ORIGINAL RESEARCH PAPER
Volume - 15 | Issue - 09 | September - 2026 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

CLINICO-CYTOLOGICAL SPECTRUM OF PLEURAL FLUID CYTOLOGY: A ONE-YEAR RETROSPECTIVE STUDY FROM A TERTIARY CARE HOSPITAL

Pathology

Pooja B Lakshatwar — Resident Doctor, Department of Pathology, Dr. Shankarrao Chavan Government Medical College and Hospital, Vishnupuri, Nanded, Maharashtra, India

Mohammed A Sameer — Professor and HOD, Department of Pathology, Dr. Shankarrao Chavan Government Medical College and Hospital, Vishnupuri, Nanded, Maharashtra, India

Panjabrao N Kadam — Associate Professor, Department of Pathology SCGMC, Nanded

ABSTRACT

Background: Pleural effusion has a wide range of etiologies, and pleural fluid cytology remains an important investigation in its evaluation. This study was undertaken to assess the spectrum of pleural fluid cytological findings in a tertiary care hospital. **Methods:** A retrospective observational study was conducted in the Department of Pathology, Dr. Shankarrao Chavan Government Medical College, Nanded, Maharashtra, from January 2025 to December 2025. A total of 802 pleural fluid samples were evaluated. Samples were classified as transudative or exudative according to Light's criteria and subjected to cytological examination using hematoxylin and eosin and Papanicolaou stains. Demographic details, nature of pleural effusion, predominant cellular pattern, and cytomorphological findings were recorded and analyzed using descriptive statistics. **Results:** Of the 802 samples, 573 were from male patients and 229 from female patients. Patients aged >50 years constituted the largest age group (n=403). A total of 256 samples were classified as transudative and 546 as exudative. Among the exudative samples, 334 were tuberculous, 196 were nonspecific/parapneumonic, and 16 showed atypical cytological features suspicious for malignancy. Lymphocyte predominance was the most frequent cellular pattern among exudative effusions (426/546), followed by neutrophil predominance (98/546) and mixed/other cellular patterns (22/546). **Conclusion:** Pleural fluid cytology demonstrated a broad spectrum of inflammatory, reactive, and atypical cytological findings. Exudative effusions predominated, with tuberculosis being the most frequent identified category, while lymphocyte predominance was the commonest cellular pattern. Pleural fluid cytology remains a useful minimally invasive investigation for the evaluation of pleural effusions, particularly in settings where tuberculosis is a major cause of exudative effusion.

KEYWORDS

Pleural Effusion; Pleural Fluid Cytology; Tuberculosis; Exudative Effusion; Lymphocyte Predominance; Reactive Mesothelial Cells

INTRODUCTION

Pleural infection is not a new disease. Hippocrates (460–377 BC) described pleurisy and its progression to empyema if left untreated and pioneered one of the earliest methods of drainage of the intercostal space. Centuries later, pleural infection continues to be a common problem worldwide, accounting for significant morbidity and mortality. Its incidence has been rising, with elderly, immuno-compromised, and hospitalized patients being particularly vulnerable. [1]

Pleural effusion is the abnormal accumulation of fluid within the pleural space, the thin cavity between the pleural layers surrounding the lungs. It can arise from a variety of etiologies, ranging from heart failure and pneumonia to malignancies such as lung cancer and systemic inflammatory disorders such as lupus. [2]

Establishing the cause of a pleural effusion can be challenging. Analysis of pleural fluid is a powerful tool for determining the underlying cause of pleural effusion. Despite its diagnostic value, pleural fluid analysis is often underused. [3]

With the relative ease of percutaneous access to the pleural space, techniques such as pleural biopsy and thoracoscopy have become increasingly utilized, particularly in developed countries. However, in developing countries such as India, where such specialized facilities are available only in selected advanced pulmonary medicine centers, pleural fluid analysis and cytology continue to be important tools in the diagnosis of various pleural and pulmonary diseases. Thoracentesis can be safely performed to obtain a pleural fluid sample when the thickness of the pleural fluid layer is at least 10 mm. [4]

The present study was therefore undertaken to evaluate the spectrum of pleural fluid cytological findings in a tertiary care hospital over a period of one year.

