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Diagnostic Accuracy of Pleural Fluid C Reactive Protein in differentiating Pleural Effusion Type: Lights, Criteria as the Standard

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ABSTRACT

Background: Pleural effusion is a life threating infection of the respiratory tract. Its early diagnosis is crucial to achieve possible management. CRP play very important role in its diagnosis. **Objective:** The aim of this study was to determine the Diagnostic accuracy of pleural fluid C reactive protein in differentiating pleural effusion type by taking lights criteria as standard. **Materials and method:** The current cross-sectional study was carried out at the department of Pulmonology Hayatabad Medical Complex Peshawar from 15th march 2025 to 20th June 2025 after taking approval from the research team of the institute. A total of 100 individuals of both genders and different age groups (above 18 years) radiologically diagnosed with pleural effusion and underwent diagnostic thoracentesis were included in the study. Using Light's criteria, pleural effusions were categorized as either exudative or transudative. To measure CRP in pleural fluid, the high-sensitivity immunoturbidimetric technique was used. The value was given in milligrams per liter. SPSS version 27 was used to do the statistical analysis. **Results:** In this study of 100 participants, 40 had exudative and 60 had transudative effusions. Males predominated in both groups. The transudative group was older (66.4 vs. 61.3 years, p=0.049). Congestive heart failure was common in transudative cases, while tuberculosis and pneumonia were prevalent in exudative cases (p<0.001). Mean CRP was higher in exudative effusions (11.6 vs. 2.9 mg/dL, p<0.001), indicating its diagnostic value in differentiating effusion types. **Conclusion:** The present study concluded that Pleural fluid CRP is a sensitive and easily accessible marker that may be used to distinguish between transudative and exudative effusions. When combined with Light's criteria and clinical expertise, it enhances diagnostic precision and permits prompt and appropriate treatment.

INTRODUCTION

A buildup of fluid in the pleural space, which is the area between the lungs and the chest cavity, is called a pleural effusion.[1] Having a normal quantity of fluid in the body, lubricates the lungs and prevents the frictional stress that breathing causes.[2-3] Approximately 3 million cases of pleural effusion occur annually in developed nations worldwide and it is One of the most frequent cause of morbidity and death in pulmonary disorders.[4]By using modified Light's criteria, the pleural effusion may be categorized as either transudative or exudative. [5-] Pleural infection, damage, inflammation, or lymphatic blockage may all result in exudative pleural effusion. Malignancy, pneumonia, pleural or pulmonary TB, viral infections, and inflammatory conditions including chylothorax (thoracic duct damage or lymphatic blockage) are among the frequent causes. Transudative develops by systemic sickness induced owing to rise & decrease in capillaries hydrostatic & osmotic pressure correspondingly in the space of pleura. Hepatic conditions such as cirrhosis, hypoalbuminemia, nephrotic syndrome, and congestive heart failure are the main causes of transudate pleural effusion.[6] Using Light's criteria, pleural fluid analysis is always necessary to distinguish between exudative and transudative effusions.[6] Pleural fluid effusion is considered exudative if the lactate dehydrogenase (LDH)/serum LDH ratio is greater than 0.6, pleural fluid LDH is greater than two-thirds of the normal upper limit for serum, and/or pleural fluid protein/serum protein > 0.5. The pleural effusion is regarded as transudative if none of these criteria are satisfied. The primary drawback of Light's criteria is that they classify around 25% of pleural effusions brought on by congestive heart failure as exudates.[7] unfortunately; the sensitivity and specificity of

pleural fluid analysis are insufficient to identify the etiology. This results in invasive therapies, including thoracoscopies and closed pleural biopsies. The discovery of the illness etiology in pleural effusions and the wealth of potential credible biomarkers on pleural fluid samples have expedited clinical diagnostic procedures. Hepatocytes in the liver produce C-reactive protein (CRP), also known as "acute-phase proteins," which is released in response to a variety of stimuli. They are first produced during inflammatory processes, provide improved defense against infections, aid in the quick restoration of homeostasis following infection, and reduce tissue damage. CRP is induced in the liver by the main pro-inflammatory mediators, including interleukin-6 and tumor necrosis factor.[8] CRP levels are elevated in serum and plasma in patients with pneumonia, and they are important in the identification of the illness.[9] Because circulating CRP may seep into the pleural cavity and elevated concentration levels may aid in diagnosis, many investigations have demonstrated that CRP may function as a potential biomarker for pleural infection. However, a growing body of research indicates both pleural and serum CRP may be useful in diagnosing pleural effusion.[10-13] The aim of this study was to find out the diagnostic accuracy of pleural fluid c reactive protein in differentiating pleural effusion type: lights, criteria as the standard.

