

Understanding Clinical and Etiologic Profile of Pleural Effusions in Critically Ill Patients: A Cross-Sectional Study from North India.

Abhishek Gaurav¹, Priyanka Verma², Vipin Jamdagni¹

Abstract

Background: Pleural effusion may be a presenting complaint or may develop post admission, recognizing the cause and initiating appropriate treatment can have a substantial impact on the prognosis and outcome, particularly in critically ill or mechanically ventilated patient. **Aim:** The study aimed to document the variety of causes of Pleural Effusion in North India in ICU patients. **Methods:** A cross-sectional study focused on 70 patients admitted to the medical ICU who presented with clinical and/or radiographic evidence of pleural effusion. **Results:** Nearly 22% of the patients had pleural effusion, with tuberculosis infections as the most common cause and interestingly, 5.7% of cases remained undiagnosed. **Conclusion:** In ICUs, pleural effusions are common and infections, particularly tuberculous pleural effusion, were the primary contributors, followed by parapneumonic effusions and heart failure. Our study highlights the importance of early identification and appropriate management of pleural effusions in ICU patients.

Keywords: Pleural effusion, critical ill, intensive care unit

¹Dept of Medicine, SGT Medical Collage, Gurugram, Haryana, India ²Aarvy Healthcare, Gurugram, Haryana, India

Corresponding Author: Dr. Abhishek Gaurav, Assistant Professor, Dept of Medicine, SGT Medical Collage, Gurugram, Haryana, India Email: drabhishekgaurav01@gmail.com

Received: 02nd June 2023

Accepted: 20th June 2023

How to Cite this Article: Gaurav A, Verma P, Jamdagni V. Understanding clinical and etiologic profile of Pleural effusions in critically ill patients: a cross-sectional study from North India. J Int Med Sci Acad 2023;36(3):278-283.

Access this article online : www.imsaonline.com



Introduction

Pleural effusion is a condition where an excessive buildup of fluid in the pleural space results from an imbalance between fluid production and its removal. This condition is classified into two main categories: transudative and exudative effusions, and Light's criteria commonly used to differentiate between these two types of effusions [1]. In the ICU, most pleural effusions result from pulmonary and organ system disorders rather than primary pleural issues, with causes including infections like pneumonia and tuberculosis, heart failure, fluid overload due to conditions such as hypoalbuminemia, aggressive intravenous fluid administration, acute kidney injury, and positive pressure ventilation [2,3]. Numerous studies have reported a significant occurrence of pleural effusions in critically ill individuals receiving mechanical ventilation, with prevalence rates varying widely and reaching as high as 50% to 70% in certain studies [4]. The presence of pleural effusion can have a substantial impact on the prognosis and outcome, particularly in critically ill or mechanically ventilated patient. There is paucity of Indian data on etiological profile of effusion in ICU settings. We conducted a cross-sectional study with a specific focus on analysing the clinical and etiological characteristics of pleural effusions in patients within the ICU.

Material and Methods

This cross-sectional study was conducted at ICU, CCU and RICU of SGT Medical Collage and Hospital, Gurugram Haryana over a period of 18 months

Patient Selection

This cross-sectional study focused on 70 patients admitted to the medical ICU who presented with clinical and/or radiographic evidence of pleural effusion and met the specified selection criteria.

Inclusion criteria encompassed patients admitted to the ICU with evidence of pleural effusion, those with aspirable effusions, and individuals providing informed written consent. Conversely, exclusion criteria comprised patients with hemodynamic instability, small non-aspirable effusions, and severe homeostatic abnormalities (platelets < 50,000/ μ l, INR > 2, or APTT more than twice the control). Of the 70 patients, 60 patients presented with effusion on the day of admission, while 10 patients developed effusion after admission.

Procedure for assessing and managing pleural effusion

Clinical Assessment

The presence and location of pleural effusion was initially assessed clinically, based on history and physical examination.