MATERIALS AND METHODS

A retrospective observational study was conducted in the Department of Pathology, Dr. Shankarrao Chavan Government Medical College, Nanded, Maharashtra, India, over a period of one year from January 2025 to December 2025. A total of 802 pleural fluid samples received in the Department of Pathology during the study period were included in the study. Demographic details including age and sex were obtained from the available laboratory records.

Pleural fluid samples were classified as transudative or exudative based on Light's criteria. Exudative effusions were further evaluated cytologically for the predominant cellular pattern and other cytomorphological findings. Pleural fluid samples were received in variable volumes and were centrifuged for 15–20 minutes. The centrifugation speed was not recorded. Two to three smears were prepared from each sample. Hematoxylin and eosin (H&E) and Papanicolaou (Pap) stains were used for cytological examination. The smears were evaluated for inflammatory cells, reactive cellular changes, atypical cells, and malignant cells. Cases showing atypical cellular features that were inconclusive for malignancy were categorized as suspicious for malignancy, while cases showing definite malignant cells were categorized as malignant. In cases where malignancy was suspected, three different samples obtained at different time points were examined for confirmation.

The inclusion criteria were adequate samples with a detailed history of the patient. Samples that were inadequate or were received without a detailed history were excluded from the study.

The demographic and cytological findings were retrieved from laboratory records and analyzed using descriptive statistics. The variables assessed included age, sex, nature of pleural effusion, predominant cell type among exudative effusions, suspicious cytological findings, and malignant cells.

Ethical approval for the study was obtained from the Institutional Ethics Committee of Dr. Shankarrao Chavan Government Medical College, Nanded.

RESULTS

A total of 802 pleural fluid samples were evaluated during the study period from January 2025 to December 2025. Of these, 573 samples were from male patients and 229 from female patients. The age distribution showed a predominance of patients in the older age groups, with the highest number of samples observed in patients aged >50 years (n=403), followed by the 40–50 years age group (n=233). The remaining samples were distributed across the 0–10 years (n=21), 10–20 years (n=37), 20–30 years (n=45), and 30–40 years (n=67) age groups (Table 1).

Table 1. Age and Sex Distribution of the Study Population

Variable	Number of cases
Sex	
Male	573
Female	229
Age group (years)	
0–10	21
10–20	37
20–30	45
30–40	67
40–50	233
>50	403
Total	802

Cytological Spectrum of Pleural Fluid

Based on Light's criteria and cytological findings, 256 cases were classified as transudative effusions, associated with congestive heart failure, cirrhosis, and nephrotic syndrome. A total of 546 cases were classified as exudative effusions. Among these, 196 cases were categorized as nonspecific/parapneumonic exudates, while 334 cases were categorized as tuberculous exudates. In addition, 16 exudative cases showed atypical cytological features that were inconclusive for malignancy and were categorized as suspicious for malignancy (Table 2).

Table 2. Distribution of Pleural Fluid Samples According to Cytological Category

Category	Number of cases
Transudate – CHF, cirrhosis, nephrotic syndrome	256
Exudate – Nonspecific/Parapneumonic	196
Exudate – Tuberculous	334
Suspicious for malignancy – atypical/inconclusive	16
Total	802

Cellular Pattern in Exudative Pleural Effusions

Among the 546 exudative pleural fluid samples, lymphocyte predominance was the most frequent cellular pattern, observed in 426 cases, followed by neutrophil predominance in 98 cases and mixed/other cellular patterns in 22 cases (Table 3). Representative lymphocyte-predominant inflammatory and neutrophil-predominant smears are shown in Figures 1 and 2, respectively. Representative reactive mesothelial cells are shown in Figure 3.

