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Research Article

Clinical Profile and Etiological Spectrum of Exudative Pleural Effusion

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Abstract

Background: Exudative pleural effusion is commonly caused by tuberculosis and malignancies, often presenting significant diagnostic challenges in clinical practice. The need to combine clinical characteristics with a cost effective and targeted approach towards making a definitive diagnosis cannot be overemphasized. This study examines the clinical presentation, demographic characteristics, and etiological spectrum of exudative pleural effusion in a Nigerian tertiary care setting. *Methods:* This prospective study involved 58 patients, aged 19 to 87 years who were referred to the cardiothoracic unit of the University of Benin Teaching Hospital over a period of one year with undiagnosed exudative pleural effusion. The demographics, clinical presentation and investigations including laboratory, radiological and pleural fluid characteristics were recorded. The data were subsequently analyzed using SPSS version 25, with results expressed as frequencies, percentages, means, and standard deviations. *Results:* The study revealed malignancy (50%) and tuberculosis (43.2%) as the leading causes of undiagnosed exudative pleural effusion in our environment. Dyspnea (91.4%), cough (87.9%), and chest pain (79.3%) were the most common symptoms. It also demonstrated male preponderance with a male to female ratio of 1.1:1 and a mean age of 51.16±17.487. Left sided effusion predominates (56.9%) as compared to the right (43.1%). Hemorrhagic effusion featured prominently in cases of malignancy (82.8%) while turbid effusion was commoner in cases of tuberculosis (72.0%). *Conclusion:* These findings highlight the need for a thorough clinical evaluation and targeted diagnostic strategies to optimize patient outcomes.

Keywords

Exudative Pleural Effusion, Tuberculosis, Lung Cancer, Clinical Presentation, Ultrasonography, Pleural Biopsy

1. Introduction

Pleural effusion, characterized by abnormal fluid accumulation in the pleural cavity, is a diagnostic challenge due to its varied etiology and thus requires comprehensive evaluation to effectively determine the specific cause in order to achieve successful management [1]. Many common medical conditions manifest as pleural effusion but a vast majority of them are of benign nature [2]. It has however been documented that tuberculosis and malignancies are the most frequent causes of exudative pleural effusion worldwide [2], with geographical and socio-economic factors influencing prevalence. Pleural fluid collections are either transudative or exudative. The Light's criteria [3] provides the basis for differentiating transudative effusion from exudative pleural fluid collections. Pleural effusion is exudative if it satisfies any one of the following criteria: pleural fluid protein/serum protein ratio >0.5

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or pleural fluid lactate dehydrogenase (LDH)/serum LDH ratio >0.6 or pleural fluid LDH level greater than two-thirds the upper limit of normal [3].

The initial diagnostic evaluation of pleural effusion includes chemical, microbiological studies and cytological analysis [4, 5]. Approximately 40% of pleural effusions remain undiagnosed after an initial thoracocentesis thereby necessitating pleural biopsy procedure.[6] The determination of the etiology of pleural effusion is an important factor for effective treatment [7]. The complex interplay of clinical presentation, patient history, and physical examination forms the basis for understanding the etiological landscape of pleural fluid collection [8].

Pleural effusion is seen on chest radiograph as an area of homogenous opacity with blunting of the costophrenic and cardiophrenic angles. In cases where the fluid in the pleural cavity is small, a lateral view of the chest X-ray gives a better imaging than a posterolateral one.[9] Chest ultrasonography is gaining momentum in the recent times in the evaluation of patients with pleural effusion as it appears to be more sensitive than chest radiograph. It is safe and has no radiation but possesses the benefit of repeatability [10]. It is an efficient tool in the hands of experts when identifying loculations and septations in the pleural space and can as well be used to guide thoracocentesis and choose the site of pleural biopsy and insertion of intercostal tube. A computerized tomography scan is usually indicated in conditions where lung parenchyma and mediastinal abnormalities are suspected. It also helps to quantify the amount of fluid in the pleural space [11] and aids image guided biopsy.

