

CHEST RADIOGRAPHS AND THEIR RELIABILITY IN THE DIAGNOSIS OF TUBERCULOSIS

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ABSTRACT

Radiology plays an important role in the diagnosis of pulmonary tuberculosis. Many medical practitioners believe in and rely primarily on the chest x-ray for the diagnosis of pulmonary tuberculosis. This study attempts to evaluate the reliability and validity of chest radiographs. This study was carried out in the tuberculosis clinic of BPKIHS. 75 radiographs were chosen for the study and viewed by 25 physicians of varying qualifications. Their findings were compared with the gold standard. The overall sensitivity and specificity was 78% and 51% respectively. There was poor agreement between the best physician and the best radiologist. This study has demonstrated an unsatisfactory sensitivity and specificity of chest x-rays in the diagnosis of pulmonary tuberculosis. The over-diagnosis and over-treatment due to chest x-rays could lead to an unmanageable burden on the resources of a poor country like Nepal. Private practitioners should be made aware about the importance of bacteriological diagnosis of tuberculosis before initiating drug therapy.

Key Words: Chest radiograph, pulmonary tuberculosis, specificity, sensitivity.

INTRODUCTION

The introduction of radiography was an important landmark in our knowledge of natural history of tuberculosis. The key to tuberculosis control is case finding and radiology plays a major role in both active and passive tuberculosis diagnoses. However, the diagnosis of pulmonary tuberculosis using X-rays is often disputed. Certain radiological manifestations have been considered as highly suggestive and even diagnostic of tuberculosis.¹ "Radio logically in adults the lung component is usually more obvious and glandular component of the primary complex may not be visualized. The lesion is more often in the upper zone."²

This is despite the fact that no radiological abnormalities are unique to tuberculosis. The enthusiasm, with which radiology was received and applied frequently, causes the method to

be overrated as a method of diagnosis of tuberculosis. Many practitioners of medicine believe in and primarily rely on a chest x-ray alone for the diagnosis of tuberculosis.³ In National Tuberculosis Center (NTC) treatment centers high number of sputum negative cases are referred by medical practitioners with a radiological diagnosis of tuberculosis. During the treatment of pulmonary tuberculosis, the radiologist is often asked the following questions: 1) is it really TB?; 2) is there any improvement?; 3) when is the X-ray check-up required? However, the conventional wisdom in medicine suggests that chest radiographs tend to both over and under estimate the diagnosis of pulmonary tuberculosis as compared to sputum examination. This study attempts to study the reliability and validity of chest radiographs for the diagnosis of pulmonary tuberculosis.

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MATERIALS AND METHODS

Study site

This study was carried out at the tuberculosis clinic of B.P. Koirala Institute of Health Sciences (BPKIHS), a hospital in eastern Nepal with a well defined referral pattern leading to 10% referred and the rest direct reporting of patients to its OPD. It is an autonomous medical institute established in 1993 which was upgraded to an deemed university in 1998. The case holding is around 175 patient every year of different types of tuberculosis. (i.e. Pulmonary Tuberculosis, Abdominal, Eye, Genitourinary, Gland tuberculosis etc.)

Methodology

Seventy-five radiographs were chosen from the BPKIHS tuberculosis clinic. Chest radiographs included were of patients with the following diagnoses: sputum positive cases (39), healed tuberculosis (17), tuberculosis pleural effusion (5), non-tuberculosis lung lesions (7) and healthy patients (7). For each case a diagnosis was arrived after review by an expert panel, which included a radiologist, surgeon and physician. The panel used a combination of clinical signs and symptoms, radiological findings, bacteriological findings and response to anti-tuberculosis chemotherapy as criterias for the diagnosis. The diagnosis made by the panel was considered the "Gold standard" for further analysis.