Table 3. Predominant cellular pattern in exudative pleural effusions

Predominant cellular pattern	Number of cases
Lymphocyte predominant	426
Neutrophil predominant	98
Mixed/Other	22
Total	546

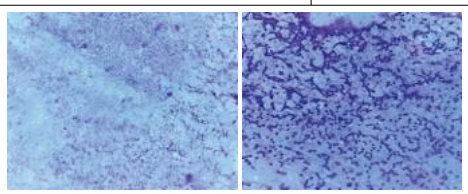

Figure 1. Lymphocyte-predominant Inflammatory Pattern in Pleural Fluid. (A) Pleural fluid smear showing lymphocyte-predominant inflammatory cellularity at 10× magnification. (B) Same smear showing lymphocyte-predominant inflammatory cellularity at 40× magnification. *(H&E stain).*

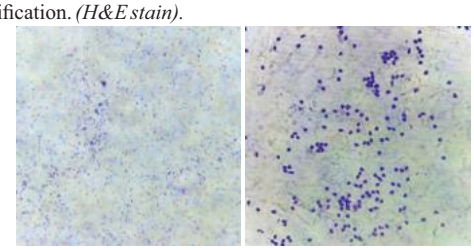

Figure 2. Neutrophil-predominant inflammatory pattern in pleural fluid. (A) Pleural fluid smear showing neutrophil-predominant inflammatory cellularity at 10× magnification. (B) Same smear showing neutrophil-predominant inflammatory cellularity at 40× magnification. *(H&E stain).*

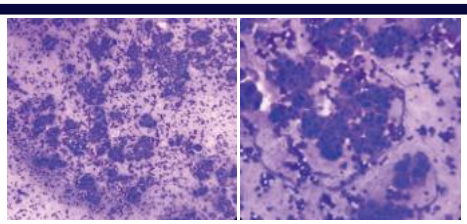

Figure 3. Reactive mesothelial cells in pleural fluid. (A) Pleural fluid smear showing reactive mesothelial cells at 10× magnification. (B) Same smear at 40× magnification. *(H&E stain).*

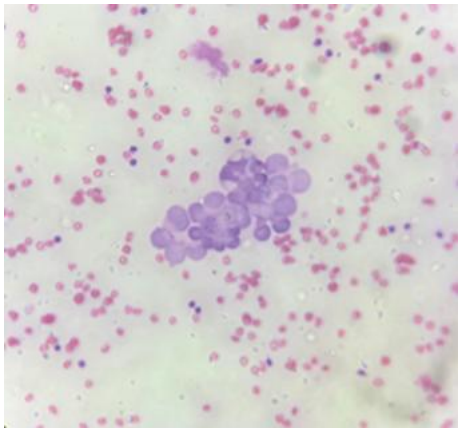

Figure 4. Malignant cells in pleural fluid. Pleural fluid smear showing malignant cells at 40× magnification. *(H&E stain).*

DISCUSSION

In the present study, 802 pleural fluid samples were evaluated over one year. A male predominance was observed, with 573 samples from male patients and 229 from female patients (male-to-female ratio, 2.5:1). This was comparable with the findings of Ngairangbam and Borkar, who reported males in 72% of 50 cases, Mandal et al., who reported 70% males among 150 cases, and Singh et al., who reported 65.2% males among 316 patients. [5–7] The present study also showed a predominance of older patients, with 403 cases aged >50 years and 233 aged 40–50 years. This differed from Mandal et al., who reported the highest proportion in the 31–40-year age group, and Ngairangbam and Borkar, who reported a predominance in the third decade. [5,6] Singh et al. reported a mean age of 46.8 ± 17.2 years. [7]