In industrialized nations of the world the estimated prevalence of pleural effusion is 320 cases per 100,000 people, with etiological distribution related to the prevalence of the underlying diseases [12]. In the United States the incidence of pleural effusion is estimated to be about 1.5 million cases annually [13] whereas in the UK, more than 0.3% of the population has pleural effusion each year [14]. It is reported that, pleural diseases account for 7.7% of respiratory morbidity in the South West Nigeria, the majority occurring in patients between the ages of 15 and 44 years. [15] Ogunleye et al in their work on aetiology and demographic attributes of common pleural collections in an African population reported 372 cases of pleural effusion over a 55-month period with male to female ratio of 1:1 and most of them between the ages of 20 and 49 years [16].

The objectives of the study includes

To determine the aetiology of undiagnosed exudative pleural effusion referred to the cardiothoracic unit of the University of Benin Teaching Hospital.

To study the clinical presentation of the patients with undiagnosed exudative pleural effusion.

To determine the correlation between the nature of effluents from the pleural space and the final diagnosis.

2. Method

2.1. Study Setting

The study was conducted in the Cardiothoracic Unit, Department of Surgery, University of Benin Teaching Hospital (UBTH), a tertiary healthcare centre in southern Nigeria. The hospital serves as a major referral centre for patients with thoracic diseases from Edo State and neighbouring states.

2.2. Study Design and Study Population

This was a prospective observational study conducted over a period of one year. The study population comprised adult patients referred to the Cardiothoracic unit with undiagnosed exudative pleural effusion.

2.3. Participant Eligibility

Patients were eligible for inclusion if they were aged 18 years or older and had clinical, radiological, and laboratory evidence of exudative pleural effusion according to Light's criteria. Patients who did not meet the criteria for exudative pleural effusion or from whom adequate clinical and diagnostic data could not be obtained were excluded.

2.4. Sample Size and Sampling

A total of 58 consecutive patients who met the eligibility criteria were enrolled during the study period.

2.5. Clinical and Demographic Data Collection

Demographic and clinical information was obtained using a structured data collection instrument. Variables collected included age, sex, presenting symptoms, relevant clinical findings, and other pertinent clinical characteristics. Results of relevant laboratory and radiological investigations were also recorded.

2.6. Pleural Fluid Evaluation

Pleural fluid obtained from eligible participants was subjected to appropriate laboratory investigations for the evaluation of the underlying cause of the effusion. Pleural fluid characteristics and relevant biochemical, microbiological, and cytological findings were documented.Exudative pleural effusion was classified according to Light's criteria.

2.7. Cytological and Histopathological Evaluation

Pleural fluid cytological examination was performed where indicated. Pleural tissue obtained through biopsy was submit-

ted for histopathological examination. Cytological and histopathological findings were used, along with the clinical, radiological, and laboratory findings, to establish the definitive aetiology of the pleural effusion.

2.8. Definition of Final Diagnosis

The final aetiological diagnosis was established based on the overall clinical assessment and available diagnostic findings, including pleural fluid investigations, cytology, and histopathological examination.

2.9. Data Management and Statistical Analysis

Data were entered, coded, and analysed using the Statistical Package for the Social Sciences (SPSS), version 25. Categorical variables were summarized using frequencies and percentages. Continuous variables were expressed as means and standard deviations, as appropriate.

2.10. Ethical Considerations

Ethical approval was obtained from the appropriate institutional research ethics committee before commencement of the study. Written informed consent was obtained from all participants before enrolment. Patient information was treated confidentially and used solely for the purposes of the study.

3. Results

Demographics: The study included 30 males and 28 females, with a male-to-female ratio of 1.1:1. The mean age was 51.16 ± 17.49 years.

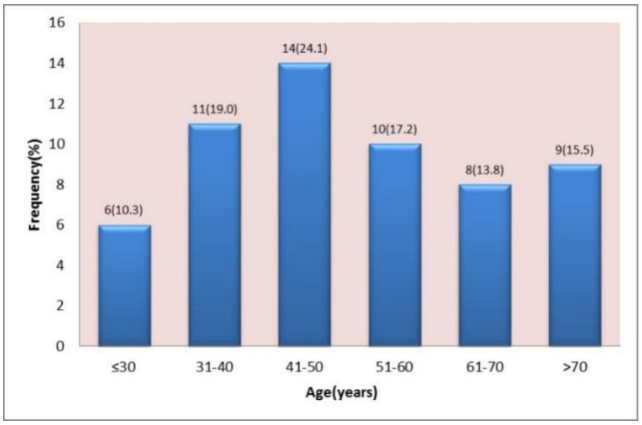

Figure 1. *Age distribution of the patients.*

Figure 1 shows the bar chart of age distribution of the patients in the study. The age range of patients was between 19-87 years. The peak age distribution was 41-50 years accounting for 24.1% of the total population. The mean age of the study population was 51.16±17.487. Over 40% of the population was between the ages of 41 to 60 years while 29.3% each were below 40 years and above 60 years respectively.

