

Investigation of Adenosine Deaminase Activity in Tuberculosis Pleural Effusion

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Abstract

Background: Adenosine deaminase is an enzyme found in T lymphocytes that increases in the pleural fluid due to the cell-mediated immune response towards mycobacterium. In this study, the role of adenosine deaminase activity as a biomarker is assessed for the diagnosis of tubercular pleural effusion.

Methods: 200 participants are studied in this study at BMIMS, Bihar, India. They were divided into two groups, the control group and the group with diagnosis of tuberculosis. Blood samples and pleural effusion were evaluated for haemoglobin levels, total leucocyte count, erythrocyte sedimentation rate, adenosine deaminase activity, protein, and glucose levels.

Results: The adenosine deaminase activity, protein level, and glucose level in the pleural effusion of the control group were 16.6, 5.8 g/dl, and 74mg/dl respectively. The tuberculosis group had adenosine deaminase activity, protein level, and glucose level in the pleural effusion as 79, 6.35 g/dl and 37.4mg/dl respectively. When the data from both the group is compared the p-value is less than 0.05. Similarly, a statistically significant difference was found in the erythrocyte sedimentation rate among both groups.

Conclusion: From this study, it is found that adenosine deaminase activity in the pleural effusion is strongly indicative of tuberculosis. The standard range of adenosine deaminase activity is 40 U/L. If adenosine deaminase activity is found to be greater than the cut-off value, then tubercular pleural effusion is diagnosed. This method of confirming tubercular pleural effusion is reliable, cheaper, and relatively rapid.

Keywords: tuberculosis, pleural effusion, adenosine deaminase activity

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Introduction

Exudation from the lungs causes the accumulation of pleural fluid. Pleural effusion can occur due to infection and malignancy. When the effusion occurs, it is not easier to detect, as a biopsy is required to test the pleural effusion. Infection by mycobacterium causes tuberculosis which either affects the lungs or other parts of the body or simply both [1]. This infection can cause exudation from the lungs.

When the pleural fluid is examined, it can indicate the causative organism, and based on the other cellular products present, the diagnosis of the underlying cause and stage it has reached can be determined [2]. Lymphocytes are the immune cells that are present in the area where inflammation or infection has occurred. Infection of the lung due to mycobacterium causes the accumulation of lymphocytes in the lungs. An enzyme known as adenosine

deaminase increases in the lymphocytes, which breaks down the adenosine of the causative organism into ammonia and inosine [3,4].

Based on the amount of enzyme detected in the pleural fluid, the physician can assess the level of the infection. So adenosine deaminase becomes the biomarker for the diagnosis of infection and malignancy. An assay of the adenosine deaminase in the pleural fluid along with the histological examination of the fluid, can give an accurate diagnosis. The determination of the amount of adenosine deaminase is a cheaper and faster technique for diagnosis [5,6]. Although there is standardized treatment available for tuberculosis, delays in diagnosis can lead to an increase in morbidity rates.

In India, the cases of pulmonary tuberculosis are increasing, and a reliable biomarker can make diagnosis easier and earlier [7]. This study aims to

determine the concentration of adenosine deaminase in the pleural exudates as a biomarker for cell-mediated immunity in the infection caused by mycobacterium in the lungs.

Method

A prospective study was conducted with 200 participants. The study consisted of a control group that comprised 100 patients and a group with pleural effusion due to tuberculosis, namely Group A and Group B. The ratio of females and males was 1:1. The mean age of the participants in the study was 52 years. The participants were attending the outpatient department of the **BMIMS, Bihar, India** for the period of 15 October 2022 to 15 April 2023. The tuberculosis group consisted of patients with confirmed tuberculosis diagnoses.

The blood samples and pleural fluid samples were taken to perform the haematological test and the biochemical test. A physical examination of both fluids was done. The body mass index of the participants in the study was done. The biochemical test of the pleural fluid was done on the concentrate

obtained after centrifugation. The level of proteins, glucose, total count of lymphocytes, and biomarker adenosine deaminase were determined in the pleural fluid.

