensitivity of PPD and Radiology have been identified as 0.74 and 0.73 respectively. Diagnostic method with the highest specificity value was found to be radiology. The positive predictive values of PPD, radiology, clinical and sputum smear were identified as 98, 94, 96 and 92%, respectively. PPD had the lowest negative predictive value with 26%. In our study, the validity of the diagnostic methods for the tuberculosis are compatible with the literature. These methods in the diagnosis of tuberculosis are still valid. We think our study may add to the current data in the literature about the topic.

Key words: Validity, specificity, sensitivity, PPD, TST, sputum smear, culture, tuberculosis, clinical features.

INTRODUCTION

Every year, there are 8.8 million new active TB cases and nearly 2 million TB deaths worldwide, 5,000 every day, mostly in the poorest communities of the developing world. One third of the world's population has latent TB which may later develop into an active form of the disease. TB has also become the leading cause of death among people with HIV. A key challenge for the public health community is to be able to effectively diagnose patients so that valuable resources and medicines are not wasted on misdiagnosis and repeat treatments. The lack of accurate diagnosis leads to an unacceptable burden of human suffering and to a waste of precious resources in poor countries (Diagnostics for tuberculosis [Internet], cited 2009, December 2). Bacteriological culture, considered the diagnostic gold standard, can identify the

M. tuberculosis organism in over 80% of TB cases with a specificity of over 98% (Lee et al., 2003; Roggenkamp et al., 1999; Idigoras et al., 2000). When present in sufficiently high concentrations, the bacteria can be readily identified by trained technician using this technique, which has changed little since it was invented over 100 years ago (Diagnostics for tuberculosis [Internet], cited 2nd December, 2009,).

METHODS

Eighty-one people who were suspected to have tuberculosis were included in the study. The validity of the applied methods for the diagnosis of tuberculosis tuberculin skin test (TST), sputum smear, and used in diagnostic chest X-ray findings (CXR), clinical features and history were evaluated as culture was considered the reference test.

We used conventional microscopy in sputum smear examination for the detection of acid-fast bacilli (AFB). All sputum samples were decontaminated and concentrated using the N Acetyl-L- Cysteine-Sodium Hydroxide procedure. The sputum smears were prepared using the conventional centrifugation method and were stained with

*Corresponding author. E-mail: sulhattinaslan@mynet.com. Tel: +90 346 258 00 00/0213, 905326944371. Fax: +90 346 258 13 05.

carbofuchsin (Ziehl-Neelsen) method (Ebersole, 1995). Sputum sediments were inoculated onto Lowenstein-Jensen media and incubated at 37 °C in 5% CO₂ for up to six weeks (Lambi, 1995).

Admission CXR were scored as typical of TB (the presence of nodular, alveolar, or interstitial infiltrates predominantly affecting the zones above the clavicles or upper zones; the presence of cavitation affecting the upper zones or the apical segment of the lower lobe), compatible with TB (enlarged hilar nodes, pneumonic lesion, atelectasis, mass lesion, miliary, pleural exudate), or atypical (any other pattern, including normal CXR) (Tattevin et al., 1999).

Cardinal symptoms of pulmonary TB are cough, sputum, night sweats, subfebril fever, anorexia, weight loss, dyspnea, chest pain, hemoptysis (Arango et al., 1973; MacGregor et al., 1975). Persistent cough or get dry mucous is the most common symptoms of the disease (Friedman et al., 1994). Hemoptysis primarily is seen advanced stages of the disease (Hopewell, 1995). Dyspnea in patients may seem more intense parenchymal involvement, pleural effusion, and also are more common in the form of millier tuberculosis (Arango et al., 1973) Chest pain frequently seen in pleura and parenchymal involvement in case of close to pleura (Hopewell, 1995). In this study, in addition to presence of at least three of the following symptoms dyspnea, sputum production, 21 days long lasting cough, and 15 days long lasting chest pain (Friedman et al., 1994) and presence of one or more of the other symptoms was accepted as clinically positive.

