



## **Diagnostic Utility of the Cell Block Technique in Cytological Evaluation of Body Fluids: An Observational Cross-Sectional Study at a Tertiary Care Centre**

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### **ABSTRACT**

#### **Background:**

Distinguishing benign from malignant serous effusions on conventional smear (CS) cytology alone remains a frequent diagnostic dilemma. The cell block (CB) technique concentrates cellular material into a paraffin-embedded block, preserving architecture and permitting immunohistochemistry (IHC) on the same specimen.

#### **Objective:**

To assess the spectrum of cytological diagnoses and the diagnostic utility of the CB method, using 10% alcohol-formalin fixation, in body fluid specimens at a tertiary care centre.

#### **Methods:**

This hospital-based observational cross-sectional study was conducted in the Department of Pathology, Pt. B.D. Sharma PGIMS, Rohtak, from January to December 2021. A total of 156 consecutive body fluid samples were processed in parallel by CS and CB. Cases were categorised as benign/inflammatory, non-diagnostic, suspicious for malignancy, or malignant, and malignant cases were characterised by IHC on CB sections. Data were analysed descriptively.

#### **Results:**

Pleural fluid constituted 141 (90.4%) samples, ascitic fluid 13 (8.3%), and bronchoalveolar lavage 2 (1.3%). Males comprised 81 (51.9%) patients; ages ranged from 15 to 85 years, with the 41–50-year group most represented (26.9%). Final diagnoses were benign/inflammatory in 81 (51.9%), non-diagnostic in 42 (26.9%), suspicious for malignancy in 11 (7.1%), and malignant in 22 (14.1%) samples. Adenocarcinoma was the most common malignancy (11/22, 50.0%). CB sections preserved three-dimensional clusters and cell balls, and IHC, including TTF-1, supported primary-site assignment.

#### **Conclusion:**

The CB technique with 10% alcohol-formalin fixation is simple, inexpensive, and requires no special equipment. It improves cellularity and architectural preservation and provides material for IHC, making it a valuable adjunct to CS in effusion cytology.



### Recommendation:

CB preparation should be performed routinely alongside CS for body fluid specimens, particularly equivocal cases, and prospective studies with histopathological correlation should establish its diagnostic accuracy.

**Keywords:** Cell block; body fluid cytology; serous effusion; pleural effusion; immunohistochemistry; cross-sectional study.

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### INTRODUCTION

Cytological examination of serous effusions is one of the most frequently performed investigations in clinical pathology practice, offering a rapid, minimally invasive route to diagnosis, staging, prognostication, and management planning in both neoplastic and non-neoplastic disease.[1] A positive cytological diagnosis of malignancy in an effusion is often accepted as definitive, since it may obviate more invasive biopsy procedures and directly influence oncological management.[1] However, distinguishing malignant cells from reactive or atypical mesothelial cells on conventional smear (CS) examination remains a persistent diagnostic dilemma in day-to-day practice, and reliable differentiation frequently requires correlation with clinical findings, detailed morphological evaluation, and, where necessary, immunocytochemistry.[1,2]

Conventional smear preparation, while simple and widely practised, has recognised limitations: cellular material may be scant, admixed with blood or inflammatory debris, and architectural relationships between cells are frequently lost, all of which can obscure a definitive diagnosis.[2,3] The cell block (CB) technique is among the oldest ancillary methods for the evaluation of body cavity fluids and is particularly useful when the cytomorphological findings on smear are equivocal or misleading.[1,3] By concentrating the cellular sediment into a formalin-fixed, paraffin-embedded block that can be sectioned and stained in a manner familiar to every histopathologist, the CB method improves cellular yield, preserves three-dimensional architectural patterns such as papillae and cell balls, and provides crisper nuclear and cytoplasmic detail than is generally achievable on smear alone.[2–5] Several comparative series have shown that CB, used alongside CS, increases both the sensitivity of malignancy detection and the overall diagnostic yield of effusion cytology.[2,4,6]

A further advantage of the CB technique is that it generates multiple paraffin sections from a single aspirate, allowing special stains and a panel of immunohistochemical markers to be applied to the same cellular material.[3,7] This is of

particular value once a positive diagnosis of malignancy is made, since identifying the primary site and histological type of the tumour is essential for appropriate surgical management, chemotherapy, or radiotherapy, and can meaningfully influence patient survival.[3,8,9] Markers such as thyroid transcription factor-1 (TTF-1), calretinin, Wilms tumour-1 (WT-1), caudal-type homeobox 2 (CDX2), and oestrogen receptor are commonly used in this setting to separate reactive mesothelial proliferations from metastatic adenocarcinoma and to suggest a probable primary site.[8–11] Despite this body of evidence, the CB technique remains underutilised relative to CS in many routine cytopathology laboratories, partly owing to a perception that it is technically demanding or resource-intensive.[6,7]

With this background, the present study was undertaken to assess the spectrum of cytological diagnoses in body fluid specimens received in the Department of Pathology of a tertiary care teaching hospital, and to evaluate the utility of the cell block method — prepared using the simple and inexpensive 10% alcohol–formalin fixation technique — as an adjunct to conventional smear cytology in this setting.