Twenty-five physicians of varying experience and qualifications were chosen for this study. Thirteen of them (52%) held vari-

ous post-graduate qualifications while the rest had the MBBS degree. Of the 13 specialists 4 of them were radiologists. Each physician was asked to view the 75 radiographs serially. They were asked to classify the X-ray into the following categories: active tuberculosis, inactive tuberculosis, healed tuberculosis, non-tuberculosis lung lesions and normal. Only those radiographs were chosen whose record was available for bacteriological reports at start, 2nd month, 5th month and after completion of treatment. Availability of X-rays reports, history of patient with clinical signs and symptoms were also taken. Those cases which were incomplete in the above criterias were not included in study. The findings of the physicians were compared against the "gold standard" to provide indices of reliability and validity.

RESULTS

Of the 25 doctors who participated in the study, 76% were less than 35 years of age, 68% had passed out after 1990. Thirteen of them (52%) held various post-graduate qualifications while the rest had the MBBS degree. Of the 13 specialists 4 of them were radiologists. (Tables I - III)

The overall ability to diagnose any tuberculosis was studied. The sensitivity was 78% and specificity was 51%. The ability to differentiate active tuberculosis was also studied. The sensitivity was 60% and specificity 72%. (Tables V and VI) Physicians were also evaluated on the basis of the 75 radiographs with each physician receiving 1 point for each correct answer. The maximum score was 54 and the minimum 22. Overall, those

Table I : Age - Gender distribution

Age-group in Years	Gender		Total
	Male	Female	
25 - 29	5 (22.7)	3 (10.0)	8 (32)
30 - 34	11 (50)	0	11 (44)
35 - 39	2 (9.1)	0	2 (8)
40 - 44	2 (9.1)	0	2 (8)
45 +	2 (9.1)	0	2 (8)
Total	22	3	25

Table II : Year of passing MBBS

Year	No. (40)
<1970	2 (8)
1970-1980	1 (4)
1981-1990	5 (20)
>1990	17 (68)
Total	25

Table III : No of Radiographs seen/day by a doctor

No. of Radiographs/day	No. (40)
<-10	5 (20)
11-20	7 (28)
>-21	2 (8)
No response	11 (44)
Total	25

Table IV : Validity of Chest x-ray in diagnosing tuberculosis

Diagnosis by Physician	True diagnosis		Total
	Tb	No Tb	
Tb	1191	172	1363
No Tb	334	178	512
Total	1525	350	1875

Sensitivity : 78.1%

Specificity : 50.9%

Table V : Validity of Chest x-ray in diagnosing active tuberculosis

Diagnosis by Physician	True diagnosis		Total
	Tb	No Tb	
Tb	597	245	842
No Tb	403	630	1033
Total	1000	875	1875

Sensitivity : 59.7%

Specificity : 72%

Table VI : Score of physicians in reading Chest X-ray

	Overall (n=25)	Inexperienced (n=13)	MBBS (n=12)
Maximum	54	54	39
Minimum	22	33	22
Mean	35.8	36	32
Median	35	43	31.4

Table VII : Agreement between physician and radiologist

Diagnosis by Radiologist	Physician's diagnosis		Total
	Correct	Wrong	
Correct	34	20	54
Wrong	9	12	21
Total	43	32	75

