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Original Article

Clinical Presentations and Outcome of Patients with Pleural Effusion: A Study at a Tertiary Care Center

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Abstract

Background
Pleural effusion is the collection of fluid in the pleural space. Divided into exudative and transudative type. This study aims to find the clinical profile, etiology, and outcome of the patients with pleural effusion.

Materials and Methods
This was a prospective descriptive study done in a tertiary center from 8th March 2024 to 7th September 2024. Ethical approval was taken from the institutional review committee (Ref:12/2024). A total of 60 adult patients with new onset pleural effusion were included in the study, with their demographics, clinical profile, and immediate outcome being studied.

Results
A total of 60 patients were included, the male-to-female ratio was 1.14: 1, with the mean age being 46.31 ± 9.62 years, with 32 (53.33%) patients of the age group 40-59 years. Tuberculosis was the most common etiology of pleural effusion occurring in 21 (35%) cases, followed by para-pneumonic effusion in 16 (26.67%) and congestive cardiac failure in 9 (15%). Shortness of breath was the most common symptom seen in 43 (71.67%) cases, while lymphocytosis was the most common hematological manifestation in 46(76.67%). The mean Adenosine Deaminase level was 67.21 ± 24.21 International Units /Litre. Two (3.33%) cases ended in mortality. The mean hospital stay was 8.86 ± 3.31 days. A rare occurrence of re-expansion pulmonary edema was observed.

Conclusion
The most common cause of pleural effusion in our setting is tuberculosis followed by para-pneumonic effusion, with 40-59 years of age being the most common age group. Adenosine deaminase level is a reliable indicator of tubercular pleural effusion.

Keywords: *Pleura, Pleural effusion, Pneumonia, Tuberculosis*

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Introduction

Pleural effusion is the pathological collection of fluid in the pleural space[1]. Around 1.5 million cases of pleural effusion occur annually in the United States, while real figures for Nepal are unavailable [2]. Most of the cases of pleural effusion have been described to be congestive heart failure, pneumonia, and malignancy. Pleural effusions are classified as exudative and transudative according to the Light's criteria [3]. Transudative effusions occur due to the imbalance of oncotic and hydrostatic pressure, with congestive cardiac failure being the most common cause [4, 5]. Exudative occurs due to alteration of the local inflammatory factors which precipitate a protein-rich pleural fluid, which exceeds maximal lymph flow [6]. Tuberculosis is the most common cause of exudative pleural effusion in Nepal [7].

The real burden of pleural effusion in Nepal is still understudied. In contrast, pleural effusion continues to be one of the country's most common health burdens, with tubercular effusion causing most of the effusions [8].

The study aims to study the clinical presentations, etiologies, and outcomes of the patients with pleural effusion at our tertiary center.

Materials and Methods

This was a descriptive, cross-sectional study done by collecting data prospectively from 8th March 2024 to 7th September 2024. In this research, patients who were admitted to a tertiary hospital with the presence of pleural effusion were studied. Ethical approval was taken from the Institutional Review Committee of Nobel Medical College Teaching Hospital (Ref:12/2024) Data was collected after obtaining written informed consent from participants included in the study, following a thorough explanation of the nature and purpose of the study. All patients admitted with new onset pleural effusion at Nobel Medical College Teaching Hospital, Biratnagar, Morang, Nepal were included in the study. Patients previously incompletely treated at other centers, patients with hemothorax, and non-consenting patients were excluded from the study.

Variables like age, sex, associated symptoms (fever, cough, sputum, chest pain, dyspnoea, weight loss), laboratory examinations, pleural fluid analysis, including biochemistry, cytology and microbiology, chest radiograph, diagnosis, treatment, and immediate outcome were studied during the study. A consecutive sampling technique was used for data collection. The sample size was calculated using the following formula:

$N = (Z^2 \times p \times q)/ e^2$

$= (1.96 \times 1.96 \times 0.02 \times 0.98)/ 0.05^2$

~ 30

According to a study by Taghizadeh et al., around 2% of hospital admissions were due to pleural effusions. The study would require a minimal sample size of 30 to estimate the expected proportion with 5% absolute precision and 95% confidence [9]. To increase the study's accuracy and reduce any biases, double the minimum sample size was taken. Hence, 60 patients were included in the study.