### MATERIALS AND METHODS

#### Study design

This was a hospital-based, observational, cross-sectional study. Each body fluid sample was evaluated once, at the time of receipt, by both the conventional smear and the cell block methods, and no patient follow-up was undertaken. The study is reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional studies.

#### Study setting and period

The study was conducted in the Cytopathology Section of the Department of Pathology, Pt. B.D. Sharma Postgraduate Institute of Medical Sciences (PGIMS), Rohtak, Haryana, India, over a 12-month period from January 2021 to December 2021. PGIMS Rohtak is a government-funded tertiary care teaching and referral hospital affiliated with Pt. B.D. Sharma University of Health Sciences, Rohtak. It



provides undergraduate, postgraduate, and super-speciality medical training and offers comprehensive outpatient, inpatient, emergency, and intensive care services across medical and surgical disciplines, including pulmonary and critical care medicine, internal medicine, medical and radiation oncology, gastroenterology, general surgery, and obstetrics and gynaecology. The hospital serves a predominantly rural and semi-urban population from Haryana and receives referrals from neighbouring states. The Department of Pathology offers round-the-clock diagnostic services, and its cytopathology section processes fine-needle aspiration, exfoliative, and body fluid specimens from inpatient and outpatient services, with in-house histopathology processing and immunohistochemistry facilities.

### Study population and sampling

All body fluid samples (pleural fluid, ascitic fluid, and bronchoalveolar lavage) submitted to the cytopathology section for diagnostic evaluation during the study period were screened, and eligible samples were enrolled by consecutive (total enumeration) sampling. A total of 156 samples fulfilled the eligibility criteria and constituted the study sample.

### Inclusion criteria

- Pleural fluid, ascitic fluid, and bronchoalveolar lavage samples received for cytological evaluation during the study period.
- Patients of either sex and of any age.
- Samples with sufficient volume to permit preparation of both conventional smears and a cell block.
- Samples accompanied by a completed requisition form recording the patient's age, sex, and relevant clinical details.

### Exclusion criteria

- Samples with insufficient residual volume after smear preparation for a cell block to be prepared.
- Samples received in leaking, broken, or unlabelled containers, and samples that were grossly clotted or autolysed owing to delay in transport.
- Repeat samples from the same patient during the study period (only the first sample from each patient was included).
- Other body fluids not within the scope of the study, such as cerebrospinal fluid, urine, and synovial fluid.

### Sample processing

Each sample was processed in parallel by (a) the conventional smear method and (b) the cell block technique.

Conventional smears were prepared from the centrifuged sediment and stained according to the routine departmental protocol. For cell block preparation, the residual fluid after smear preparation was centrifuged and the sediment fixed in 10% alcohol-formalin, which reduces cellular destruction compared with formalin alone and thereby improves cellularity and preservation of morphological detail.[2] The fixed sediment was processed routinely, embedded in paraffin, sectioned, and stained with haematoxylin and eosin (H&E). Cases with a cytomorphological diagnosis of malignancy, or findings suspicious for malignancy, on CS and/or CB were further evaluated with a panel of immunohistochemical markers (including TTF-1), selected according to the morphology and clinical context, applied to cell block sections to confirm the diagnosis and, where possible, indicate the likely primary site.

### Diagnostic categorisation

On the basis of combined light-microscopic evaluation of CS and CB (supplemented by IHC where performed), each case was assigned to one of four categories: benign/inflammatory, non-diagnostic (inadequate cellularity or non-representative sample), suspicious for malignancy, or malignant. Malignant cases were further sub-classified by cytomorphological and immunohistochemical type.

### Study variables

The variables recorded for each sample were patient age, sex, type of body fluid, final cytological diagnostic category, and, for malignant cases, the cytomorphological and immunohistochemical subtype.

