ORIGINAL ARTICLE

Association of Erythrocyte Sedimentation Rate with Treatment Outcome in Patients Suffering from Pulmonary Tuberculosis: A Cross-Sectional Study in Islamabad

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ABSTRACT

Objective: To assess the association of erythrocyte sedimentation rate with treatment outcome in patients suffering from pulmonary tuberculosis.

Study Design: Cross-sectional study.

Place and Duration of Study: This study was conducted at the Department of Medicine, Margalla General Hospital, Islamabad, Pakistan from July 2022 to January 2023.

Methods: Patients who were diagnosed with pulmonary tuberculosis by a consultant pulmonologist based on clinical and radiological criteria were included in the study. They underwent all baseline investigations, including erythrocyte sedimentation rate, at the time of diagnosis. Patients were started on the usual treatment of pulmonary tuberculosis and followed up for three months. At the end of three months, clinical outcome was determined along with repetition of erythrocyte sedimentation rate, and the association between both parameters was assessed.

Results: A total of eighty-seven patients with pulmonary tuberculosis were included in the final analysis after application of inclusion/exclusion criteria. AT the end of three months, 70 (80.4%) patients had significant clinical improvement, while 17 (19.6%) did not show significant clinical improvement. 77 (88.5%) patients had an Erythrocyte sedimentation rate less than 50mm/h while 10 (11.5%) had more than 50mm/h. Chi-square analysis showed that reduced levels of Erythrocyte sedimentation rate had a statistically significant relationship with the presence of clinical improvement at the end of three months of treatment (*P*-value<0.001).

Conclusion: Reduction in Erythrocyte sedimentation rate was found to be associated with clinical improvement at the end of three months of treatment in patients suffering from pulmonary tuberculosis. As a cost-effective biochemical marker associated with clinical improvement, it can be effectively incorporated into patient management plans.

Keywords: *Erythrocyte Sedimentation Rates, Treatment Outcome, Tuberculosis.*

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Introduction

Infections have constantly been disrupting human life and affecting health-related mortality and morbidity in all ages.[1] Acute infection usually does not pose much burden on the patient and the health care system, but chronic infections affecting multiple systems are a serious threat to patients' life and long-term health. Pulmonary tuberculosis, even in 2021, is a significant cause of mortality and morbidity in developing countries.[2] Even developed countries have not been entirely free from this devastating infection.[3]

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Clinicians treating chronic infections like tuberculosis have devised specific methods to assess treatment response during and at the end of treatment.[4] Usually, clinical and radiological methods remain the main primary source of gauging the response to treatment. However, some inflammatory or biochemical markers have been used to look for outcomes during or after the treatment.[5] Cost-effective and reliable markers have always haunted clinicians and researchers in this regard.[6]

Erythrocyte estimation rate (ESR) has been used less in recent times for clinical purposes. Though it was a non-specific investigation, it still had utility in a number of inflammatory conditions, especially in developing countries, where cost is a significant concern. Diagnostic performance of chest x-ray and erythrocyte sedimentation rate in comparison with geneXpert® for tuberculosis case notification among HIV patients was studied by Abebe Sorsa in 2020. He came up with the findings that chest x-ray in the diagnostic work of tuberculosis among HIV patients plays an unprecedented role, while ESR has little clinical significance in the evaluation of TB.[7]

Pakistan, like most developing countries, bears a huge burden of tuberculosis. Being a resource-limited country, clinicians have always been in search of cost-effective methods to monitor the progression of the disease and outcomes. A recent local study published by Laghari et al. concluded that ESR was significantly raised in Patients of TB at the time of diagnosis.[8] Limited local data has been available regarding the role of ESR in the monitoring of disease outcome. We therefore planned this study with the rationale to assess the association of erythrocyte sedimentation rate with treatment outcome in patients suffering from pulmonary tuberculosis.