MATERIALS AND METHOD

The current cross-sectional study was carried out at the department of Pulmonology Hayatabad Medical Complex Peshawar from 15th march 2025 to 20th June 2025 after taking approval from the research team of the institute. A total of 100 individuals of both genders and different age groups (above 18 years) radiologically diagnosed with pleural effusion and underwent diagnostic thoracentesis were included in the study while individuals with hemothorax, chylothorax and post-trauma effusions who had received antibiotic, steroid, or diuretic treatment for more than a week before to thoracentesis were excluded. Aseptic pleural fluid has been collected and sent for routine tests, including those for protein, LDH, glucose, and CRP. Blood was taken sequentially to measure serum LDH and serum protein. Using Light's criteria, pleural effusions were categorized as either exudative or transudative. To measure CRP in pleural fluid, the high-sensitivity immunoturbidimetric technique was used. The value was given in milligrams per liter. SPSS version 27 was used to do the statistical analysis. While the categorical data were shown as frequencies and percentages, the continuous values were shown as ± slandered deviation. The mean pleural fluid CRP levels in the exudative and transudative groups were compared using the independent sample t-test. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of 100 individuals were enrolled in this study .In the exudative group there were 40 participants and transudative group had 60 individuals. In the exudative group there were 36(60%) male and in transudative group 26(65%) had male. Female gender was more common in 24(40%) in exudative group as compared to transudative group 14(35%).The transudative group had a comparatively greater age (66.4 vs. 61.3 years, p = 0.049). Congestive heart failure was among the most common cause of transudative effusions (67.5% vs. 11.66 %, p<0.001), whereas infection history, particularly Tuberculosis or infections such as pneumonia, were significantly more common in exudative individuals (53.3 % vs. 15%, p<0.001). There was no statistically significant difference between end-stage renal disease and chronic liver disease, however malignancy was more prevalent in exudative individuals (p = 0.018). The mean pleural fluid CRP concentrations were significantly higher in exudative effusions (11.6 ± 29.3 mg/dL) than in transudative effusions (2.9 ± 3.2 mg/dL), suggesting that CRP may differentiate between the two as presented in **table 1**. In exudative cases, 90% were CRP positive, whereas 65% of transudative cases were CRP positive and was statistically significant (p < 0.001).This demonstrated that CRP is significantly elevated in exudative effusions and might be a useful diagnostic tool to differentiate between exudative and transudative plural effusions as presented in **table 2.**

Table 1

Clinical and Demographic Features Associated with the Etiology of Pleural Effusion

Features	Transudative N= 40	Exudative N= 60	Value of P
Mean age in years	66.4 ± 15.4	61.3 ± 17.8	0.049
Gender			
Male	26(65%)	36(60%)	0.78
Female	14(35%)	24(40%)	0.65
CRP (mg/dL) Mean ± SD	2.9 ± 3.2	11.6 ± 29.3	_
Malignancy (Active or History)	4(10%)	18(30%)	0.018
Infection history (pneumonia/TB	6(15%)	32(53.3%)	<0.001
End-Stage Renal Disease	4(10%)	8(13.3%)	0.23
Chronic Liver Disease	9(22.5%)	6(10%)	0.07
Congestive Heart Failure	27(67.5%)	7(11.66%)	<0.001

Table 2

CRP Positive Distribution in Pleural Effusions

Status of C reactive proteins	Transudative N= 40	Exudative	Value of P
Negative	14(35%)	6(10%)	<0.001
Positive	26(65%)	54(90%)	
Total	40	60	

DISCUSSION

Pleural effusion is the term used to describe an abnormal buildup of fluid in the pleural space, or lungs cavity and the cavity of chest. [1]Approximately 3 million instances of pleural effusion occur annually in developed nations worldwide. Reduced lymphatic absorption and excessive fluid production are the main causes of pleural effusion. TB, pneumonia, pulmonary embolisms, and diseases that induce pleuro-renal syndromes, such systemic lupus erythematous, are the most frequent causes of exudative pleural effusion. Transudative pleural effusion is most often caused by nephrotic syndrome, heart failure, and fluid overload. Another important contributing factor (HD) is uremic pleurisy (exudative PE), a diagnosis of exclusion that persists or recurs with intense hemodialysis.[14] The present study was carried out to find the diagnostic