TST was performed and experienced technicians read the results by using the Mantoux method with 0.1 mL (10 tuberculin units) of purified protein derivative (PPD). Intradermal inoculation was confirmed by the cutaneous appearance of peau d'orange. Induration was measured after 72 h with a ruler and recorded in millimeters. We also assessed tuberculin skin test performance by using stratified cutoff points of 15 and 10 mm in vaccinated and unvaccinated patients, respectively ("stratified 10 mm threshold") (Department of Health, 1996; Control and prevention of tuberculosis in the United Kingdom, 2000). The culture was used as the reference method and compared with the other methods.

Statistical analysis

Data obtained from the study were evaluated using PSpss Data Editor (psppire 0.6.1). Specificity, sensitivity, positive and negative predictive values were calculated for validity of diagnostic methods by using VassarStats Clinical Calculator 1 (VassarStats: Statistical Computation Web Site [Internet], cited 2009, Dec 2).

RESULTS

Included in the study of 81 people (54 males 27 females), mean age was determined as 45.04 ± 18.69. Comparisons of the other methods according to culture results are given in Table 1. According to culture results specificity, sensitivity, positive and negative predictive values of the other diagnostic methods were given in Table 2. The most sensitive diagnostic methods were detected as clinical and sputum smears (89 and 86%). The sensitivity of PPD and radiology have been identified as 0.74 and 0.73, respectively. Diagnostic method with the highest specificity value was found to be radiology. The positive predictive values of PPD, radiology, clinical and sputum smear were identified as 98, 94, 96 and 92% respectively. PPD had the lowest negative predictive value with 26%.

DISCUSSION

Microscopic examination of stained sputum

Worldwide, the most common diagnostic test used to detect tuberculosis is microscopic examination of stained sputum or other clinical material smeared on glass slide. The proportion of cases detected by often as low as 20-30% of all microscopy is all cases (Urbanczik, 1985). Duplicate or triplicate sputum examinations are requested to help overcome this problem. Sputum smear microscopy (henceforth referred to as microscopy) is currently recommended for the diagnosis of pulmonary tuberculosis in low- income and middle-income countries, where more than 90% of tuberculosis cases occur (Tuberculosis, 2005; Foulds et al., 1999). However, in sputum smear-positive patients also may not be always positive culture results while in sputum smear-negative patients the culture results may be positive (Kubica et al., 1980; Kim et al., 1984). Smear-positive to be sputum approximately 50.000/ml bacilli finding is required. If the number of bacilli to 10,000 in 50% chance to determine if the falls (Samasti, 1986).

In some studies, microscopy has been reported to have greater than 80% sensitivity for identifying cases of pulmonary tuberculosis (Tuberculosis, 2005; Behr et al., 1999). However in other reports, the sensitivity of the test has been relatively low and variable (range 20–60%) (Urbanczik, 1985; Aber et al., 1980). In a study conducted by Crampin et al. (2001) that compared to culture, the sensitivity, specificity, and positive and negative predictive values of three smears were reported as 70, 98, 92 and 92%, respectively (Crampin et al., 2001). Mfinanga et al. (2007) were reported the sensitivity and specificity values of smear as 36.9% and of 88.9% respectively in their study.

The sensitivity value of sputum smear obtained from our study was higher than Mfinanga's work while as compatible with the other studies. The specificity value of sputum smear obtained from our study was lower than Crampin and Mfinanga's studies.

TST

PPD, tuberculin, is composed of a witch's brew of proteins from heatkilled *M. tuberculosis*. Injection of PPD under the forearm skin precipitates a hypersensitivity reaction in people with prior TB infection. This reaction presents as skin thickening at the site of injection after 24–48 h. Unfortunately, its application is problematic due to the frequency of false-positive and false-negative skin reaction (Diagnostics for tuberculosis [Internet], cited 2009 Dec 2). In a study conducted by Davinder the sensitivities were reported as 79% (CI, 71% to 86%) with tuberculin skin testing using the 15-mm threshold and 82% (CI, 74% to 89%) with the stratified 10-mm

Table 1. Comparisons of the diagnostic methods according to culture.

