Section: Pathology

Original Research Article

CONVENTIONAL SMEARS VERSUS CELL BLOCK TECHNIQUE IN BODY FLUID CYTODIAGNOSIS – A COMPARATIVE, INDIAN STUDY AT A TERTIARY CARE HOSPITAL

***Sneha Rathod*[1]**

[1]*Assistant Professor, Ashwini Rural Medical College, Hospital and research centre, Kumbhari, Solapur, Solapur, India*

Received *: 10/07/2026*
Received in revised form *: 17/08/2026*
Accepted *: 29/08/2026*

Corresponding Author:
Dr. Sneha Rathod,
Assistant Professor, Ashwini Rural Medical College, Hospital and research centre, Kumbhari, Solapur, Solapur, India.
Email: sneharathod1994@gmail.com

DOI: 10.70034/ijmedph.2026.3.778

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (3); 5039-5044

ABSTRACT

Background: Cytological evaluation of body fluids is an essential diagnostic tool for identifying the etiology of serous effusions. However, conventional smear (CS) techniques have limitations such as poor cellular preservation and difficulty in distinguishing malignant from reactive cells. The cell block (CB) technique has been proposed as a complementary method to improve diagnostic accuracy.

Materials and Methods: This cross-sectional observational study was conducted in a tertiary care teaching hospital over a period of two years (December 2019–November 2021). A total of 100 body fluid samples, including pleural, peritoneal, and pericardial fluids, were analyzed using both CS and CB techniques. Data regarding cellularity, architectural preservation, and cytological diagnosis were compared. Diagnostic performance parameters including sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated.

Results: The CB method demonstrated significantly higher marked cellularity (37 vs 14 cases; $p<0.05$) and superior architectural preservation (43 vs 5 cases; $p<0.05$) compared to CS. Lymphocytes were the predominant cells in both groups. Of the 100 cases, 12 were malignant and 88 benign. CB showed higher diagnostic concordance with final cytological diagnosis (99%) than CS (87%). Sensitivity, specificity, PPV, and NPV for detecting malignancy were higher with CB (100%, 98.87%, 91.66%, and 100%, respectively) compared to CS (58.33%, 90.9%, 46.66%, and 94.11%). CB also eliminated the "suspicious for malignancy" category.

Conclusion: The cell block technique is superior to conventional smears in body fluid cytodiagnosis, offering better cellularity, architectural preservation, and diagnostic accuracy, thereby improving detection and definitive diagnosis of malignancy.

Keywords: cell block, conventional smear, cytology, body fluid.

INTRODUCTION

Cytological examination of body fluids is a widely accepted diagnostic tool that provides valuable clinical information. It assists in identifying the etiology of serous effusions, formulating differential diagnoses, and evaluating treatment response and prognosis. However, distinguishing malignant cells from reactive mesothelial cells in conventional smears (CS) remains challenging and requires careful assessment of cytomorphological features. Diagnostic accuracy may be compromised due to factors such as cell overlap, preparation artifacts, and suboptimal processing. The cell block (CB) technique, first described by Bahrenberg in 1896, utilizes residual material from body fluids such as pleural, ascitic, and bronchial samples, as well as fine-needle aspiration specimens. It serves as a complementary method to CS and improves diagnostic sensitivity while reducing false-positive results.[1] A modified CB method using 10% alcohol–acetic acid formalin is simple, cost-effective, and

enhances diagnostic yield. Additionally, CB preserves tissue architecture and allows for multiple sections for special stains and immunohistochemistry.[2] Over time, refinements in the CB technique have improved cellular preservation and morphological detail, including nuclear and cytoplasmic features. It also retains architectural patterns such as papillae, rosettes, and acini, aiding in identifying the primary site of malignancy. CB sections often resemble histological biopsy specimens and can be stored as paraffin blocks for future studies, including immunohistochemistry and retrospective analysis.[3-5] Despite these advantages, comparative studies evaluating CS and CB techniques in body fluid cytology are limited, particularly in the Indian setting. Therefore, this study aims to compare the diagnostic utility of CS and CB methods in a tertiary care teaching hospital to enhance cytodiagnostic accuracy.

MATERIALS AND METHODS

Study design and samples included: This cross-sectional, observational single-center study was conducted in the Department of Pathology of a tertiary care teaching hospital using a non-random convenience sampling method. Body fluid samples, including pleural, peritoneal, and pericardial fluids from effusion cases, were analyzed by preparing both conventional smears and cell blocks for comparative evaluation. Data collection was carried out from December 2019 to November 2021, followed by subsequent analysis, after obtaining approval from the Institutional Ethics Committee, with a waiver of informed consent due to the absence of direct patient involvement. Only adequately preserved effusion samples were included, while clotted specimens, samples processed after more than one hour of collection, poorly preserved fluids, and fluids from sites other than the specified cavities were excluded.