Pleural effusions were first evaluated using a Chest X-ray posteroanterior view to determine whether there was significant pleural effusion. The effusion was classified as mild if it occupied less than 25% of the hemithorax, moderate if it occupied 25-50% of the hemithorax, and severe if it occupied more than 50% of the hemithorax. The pleural fluid was then aspirated aseptically and sent for microbiological, biochemical, and cytology testing. The pleural effusion was then categorized into exudative and transudative effusions according to the Light's criteria.[3] Computed Tomography (CT) scans of the chest were performed for cases that had obscure causes of intrathoracic causes for pleural effusion. Malignant cases and suspected malignancies underwent a Contrast-Enhanced CT Scan (CECT) for better visualization, staging, and management of the case.

The data were entered in a Microsoft Excel Sheet and statistical analysis was done with IBM SPSS Statistics for Windows, version 29 (IBM Corp., Armonk, N.Y., USA).

Results

During the study period of 1 year, a total of 60 patients with pleural effusions were evaluated. Among the 60 included cases, 32 (53.33%) were male while 28 (47.67%) were females. The mean age of the patients was 46.3 years ± 9.6 years. Most of the patients were in the age group of 40-59 years. Other demographic factors are tabulated in Table 1.

Table 1: Demographic factors of pleural effusion (n=60)

Variables	Values
Sex distribution	
Male	32 (53.33%)
Female	28 (47.67%)
Male to female ratio	1.14 : 1
Age distribution	
Mean	46.31 ± 9.62 years
18-40 years	17 (28.33%)
40-59 years	32 (53.33%)
>60 years	11 (18.34%)

The most common cause of pleural effusion was tubercular pleural effusion, seen in 21 (35%) cases, followed by para-pneumonic effusion following pneumonia in 16 (26.67%). Malignant pleural effusion was the third most common cause of pleural effusion in 9 (15%) cases, followed by effusion due to congestive cardiac failure in 6 cases (10%). The results are tabulated in Table 2.

Table 2: Etiology of pleural effusion (n=60)

Etiology of Pleural Effusion	Values
Tuberculosis	21 (35%)
Para-pneumonic effusion	16 (26.67%)
Malignant pleural effusion	9(15%)
Congestive cardiac failure	6(10%)
Other causes	
Rheumatic	4 (6.67%)
Meig's syndrome	2 (3.33%)
Nephrotic causes	2 (3.33%)

The most common symptom of the patients with pleural effusion was shortness of breath seen in 43 (71.67%) cases, followed by cough in 38 (63.33%) cases. Other symptoms of the patient are tabulated in Table 3.

Table 3: Symptoms of patients with pleural effusion (n=60)

Symptoms	Occurrence
Shortness of breath	43 (71.67%)
Cough	38(63.34%)
Fever	32 (53.33%)
Sputum production	29 (48.33%)
Chest pain	25 (41.67%)
Weight loss	17 (28.83%)
Blood in sputum	13 (21.67%)

Hematological evaluations of the patients were done in all cases. Most patients with pleural effusion had lymphocytosis, seen in 46 (76.67%). ADA was raised in 19 (90.47%) of the 21 cases of tubercular pleural effusion, while the cutoff value of 40U/L was not reached in other cases of pleural effusion. Other laboratory parameters are tabulated in Table 4.

Table 4: Laboratory examination of the patients (n=60)

Variables	Values
Hematological manifestation	
Lymphocytosis	46 (76.67%)
Neutrophilia	32(53.33%)
Mean Hemoglobin	10.93 ± 4.32 g/dL
Pleural fluid analysis	
Mean cell count	7248.22 ± 4401.19 / mm^3
Mean glucose	55.12 ± 22.45 mg/dL
Mean ADA	67.21 ± 24.21 U/L
ADA >40U/L	19 (31.66%)
Mean Pleural LDH: Serum LDH ratio	0.834 ± 0.39
Mean Pleural protein: Serum Protein ratio	0.671 ± 0.13
Pleural fluid microbiology	
Acid Fast Bacilli (AFB)	8 (13.33%)
Gram Stain	5 (8.33%)
Gene Xpert	10 (16.67%)
Malignant cell identification	6 (10%)