Methods

This cross-sectional study was conducted at the Department of Medicine from July 2022 to January 2023 after getting approval from the Ethical Review Committee of the institute vide IRB certificate no: DZ/158/22, dated: 14th June 2022. Sample size was calculated using the WHO sample size calculation, with a population prevalence proportion of raised ESR levels in TB patients of 73.2%.[9] Non-probability consecutive sampling was used to gather the sample. All the patients between the ages of 18 and 65 years diagnosed with pulmonary tuberculosis with raised ESR managed as inpatients or outpatients were recruited.

Patients with any infective illness other than pulmonary TB were made part of the exclusion criteria. Patients with any comorbid immunological disorders or using any anti-inflammatory or cytotoxic medications were excluded from the study. Patients who had complications of pulmonary TB or extra-pulmonary TB at time of diagnosis or required critical care unit admission were also excluded from the study. Patient who had congestive cardiac failure or those who were pregnant or had PRV were excluded.

Patients diagnosed with pulmonary TB and having raised ESR were included in the study after application of inclusion/exclusion criteria. They underwent all baseline blood investigations including ESR within 24 hours after being diagnosed with pulmonary TB. Diagnosis of pulmonary TB was made by consultant pulmonologist or medical specialist on the basis of clinical, radiological and laboratory parametrs.[10] ESR levels were considered to be significantly improved if were less than 50mm/hour.[11] Clinical improvements were ascertained by the treating consultant after three months of treatment on the basis of clinical symptoms and chest x-ray.[12]

Statistical analysis was done by SPSS 24.0. Frequency and percentage were calculated for the qualitative variables, whereas mean and standard deviation were calculated for the quantitative variables. Chi-square test was used to look for the relationship of age, gender, presence of co-morbidities, and levels of ESR with clinical improvement among the target population. *A P-value* less than or equal to 0.05 was considered significant.

Results

A total of 87 patients with pulmonary tuberculosis were included in the final analysis. The mean age of the tuberculosis patients included in the study was 37.86 ±8.655 years. Out of 87 patients, 48 (55.2%) were male, while 39 (44.8%) were female.

Table 1 summarizes the general characteristics of the study participants. At the end of three months, 70 (80.4%) had significant clinical improvement, while

17 (19.6%) did not show significant clinical improvement. 77 (88.5%) had an Erythrocyte sedimentation rate less than 50mm/hour, while 10 (11.5%) had more than 50mm/hour.

Table 2 summarizes the results of the chi-square analysis. It showed that reduced levels of Erythrocyte sedimentation rate had a statistically significant relationship with the presence of clinical improvement at the end of three months of treatment (*P*-value<0.001). Age (*P*-value-0.974), gender (*P*-value-0.375) and presence of comorbidities (*P*-value-0.054) had no significant relationship with the presence of clinical improvement in our patients.

Table 1: Characteristics of study participants

Study parameters	**N (%)**
Age (years)	
Mean ± SD	43.76 ±7.445 years
Range (min-max)	19 years - 65 years
Gender	
Male	48 (55.2%)
Female	39 (44.8%)
Erythrocyte sedimentation rate at 3 months	
<50mm/hour	77 (88.5%)
>50mm/hour	10 (11.5%)
Presence of Comorbidities	
No	75 (86.2%)
Yes	12 (13.8%)
Clinical improvement after three months	
No	70 (80.4%)
Yes	17 (19.6%)

Table-2: Relationship of erythrocyte sedimentation rate and other variables with Disease outcome at three months

Factors studied	**Poor outcome**	**Good outcome**	***Chi-square***	***P*-value**
Age				
18-40years	45 (64.2%)	11 (64.7%)	0.001	0.974
>40 years	25 (35.8%)	06 (35.3%)		
Erythrocyte sedimentation rate				
<50mm/hour	69 (98.6%)	08 (47.1%)	0.776	<0.001
>50mm/hour	01 (1.4%)	09 (52.9%)		
Gender				
Male	37 (52.8%)	11 (64.7%)	35.678	0.375
Female	33 (47.2%)	06 (35.3%)		
Presence of comorbidities				
No	63 (90%)	12 (70.5%)	4.335	0.054
Yes	07 (10%)	05 (29.5%)		