Of the 802 samples, 256 were transudative and 546 were exudative. Among the exudative samples, 334 were categorized as tuberculous, 196 as nonspecific/parapneumonic, and 16 as suspicious for malignancy. Tuberculosis was also the predominant etiology in several Indian studies. Mandal et al. reported tuberculosis in 64.67% of cases, followed by malignancy (14.67%) and parapneumonic effusion (7.33%). [6] Reddy et al. reported tuberculosis in 38% of 63 patients with exudative pleural effusion, followed by parapneumonic effusion (28.5%) and malignant effusion (22.2%). [12] Saini et al. reported tuberculosis in 45.7% of 116 patients with pleural effusion, followed by parapneumonic (12.9%) and malignant effusions (10.3%). [13] The high proportion of tuberculous effusions in the present study is therefore consistent with the findings of several Indian studies.

Lymphocyte predominance was observed in 426 of the 546 exudative samples, followed by neutrophil predominance in 98 and mixed/other patterns in 22 cases. Singh et al. reported lymphocyte predominance in 78.4% of exudative effusions. [7] Ngairangbam and Borkar reported lymphocytic predominance in tuberculous effusions and polymorph predominance in synpneumonic effusions, while Mandal et al. reported predominant lymphocytes in all tuberculous effusions and predominant polymorphs in parapneumonic effusions and empyema. [5,6] Saini et al. similarly found tuberculosis and malignancy to be common among lymphocyte-predominant effusions, whereas parapneumonic effusion and empyema were more frequently associated with neutrophil predominance. [13]

A total of 16 exudative samples showed atypical cytological features and were categorized as suspicious for malignancy. Such cases may be difficult to interpret because reactive mesothelial hyperplasia and inflammatory changes can mimic malignant cells. Singh et al. noted

that these changes may reduce the specificity and positive predictive value of pleural fluid cytology. [7] Reactive mesothelial cells are therefore an important component of pleural fluid cytological evaluation, and Batra and Antony described their morphological changes in various pleural and lung diseases. [14] Representative inflammatory and reactive mesothelial smears in the present study are shown in the corresponding figures.

Pleural fluid cytology provides a minimally invasive approach to the evaluation of pleural effusions. Singh et al. reported its utility particularly in tuberculosis and malignant effusions, while also emphasizing the need for additional investigations when cytological findings are inconclusive. [7] Pairman et al. similarly found pleural fluid cytology useful as an initial investigation in suspected malignant pleural effusion, although its diagnostic performance varied according to the clinical and pathological context. [10]

CONCLUSION

Pleural fluid cytology demonstrated a broad spectrum of inflammatory, reactive, and atypical cytological findings in the present study. Among the 802 samples evaluated, exudative effusions were more frequent than transudative effusions, with tuberculosis being the predominant identified etiology. Lymphocyte predominance was the most common cellular pattern among exudative effusions, while neutrophil-predominant and mixed cellular patterns were also observed. A small proportion of samples showed atypical cytological features suspicious for malignancy. The findings highlight the usefulness of pleural fluid cytological evaluation as a practical and minimally invasive investigation in the assessment of pleural effusions, particularly in settings where tuberculosis constitutes a major cause of exudative effusion.

Limitations

This study was conducted retrospectively at a single tertiary care centre, which may limit the generalizability of the findings to other healthcare settings. The analysis was based on available laboratory records and cytological findings, and therefore the study was limited by the extent and completeness of information available in the records. As the study focused on pleural fluid cytology, further clinicopathological correlation may be required in cases with atypical or inconclusive cytological findings.

Declarations

Ethics Approval: Ethical approval for the study was obtained from the Institutional Ethics Committee of Dr. Shankarrao Chavan Government Medical College, Nanded, Maharashtra.
Funding: The authors received no financial support for this study.
Conflict of Interest: The authors declare that they have no conflict of interest.