All cases underwent chest X-rays in postero-anterior view, and they were classified as mild, moderate, and severe pleural effusions. Pleural effusions were identified in 43 (71.66%) cases using chest X-ray. For the other 17 (28.34%) cases, small pleural effusion was diagnosed using a CT scan of the chest. Malignant cases underwent Contrast-Enhanced CT Scan (CECT) Chest for better staging and management. Other radiological findings are tabulated in Table 5.

Table 5: radiological presentation of pleural effusion in chest x-ray (n=60)

Variables	Values
Chest X-Ray proven pleural effusions	43 (71.66%)
Mild pleural effusions	21 (35%)
Moderate pleural effusions	14 (23.33%)
Severe pleural effusions	8 (13.33%)

Among the 60 patients included in the study, only 2 mortalities were recorded. Both were malignant types of pleural effusions, one being lung cancer and the other being Hodgkin's lymphoma. All other cases received appropriate therapies according to the etiologies. The malignancies were referred to specialized centers, while the cases of Meig's syndrome were referred to the Gynecology department. The mean hospital stay was 8.86 ± 3.31 days, with malignant and para-pneumonic effusions being managed as inpatients longer than with other etiologies. Of the 60 patients, all patients (22 patients) with pleural effusions graded as moderate or severe were inserted a chest tube for drainage. All parameters

of the final outcome are tabulated in Table 6.

Table 6: Final Outcome of the patients (n=60)

Variables	Values
Final Outcome	
Favorable	52 (86.67%)
Referred	6 (10%)
Mortality	2 (3.33%)
Management modality	
Chest tube Inserted	22 (36.67%)
Conservative	38 (63.33%)
Mean hospital stay	8.86 ± 3.31 days
Complications	
ICU Stay	12 (20%)
=2 week inpatient care	5 (8.33%)
Acute Dyspnea	8 (13.33%)
Pneumothorax	3 (5%)
Re-expansion pulmonary edema	1 (1.67%)

Discussion

During the study period, 60 patients with pleural effusion were studied. The male-to-female occurrence was almost similar, with 53.33% male and 47.67% female. Their respective studies by Mishra et al. and Agrahari et al. found that pleural effusion incidence is similar in both sexes in Nepal [7, 8]. Similarly Ogunleye found similar occurrences in Africa [10]. In our study, the most common age group was between 40-59 years, with mean age of presentation at 46.3 ± 9.6 years. In the studies by Mishra et al., they found the mean age of presentation of tubercular pleural effusion to be 42.3 ± 18.9 years and that of parapneumonicpleural effusion to be 44.1 ± 17.7 years which closely relates to our study [8]. Similarly, in their respective studies, Agrahariet. al and Dhital et al. found the incidence of pleural effusion to be higher in the younger age group [7, 11]. In a study by Tian et al. in China, the most common age group was 60-79 years with malignant pleural effusion significantly contributing to pleural effusion incidence [2]. The incidence of pleural effusion is highly dependent on the region and the most common cause in that region.

In our study, the most common cause of pleural effusion was tubercular pleural effusion. This occurrence follows a similar trend in Nepal as recorded in the studies of Mishra et al., Agrahari et al., and Dhital et al., wherein they also found the most common cause of pleural effusion to be tuberculosis [7, 8, 11]. Tuberculosis is the most common cause of pleural effusion in other parts of South Asia, as evidenced by the works of Pathak et al. in India, and Mohith et al. in Bangladesh [12, 13]. Similarly, in Africa the incidence of tubercular pleural effusion was 38.1% of all cases of non-malignant pleural effusions [10]. In areas of better healthcare the most common cause of pleural effusion shifts from tuberculosis to congestive heart failure, para-pneumonic effusion, and also malignant pleural effusion starts to contribute a major portion of the pleural effusion incidence. This is evidenced by the review by Jany et al. where they concluded the most common cause of pleural effusion is congestive heart failure, cancer, pneumonia, and pulmonary embolism [1]. In China, the most common cause of pleural effusion is para-pneumonic effusion followed by malignant pleural effusion [2]. This shows that the trend of pleural effusion is widely different according to the studied population and region. The regions with better healthcare suffer less from infective etiologies such as tuberculosis, para-pneumonic effusions, and empyema than their poorer counterparts.