accuracy of pleural fluid c reactive protein in differentiating pleural effusion type: lights, criteria as the standard. In the exudative group there were 40 participants and transudative group had 60 individuals. In the exudative group there were 36(60%) male and in transudative group 26(65%) had male. The transudative group had a comparatively greater age (66.4 vs. 61.3 years, p = 0.049). So in this study male gender were higher in frequency than the female in both groups however there was no noticeable gender difference between the two groups. Our study findings are similar to the study conducted by Chandrik Babu et al. in which males were 65% and females were 34%.[15] In another study conducted by Waffa et al. the mean age was around 55 years old, and male participants reported pleural effusion more often than female individuals.[16] These results support our study. The liver produces the acute-phase protein known as C-reactive protein (CRP) in reaction to inflammation. It dramatically rises in cases of inflammation, tissue injury, or infections. Exudative & transudative effusions may be distinguished in pleural effusions by high levels of CRP, especially in pleural fluid. They are also very helpful in identifying infectious sources, such as parapneumonic effusions.[17] In clinical practice, CRP is a highly practical, easy, and affordable diagnostic tool because of its high sensitivity. Traditionally, this distinction has been made using Light's criteria, which are based on the concentrations of lactate dehydrogenase (LDH), serum protein, and pleural fluid. However, Light's criteria may not be enough in some clinical situations, such as diuretic patients. Other biomarkers, such C-reactive protein (CRP), have also gained interest in these circumstances because of their diagnostic usefulness.[18] In our study, we found that exudative patients had significantly higher pleural fluid CRP levels (mean 11.6 ± 29.3 mg/dL) than transudative patients (mean 2.9 ± 3.2 mg/dL). Furthermore, a very significant difference ($p < 0.001$) was seen in the CRP positivity recorded in 90% of exudative patients but only 65% of transudative cases. A study by Muralidharan et al. (2023) showed that the concentrations of pleural fluid (PF) and serum CRP vary considerably depending on the etiology of pleural effusion. Parapneumonic effusions had the highest CRP concentrations, whereas tuberculous and cancerous effusions had lower values. Transudative effusions had the lowest CRP concentration, at . [19]These results provide credence to the theory that pleural CRP is a reliable indicator of exudative pleural illness, most likely reflecting the underlying infections or inflammatory processes that are most often present in such effusions.[20]

According to the findings of a previous work by Li et al., pleural CRP may function as a marker for pleural infection as serum CRP may seep into the pleural space. The diagnosis of parapneumonic effusions and the differentiation of unclassified from classified cases have been investigated using serum and pleural CRP.[21] Likewise, Izhakian et al. (2016) evaluated the diagnostic efficacy of pleural fluid CRP in distinguishing parapneumonic effusions from other types in a retrospective analysis.[22] TURA Y et al. (2000) found in another comparative investigation that exudative effusions had a considerably higher pleural CRP content than transudative effusions. In their investigation, they found that the highest CRP levels (mean of 89 mg/L) were found in parapneumonic effusions among the exudates. The diagnostic threshold for parapneumonic effusions was 93.7% sensitive and 76.5% specific, with a CRP cut-off of >30 mg/L. CRP helped to differentiate between the genesis and type of pleural effusion.[23] Furthermore, the severity of the disease may be correlated with CRP levels, which may possibly serve as a prognostic indicator. According to some research, CRP can be used to evaluate how well a patient is responding to therapy, especially in cases of infectious effusions like TB or empyema, where a decrease in CRP levels may suggest that the inflammation has resolved. Ansar et al. [24] also demonstrated that in the context of infection or injury, C-reactive protein (CRP) rises quickly. It is a helpful marker for inflammatory illness monitoring and diagnosis. According to case studies, there is a correlation between CRP levels and clinical presentation, making it a diagnostic and prognostic factor.CRP has certain drawbacks in addition to its advantages. It is a non-specific marker that, regardless of pleural involvement, may be elevated in autoimmune diseases, systemic inflammatory processes, or cancer. Mouliou et al. [25] also discovered that CRP is a likely biomarker for a wide range of illnesses, including cancer, autoimmune, respiratory, and cardiovascular conditions. As a result, its interpretation must always be viewed within the framework of the whole clinical circumstance. The current research demonstrates that pleural fluid CRP is a useful diagnostic tool for differentiating between exudative and transudative effusions. There is a substantial correlation between elevated CRP and exudative causes, particulate matter, and malignant etiologies. When combined with clinical judgment and Light's criteria, CRP enhances diagnosis reliability and facilitates prompt and appropriate treatment choices. CRP should be a standard test in the first workup of pleural effusions due to its accessibility and inexpensive cost, particularly in countries with limited resources.

CONCLUSION

The present study concluded that Pleural fluid CRP is a sensitive and easily accessible marker that may be used to distinguish between transudative and exudative effusions. When combined with Light's criteria and clinical expertise, it enhances diagnostic precision and permits prompt and appropriate treatment.

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