Imaging confirmation

Confirmation of pleural effusion was then done using various imaging techniques, including Chest X-ray, Chest ultrasound, and in some cases, a CT scan of the chest. These imaging methods helped visualize the extent and location of the effusion.

Thoracentesis

If pleural effusion was confirmed and required intervention, thoracentesis was performed. The procedure was done with the patient in an upright and slightly leaning forward position (with arm support) or in a supine position for patients who could not sit or were on ventilator support.

Aseptic Precautions

The procedure was performed with strict aseptic precautions to minimize the risk of infection. This included sterilizing the area and using sterile equipment.

Local Anaesthesia

Local anaesthesia, typically in the form of lidocaine injection was administered to numb the area where the needle was to be inserted. This helped minimize discomfort during the procedure.

Needle Placement

A large-bore needle-catheter device, typically in the range of 16 to 19-gauge, was used for thoracentesis. The needle was inserted at a specific location, which is typically the upper border of a rib one intercostal space below the fluid level in the midscapular line.

Fluid Aspiration

The needle was advanced with periodic aspiration until it pierced the parietal pleura and reaches the pleural fluid. This step ensured that the fluid was safely accessed.

Catheter Use

After accessing the pleural fluid, the needle was removed, and a catheter was used to withdraw the pleural fluid. This technique

helped reduce the risk of pneumothorax (a potential complication.)

Therapeutic Thoracentesis

In cases where indicated, therapeutic thoracentesis was performed to remove a significant amount of pleural fluid, which helped alleviate symptoms and improve lung function.

Fluid Sample Collection

All pleural fluid samples were collected under aseptic conditions in a sterile container. These samples were then immediately transported to the laboratory for further testing and analysis.

Diagnostic criteria for classifying the causes of pleural effusions into various categories

After confirmation of pleural fluid via clinical, radiological methods, pleural aspiration as described was done.

The results were initially divided into two broad categories depending on Lights Criteria

- 1) Exudative
- 2) Transudative

Light's Criteria are used to determine whether a pleural effusion is exudative or transudative.

Satisfying any ONE criterium means it is exudative:

- Pleural Total Protein/Serum Total Protein ratio > 0.5
- Pleural lactate dehydrogenase/Serum lactate dehydrogenase ratio > 0.6
- Pleural lactate dehydrogenase level > 2/3 upper limit of the laboratory's reference range of serum lactate dehydrogenase.

After this the fluid was further analysed to reach an etiology as described below:

Table 1: Analysis of pleural effusion.

Test	Test Value	Suggested Diagnosis
Lactate dehydrogenase (LDH) LDH Fluid/LDH Serum Protein Fluid/ Protein Serum	> 2/3 of upper limit of normal serum LDH > 0.6 > 0.5	Exudate
Cell count and differential		
+ Red cells	>100.000 per mm ³	Malignancy, infection, pulmonary embolism (PE), trauma
+ White cells - Neutrophils - Lymphocytes	>10.000 per mm ³ > 50% > 50%	Empyema, other exudates Parapneumonic, PE, abdominal cause TB, malignancy, PE, Heart Surgery
Cytology	Neoplastic cells present	Malignancy
Adenosine deaminasa (ADA)	> 40 U per L	Tuberculosis (90%)
pH	< 7.2	Empyema, complicated parapneumonic
Glucose	< 60 mg/dl	Complicated parapneumonic, Empyema, TB, rheumatoid arthritis
Stains and cultures*		
Ziehl and Lowenstein Gran stain Aerobic/anaerobic cultures	Positive Positive Positive	Tuberculosis Bacterial pneumonia Bacterial pneumonia

* if infectious origin is suspected

Tuberculous Pleural Effusion

This type of effusion was usually associated with tuberculosis (TB) and is characterized by subacute or acute symptoms, including fever and breathlessness. It tends to be unilateral and may be associated with pulmonary infiltrates. Key diagnostic features include a predominantly lymphocytic cell count in the pleural fluid, a high adenosine deaminase (ADA) level (>40), positive acid-fast bacilli (AFB) culture in fluid, or the presence of granulomas on pleural biopsy. Response to anti-TB treatment (ATT) can also support this diagnosis.