Discussion

ESR turned out to be a cost-effective investigation significantly associated with clinical outcomes in our study participants. Pulmonary tuberculosis is one of the most commonly encountered chronic bacterial infection in our part of the world.[2] Patients suffering from this condition usually belong to compromised socio-economic class.[1,3] Public sector

facilities provide adequate management to these patients, but still, in a developing country, the cost of management is a major concern for health care professionals.[8] Though most guidelines have not been in favor of the use of ESR, being a cost-effective and simple investigation, clinicians and researchers in third-world countries are still putting in efforts to look for the utility of this investigation.[10] We conducted this study to assess the association of erythrocyte sedimentation rate with treatment outcome in patients suffering from pulmonary tuberculosis.

Rohini et al. in 2016 assessed various hematological parameters in patients of tuberculosis during the course of illness.[13] They came up with the findings that serum hemoglobin level, red cell count, and platelet count were decreased in patients, whereas ESR, CRP, and white cell count were increased as compared to patients who did not suffer from this chronic infection. We followed up patients for three months and found a significant reduction in ESR. These results, supported by other studies, may warrant policymakers to incorporate this basic and cost-effective investigation in management plans during the course of treatment of tuberculosis.

Ding et al. in 2018 studied an interesting aspect of hematological parameters in patients of resistant pulmonary tuberculosis.[14] They included patients who were put on linezolid and assessed the impact of treatment on ESR and other inflammatory markers. They revealed that CRP and ESR decreased significantly after the treatment with linezolid, which indicates that these parameters may have a role in monitoring response to treatment. We did not include treatment-resistant patients, but similar findings were generated in routine patients of pulmonary tuberculosis.

Al-Marri et al., in their study years ago, concluded that ESR may not be of much value in diagnosis or assessing the course of illness of TB, as 1/3rd of their study participants had normal ESR at the time of diagnosis of tuberculosis.[15] Singh et al. in 2021 compared the role of various inflammatory markers, including ESR, in differentiating between pulmonary and extra-pulmonary. They found out that ESR is not of much utility for this purpose.[16]

A study published in 2014 from Brazil looked for the role of inflammatory markers in the treatment of pulmonary tuberculosis. They concluded that ESR and CRP proved to be good markers in the diagnosis and monitoring of treatment in patients suffering from pulmonary TB. CRP was better in this regard in their data set when compared to ESR.[17] We did not study different markers, but a reduction in ESR was associated with recovery in patients after the treatment.

An Egyptian study in 2020 concluded that CRP and ESR showed equal capabilities of monitoring response to therapy in multidrug-resistant tuberculosis.[18] A recent meta-analysis gathered data from a large number of studies regarding the role of biomarkers in predicting active tuberculosis.[19] A longitudinal study published in 2024 concluded that inflammatory parameters, including ESR, indicate disease severity, and sustained high levels are linked to lower treatment efficacy.[20] We wanted to make the same point that if ESR is equally good in determining response, then its use in routine clinical practice should not be discouraged, especially in a developing country like ours. Incorporation of new and more sophisticated investigations should not be the only reason to make basic investigations obsolete.

The main limitation of this study was that the outcome was seen at three months, and patients were not followed up for three months. Patients may have recall bias for recent infections or other illnesses, which could affect the ESR at the time of outcome assessment. The study included patients from only one center, which limits the generalizability of the results. Addressing these limitations and planning large studies with better design would be beneficial in the future.

Conclusion

Reduction in Erythrocyte sedimentation rate was found to be associated with clinical improvement at the end of three months of treatment in patients suffering from pulmonary tuberculosis. Being a cost-effective biochemical marker and having an association with clinical improvement, it can be incorporated into the management plan of patients suffering from pulmonary tuberculosis.

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of interest

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MA: Conception and design of the work
ZH: Manuscript writing for methodology design and investigation
SA: Data acquisition, curation, and statistical analysis
RA: Revising, editing, and supervising for intellectual content
HQ: Validation of data, interpretation, and write-up of results
SH: Writing the original draft, proofreading, and approval for final submission