### Efforts to address potential sources of bias

Selection bias was minimised by consecutive enrolment of all eligible samples received during the study period rather than selective inclusion of clinically suspicious cases. Measurement bias was reduced by processing every sample with the same standardised protocol, by preparing the conventional smears and cell block from the same specimen in parallel, and by assigning diagnoses according to predefined diagnostic categories. Slides were reviewed by the reporting pathologists, and difficult or equivocal cases were reviewed by a senior cytopathologist, with the final diagnosis reached by consensus. Information bias was limited by extracting demographic and clinical details directly from the requisition forms and departmental records using a structured data sheet, and data entries were cross-checked against the source records before analysis.



### Statistical analysis

Data were entered into Microsoft Excel and analysed descriptively. Categorical variables (fluid type, diagnostic category, malignancy subtype, age group, and sex) were expressed as frequencies and percentages. Age was grouped into 10-year intervals (11–20 to 81–90 years). The distribution of diagnostic categories was cross-tabulated by sex. As the study was descriptive, no hypothesis testing was performed.

### Ethical considerations

The study protocol was reviewed and approved by the Institutional Ethics Committee (IEC), Pt. B.D. Sharma PGIMS, Rohtak. The study used only material from samples collected as part of routine diagnostic care and involved no additional procedure, intervention, or risk to patients. Written informed consent for the diagnostic procedure was obtained from all patients (or from the legal guardian/next

of kin where the patient was unable to consent) by the treating clinicians in accordance with hospital policy, and the IEC waived the requirement for separate consent for the use of anonymised residual material and data. Patient identifiers were removed before analysis, and confidentiality was maintained throughout. The study was conducted in accordance with the principles of the Declaration of Helsinki (2013 revision).

## RESULTS

### Demographic characteristics

A total of 156 body fluid samples from 156 patients were analysed. Male patients numbered 81 (51.9%) and female patients 75 (48.1%), giving a male-to-female ratio of 1.08:1. Patient age ranged from 15 to 85 years. The largest proportion of samples came from the 41–50-year age group (42 samples, 26.9%), while the fewest came from the 11–20-year age group (3 samples, 1.9%) (Table 1).

**Table 1** Demographic Characteristics of the Study Participants (N = 156)

| Characteristic           | n          | %            |
|--------------------------|------------|--------------|
| <b>Sex</b>               |            |              |
| Male                     | 81         | 51.9         |
| Female                   | 75         | 48.1         |
| <b>Age group (years)</b> |            |              |
| 11–20                    | 3          | 1.9          |
| 21–30                    | 14         | 9.0          |
| 31–40                    | 22         | 14.1         |
| 41–50                    | 42         | 26.9         |
| 51–60                    | 34         | 21.8         |
| 61–70                    | 25         | 16.0         |
| 71–80                    | 11         | 7.1          |
| 81–90                    | 5          | 3.2          |
| <b>Total</b>             | <b>156</b> | <b>100.0</b> |

*Note. Age range 15–85 years. Percentages are calculated on the total sample (N = 156).*

### Distribution of samples by fluid type

Of the 156 samples, 141 (90.4%) were pleural fluid, 13 (8.3%) were ascitic fluid, and 2 (1.3%) were bronchoalveolar lavage specimens (Table 2).

**Table 2** Distribution of Body Fluid Samples by Type (N = 156)

| Type of body fluid     | n          | %            |
|------------------------|------------|--------------|
| Pleural fluid          | 141        | 90.4         |
| Ascitic fluid          | 13         | 8.3          |
| Bronchoalveolar lavage | 2          | 1.3          |
| <b>Total</b>           | <b>156</b> | <b>100.0</b> |

### Final cytological diagnosis

On combined cytomorphological evaluation, 81 samples (51.9%) were categorised as benign/inflammatory, 42 (26.9%) as non-diagnostic, 11 (7.1%) as suspicious for malignancy, and 22 (14.1%) as malignant (Table 3).

**Table 3** Final Cytological Diagnosis on Combined Conventional Smear and Cell Block Evaluation (N = 156)

| Diagnostic category       | n          | %            |
|---------------------------|------------|--------------|
| Benign/inflammatory       | 81         | 51.9         |
| Non-diagnostic            | 42         | 26.9         |
| Suspicious for malignancy | 11         | 7.1          |
| Malignant                 | 22         | 14.1         |
| <b>Total</b>              | <b>156</b> | <b>100.0</b> |

### Diagnostic category by sex

The distribution of diagnostic categories by sex is shown in Table 4. Malignancy was more frequent among female patients (14 of 75; 18.7%) than among male patients (8 of 81; 9.9%), and females accounted for 14 of the 22 malignant cases (63.6%). The non-diagnostic, benign/inflammatory, and suspicious categories showed a slight male preponderance, consistent with the overall sex distribution of the cohort.