The most common symptoms were shortness of breath, fever, and cough. This is similar to other studies [8,11]. The shortness of breath was more severe in patients with congestive cardiac failure. The hematology examination revealed that lymphocytosis and neutrophilia are common in patients with pleural effusion. These findings are similar to the studies by Agrahari et al. and Dhital et al [7, 11]. Lymphocytosis is the most common occurrence in the presence of tubercular pleural effusion [14]. Neutrophilia was more common in para-pneumonic effusions than in the cases of tubercular effusions. Para-pneumonic effusions are caused due to the spread of pneumonia and are a cause of neutrophilia [15]. In our study, the mean pleural-to-serum LDH ratio was 0.834 ± 0.39. The mean pleural-to-serum protein ratio was 0.671 ± 0.17. This showed a higher prevalence of exudative effusion, due to a high incidence of tubercular, parapneumonic, and malignant pleural effusion. Exudative pleural effusions would cause an increased pleural-to-serum LDH and protein ratio [5].

The presence of ADA ≥40 IU/L in the pleural fluid is highly sensitive and specific for tubercular pleural effusion [16]. In our study, the cut-off value of 40 IU/L was present in 19 of the 21 cases of tubercular effusion, while other cases of pleural effusion failed to reach that level. The microbiology of the pleural fluid is a poor indicator of the disease. The yield of acid-fast bacilli from the pleural fluid of a tubercular effusion is less than 10% [17]. Similarly, the yield of other bacteria on gram stain is under 2% [18]. In our study, the positive microbiological yield was also low and less sensitive. The sensitivity and specificity of Gene Xpert for the diagnosis of tuberculosis

through pleural effusion are around 25% and 100% respectively [19]. In our study, the Gene Xpert was positive in 10 cases which is 47.61% of the cases of tubercular pleural effusion. The low sensitivity of the Gene Xpert was improved with the use of multiple assays on the sample. Even after this, the sensitivity was only raised slightly higher. The diagnosis of tubercular pleural effusion was done with the help of a combined approach of AFB, Gene Xpert, ADA values, radiological evidences of pulmonary tuberculosis, or a high clinical suspicion of pulmonary tuberculosis.

The outcome of the pleural effusion was mostly favorable with the use of a chest tube for moderate and severe pleural effusion. The tubercular effusion responded well to the anti-tubercular therapy, while para-pneumonic effusion responded to various antibiotics that were used accordingly. According to studies, pleural effusions admitted to ICU have a longer duration of stay, more hours of mechanical ventilation, and drainage of effusion being difficult and re-accumulation being very frequent [20,21]. In our study, there were 12 (20%) cases admitted to the ICU with 2 of those cases resulting in mortalities. The stay of those cases was significantly longer than other cases. Re-expansion pulmonary edema is a rare entity and with studies claiming the incidence is lower than 1% [22]. In our study, a case of pleural effusion due to para-pneumonic effusion underwent thoracotomy and drainage. There, the patient developed pulmonary edema after 2 hours, leading to a diagnosis of re-expansion pulmonary edema.

Our study was a single-center study with relatively small study population, which may not be enough to generalize for the entire population. However, our study correlates well with the studies done by other researches, especially in Nepal and the South Asian region. Further studies with a multicenter approach and a wider study population should be done to determine a more accurate clinical profile of the patients with pleural effusion.

Conclusion

The most common etiology of pleural effusion was tuberculosis, followed by para-pneumonic effusion, with the most common age group being 40-59 years. The most common symptom was shortness of breath, followed by cough and fever. Lymphocytosis and neutrophilia are common occurrences. ADA is a reliable modality to diagnose tubercular effusion. The outcome of most of the cases was favorable while undesirable outcomes are also frequent.

Conflict of interest: None

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