The level of haemoglobin, total leucocyte counts, differentiated leucocyte count, and erythrocyte sedimentation rates were determined in the blood sample obtained. The body mass index was determined to assess the nutritional level of the patients. The data obtained was subjected to statistical analysis, and the data of the control and tuberculosis groups was compared using Pearson’s value; if it was less than 0.05, it was considered significant.

Results

The results of the evaluation of the blood sample and pleural fluid sample were statistically analyzed. Table No. 1 shows the comparison of the average values between the control group and the tuberculosis group. The p-values were used to determine the significance of the differences while comparing the averages of both groups.

Table 1: average values of the parameters evaluated in the blood sample and pleural fluid

Parameters	Control group	Tuberculosis group	P-value
Evaluation of the blood samples			
Haemoglobin (gm/dl)	14.92	14.8	Insignificant
Erythrocyte sedimentation rate (mm)	5.92	21.0	Significant
Total leucocyte count (cumm)	7640	7773	Insignificant
Evaluation of the pleural fluid samples			
Adenosine deaminase activity (U/l)	16.6	79.0	Significant
Protein (g/dl)	5.8	6.35	Significant
Glucose (mg/dl)	74.0	37.4	Significant
Body mass index	20.0	18.0	Insignificant

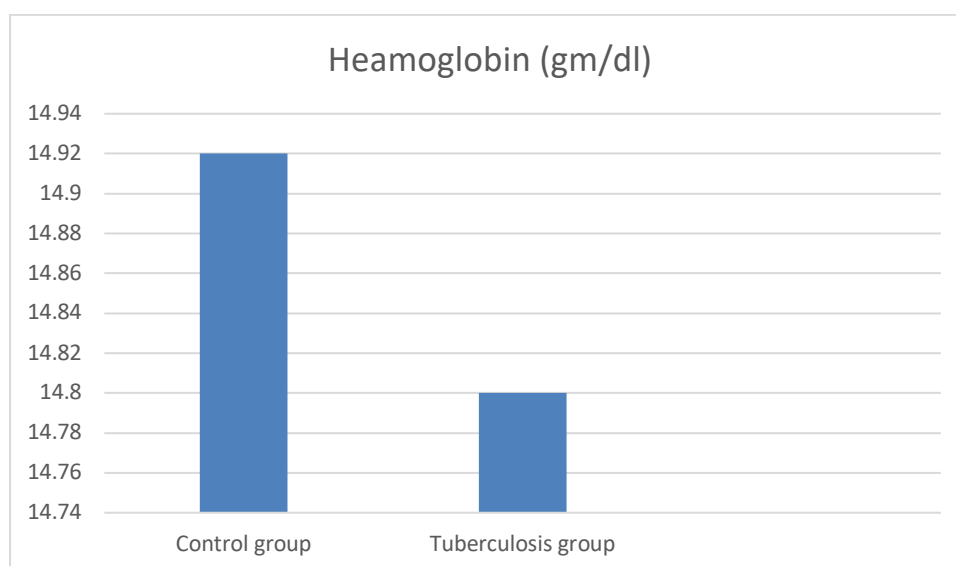


Figure 1: Comparing heamoglobin values in both the groups

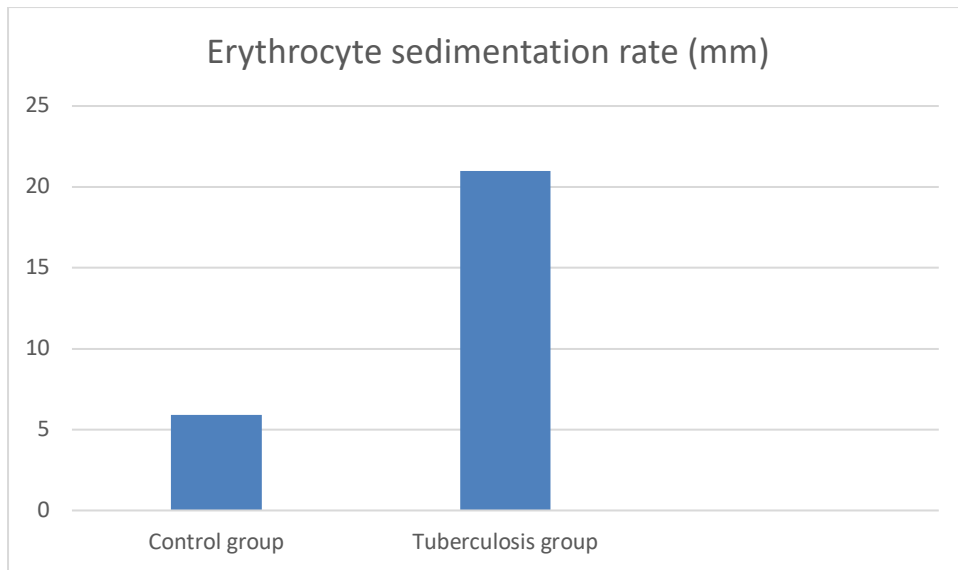


Figure 2: Comparing Erythrocyte sedimentation rate (mm) in both the groups