 $K = 0.17 (0 - 0.38)$

* Figures in parenthesis indicate the 95% CI

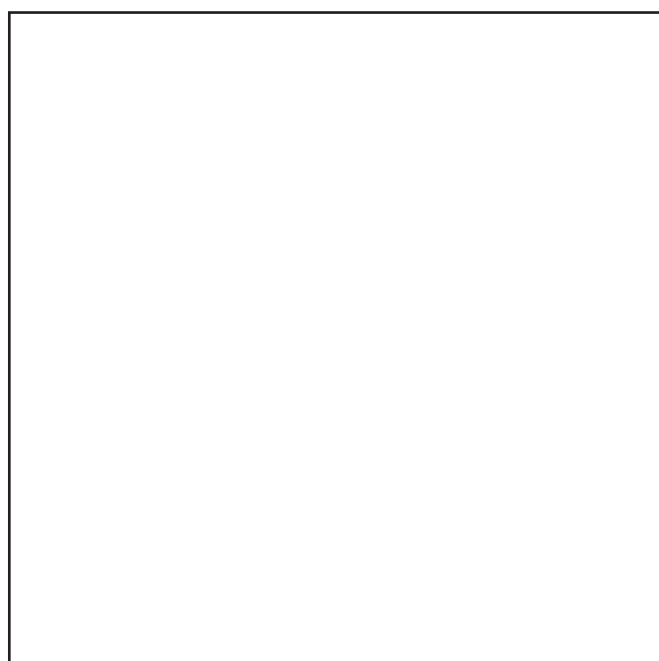


Fig. 1 : X-ray - 1

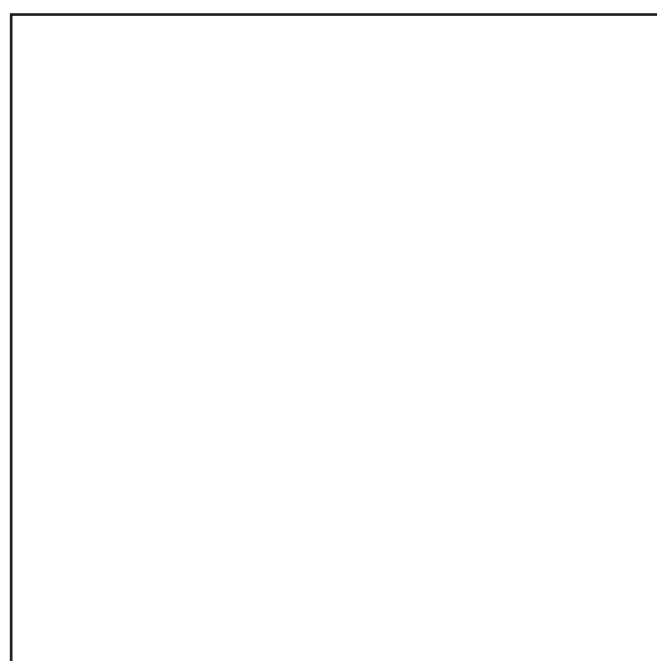


Fig. 2 : X-ray - 2

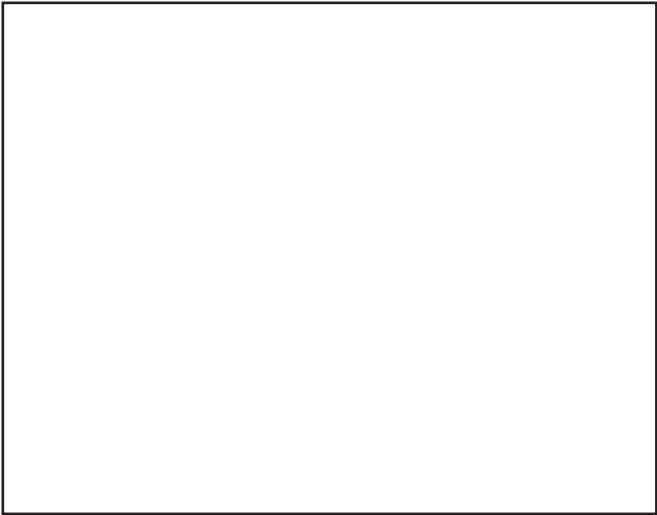


Fig. 3 : X-ray - 3