Heart Failure-Related Pleural Effusion

Effusions related to heart failure are typically associated with clinical signs such as jugular venous distention, S3 gallop heart sound, and basilar crackles. Chest radiographs may show cardiomegaly and bilateral alveolar edema, often with bilateral effusions. The pleural fluid is transudative in nature. Abnormal findings on echocardiography can further support this diagnosis.

Parapneumonic Pleural Effusion

These effusions are associated with pneumonia and were characterized by fever and new localized pulmonary infiltrates. There was usually a clinical or microbiological confirmation of pneumonia, and the effusion can be ipsilateral to the pneumonia site. It could also present as free-flowing or loculated.

Fluid Overload due to Acute Kidney Injury

Patients with acute kidney injury may develop pleural effusions as part of generalized fluid overload. Clinical signs include edema and basilar crackles. Chest radiographs often show bilateral effusions, and the pleural fluid is transudative.

Atelectasis-Related Pleural Effusion

Effusions related to atelectasis was associated with specific chest radiograph findings, such as plate-like changes, volume loss, and small ipsilateral effusion. Rapid resolution of the fluid with the resolution of atelectasis is a key feature.

Hypoalbuminemia-Related Pleural Effusion

Transudative effusions can occur in patients with serum albumin levels below 2.5 g/dL.

Empyema

Empyema is characterized by pleural fluid with pus or compatible pleural fluid chemistries. Positive pleural fluid Gram stain or culture can confirm the diagnosis.

Malignant Pleural Effusion

A cytological examination that is positive for malignant cells confirms a malignant pleural effusion.

Hemothorax

The presence of blood during thoracentesis indicates a hemothorax.

Uremic Pleural Effusion

Patients receiving long-term hemodialysis may develop a unilateral effusion that resolves with continued dialysis and without another identified cause.

Liver Abscess-Related Pleural Effusion

Clinical, laboratory, and imaging evidence of a liver abscess, along with an exudative pleural effusion, supports this diagnosis. The effusion typically resolves as the liver abscess is treated.

Rheumatoid Arthritis-Related Pleural Effusion

When there are exudative pleural effusions in individuals diagnosed with rheumatoid arthritis and no other identifiable cause is present, these effusions can be attributed to the rheumatoid arthritis itself. Pleural fluid is categorized as exudative when it satisfies any of the following conditions: a pleural fluid protein/serum protein ratio higher than 0.5, a pleural fluid lactate dehydrogenase (LDH)/serum LDH ratio greater than 0.6, or a pleural fluid LDH level that surpasses two-thirds of the upper limit.

After classifying the pleural fluid as either exudate or transudate, further diagnostic tests and clinical evaluation can help pinpoint the specific cause, guiding appropriate treatment. The classification is crucial as it helps narrow down the differential diagnosis and informs the next steps in patient management.

Statistical Analysis

The analysis of data was conducted utilizing SPSS software (IBM Corp, Armonk, NY, USA; version 20.0). Continuous variables that followed a normal distribution were compared using the ttest, while non-normally distributed continuous variables were examined using the Mann-Whitney U test. For categorical variables, the chi-square test or Fisher's exact test was employed for assessment.

Results

Over the course of 18 months, our research study included 70 patients who were diagnosed with pleural effusion, comprising 22.5% of a total of 310 admissions to the intensive care unit (ICU). Among the study participants, 52% were male, and a significant portion of the group (35%) were in the age range of 60 to 70 years, with a mean of 50.12 years (SD 9.10).

The study's results indicated that tuberculous infections were the most common cause of pleural effusions (28.6%), followed by heart failure (11.4%), parapneumonic conditions (11.4%), malignancy (7.1%), fluid overload secondary to AKI (7.1%), atelectasis (5.7%), and various other miscellaneous causes (18%). Interestingly, 5.7% of cases remained undiagnosed. During their hospitalization, 30% of patients required mechanical ventilation, and nine patients (12.8%) died during the study period.