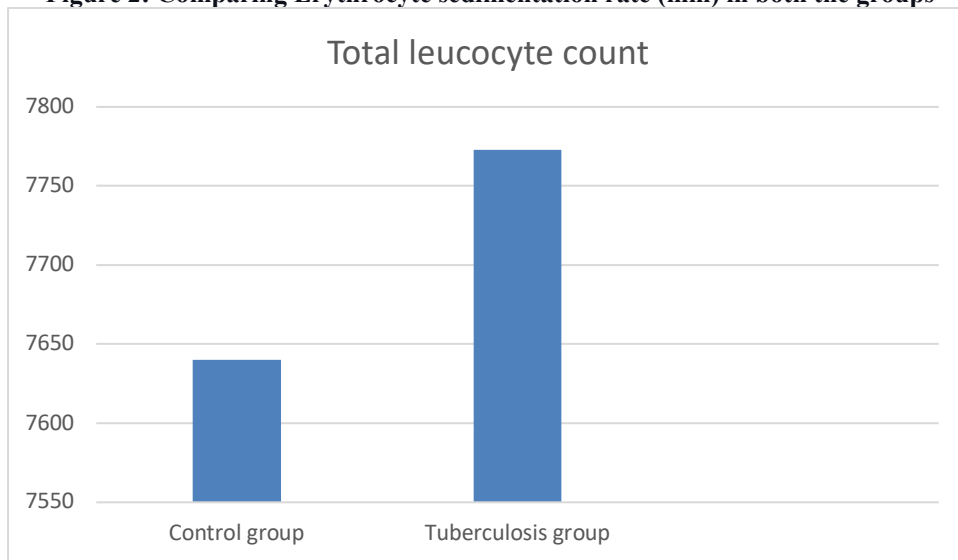


Figure 3: Comparing total leucocyte count in both the groups

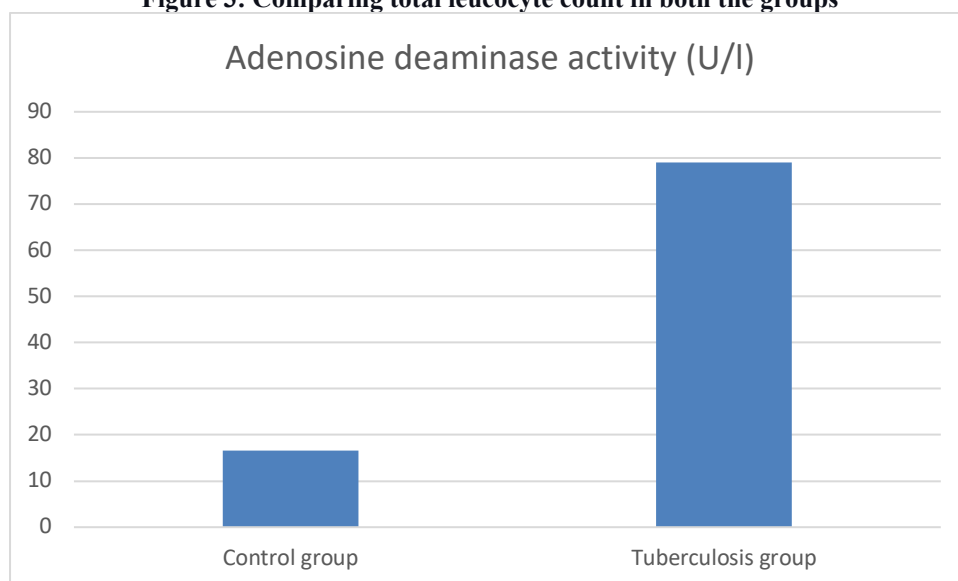


Figure 4: Comparing adenosine deaminase activity in both the groups

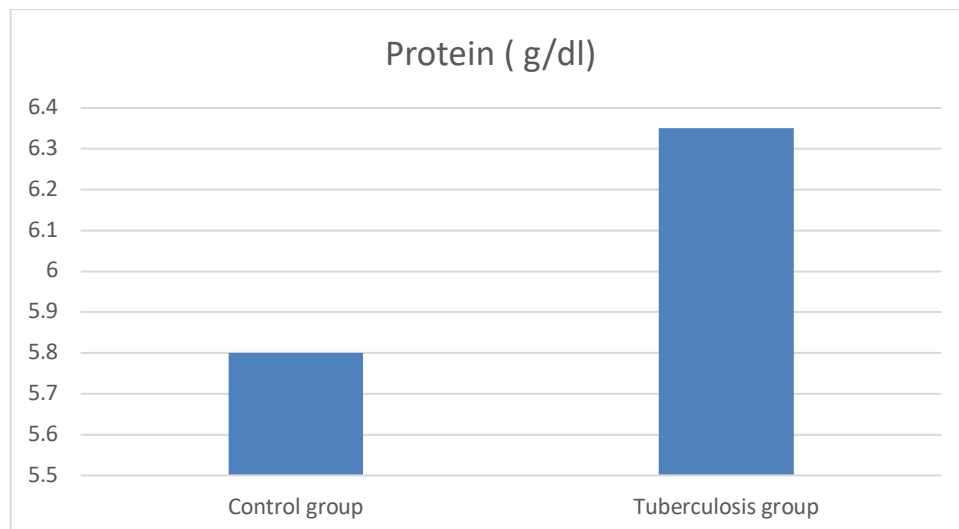


Figure 5: Comparing protein values in both the groups

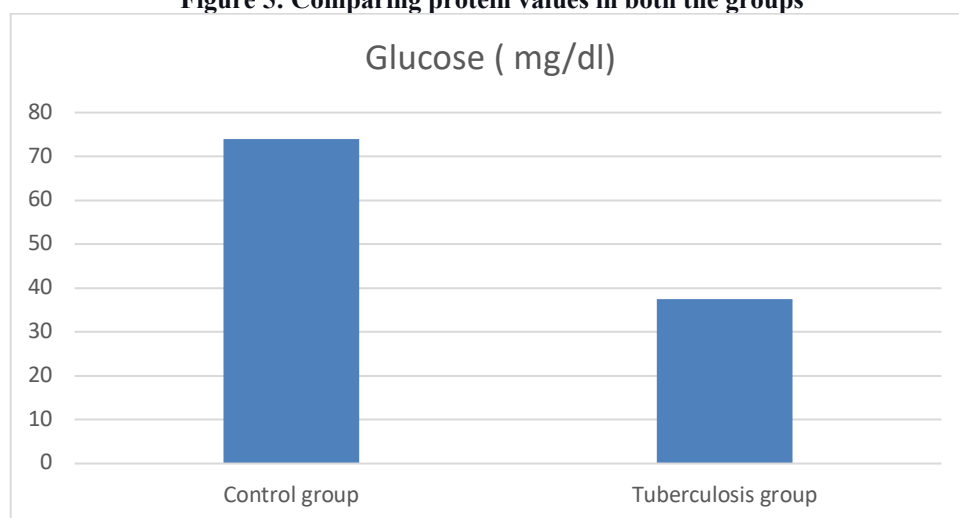


Figure 6: Comparing glucose values in both the groups

In this case controlled prospective study there were equal proportion of males and females. The average age of the participants was 52 years. The haemoglobin levels and the body mass index values in the tuberculosis group were towards the lower end indicating poor nutrition. There was a significant difference in the erythrocyte sedimentation rate which was by the diagnosis of tuberculosis in the other group. However, numerically there was a difference in the total leucocyte count but statistically, the difference was not significant.

The average values of biochemical tests of the pleural fluid such as protein, glucose and adenosine deaminase activity were compared the difference was statistically significant. Especially the adenosine deaminase activity among the tuberculosis group was much higher. The cut-off value of the adenosine deaminase activity was 40U/L. The average value was greater in the tuberculosis group than the cut-off value and the difference between the adenosine deaminase

activity in the control group and the tuberculosis group was statistically significant.

Discussion