	Pulmonary tuberculosis		Total
	Absent	Present	
Sputum smear			
Positive	5	56	61
Negative	11	9	20
Totals	16	65	81
PPD			
Positive	1	40	41
Negative	5	14	19
Total	6	54	60
CXR			
Positive	2	47	49
Negative	14	17	31
Totals	16	64	80
Clinical features and history			
Positive	4	58	62
Negative	12	7	19
Total	16	65	81

threshold (Dosanjh et al., 2008) . The sensitivity and specificity of PPD were reported as 53.8 and 98.1%, respectively by Wang et al (Wang et al., 2001). Berkel et al. (2005) were reported the PPD sensitivities at cut-off values of 5, 10 and 15 mm, as 98.9, 95.4 and 79.8%, respectively. The unadjusted specificities at these cut-off values were reported as 95.3, 97.1 and 98.8%, respectively.

The PPD sensitivity value obtained from our study was higher than Wank's and less than Berkel's while compatible with Davinder's study. Although not very different; our PPD specificity value was lower than the other studies.

CXR

Radiology plays an important role in the diagnosis of pulmonary tuberculosis. It is still widely believed that tuberculosis of the lung can be diagnosed by chest X-ray alone. However, practical experience and numerous studies have shown that diagnosis when used alone no radiographic pattern is diagnostic of tuberculosis (Nyboe et al., 1968) . Many diseases of the lung have a similar radiographic appearance that can easily mimic tuberculosis (Nakamura et al., 1970). Similarly the lesions of pulmonary tuberculosis can take almost any form on a radiographic picture (Diagnostic Standards and Classification of Tuberculosis in Adults and Children, 1999). In a study conducted by Kumar the chest x-rays sensitivity

and specificity values were reported as 78 and 51%, respectively. Kumar's study (2005) has demonstrated an unsatisfactory sensitivity and specificity of chest x-rays in the diagnosis of pulmonary tuberculosis. The sensitivity and specificity of chest x- rays were identified as 91 and 67%, respectively, by Van Cleeff et al. (2005). Van Cleeff in his different study the sensitivity and specificity for CXR were reported as 80 and 67%, respectively. The latter values on CXR changed significantly when only the score 'highly consistent with TB' was used (49 and 90%) (van Cleeff et al., 2003).

In our study the CXR sensitivity value showed compliance with the work of Van Cleeff and Kumar. But the specificity value obtained from our study was higher than the other studies.

Clinical features and history

In the literature relating to the validity in the diagnosis of the clinical features and history we did not find specific values. More frequently observed findings are given. The absence of criteria for the clinical diagnosis of tuberculosis can cause this.

English et al reported that the most common symptoms in patients proven to have TB were cough (100%), followed by difficult breathing (70%), new sputum production (63%), loss of weight (50%), and night sweats (50%) (English et al., 2006). El-Sony et al. (2003) reported that among pulmonary tuberculosis patients, the

Table 2. Validity of diagnostic methods according to culture.

	Sensitivity		Specificity		+ predictive value		- predictive value	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Sputum smear	86	75-93	69	41-88	92	81-97	55	32-76
PPD	74	60-85	83	36-99	98	86-100	26	10-51
CXR	73	61-83	88	60-98	96	85-99	45	28-64
Clinical features and history	0.89	78-95	75	47-92	94	84-98	63	39-83

majority complained of cough (94.5%), weight loss (91.6%), fever (78.2%), night sweats (62.8%) shortness of breath (74.8%), chest pain (57.7%), and a smaller proportion of haemoptysis (19.8%). Wisnivesky et al. (2003) reported in their systematic review that in most studies the presence of TB risk factors, chronic symptoms, fever were associated with TB. In our study, it was observed that, the most sensitive diagnostic methods were clinical features and history. The sensitivity and specificity value of clinical features and history was powerful enough compared with the other diagnostic methods.

Conclusion

In our study, the validity of the diagnostic methods for the tuberculosis is compatible with the literature. These methods in the diagnosis of tuberculosis are still valid. The minor diversity of the results obtained from our study may be due to differences of used methods in other studies. We think our study may add to the current data in the literature about the topic.

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