**Table 4** Distribution of Final Cytological Diagnosis by Sex (N = 156)

| Diagnostic category       | Male, n (%)       | Female, n (%)     | Total, n   |
|---------------------------|-------------------|-------------------|------------|
| Benign/inflammatory       | 45 (55.6)         | 36 (48.0)         | 81         |
| Non-diagnostic            | 22 (27.2)         | 20 (26.7)         | 42         |
| Suspicious for malignancy | 6 (7.4)           | 5 (6.7)           | 11         |
| Malignant                 | 8 (9.9)           | 14 (18.7)         | 22         |
| <b>Total</b>              | <b>81 (100.0)</b> | <b>75 (100.0)</b> | <b>156</b> |

*Note. Column percentages are calculated within each sex. Percentages may not total exactly 100.0 owing to rounding.*

### Spectrum of malignant diagnoses

Among the 22 malignant cases, adenocarcinoma was the most common diagnosis (11 cases, 50.0%), followed by malignant cells not further typed on the available material (5 cases, 22.7%), poorly differentiated carcinoma (3 cases, 13.6%), and

single cases (4.5% each) of metastatic malignant round cell tumour, non-Hodgkin lymphoma, and non-small cell lung carcinoma (Table 5).

**Table 5** *Spectrum of Malignant Diagnoses on Cell Block With Immunohistochemical Correlation (n = 22)*

| Malignancy subtype                     | n         | %            |
|----------------------------------------|-----------|--------------|
| Adenocarcinoma                         | 11        | 50.0         |
| Malignant cells, not further typed     | 5         | 22.7         |
| Poorly differentiated carcinoma        | 3         | 13.6         |
| Metastatic malignant round cell tumour | 1         | 4.5          |
| Non-Hodgkin lymphoma                   | 1         | 4.5          |
| Non-small cell lung carcinoma          | 1         | 4.5          |
| <b>Total</b>                           | <b>22</b> | <b>100.0</b> |

*Note. Percentages are calculated on malignant cases (n = 22) and may not total exactly 100.0 owing to rounding.*

### Morphological and immunohistochemical findings on cell block

On cell block sections, malignant cells characteristically formed three-dimensional clusters, cell balls, and papillary groups with pleomorphic, hyperchromatic nuclei, irregular nuclear contours, prominent nucleoli, and moderate to abundant, often foamy, cytoplasm (Figures 1 and 2). These

architectural features were considerably better preserved on CB than on conventional smears. Immunohistochemistry performed on cell block sections was of direct diagnostic value: TTF-1 positivity (Figure 3) supported a pulmonary origin in cases of metastatic adenocarcinoma involving the pleural space, illustrating the ability of the CB technique to provide material for primary-site work-up from a single sample.

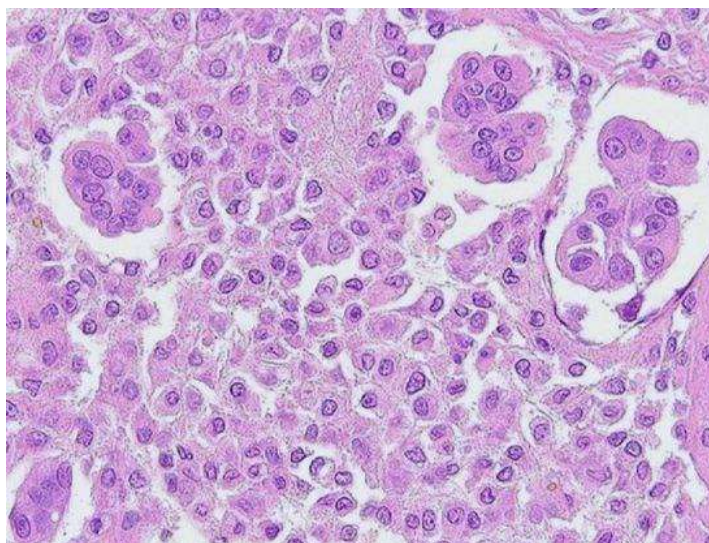


**Figure 1:** Haematoxylin and eosin–stained section of a cell block prepared from pleural effusion, showing three-dimensional clusters and cell balls of malignant epithelial cells, a feature suggestive of metastatic lung adenocarcinoma.