A significant portion of patients (57.2%) required ICU admission primarily because of hypoxic respiratory failure. Other factors leading to ICU admission included AKI in 18.5% of cases, shock in 14.3% and cardiogenic pulmonary edema in 10%.

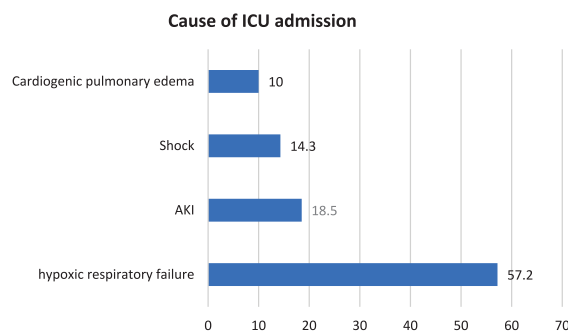


Figure 1: Reason for admission to intensive care unit (in %) (N=70).

Cause of ICU Admission

On an average, there was a time gap of 2.2 days between admission to the Medical ICU and the actual thoracentesis procedure, with a median duration of 2.5 days. This timeframe ranged from 2 to 5 days. Among the patients, 30% necessitated initial diuretic treatment (sever respiratory compromise: Respiratory rate >40/min, SPO2 <85% on RA, respiratory acidosis), and 27% required vasopressor support (hypotension BP <90mm Systolic, MAP <60, peripheral oedema, shock).

Additionally, at the time when thoracentesis was performed, 34% of the patients were under mechanical ventilation.

Regarding the nature of the effusions, 60% were unilateral, while 40% were bilateral. The majority of exudative effusions were unilateral (80%), whereas most transudative effusions were bilateral (85%). Among bilateral effusions, heart failure was the most common cause (25%), followed by parapneumonic effusion and fluid overload due to acute kidney injury AKI (Table 2).

Pleural effusion was present in 85% of patients upon admission, while 15% developed it during their hospital stays. Among those that developed during the hospital stay, 90% were transudates, and 10% were exudative (parapneumonic). Among the transudative

effusions that developed during ICU stay, the causes included heart failure, atelectasis, and hypoalbuminemia (Table 2).

Out of the total patient population, 12.8% (9 individuals) had died during the study. Six of these patients had exudative effusions, while three had transudative effusions. Five of the deceased succumbed to infections (three with tuberculous empyema and two with severe sepsis), and four died due to heart failure and cardiogenic pulmonary edema.

Most pleural effusions (77%) were classified as exudative, while 23% were transudates. Among exudative effusions, 70% were related to infections, with tuberculosis being the most common cause (35.2%), followed by parapneumonic effusion (14.8%). Transudative effusions were primarily caused by heart failure (31.2%), followed by acute kidney injury (25%) and atelectasis (18.7%).

Infectious exudates encompassed conditions such as tuberculosis, parapneumonic effusion, empyema, and liver abscess, while non-infectious exudates included malignancy, hemothorax, heart failure, rheumatoid arthritis, and uremic effusion. Out of the total effusions, 48.6% were of infectious nature, and 45.7% were non-infectious in origin.

Table 2: Cause of pleural effusion-etiology (n=70)

