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An Evaluation of Sputum Smear Conversion and Haematological Parameter Alteration in Early Detection Period of New Pulmonary Tuberculosis (PTB) Patients

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***Abstract*—**Sputum smear conversion after one month of anti-tuberculosis therapy in new smear positive pulmonary tuberculosis patients (PTB+) is a vital indicator towards treatment success. The objective of this study is to determine the rate of sputum smear conversion in new PTB+ patients after one month under treatment of National Institute of Diseases of the Chest and Hospital (NIDCH). Analysis of sputum smear conversion was done by re-clinical examination with sputum smear microscopic test after one month. Socio-demographic and hematological parameters were evaluated to perceive the correlation with the disease status. Among all enrolled patients only 33.33% were available for follow up diagnosis and of them only 42.86% patients turned to smear negative. Probably this consequence is due to non-coherence to the proper disease management. 66.67% and 78.78% patients reported low haemoglobin and packed cell volume level respectively whereas 80% and 93.33% patients accounted accelerated platelet count and erythrocyte sedimentation rate correspondingly.

***Keywords*—**Followed up patients, PTB+ patients, sputum smear conversion, and sputum smear microscopic test.

I. Introduction

TUBERCULOSIS (TB) is an infectious disease caused by the bacterium, namely *Mycobacterium tuberculosis* and responsible for taking away so many lives all over the world. According to World Health Organization (WHO), TB is considered to be the second only to HIV/AIDS as the greatest killer worldwide [1]. In 2011, 8.7 million people became infected and suffered from active Tb and 1.4 million died due to this disease [1]. Mostly, the low and middle incoming countries are in alarming condition with TB. WHO survey found that over 95 % of TB death occurs in low and middle incoming countries [1]. Bangladesh also belongs to such countries struggling to overcome from this disease completely.

Acid Fast Bacillus (AFB) microscopic examination is most commonly used for the diagnosis of TB in Bangladesh. The geographical and the socio-demographic conditions are also inevitable reasons behind this health problem. This study covers the socio-demographic condition influencing the occurrence of TB, changes of some haematological parameters at disease detection period and the rate of patients getting smear negative from positive after one month with medication. This study also shows the awareness of patients about proper remedy and effectiveness of treatment and management of this disease.

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II. Method

A. Study Subjects

The study was carried out in National Institute of Diseases of the Chest and Hospital (NIDCH), Dhaka, Bangladesh. This study was initiated by taking permission from the Director of this hospital. This fundamental study focused on new pulmonary tuberculosis (PTB) patients admitted in this prominent hospital in the year 2012. All information regarding patients' health care, diagnosis and undertaking anti-TB therapy has been collected from the management authority and from the patients as well. The main focus of this study was on sputum smear conversion of PTB patients for verifying the rate of improvement after a month with medication, changes come across in haematological report at the disease identification period and some evident socio-demographic parameters which are worsening the disease status even more.

The patients having pulmonary tuberculosis were identified. The first AFB microscopic examination has been performed in all the patients of the study. There is a form in NIDCH which needs to be filled in before doing the sputum smear examination of the TB patients. The presents' disease status of all enrolled patients has been provided by the first AFB microscopic examination. According to the results of AFB microscopic examination, they were divided into two classes: smear-positive pulmonary TB (PTB+) and smear-negative pulmonary TB (PTB-) patients. Patients of these both groups received anti-TB drugs continuously for one month. None of these two groups included any multi-resistant tuberculosis (MDR) patient.

B. Data Collection

Medical history of each patient was recorded from the medical chart and register book of hospital management authority. To gather the relevant socio-demographic information, a semi-structured questionnaire was formed and both the smear-positive TB patients and smear-negative TB patients enrolled in this study were interviewed thoroughly. Among all information related to socio-demography such as gender, age, body weight, smoking habit, living area, living

status, mortality, family history with TB were paid full attention.

In case of haematological test report, the data were collected only from the hospital authority. Among all parameters, haemoglobin (Hb) level, electrolyte sedimentation rate (ESR), platelet count (PC), and packed cell volume (PCV) were focused to observe any remarkable change at the initial diagnosis period.