Table 1. *Showing the Clinical Features of the patients.*

Symptom	Frequency n=58	Percentage (%)
Dyspnoea	53	91.4
Cough	51	87.9
Chest Pain	46	79.3
Haemoptysis	25	43.1
Weight Loss	34	58.6
Fever	10	17.2
Anorexia	8	13.8

Clinical Presentation The most common symptoms were dyspnea (91.4%), cough (87.9%), and chest pain (79.3%). Weight loss (58.6%) and hemoptysis (43.1%) were also observed (Table 1).

Table 2. Showing the Causes.

Diagnosis	Frequency n=58	Percentage (%)
Malignancy	29	50.0
Tuberculosis	25	43.2
Empyema Thoracis	2	3.4
Thoracic Endometriosis	2	3.4

Etiology: Malignancy accounted for 50% of cases, followed by tuberculosis at 43.2%. Empyema thoracis and thoracic endometriosis were rare (Table 3).

Table 3. Pleural Fluid Characteristics.

Nature of Effluents	Malignancy (%)	Tuberculosis (%)	Empyema (%)	Total
Haemorrhagic	82.8	20.0	0.0	
Turbid	10.3	72.0	0.0	
Purulent	6.9	8.0	100	

Hemorrhagic effusion predominated in malignancy (82.8%), while turbid effusion was commoner in tuberculosis (72.0%) (Table 4).

Table 4. Mean and Standard Deviation of Protein and LDH Investigations.

	Range	Mean	Std. Deviation
Protein			
Pleural Fluid	2.90 (3.2 – 6.1)	4.20	0.690
Serum	2.80 (5.1 – 7.9)	6.14	0.746
Ratio	0.23 (0.59 – 0.82)	0.68	0.061
LDH			
Pleural Fluid	636 (210 – 846)	436.28	149.445
Serum	392 (228 – 620)	332.07	73.513
Ratio	0.95 (0.79 – 1.74)	1.30	0.255

The above table shows that all the patients that participated in the study had exudative pleural effusion. The figures above satisfied light's criteria for exudative effusion; the ratio of pleural fluid protein to serum protein was greater than 0.5 and the ratio of pleural fluid LDH to serum LDH was greater than 0.6 for all participants. For all cases studied, the absolute value of pleural fluid protein and pleural fluid LDH were greater than 3g/dl and 200IU/l respectively.

Table 5. Clinical Investigations.

Variables	Frequency (n = 58)	Percent
Extent of Effusion		
Massive pleural effusion	26	44.8
Moderate pleural effusion	32	55.2
Side of Effusion		
Left sided pleural effusion	33	56.9
Right sided pleural effusion	25	43.1
Full Blood Count		
Normal	40	69.0
Leucocytosis	7	12.0
Lymphocytosis	11	19.0

Table 5 shows the results of chest X-ray and the full blood count parameters for all the patients in the study. It demonstrates that 44.8% of the cases presented with massive pleural effusion while 55.2% came with moderate pleural effusion. The effusions were left sided in 56.9% and right sided in 43.1%. The full blood count shows values within normal range in 69% of cases. However 12% of cases had leukocytosis while 19% had lymphocytosis.

4. Discussion

This study was designed to evaluate the etiological spectrum and the clinical profile of patients with exudative pleural effusion referred to the cardiothoracic unit of the University of Benin Teaching Hospital. The study confirms malignancy and tuberculosis as the leading causes of exudative pleural effusion in our setting.