Cause of effusion	Total Number of patients (N=70)	N (%)			
		Bilateral (N=28)	Unilateral (N=42)	Exudate (N=54)	Transudate (N=16)
Tuberculous	20 (28.6)	1(3.5)	19(45.2)	19 (35.2)	1(6.3)
Heart Failure	8 (11.4)	7(25)	1(2.4)	3(5.5)	5 (31.2)
Uncomplicated Para- pneumonic	8 (11.4)	4(14.3)	4(9.5)	8(14.8)	0
AKI	5 (7.1)	4(14.3)	1(2.4)	1(1.8)	4 (25)
Malignancy	5 (7.1)	2(2.9)	3(7.1)	5(9.3)	0
Empyema	3 (4.3)	0	3(7.1)	3 (5.5)	0
Atelectasis	4 (5.7)	2(2.9)	2(4.7)	1 (1.8)	3 (18.7)
Hypoalbuminemia	2 (2.9)	1(3.5)	1(2.4)	0	2(12.5)
Uremic pleurisy	2 (2.9)	1(3.5)	2(4.7)	3(5.5)	0
Renal failure (dialysis)	1 (1.4)	1 (3.5)	0	1 (1.8)	0
Liver Abscess	3 (4.3)	1(3.5)	2(4.7)	3(5.5)	0
Hemothorax	3 (4.3)	1(3.5)	2(4.7)	3 (5.5)	0
Rheumatoid Arthritis	2 (2.9)	1(3.5)	1(2.4)	2(3.7)	0
Undetermined	4 (5.7)	3(10.7)	1(2.4)	3(5.5)	1(6.3)

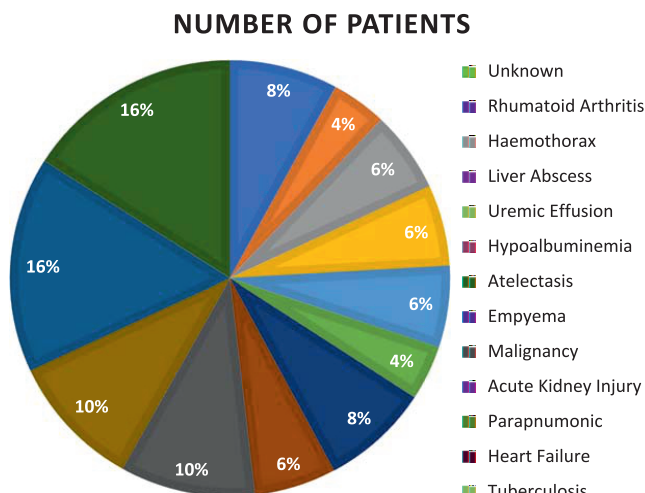


Figure 2: Causes of pleural effusion (in %).

Discussion

Pleural effusions are a frequent occurrence among patients in the ICU, but they are seldom a result of primary pleural conditions. Various factors come into play when it comes to the development of pleural effusions in ICU patients. These effusions can significantly impact the well-being of ICU patients by hampering gas exchange and influencing respiratory mechanics. Therefore, investigating the causes of pleural effusions and understanding the complex factors involved can contribute to the enhanced management of these patients.

There is a lack of comprehensive research on pleural effusions in the ICU, especially in India where these effusions are prevalent. In our investigation, we observed that infections were the primary culprits behind pleural effusions, accounting for 48.6% of all cases. These infections encompassed tuberculosis (28.6% of all effusions), parapneumonic effusions (11.4%), empyemas (4.3%), and liver

abscess-related effusions (4.3%).

Interestingly, two prior studies yielded conflicting results. Mattison et al [5], conducted in South Carolina, USA, reported that most effusions were non-infectious in origin (82%), with heart failure (35%) and atelectasis (23%) being the primary contributors. In contrast, Fartoukh et al [6], conducted in Paris, France, found that infectious causes accounted for 43% of all effusions, making it the leading cause in their study. Epidemiological factors may play a role in the variation of etiologies observed in patients from different parts of the world. Developed countries like the USA and France tend to have lower incidences of infections compared to India. India, being a tropical country with factors such as rapid urbanization, high prevalence of malnutrition, and overcrowding, is more susceptible to increased incidence and spread of infections. There are very few studies from India, that have focused on pleural effusions in the ICU.

The study conducted by Chinchkar et al [7] in 2015 highlighted that infections were the predominant cause of effusions in their respiratory ICU, accounting for 36% of cases, with parapneumonic effusions (22%) and tuberculosis (14%) being the primary contributors. However, it's important to note that the limitation of their study was the exclusive focus on patients from the respiratory ICU, which could impact the generalizability of their findings.