The main focal point of this study was AFB microscopic test. All the smear-positive TB patients were requested to come for performing follow up AFB microscopic test after one month of having medication. The first sputum smear microscopic test report was collected from hospital. By comparing these two AFB microscopic test reports, improvement rate as well as the level of management in NIDCH hospital can be given to a concrete conclusion.

The aim of this study is to reveal that whether the patients suffering from tuberculosis are being cured after taking treatment from NIDCH or they need more awareness regarding their health from the management as well as from themselves, any of the parameters in haematological report show remarkable change to be considered as an indicative tool for TB disease identification and which socio-demographic factor are intensely related with tuberculosis disease.

III. Result

A. Sputum Smear Conversions

In total, forty-five patients were enrolled to carry out the study. Among all patients forty-two were smear positive. All the PTB+ patients were asked to perform follow up checking after one month but only 14 were available for this. Statistically, this number is very insignificant and shows patients' negligence about proper treatment.

If we calculate chi square value of the availability of patients for performing follow up test, it becomes 18.667 whereas from chi square distribution chart it should be 3.84. By statistical convention, we use the 0.05 probability level as our critical value and here the null hypothesis is "all patients were available for conducting 2nd AFB microscopic test". Chi square value determination equation is -

$$X^2 = \sum \frac{(obs\ value - expvalue)^2}{expvalue} \quad (1)$$

In this case, expvalue = expected value= 42, obs value = observed value = 14, and degree of freedom = 1.

The value 18.667 is far larger than that of 3.84; so the hypothesis is statistically rejected. This is an evidence of their ignorance about follow up check up and lack of awareness about the proper treatment.

By comparing the 1st sputum smear test result with the 2nd sputum smear result, the rate of improvement can be evaluated. Following two diagrams show the first and second (after one month with anti-TB medication) AFB microscopic tests results of fourteen available patients respectively.