REFERENCES

1. Roy, B., Shak, H. J., & Lee, Y. C. G. (2021). Pleural fluid investigations for pleural infections. *Journal of Laboratory and Precision Medicine, 6*, 12. https://doi.org/10.21037/jlpm-2021-01
2. Krishna, R., Antoine, M. H., & Alahmadi, M. H. (2024). Pleural effusion. In *StatPearls*. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK448189/
3. Chopra, A., Hu, K., Feller-Kopman, D., & Judson, M. A. (2025). Pleural fluid analysis: Maximizing diagnostic yield in the pleural effusion evaluation. *Chest*. https://doi.org/10.1016/j.chest.2025.06.001
4. Kusum, A., Harsh, M., Talekar, M., Gaur, D., Kishore, S., Pathak, V., & Chauhan, N. (2007). Pleural fluid analysis—Role in diagnosing pleural malignancy. *Journal of Cytology, 24*(4), 183–188. https://doi.org/10.4103/0970-9371.41891
5. Ngairangbam, V. S., & Borkar, R. (2015). Cytological study of pleural fluids and its clinicobiochemical correlation. *Journal of Evidence Based Medicine and Healthcare, 2*(44), 7882–7884. https://doi.org/10.18410/jebmh/2015/1061
6. Mandal, S., Banik, T., Barman, R., Mandal, A., & Bar, P. K. (2019). A clinicopathological study of pleural effusion with special reference to malignant aetiology in a tertiary care hospital in West Bengal. *International Journal of Medical Research and Review, 7*(4), 280–287. https://doi.org/10.17511/ijmrr.2019.i04.03
7. Singh, K., Meghwani, M. K., & Rajput, S. S. (2025). Evaluation of pleural fluid cytology and its role in the clinical approach to pleural effusion: A prospective study. *International Journal of Academic Medicine and Pharmacy, 7*(6), 106–111. https://doi.org/10.47009/jamp.2025.7.6.20
8. Lekha, N. B., Choudhary, S., & Manjunatha, Y. A. (2020). Cytomorphological analysis of body fluids in tertiary care centre. *Indian Journal of Pathology and Oncology, 7*(3), 498–501. https://doi.org/10.18231/j.ijpo.2020.099
9. Biswas, B., Sharma, S. K., Negi, R. S., Gupta, N., Jaswal, V. M. S., & Niranjan, N. (2016). Pleural effusion: Role of pleural fluid cytology, adenosine deaminase level, and pleural biopsy in diagnosis. *Journal of Cytology, 33*(3), 159–162. https://doi.org/10.4103/0970-9371.188062
10. Pairman, L., Beckert, L. E. L., Dagger, M., & Maze, M. J. (2022). Evaluation of pleural fluid cytology for the diagnosis of malignant pleural effusion: A retrospective cohort study. *Internal Medicine Journal, 52*(7), 1154–1159. https://doi.org/10.1111/imj.15725
11. Sharma, S., Dhawan, V., Kediya, A., & Kedia, A. (2026). Spectrum of pleural fluid cytology in a tertiary care hospital: A prospective observational study. *Annals of Pathology and Laboratory Medicine, 13*(1), A15–A21. https://doi.org/10.21276/apalm.3699
12. Reddy, S. L., Varaprasad, K., Narahari, N., Bhaskar, K., Varma, G. R., & Paramjyothi, G. K. (2019). Clinical and etiological profile of an exudative pleural effusion in a tertiary care center. *Indian Journal of Respiratory Care, 8*(1), 22–26. https://doi.org/10.4103/ijrc.ijrc_8_18
13. Saini, N., Ahluwalia, S., Ahluwalia, S., Selhi, P. K., & Singh, A. (2022). Spectrum and outcome in patients with unilateral pleural effusion admitted in a tertiary care hospital. *Journal of Clinical and Scientific Research, 11*(2), 58–71. https://doi.org/10.4103/jcsr.jcsr_57_21
14. Batra, H., & Antony, V. B. (2015). Pleural mesothelial cells in pleural and lung diseases. *Journal of Thoracic Disease, 7*(6), 964–980. https://doi.org/10.3978/j.issn.2072-1439.2015.02.15