In contrast, our study included patients from all ICU settings, providing a more comprehensive perspective on the etiologies of pleural effusions. In our study, tuberculosis emerged as the most prevalent cause of pleural effusion, accounting for 28.5% of all cases. It was closely followed by heart failure and uncomplicated parapneumonic effusions, both contributing to 11.4% of the total cases. Malignant pleural effusions and volume overload due to AKI followed at 7.1%. Comparatively, in a 2015 Indian study by Chinchkar et al [7], malignancy emerged as the major cause of effusions (24%), followed by parapneumonic effusions (22%), CHF (18%), and tuberculosis (14%). Furthermore, a more recent Indian study conducted by Siddiqui et al [8] in 2016 reported that tubercular effusion was the most common (64.6%), followed by parapneumonic effusions (14.6%) and malignancy-related effusions (11.5%).

Likewise, another Indian study conducted by Raghavan et al., [9] found that the leading cause of pleural effusion was Tuberculous, followed by malignancy. These findings underscore the variability in the causes of pleural effusions among different patient populations, highlighting the importance of considering various factors when studying this condition.

In general, most studies identify infectious causes as the primary culprits behind pleural effusions in the ICU. Western literature often highlights the prevalence of parapneumonic effusions, while in India, tuberculosis plays a significant role in contributing to a substantial number of cases. Unlike Western countries, tuberculous pleural effusion is notably common in India, and it remains the leading cause of pleural effusion even in the absence of evident pulmonary disease. Additionally, effusions resulting from congestive heart failure (CCF) are frequent occurrences in ICU settings.

Patients in our study ranged from 19 years to 82 years of age with a mean age of 50.12 years. Majority of the patients were in the age group of 60-70 years (35%) followed by 31-40 years (17%). The results were consistent with study in South Carolina, USA by Mattison et al [5], demonstrated that during ICU stay majority of patients with PE were older. In Hyderabad, India a study by Reddy et al.,[10] showed that the mean age of the study population was 48.8 years. In another Indian study conducted by Raghavan et al.

[9], a total of 100 patients were included, and most of them were male. The patients were primarily within the age range of 30 to 60 years, with an average age of 46.49 years and a standard deviation of 13.5 years.

Admissions to the ICU are seldom primarily due to pleural diseases. In our study, the most common reason for admission to the ICU was hypoxic respiratory failure, accounting for 57.2% of cases, making it the predominant indication for ICU admission. Other causes included AKI, septic shock, and cardiogenic pulmonary edema. Similarly, previous studies by Mattison et al., [5] and Chinchkar et al., [7] also identified hypoxic respiratory failure as the leading cause of admission to the ICU, followed by shock and cardiovascular disorders.

Bilateral transudative pleural effusions are most frequently associated with conditions such as CCF, liver cirrhosis, renal failure, and hypoalbuminemia [11]. In our study, the most common cause of bilateral pleural effusion was heart failure (25%), followed by parapneumonic effusions (14.3%) and AKI (14.3%). This finding aligns with observations from Mattison et al. [5] and Chinchkar et al., [7] where heart failure was also identified as the most common cause of bilateral transudative effusions. On the other hand, the most common cause of unilateral effusion in our study was tuberculosis (45.2%), followed by parapneumonic effusions (9.5%).

Out of the 70 patients in our study, 60 had pleural effusion at the time of admission (85.7%), while ten patients developed it during their hospital stay (14.3%). Among these ten effusions that developed during the hospital stay, three were caused by heart failure, two by parapneumonic effusions, one by AKI, two by atelectasis, and one each by hypoalbuminemia and uremic effusion.

A previous study by Chinchkar et al.,[7] reported that 88% of effusions were preexisting at the time of admission. In our study, there were a total of 9 deaths out of 70 patients (13%). Five died from infection-related causes, including three with tuberculous empyema and two with severe sepsis. Four died due to heart failure and cardiogenic pulmonary edema. Importantly, none of the deaths occurred directly as a result of pleural disease. Mattison et al., [5] observed a 16% mortality rate in their study, while Chinchkar et al., [7] reported a mortality rate of 28% in their research.