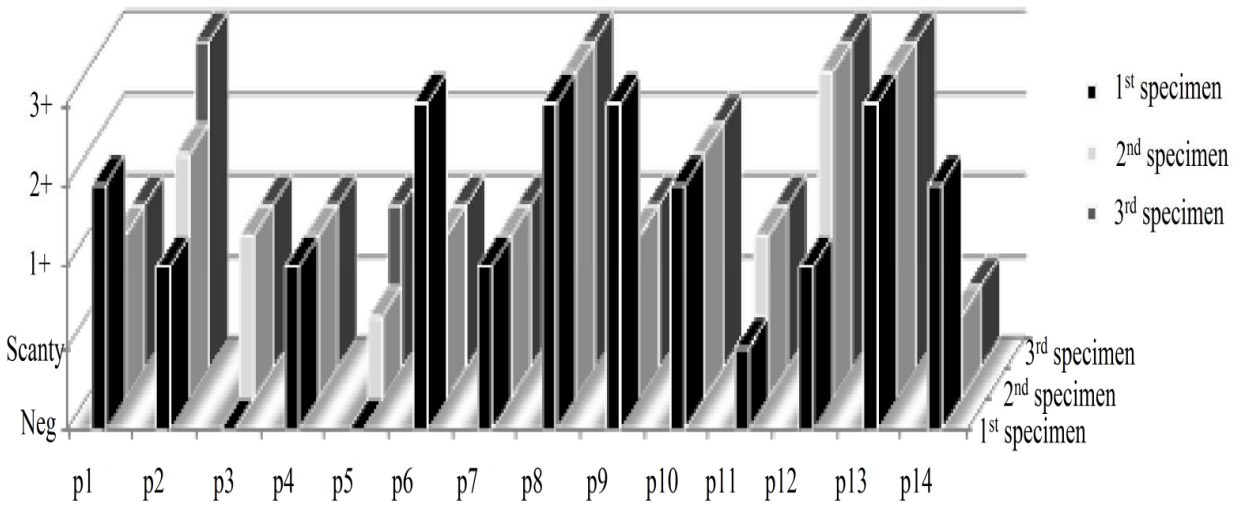

Fig. 1 First AFB microscopic test result of fourteen PTB+ patients

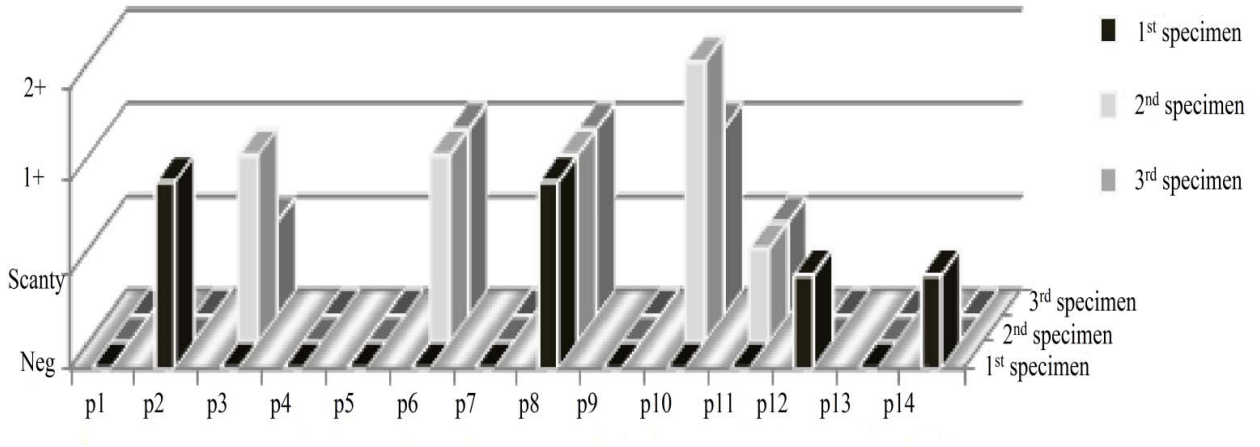

Fig. 2 Second AFB microscopic test result of fourteen PTB+ patients after one month of anti-TB medication

In both diagrams, X axis and Y axis represent individual patients and their sputum smear results respectively. Fig. 2 is demonstrating that six patients became smear negative after one month of medication but the remaining 8 patients showed smear positivity in any of their three specimens in the follow up test. Although according to physicians' opinion, all patients should turn to totally PTB- with two weeks of medication.

In the first AFB microscopic test result only 4.76% specimen showed negative result and 95.24% specimen (considering all 1st, 2nd and 3rd specimens) showed positive result (scanty, 1+, 2+, or 3+). Whereas in the case of second AFB test results, 66.67% specimen showed negative result and 33.33% specimen were positive.

This rate of improvement is also statistically insignificant. Chi square value of patients turning to completely smear negative stands 4.571, whereas from chi square distribution chart it should be 3.84 considering 0.05 probability level as critical value by statistical convention.

Here, observed value = 6, expected value= 14, degree of freedom = 1. So that, the chi square value referring to (1) is 4.571.

Therefore, null hypothesis that is "all patients should become PTB- after one month of treatment" is rejected as the chi square value is greater than that of 3.84 expected according to chi square distribution chart. It reveals that the rate of improvement from disease condition is poor.

B. Changes in Haematological Parameters

Four haematological parameters showed significant changes at diseases detection period, which are namely ESR, Hb, PC, and PCV. The percentage of patients with respective haematological report is shown in Table I.

TABLE I
PERCENTAGE OF PATIENTS ACCORDING TO THE REPORT OF THEIR HAEMATOLOGICAL PARAMETERS

Test Name	% of patients			Unit	Ref value
	Within Normal Range	Above Normal Range	Below Normal Range		
Hb	33.33%	0%	66.67%	gm/dl	Male: 12.5-17.5; Female: 11.5-16.5
Total WBC count	53.33%	24.44%	22.22%	/cmm	3,900-10,000
ESR	6.67%	93.33%	0%	Mm/1st hr	Male: 12mm or less; Female: 15mm or less
Platelet count	20%	80%	0%	/cmm	140,000- 390,000
PCV	20%	2.22%	77.78%	%	Male: 40.0-52.0; Female: 35.0-47.0

Among the 45 patients of this study, only 15 patients (33.33%) showed haemoglobin (Hb) level within the normal range. Remaining 30 patients (66.67%) showed Hb level above the reference value. Therefore, Hb level could be used as a marker for TB disease, but not surely.