4.1. Socio-demographic Characteristics

Over a period of one year a total number of 58 consecutive patients with laboratory evidence of pleural effusion were recruited into the study. Thirty (30) were males while 28 were females with a male to female ratio of 1.1: 1. These findings are in keeping with the observations noted in other studies [17-21] that have reported male preponderance in patient with pleural diseases. This may be due to the high prevalence of tobacco smoking and alcohol consumption in males compared to females in our environment. [22, 23] The mean age for the participants in this study was 51.16±17.487 and their ages range from 19 to 87 years. Previous studies have documented similar figure for mean age and age range with slight disparities. A. H Diacon et al [24] recorded a mean age range of 56 years (range 18-80), B. Heidari et al [4] recorded a mean age of 57±17 years with a range (12-82) while A. K. Singh and colleagues in 2024 [25] described a mean age of 48.83±22.87 with the age range of between 8 and 94 years. The mean age in patient with malignancy (61.33±14.497) in this study was higher than the mean age of patients with tuberculosis (42.04±14.616) and other conditions. This is consistent with the findings in a work done by B. Heidari et al in their study on exudative pleural effusion: effectiveness of pleural fluid analysis and pleural biopsy [26]. A similar observation was made in another study on the etiology of exudative pleural effusion among adults: differentiating between tuberculous and other causes, a multicenter prospective cohort study [27] in which the mean age of patient with malignancy (58.33±13.26) was higher than that in tuberculosis (37.78±10.91).

4.2. Mode of Presentation

The common symptoms presented by participants in this study were dyspnoea, 53 (91.4%), cough 51 (87.9%) chest pain 46 (79.3%) and hemoptysis 25 (43.1%) of cases. Other were weight loss 34 (58.6%), fever 10 (17.2%) and anorexia 8 (13.8%). This observation is consistent with the findings from previous studies, Hoda MB et al (2013) [28] found that the common symptoms of patients with pleural diseases in their study were dyspnoea (90.0%), cough (83.3%), and chest pains (66.7%). B. Heidari and colleagues in their study on exudative pleural effusion [26] also documented dyspnoea, cough and chest pains as the main presenting symptoms in patients with tuberculosis and malignancy. Similarly, in agreement with this study, Sahn et al (1991) [29] found dyspnoea and chest pains as the most common presenting symptoms in patient with pleura effusion. This is more so in patients having moderate to massive pleural effusion. Pleuritic chest pain is a cardinal presentation in these patients and it is the result of pleural inflammation. In consonance with our findings, Dhital

et al, in 2009 in their assessment of the clinical profile of patients with pleural effusion found shortness of breath (83%), cough (67%) and fever (66%) as the most common clinical symptoms in their patients with pleural diseases [30]. Adeoye PO et al (2017) found dyspnea, cough and fever as the commonest presentation in their study on etiology, clinical characteristics, and management of pleural effusion in Ilorin, Nigeria and [31]. Laxma RS et al (2019) and Mrinal KS and colleagues (2024) found dyspnoea, cough and fever as the commonest symptoms in their studies on Clinical and Etiological Profile of an Exudative Pleural Effusion in a Tertiary Care Center [32] and Etiological profile of Pleural Effusion: A single Centre Study.[8] respectively.

In the last four studies highlighted, it is observed that fever featured prominently in their work compared to our index study. This may be attributed to the differences in study population and the prevalence of the predisposing and/or aetiological factors for pleural effusion across the various regions. Parapneumonic effusion featured commonly in their studies which was not the case in this work.

4.3. Aetiology

The result of this study revealed that malignancy was the leading cause of exudative pleural effusion in this group of patients referred to the cardiothoracic unit as it accounted for 50% of cases studied while tuberculosis was seen in 43.2%. These findings attest that pleural biopsy is a valuable diagnostic tool for establishing the aetiology and differentiating malignant pleural effusion from tuberculous pleural effusion in patients presenting with undetermined exudative pleural effusion as all patients in this study had pleural biopsy for histology. Two studies from TB-endemic areas share similar outcome with our study as malignant diseases were also the most frequent in their series. [33, 34] In a similar study of patient with exudative or transudative pleural effusion in Islamic Republic of Iran, malignant diseases were also the most frequent aetiology identified.[35] Our study contrasted with three epidemiological studies from areas endemic in tuberculosis. In those studies, tuberculosis was found to be the most common cause of exudative pleural effusion [36-38]. Various factors have been adduced to influence the aetiology for exudative pleural effusion. These factors vary according to the geographical location and the population being studied. Factors that may influence or increase the risk of malignancy include age, smoking habit, and exposure to occupational or environmental risk factors while overcrowding, poverty and malnutrition are associated with increased risk of tuberculosis. [26].