Haematoxylin and eosin (H&E)-stained section of a cell block prepared from a pleural effusion. The section shows cohesive three-dimensional clusters and cell balls of malignant epithelial cells with smooth, rounded community borders, standing out against a background of scattered

mesothelial cells, lymphocytes, and macrophages. This architectural pattern, which is difficult to appreciate on conventional smears, is suggestive of metastatic adenocarcinoma, most likely of pulmonary origin.

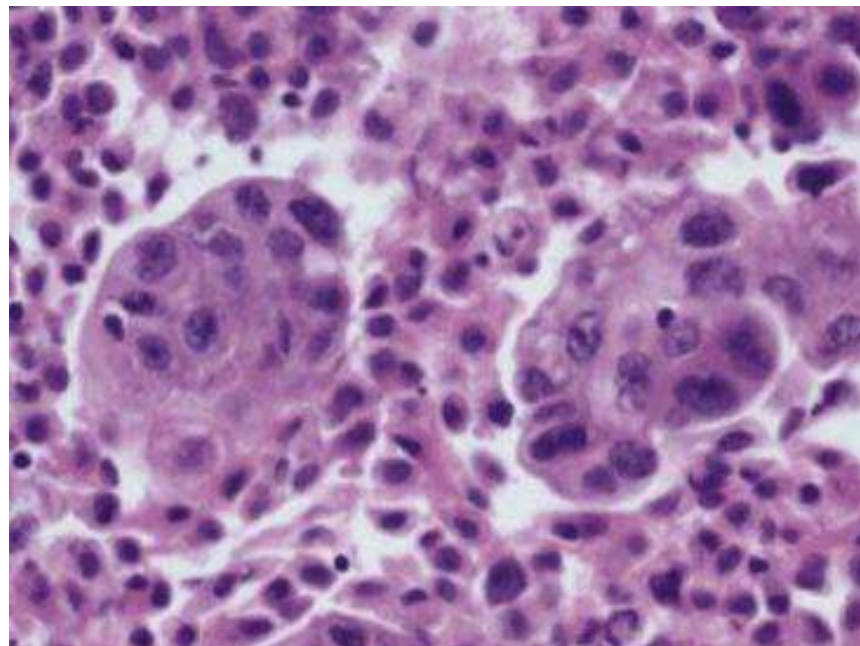


**Figure 2: Cell block section showing groups of malignant epithelial cells with pleomorphic, hyperchromatic nuclei, irregular nuclear contours, prominent nucleoli, and moderate to abundant foamy cytoplasm.**

H&E-stained cell block section from a malignant pleural effusion at higher magnification. Groups of malignant epithelial cells display marked nuclear pleomorphism, hyperchromasia, irregular nuclear membranes, and prominent nucleoli, with moderate to abundant, finely vacuolated (foamy) cytoplasm. The crisp nuclear and cytoplasmic detail preserved by alcohol-formalin fixation facilitates distinction from reactive mesothelial cells.

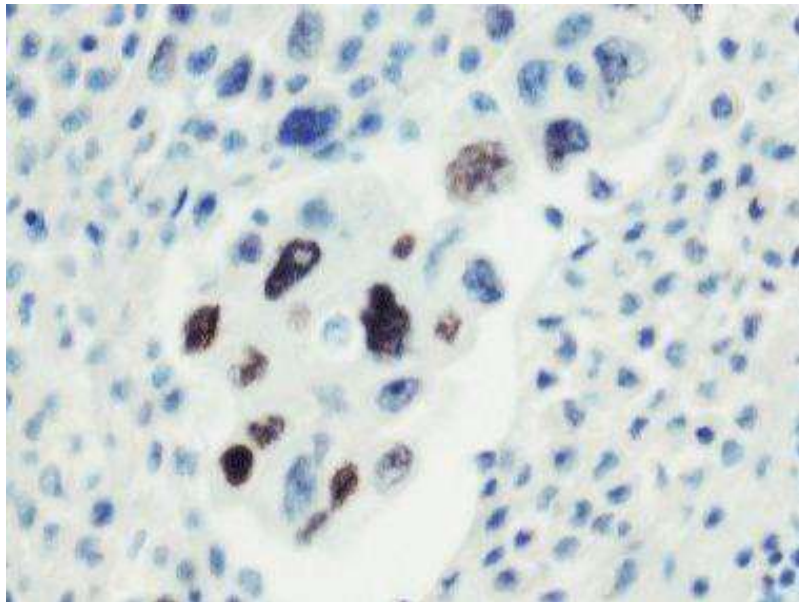


**Figure 3: Immunohistochemistry on cell block section showing strong nuclear positivity for thyroid transcription factor-1 (TTF-1) in malignant cells, supporting a pulmonary primary.**

Immunohistochemistry for thyroid transcription factor-1 (TTF-1) on a cell block section from a malignant pleural effusion. The malignant epithelial cells show strong, diffuse nuclear positivity (brown chromogen), whereas the background mesothelial and inflammatory cells are negative. This staining pattern supports a pulmonary primary for the metastatic adenocarcinoma and illustrates the use of the cell block as a substrate for ancillary testing.