Tuberculosis is a curable disease in India but there are various tests conducted for tuberculosis, some of which are inconclusive while others such as X-rays and biopsies are difficult. Adenosine deaminase is a biomarker present in the T lymphocytes which is the major leucocyte accumulated in the pleural effusion when mycobacterium infects the lungs [2, 4].

In this study, the tuberculosis group has lower haemoglobin levels and the body mass index of these patients is comparatively lower which indicates nutrition deficiency among those who are infected by Mycobacterium. Studies conducted previously on tuberculosis patients show similar results [5, 6].

The group which has tuberculosis shows an erythrocyte sedimentation rate more than that of the other group which again confirms the diagnosis of

tuberculosis infection in these patients. The leucocyte count in both groups is almost the same. It is the total leucocyte count which is generally not indicative of any infectious state. Hence the p-value in this case is not found to be statistically significant. From the observation, it is found that the patients of tuberculosis are anemic, nutritionally deficient and have a high erythrocyte sedimentation rate. The findings of our study are consistent with the other studies conducted previously [7, 8].

Adenosine deaminase is an enzyme for the catabolism of adenosine in the causative organism it is 10 times higher in T lymphocytes than in the other cells. When an individual is infected with mycobacterium their pleural effusion has a higher number of lymphocytes. These lymphocytes are released in response to the infection which causes increase in the adenosine deaminase activity.

As found in this study the control group has significantly lower activity of adenosine deaminase compared to the tuberculosis group. Thus, the adenosine deaminase enzyme is a biomarker for the infection of Mycobacterium. This finding is confirmed in another study conducted on the activity of adenosine deaminase activity on tuberculosis patients [9]. It has been also reported in a study increase in the adenosine deaminase activity is associated with a weakened immune system towards tuberculosis [10].

The increase in the T lymphocytes is due to the cellular immune response towards mycobacterium infection which is the reason for the increase in adenosine deaminase activity in such patients who have tuberculosis infection in their lungs. However, there are other studies which report that pleural effusion had increased adenosine deaminase activity during other infections and malignancies such as lymphoma [11, 12]. Therefore, the clinical findings and the diagnosis should be correlated while confirming the diagnosis.

Conclusion

From this study, it is found that adenosine deaminase activity in the pleural effusion is a strong indicator of tuberculosis. The standard range of adenosine deaminase activity is 40U/L. If adenosine deaminase activity is found to be greater than the cut-off value then tubercular pleural effusion is diagnosed. This method of confirming tubercular pleural effusion is reliable, cheaper and rapid comparatively.

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