Conclusion

In ICUs, pleural effusions are common, and our study aimed to identify their main causes. Infections, particularly tuberculous pleural effusion, was the primary contributors (28.6%), followed by parapneumonic effusions and heart failure (both 11.4%).

While most were common and with obvious etiology and were identified and managed, we should also be open to presence of other conditions like Malignancy and AKI (7.1%), Hypoalbuminemia (2.9%), Rheumatoid Arthritis (2.9%),.. Availability of good radiology, biochemistry, pathology and microbiology labs are of utmost importance in early diagnosis and treatment. Despite our best efforts 5.7% were undiagnosed due to various limitation.

Most pleural effusions (88%) were the presenting finding during ICU admission, but many did develop effusion during their stay in the ICU, hence emphasis should be paid on daily assessment and more frequent radiology assessment in sick patients or those on ventilatory support. Mean age of admission was 50.12 years, and with a growing geriatric population this number will increase in coming time.

Although our sample size and study were in a relatively small

group of people the findings are consistent with other studies conducted so far, our clinical features are more due to infective diseases vis-a-vi others. In summary, our study highlights the importance of early identification and appropriate management of pleural effusions in ICU patients. By considering early screening, regular follow up of patient and education of healthcare teams can enhance the care and prognosis of patients with pleural effusions in the ICU setting.

Conflict of Interest:	All authors declare no COI
Ethics:	There is no ethical violation as it is based on voluntary anonymous interviews
Funding:	No external funding
Guarantor:	Dr. Abhishek Gaurav will act as guarantor of this article on behalf of all co-authors.

References

1. Light RW, Macgregor MI, Luchsinger PC, Ball WC Jr. Pleural effusions: The diagnostic separation of transudates and exudates. *Ann Intern Med* 1972;77:507-13
2. Chetty KG. Transudative pleural effusions. *Clin Chest Med* 1985;6:49-54.
3. Collins TR, Sahn SA. Thoracentesis. Clinical value, complications, technical problems, and patient experience. *Chest* 1987;91:817-22.
4. Bediwy AS, Al-Biltagi M, Saeed NK, Bediwy HA, Elbeltagi R. Pleural effusion in critically ill patients and intensive care setting. *World J Clin Cases* 2023; 11(5): 989-999.
5. Mattison LE, Coppage L, Alderman DF, Herlong JO, Sahn SA. Pleural effusions in the medical ICU: prevalence, causes, and clinical implications. *Chest*. 1997 Apr;111(4):1018-23. doi: 10.1378/chest.111.4.1018. PMID: 9106583.
6. Fartoukh M, Azoulay E, Galliot R, Le Gall JR, Baud F, Chevret S, Schlemmer B. Clinically documented pleural effusions in medical ICU patients: how useful is routine thoracentesis? *Chest*. 2002;121:178-184.
7. Chinchkar NJ, Talwar D, Jain SK. A stepwise approach to the etiologic diagnosis of pleural effusion in respiratory intensive care unit and short-term evaluation of treatment. *Lung India* 2015;32:107-15.
8. Siddiqui MA, V K Srivastava. Clinical And Etiological Profile of Patients With Pleural Effusion: A Retrospective Cross-Sectional Study in North India. *Indian Journal of Applied Research*. 2016;6(5):285-87.
9. Raghavan S, Jayachandran. R. Sandra Mosses. Clinical and Etiological Profile of Patients with Pleural Effusion in A Tertiary Care Centre. *Journal of Medical Science and clinical research*. 2017;5(6):23553-58.
10. Reddy SL, Varaprasad K, Narahari N, Bhaskar K, Varma GR, Paramjyothi GK. Clinical and etiologic profile of an exudative pleural effusion in a tertiary care center. *Indian J Respir Care* 2019;8:22-6.
11. Bhatnagar R, Maskell N. The modern diagnosis and management of pleural effusions. *BMJ* 2015;351:h4520.