## DISCUSSION

The present study, comprising 156 body fluid samples evaluated over a one-year period, found pleural fluid to be by far the most common specimen type (90.4%), reflecting the referral pattern typical of a tertiary care respiratory and oncology workload, with ascitic fluid and bronchoalveolar lavage contributing smaller proportions. Overall, just over half of the samples (51.9%) were benign or inflammatory, a little over a quarter (26.9%) were non-diagnostic, and 14.1% were malignant — a distribution broadly comparable with other Indian tertiary care series using combined CS–CB workflows, in which malignancy rates in effusion cytology have generally ranged from roughly 10% to 20%. [2,4,6] The higher frequency of malignancy among female patients (18.7% versus 9.9% in males) is likely to reflect the contribution of breast and gynaecological malignancies to

malignant effusions in women, although the small number of malignant cases precludes firm conclusions.

Adenocarcinoma was the predominant malignant diagnosis in this series (50.0% of malignant cases), consistent with the well-established observation that metastatic adenocarcinoma — most often of pulmonary, breast, gastrointestinal, or ovarian origin — accounts for the majority of malignant effusions, since these tumours frequently seed the pleural and peritoneal surfaces. [9,11] This mirrors the findings of Shivakumarswamy et al., who evaluated 60 pleural fluid samples by CS and CB and similarly reported that the CB method yielded superior cellularity, better preservation of architectural patterns, and an additional yield of malignant cells compared with CS alone, using the same 10% alcohol–formalin fixation protocol employed in the present study. [2] Dey et al., in an institution-based study of 50 effusion samples, likewise found that CB produced better detection of malignancy and reduced the proportion of suspicious or equivocal results compared with conventional smears. [6] A comparative Thai study of exudative pleural effusions by Assawasaksakul et al. similarly demonstrated an incremental diagnostic yield when CB was combined with CS rather than CS used alone. [4]

The architectural preservation achieved with CB in the present series — three-dimensional cell balls, papillary



clusters, and crisp nuclear detail — corresponds closely to the morphological advantages described in the wider literature, where CB is repeatedly shown to retain tissue-like architecture that is difficult to appreciate on a two-dimensional smear and that materially assists in distinguishing malignant epithelial clusters from reactive mesothelial aggregates.[2,3,5] This architectural advantage is particularly relevant given that reactive atypical mesothelial cells remain one of the most persistent mimics of malignancy in effusion cytology.[1,2]

A further strength of the CB technique, well illustrated by the malignant cases in this series, is its capacity to serve as a substrate for immunohistochemistry without the need for a repeat invasive procedure. TTF-1 positivity, present in the illustrative case in this series, is one of the most extensively validated immunomarkers for confirming a pulmonary origin of metastatic adenocarcinoma in serous effusions; a meta-analysis of 20 studies (1,213 subjects) reported a pooled sensitivity of 74% and specificity of 99% for TTF-1 in this clinical scenario.[12] Other authors have shown that TTF-1 can be combined with markers such as WT-1, CDX2, oestrogen receptor, and cancer antigen 125 (CA-125) to build a discriminatory panel capable of separating pulmonary from extrapulmonary (breast, ovarian, gastrointestinal) adenocarcinomas presenting as effusions, and calretinin remains the mainstay marker for confirming a reactive or benign mesothelial population.[8–10] The ability of CB to provide material for such panels from the very sample already submitted for routine cytology is a practical advantage that is increasingly recognised as central to the modern work-up of malignant effusions, particularly as primary-site identification directly guides oncological management.[9,13]

### Generalizability

The findings of this study are derived from consecutive samples received at a large, government-funded tertiary care teaching hospital that serves a predominantly rural and semi-urban population and receives referrals from several neighbouring states. They are therefore likely to be generalisable to other tertiary care and teaching hospitals in India and in comparable low- and middle-income country (LMIC) settings with a similar case mix, in which pleural effusions related to pulmonary, infective, and malignant disease predominate. Because the 10% alcohol–formalin cell block method requires only a centrifuge and routine histopathology processing, with no specialised equipment, reagents, or training, the technique itself is readily transferable to district hospitals and smaller laboratories that already process tissue biopsies. However, the observed

distribution of diagnostic categories — particularly the proportion of malignant cases — is influenced by tertiary referral patterns and may not apply to primary or secondary care settings, where the prevalence of malignant effusions is lower. In addition, as more than 90% of samples were pleural fluids, extrapolation of the findings to ascitic fluid, bronchoalveolar lavage, and other body fluids should be made with caution.