Erythrocyte sedimentation rate (ESR) indirectly measures how much inflammation is in the body. From the 45 patients of test sample, 3 patients had the ESR level within the normal range that is 12 mm or less/ 1st hour for male and 15 mm or less/ 1st hour for female; 42 patients (93.33%) had the ESR level above the normal range. There was no patient having the ESR level content below the normal range. As 93.33% new tuberculosis patients showed high level of ESR, it can be highly indicative to the determination of tuberculosis disease but does not make any confirmation as 6.67% patients showed normal range of ESR level.

Another common test of CBC (Complete Blood Count) is checking the PCV (Packed Cell Volume) level. Packed Cell Volume (PCV) describes the volume that is occupied by a cell pellet after centrifugation. The test was carried out on all the sample patients. Among them nine (20%) were with the PCV level within the normal range, that is 40.0-52.0% for male and 35.0-47.0% for female; 35 patients (77.78%) were with the PCV level below the normal range and only one (2.22%) was with the PCV level above the normal range. As the PCV level was below than the normal range in most of the tested tubercular patients (80%), it is pointing that abnormal PCV value could be a significant parameter in TB disease.

In the CBC (Complete Blood Count) test of the platelet count (PC) from the 45 patients, 9 patients (20%) had the total platelet count within the normal range that is 140,000-390,000/cmm whereas 36 patients (80%) have the total platelet count above the normal range. There was no patient having the total platelet count content below the normal range. A high percentage of patients having PC value above the normal range can be used as one of the indicators towards TB disease.

From the study of the CBC (Complete Blood Count) test among 45 patients, twenty-four patients had the total WBC count within the normal range which is 3900-10000 /cmm, whereas 11 patients (24.44%) had the total WBC count above the normal range and 10 patients (22.22%) were below the normal range. Since, the normal and out of normal range with tuberculosis patients was almost fifty-fifty, it can be assumed that there is no effect of TB disease on the total count of WBC.

C. Socio-Demographic Criteria

Some socio-demographic criteria are found to be prominent in accelerating the disease condition. Table II shows the socio-demographic criteria of all enrolled patients and their respective percentage.

A high percentage of male patients have been found in the both PTB+ and PTB- groups and that was 76.19% and 66.67% respectively. The prevalence of TB has been identified at the age below 50 years in the groups individually, which were 54.76% in PTB+ group and 66.67% in another group. Weight loss has been found as the most common symptom in the PTB+ group and 69.05% of the patients in the PTB+ group of this study had their weight below or equal 45 kg.

TABLE II
SOCIO-DEMOGRAPHIC CRITERIA

Criteria	PTB+ group (n=42)	PTB- group (n=3)
Gender		
Male	32 (76.19%)	2 (66.67%)
Female	10 (23.81%)	1(33.33 %)
Age		
≥50 Years	19 (45.24%)	1 (33.33%)
<50 Years	23 (54.76%)	2 (66.67%)
Weight		
45 kg <	13(30.95%)	2 (66.67%)
45 kg ≥	29 (69.05%)	1 (33.33%)
Living area		
Rural	24 (57.14%)	0
Urban	6 (14.29%)	1 (33.33%)
Semi urban	12 (28.57%)	2 (66.67%)
Living status		
Upper middle	2 (4.76%)	0
Lower middle	18 (42.86%)	3 (100%)
Poor	22 (52.38%)	0
Smoking habit		
Yes	31 (73.81%)	1 (33.33%)
No	11(26.19%)	2 (66.67%)
Mortality	1 (2.38%)	0
Hereditary TB		
Yes	3 (7.14%)	1 (33.33%)
No	41 (97.62%)	0

The occurrences of TB were more (57.14%) in rural area in the PTB+ group, whereas the percent was 66.67% in semi urban area in the other group. A large proportion of patients from lower middle and poor class have been seen in both groups. The PTB+ group had significantly higher percentage of patients (73.81%) with smoking habit. Although the rate was very small but the mortality (2.38%) in the PTB+ group was another important variable in this study which is clearly indicating the importance of immediate measures of this disease. TB can be inherited and a small percentage of hereditary TB has been found in both groups which was 7.14% in the first group and 33.33% in the other.