4.4. Pleural Fluid Characteristics and Diagnosis

Available data from this study indicate that haemorrhagic effusion featured prominently in cases of malignancy than in tuberculosis or other benign conditions. While 82.8% of all cases of malignancy had haemorrhagic effusion, only 20.0% of all cases of tuberculosis had haemorrhagic effusion. It was also observed that massive effusions were more in malignant conditions than in tuberculous effusion. These observations are in keeping with findings of Heidari B et al in their study on exudative effusion. They concluded that large and bloody pleural effusions with a high protein concentration favour malignant pleural effusion rather than tuberculosis [26]. Koppu in his descriptive study on the clinical profile of malignant pleural effusions in a tertiary care centre in 2022 also demonstrated that massive pleural effusion were commonly associated with carcinoma of the lungs [39]. The mean and standard deviation for pleural fluid protein and LDH in our study were 4.20±0.690 and 436.2 8±149.445 respectively. This is consistent with findings in a study done by Hoda M. Bahr and colleagues [28] in which they found 4.30±0.71 and 415.9±367.35 respectively.

In the present study, left sided effusion predominates, accounting for 56.1% of the patients with exudative pleural effusion. This figure is in consonance with findings in the study by Mrinal KS and colleagues (2024) in which they have similar observations [8]. Our findings contrasted with the observations in a descriptive study in India that reported right sided effusion predominance [40]. This could be attributed to the fact that while our study examined undiagnosed exudative pleural effusion, the referenced study on the other hand, described both exudative and transudative pleural effusions. Also, that the studies were conducted in two different regions of the world could be a contributory factor as the prevalence of the aetiological factors are different.

4.5. Cytology of Pleural Fluid

The diagnostic yield on cytology in cases of malignancy in the present study was 51.8%. In patients with malignant pleural effusion, cytological examination is a fast, efficient and minimally invasive procedure to establish the diagnosis. Our yield on cytology was slightly lower than the yields documented in some studies in literature as reported by NA Maskeli et al, MMkamel et al, EJ Helm et al and Cuneyt Tetikkurt et al in which they reported values between 60% and 70% [18, 41-43] However, in 2026 Ebtisan M. Gad and associates [44] recorded a lower yield of 37.5% in their study on pleural fluid cytology versus pleural biopsy in malignant pleural effusion The discrepancy observed above may probably be due to the presence of different diseases, tumor type, tumor burden in the pleural space, tumour location, volume of pleural fluid examined, sample handling and the skills of the cytologist. Cytology of pleural fluid is the most informative and definitive initial diagnostic step in pathologic states involving the pleura [43]. It is simple, minimally invasive, and may be considered as the best initial diagnostic tool in the hands of experienced cytologist. Also, thoracocentesis has no severe complications which makes cytology more compelling. The differential diagnosis of any pleural pathology can be considerably narrowed down by the examination of the pleural fluid

alone. Cytology can lead the clinician to the definitive diagnosis or may indicate the next step that would lead to the necessary pathway to arrive at the final diagnosis. This would help to prevent unnecessary invasive interventions. In most diseases related to pleural effusion, the pleural fluid analysis yields important diagnostic information and in certain cases it provides the final diagnosis. Cytological diagnosis of malignant effusions has been reported to have yields between 40% and 87% in different studies [45-47] several factors may influence its sensitivity. The effusion may develop secondary to other factors such as infection, pulmonary emboli or lymphatic blockade. The incidence of positive pleural cytology is higher in patients with a large tumor burden in the pleural surface by causing more exfoliated malignant cells to be in the effusion [48-50].

5. Conclusion

This study highlights the clinical and etiological profiles of exudative pleural effusion in a tertiary care setting. Clinical presentation varies with dyspnoea being the most common symptom. Malignancy and tuberculosis remain the most common aetiology, emphasizing the need for a thorough diagnostic approach. Incorporating imaging guidance, such as ultrasound, into routine practice can improve outcomes.

Abbreviations

LDH Lactose Dehydrogenase

Author Contributions

Author Contributions

Collins Osaro Iyamu: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Validation, Writing – original draft, Writing – review & editing

Stanley Ukadike Okugbo: Conceptualization, Formal Analysis, Methodology, Project administration, Supervision, Validation, Writing – original draft, Writing – review & editing

Conflicts of Interest

The authors declare no conflicts of interest.

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