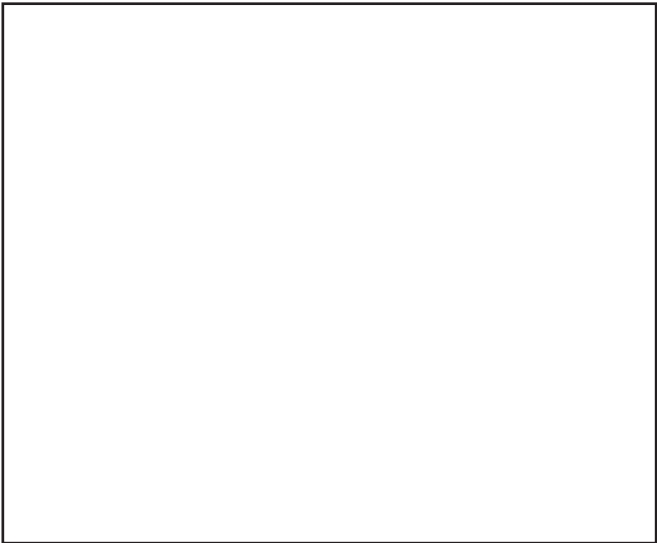


Fig. 4 : Records of patients.

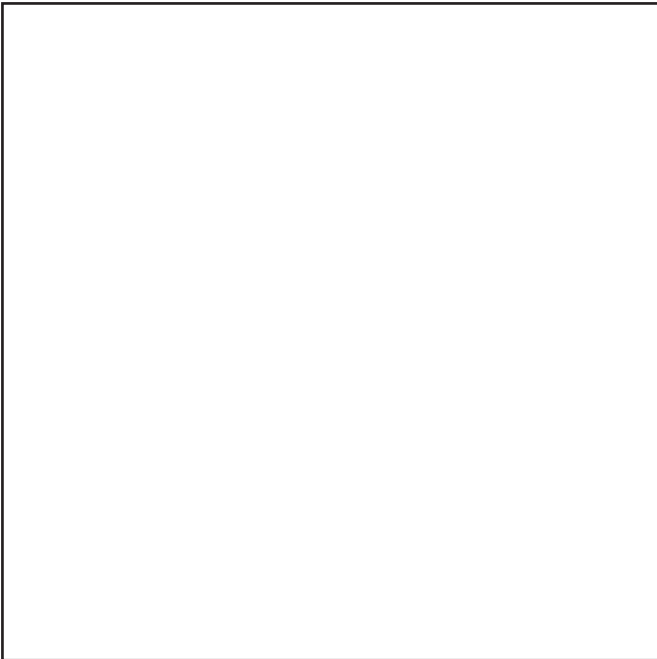


Fig. 5 : Plain sketch to be filled by interpreter after reading X-rays.

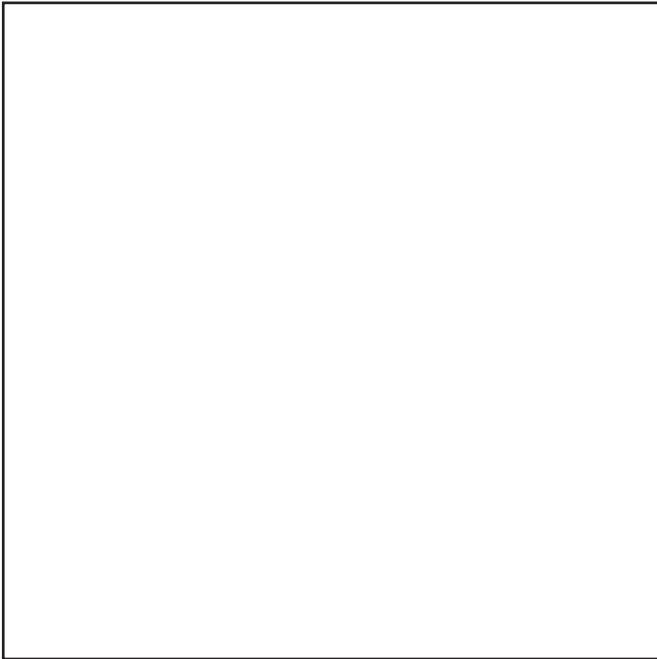


Fig. 6 : After reading X-ray sketch filled by interpreter.