IV. Discussion

Sputum smear conversion is a key parameter to assess the quality of patients' treatment and management. We undertook this study to gain insight into the time to sputum smear conversion as a measure of being cured. In this study only 14 (33.33%) patients of PTB+ group did sputum smear examination at 1st follow-up after one month. Sputum smear conversion at 1st month follow-up of new smear positive (PTB+) patients was only 42.86%. The present study is opposing the study of Bawri et al [2] which states smear conversion of 71% at the end of 1st month. This result is clearly indicating the lack of patients' adherence as well as efficacy of treatment cycle.

Four haematological parameters of enrolled patients showed noteworthy changes to be pointed out. In case of pulmonary tuberculosis patients, increased ESR, anemia, elevated PC, and decreased PCV value can be considered as noticeable haematological changes and manifestation as well.

ESR usually rises in case of infectious condition and known as a non-specific indication of inflammation. Some researchers in Ludhiana [3] found high ESR value in tuberculosis patients and documented the ESR level of TB patients being 66.86 mm/hr. An elevated ESR level with TB patients was also reported in another research study in Pakistan where the value was 64.3 mm/hr [4]. In our study we also found significantly elevated ESR level. 93.33% of tuberculosis patients showed ESR value above the normal range. High level of ESR is highly remarkable with TB disease and can be considered as diagnosis tool.

Many studies have shown evidence of anemia with pulmonary tuberculosis patients. Prevalence of anemia is reported to be 64% with TB patients in a study conducted in Tanzania [5] which is more or less similar to ours'. In our study we also observed 66.67% patients having the Hb level below the normal range. So anemia is an acute outcome related with TB disease which is observed in both male and female patients among 45 study samples.

Increased platelet count has been observed as another manifestation in our study. Although in two different studies performed separately in East London and Hungary, elevated platelet count occurred in 52% and 8% [6], [7] respectively whereas our study revealed 80% pulmonary tuberculosis patients with significantly increased PC level.

77.78% tuberculosis patients of this study have been reported with PCV level below the normal range. This result resembles the significantly low PCV outcome documented by researcher in Nigeria [8].

Gender is a very important aspect in the prevalence of TB. TB is a more a disease of men than women. In this study there was 76.19% of male patients in PTB+ group and 66.67% in PTB- group. Globally, the ratio of female to male tuberculosis cases notified is 1/1·5–2·1. 70% more smear-positive male tuberculosis patients than female patients are diagnosed every year [9]. In different studies it has been found that tuberculosis prevalence appears to be large in Asia. It may be due to more restricted participation of women in society [10]. Fear of social stigma could be another reason of this phenomenon.

In developing countries most affected individuals are below 50 years of age, which is indirectly having a large negative impact on the economies of such nations [11]. During conducting the study in a developing country like Bangladesh, we have found that this percentage was 54.76% in case of PTB+ group and 66.67% in the other group.

TB is a poverty related disease which is associated with poor living condition, lack of financial support, less access to health care services [12]. TB is traditionally regarded as disease of the poor. One study carried out in 2011 revealed, "Most of 2–3 million people who die of the disease every year come from the developing world or from poor, urban neighborhoods in wealthier nations" [13]. In our study the majority of the patients were from semi-urban area and a large percentage of them were from lower middle class families.

Smoking leads to faster and more severe progression of TB [14]. Michael N. Bates, Ph.D., and colleagues at the School of Public Health, University of California, Berkeley, performed a meta-analysis of 24 previously published studies that examined the association between smoking and TB. Across the studies, individuals who smoked had a 73 percent increased risk of becoming infected with tuberculosis and were more than twice as likely to develop active tuberculosis than those who did not smoke [15]. Supporting such study, we also found a correlation between TB and smoking habit as 73.81% of the adult male patients were chain smoker before diagnosed with TB. The good news is that all of them were highly concerned about their treatment and management of TB after diagnosed with TB and all of them quit smoking.