### Limitations

The findings of this study should be interpreted in light of the following limitations:

It was a single-centre study conducted over a single year, which may limit the representativeness of the diagnostic spectrum.

A histopathological or clinical-outcome reference standard was not applied uniformly to every case; consequently, formal sensitivity, specificity, and predictive values of CB relative to CS could not be calculated.

Diagnoses were assigned on combined CS and CB evaluation, so the separate diagnostic yield of each method and the incremental yield attributable to CB were not quantified.

The numbers of ascitic fluid and bronchoalveolar lavage samples were small, limiting subgroup inference for these fluid types.

The proportion of non-diagnostic samples (26.9%) was relatively high, which may reflect sample volume, pre-analytical handling, or the low cellularity of many benign effusions.

Immunohistochemistry was performed selectively on suspicious and malignant cases with a morphology-guided panel, and 5 malignant cases could not be further typed on the available material.

The analysis was descriptive, and the relationship of findings with clinical, radiological, and follow-up data was not evaluated.

Nonetheless, the consistency of the present findings with earlier, larger comparative series[2,4,6,12] lends confidence to the conclusion that the CB technique, prepared with the simple 10% alcohol–formalin method, meaningfully augments conventional smear cytology in this setting.

### Recommendations

On the basis of the findings of this study, the following recommendations are made:

Cell block preparation using 10% alcohol–formalin fixation should be incorporated as a routine adjunct to conventional smear examination for all body fluid specimens, and should



be considered mandatory when smear findings are atypical, suspicious, or equivocal.

2. Clinicians should be encouraged to submit an adequate volume of fresh fluid so that sufficient material is available for both smears and a cell block, which may also reduce the proportion of non-diagnostic samples.
3. Laboratories should adopt a standard operating procedure for cell block preparation and a morphology-guided immunohistochemical panel (for example, TTF-1, calretinin, WT-1, CDX2, and oestrogen receptor) applied to cell block sections for the typing and primary-site assignment of malignant effusions.
4. Cell block material should be preserved appropriately, as it can serve as a substrate for predictive molecular testing (for example, epidermal growth factor receptor [EGFR] and anaplastic lymphoma kinase [ALK] testing in lung adenocarcinoma), avoiding repeat invasive procedures.
5. Future prospective, multicentre studies with histopathological and clinical follow-up as the reference

standard should compare the separate and combined diagnostic yields of CS and CB and establish the diagnostic accuracy of the technique across fluid types.

## CONCLUSION

The cell block technique, using 10% alcohol–formalin as a fixative, is a simple, inexpensive method that does not require special training or instrumentation and can be readily incorporated into the routine cytopathology workflow. In this tertiary care series, cell block sections provided good cellularity and better preservation of architectural detail than conventional smears, aiding the recognition of malignancy, and allowed multiple sections to be obtained for special stains and immunohistochemistry when required. The CB technique should therefore be regarded as a useful and practical adjunct to routine conventional smear examination in the cytological evaluation of body fluids.

## LIST OF ABBREVIATIONS

| Abbreviation | Full form                                                            |
|--------------|----------------------------------------------------------------------|
| ALK          | Anaplastic lymphoma kinase                                           |
| BAL          | Bronchoalveolar lavage                                               |
| CA-125       | Cancer antigen 125                                                   |
| CB           | Cell block                                                           |
| CDX2         | Caudal-type homeobox 2                                               |
| CS           | Conventional smear                                                   |
| EGFR         | Epidermal growth factor receptor                                     |
| H&E          | Haematoxylin and eosin                                               |
| IEC          | Institutional Ethics Committee                                       |
| IHC          | Immunohistochemistry                                                 |
| LMIC         | Low- and middle-income country                                       |
| PGIMS        | Postgraduate Institute of Medical Sciences                           |
| STROBE       | Strengthening the Reporting of Observational Studies in Epidemiology |
| TTF-1        | Thyroid transcription factor-1                                       |
| WT-1         | Wilms tumour-1                                                       |

## DECLARATIONS

### Ethics approval and consent to participate

Approved by the Institutional Ethics Committee, Pt. B.D. Sharma PGIMS, Rohtak. The study was performed on samples received routinely as part of standard diagnostic care, caused no additional harm to patients, and the

requirement for separate informed consent for the use of anonymised residual material was waived by the committee. Patient confidentiality was maintained throughout data collection and analysis.