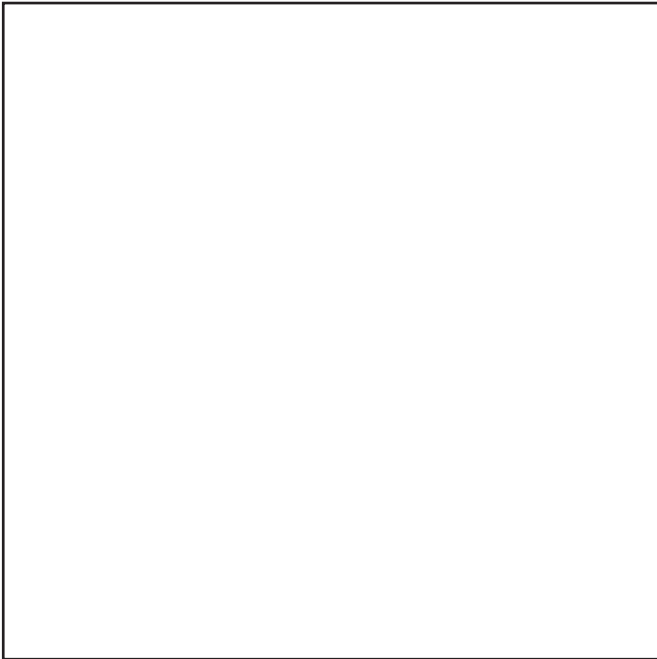


Fig. 7 : Diagnosis of individual X-rays written by individual interpreter.

with a post-graduate qualification seem to be better than those with a bachelor's degree. (Table VII)

The data were analyzed to look at the agreement between the "best physician" and "best radiologist". The scores of individuals were used for this. The Kappa was 17%.

DISCUSSION

This study has demonstrated unsatisfactory sensitivity and specificity of chest x-rays in the diagnosis of pulmonary tuberculosis. If this test was used in the general population, where only 2% of the populations have tuberculosis and about 5% symptoms of tuberculosis then the positive predictive value among the symptomatic will only be about 60% and the negative predictive value 72%. Chest radiography can undoubtedly be helpful in localizing abnormalities in the lung but the bacteriological findings are vital for the final proof of the tubercular etiology. To give chemotherapy as a matter of routine to persons with x-ray shadows of unknown origin would lead to treating a large proportion of them unnecessarily and exposing them to hazards of drug toxicity.

The discovery of the x-rays by W. C. Roentgen 100 years ago significantly improved the diagnosis and follow-up of tuberculosis, therapy control became possible, and the basis for prevention was set by early detection. Unfortunately, it is common practice in many countries to rely on X-ray alone for the diagnosis of tuberculosis. The over-diagnosis is followed by over-treatment and a consequent unmanageable burden on the health resources.⁴ The low sensitivity could also lead to under-diagnosis and consequently denial of chemotherapy to persons with active tuberculosis.

Today, therapists and radiologists are again challenged by the renaissance of tuberculosis, partially in new “clothes” by increasing numbers of HIV-patients. These specific changes clinically and radiological often appear atypical, and require

subtle radiological diagnostics with the use of new imaging modalities. Today, optimal diagnosis of tuberculosis includes the bacteriologic and clinical diagnosis and radiological imaging. To face the challenge of recurrent tuberculosis an intensive interdisciplinary cooperation of therapists and radiologists is necessary.⁵

In the developing world, most patients with tuberculosis tend to go to private practitioners for their treatment and care. This group for various reasons believes in and primarily relies on a chest x-ray alone for the diagnosis of tuberculosis.³ It is therefore vital that the private practitioners be educated and convinced about the need to obtain bacteriological proof of tuberculosis. We believe that this measure is necessary to ensure more objective diagnosis of tuberculosis and more optimal utilization of scarce national resources.

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