Our study has shown 2.38% mortality rate in PTB+ group. Although TB is a deadly disease, other possible risk factors like advanced age may be associated with the incidents.

V. Conclusion

The rate of sputum smear conversion in this study was disappointing, which is really a matter of concern. Sputum smear result at the end of 1st month strongly predicts the success trend of the treatment. Research is needed to elucidate this negative trend to prevent treatment default. Among all the haematological parameters, increased ESR, PC and decreased PCV and Hb are worth mentioning.

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REFERENCES

[1] World Health Organization, "Tuberculosis", October 2012, fact sheet N°104. Available from http://www.who.int/mediacentre/factsheets/fs104/en/
[2] S. Bawri, S. Ali, C. Phukan, B. Tayal, and P. Baruwa, "A study of sputum conversion in new smear positive pulmonary tuberculosis cases at the monthly intervals of 1st, 2nd & 3rd month under directly observed treatment, short course (Dots) regimen", *Lung India*, July-September 2008, vol. 25, no.3, pp. 118–123.
[3] K. P. Kaur, B. Arora, D. K. Chhina, V. Gupta, "Comprehensive evaluation of patient characteristics and clinical parameters as a diagnostic aid in tuberculosis", *The Internet Journal of Laboratory Medicine*, 2012, vol. 5, no. 1.
[4] T. Talat, B. M. Bhatti, M. Yaqoob, "Comparative efficacy of different laboratory techniques used in diagnosis of tuberculosis in human population", *Journal of Medical Sciences*, 2002, vol. 2, issue 3, pp. 137-44.
[5] S. Isanaka et al, "Iron deficiency and anemia predict mortality in patients with tuberculosis", *The Journal of Nutrition*, February 2012, vol. 142, no. 2, pp. 350-357.
[6] C. D. Morris, A. R. Bird and H. Nell, "The haematological and biochemical changes in severe pulmonary tuberculosis", *The Quarterly Journal of Medicine*, December 1989, vol. 73, issue 3, pp. 1151-1159.
[7] G. Bozoky, E. Ruby, I. Goher, J. Toth and A. Mohos, "Hematologic abnormalities in pulmonary tuberculosis", *Orvosi Hetilap*, April 1997, vol. 138, issue 17, pp. 1053-1056.
[8] O. A. Awodu, I. O. Ajayi and A. A. Famodu, "Haemorheological variables in Nigeria pulmonary tuberculosis patients undergoing therapy", *Clinical Hemorheology Microcirculation*, 2007, vol. 36, no. 4, pp. 267-75.
[9] V. K. Diwan and A. Thorson, "Sex, gender, and tuberculosis", *THE LANCET*, March 1999, vol. 353, pp. 1000-1001.
[10] M. W. Borgdorff, N. J. D. Nagelkerke, C. Dye and P. Nunn, "Gender and tuberculosis: a comparison of prevalence surveys with notification data to explore sex differences in case detection," *The International Journal of Tuberculosis and Lung Disease*, 2000, vol. 4, no. 2, pp. 123-132.
[11] S. A. Qazi, S. Khan and M. A. Khan, "Epidemiology of childhood tuberculosis in a hospital is setting", *Journal of Pakistan Medical Association*, Pakistan, June 1998, pp. 164-167.
[12] T. Nyirenda, "Epidemiology of tuberculosis in Malawi", *Malawi Medical Journal: Special Edition on Burden of Disease in Malawi I*, Malwai, September 2006, vol. 18, no. 3, pp. 147-159.
[13] C. W. Schmidt, "Linking TB and the Environment: An Overlooked Mitigation Strategy", *Environ Health Perspect*, November 2008, vol. 116, no. 11, pp. A478.
[14] M. N. A. Gomez, J. Alcaide, P. Godoy, M. A. Romero and I. H. Rey, "Clinical and epidemiological aspects of smoking and tuberculosis: A study of 13038 cases," *The International Journal of Tuberculosis and Lung Disease*, April 2005, vol. 9, no. 4, pp. 430-436(7).
[15] M. N. Bates et al, "Risk of tuberculosis from exposure to tobacco smoke," *Archives of Internal Medicine*, 2007, vol. 167, pp. 335-342.