### Conflict of interest

The authors declare that there is no conflict of interest.

### Data availability

The datasets generated and/or analysed during the current study are available from the corresponding author on reasonable request.

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This research received no external funding and was entirely self-funded by the authors.

### Authors' contributions

**Akhil Kumar:** Conceptualization, study design, methodology, literature review, supervision of data collection, interpretation of findings, formal analysis, validation, and manuscript preparation.

**Vibhuti Thukral:** Conceptualization, methodology, literature review, supervision of data collection, interpretation of findings, and manuscript preparation.

**Ankita Kumar:** Literature review, supervision of data collection, and manuscript preparation.

**Anjali Sharma:** Literature review, supervision of data collection, and manuscript preparation.

**Veena Gupta:** Conceptualization, study design, methodology, literature review, supervision of data collection, interpretation of findings, formal analysis, and validation.

**Sunita Singh:** Conceptualization, study design, methodology, and literature review.

All authors read and approved the final manuscript.

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### References

1. Geisinger KR, Raab SS, Stanley MW, Silverman JF, Abati A. Effusions. In: Modern Cytopathology. Philadelphia: Churchill Livingstone; 2003. p. 257-309.
2. Shivakumarswamy U, Arakeri SU, Karigowdar MH, Yelikar BR. Diagnostic utility of the cell block method versus the conventional smear study in pleural fluid cytology. J Cytol. 2012;29(1):11-15. <https://doi.org/10.4103/0970-9371.93210>
3. Nambirajan A, Kaur K, Jain D. Cell blocks in cytopathology: An update. Cytopathology. 2018;29(6):505-524. <https://doi.org/10.1111/cyt.12627>
4. Assawasaksakul T, Boonsarngsuk V, Incharoen P. A comparative study of conventional cytology and cell block method in the diagnosis of pleural effusion. J Thorac Dis. 2017;9(10):3161-3167. <https://doi.org/10.21037/jtd.2017.08.52>
5. Khan N, Sherwani KR, Afroz N, Kapoor S. Usefulness of cell blocks versus smears in malignant effusion cases. J Cytol. 2006;23(3):129-132. <https://doi.org/10.4103/0970-9371.239480>
6. Dey S, Nag D, Nandi A, Bandyopadhyay R. Utility of cell block to detect malignancy in fluid cytology: Adjunct or necessity? J Cancer Res Ther. 2017;13(3):425-429. <https://doi.org/10.4103/0973-1482.177501>
7. Madakshira MG, Kolavadi SS, Varma V, Bharadwaj R. Cell block - a useful adjunct in cytopathology of serous effusions. Natl J Lab Med. 2017;6(2):PO26-PO31.
8. Zhu W, Michael CW. WT1, monoclonal CEA, TTF1 and CA125 antibodies in the differential diagnosis of lung, breast and ovarian adenocarcinomas in serous effusions. Diagn Cytopathol. 2007;35(6):370-375. <https://doi.org/10.1002/dc.20643>
9. Batool S, Sadaf S, Chughtai AS, Qasim A, Zafar A, Jamil A. Diagnostic accuracy of cell block and immunohistochemistry in effusion cytology. Cureus. 2023;15(2):e34958. <https://doi.org/10.7759/cureus.34958>
10. Fatima N, Cohen C, Lawson D, Siddiqui MT. TTF-1 and Napsin A double stain: a useful marker for diagnosing lung adenocarcinoma on fine-needle aspiration cell blocks. Cancer Cytopathol. 2011;119(2):127-133. <https://doi.org/10.1002/cncy.20135>
11. El Hag M, Schmidt L, Roh M, Michael CW. Utility of TTF-1 and Napsin-A in the work-up of malignant effusions. Diagn Cytopathol. 2016;44(4):299-304. <https://doi.org/10.1002/dc.2344>
12. Su XY, Li GD, Liu WP, Xie B, Jiang YH. Diagnostic value of thyroid transcription factor-1 for pleural or other serous metastases of pulmonary adenocarcinoma: a meta-analysis. Sci Rep. 2016;6:19785. <https://doi.org/10.1038/srep19785>
13. Miyoshi S, Sasada S, Izumo T, Matsumoto Y, Tsuchida T. Diagnostic utility of pleural fluid cell



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block versus pleural biopsy collected by flex-rigid  
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