Specimen evaluation and cell-block preparation: All received fluid samples underwent gross examination for volume, color, clarity, and specific gravity. Any clots present were carefully removed, sectioned, fixed in 10% buffered formalin, and processed. The remaining fluid was mixed and centrifuged at 300 rpm for 10 minutes, and the sediment was used for both conventional smear and cell block preparation using the plasma–thromboplastin method. For cell block preparation, approximately 15 ml of well-mixed fluid was centrifuged, the supernatant discarded, and the sediment combined with plasma and thromboplastin to form a clot. This clot was then transferred to a labeled cassette, wrapped in formalin-moistened filter paper, fixed in 10% neutral buffered formalin for 4–5 hours, and processed as a tissue specimen. Standard universal safety precautions were followed throughout, including the use of gloves, masks, and biosafety cabinet during handling and processing.

Parameters assessed and Statistical analysis: The study evaluated multiple parameters including demographic details (age and gender), clinical history and examination findings, as well as relevant hematological and radiological investigations where available. Provisional clinical diagnoses were noted and compared with cytological findings. Diagnostic performance of the cell block method was assessed in terms of sensitivity and specificity. Both conventional smear and cell block techniques were analyzed for their ability to identify benign and malignant lesions, and a final diagnosis was established for each specimen.

Following data collection, all variables were entered into Microsoft Excel and analyzed using GraphPad InStat version 3.0. Quantitative data were expressed as mean and standard deviation where applicable, while descriptive statistics were used to summarize demographic and clinical characteristics. The diagnostic performance of the cell block method was assessed by calculating sensitivity and specificity in comparison with the conventional smear method. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Demographic and baseline characteristics: A total of 100 patients were included in the study, with a mean age of 44.97 ± 14.27 years (range: 18–72 years). Males constituted 56% of the study population. Most patients were in the 41–50 years age group (28%), followed by 31–40 years (22%). Patients aged 18–30 years accounted for 17%, while 16% were between 51–60 years and 15% were above 60 years.

The most common clinical diagnosis in the study was congestive cardiac failure (18%), followed by pneumonia (16%). Suspected or confirmed pulmonary tuberculosis and malignancy were each noted in 12% of cases. Pleural effusion was clinically diagnosed in 11% of patients, while cirrhosis accounted for 10%. The complete distribution of clinical diagnoses is presented in [Figure 1].

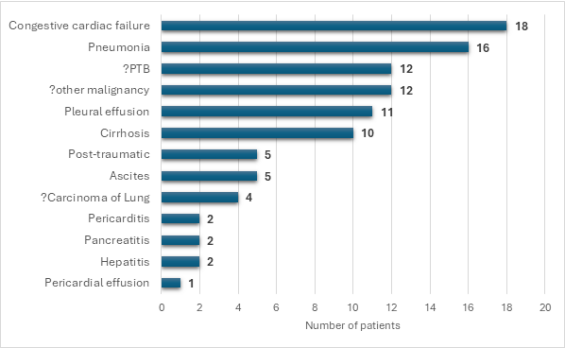

Figure 1: Clinical diagnosis of patients enrolled in study

Type of body fluid sample and cellularity status: Among the study participants, pleural fluid analysis

was performed in 72% of cases, ascitic fluid in 24%, and pericardial fluid in 4%.

Comparison of cellularity between the two methods showed that marked cellularity was significantly higher in the cell block (CB) group (37 cases) compared to the conventional smear (CS) group (14 cases) ($p<0.05$). Moderate cellularity was more frequently observed in the CS group (70 cases) than in the CB group (50 cases), while mild cellularity was noted in 16 and 13 cases, respectively. [Table 1]

Table 1: Cellularity status of patients in study

	Conventional smear (CS) method	Cell block (CB) findings
Mild	16	13
Moderate	70	50
Marked	14	37
P value	<0.01* considered significant by chi-square test	

The distribution of predominant cell types was comparable between the two methods, with no statistically significant difference ($p>0.05$). Lymphocytes were the most common cells observed in both the CS (48 cases) and CB groups (49 cases). Pleomorphic cells were the second most frequent, identified in 24 cases in each group. [Figure 2]

Retention of cellular architecture: Assessment of cellular architecture showed significantly better preservation in the CB group, with excellent retention observed in 43 cases compared to 5 cases in the CS group ($p<0.05$). Moderate architectural preservation was more common in the CS group (79 cases) than in CB group (55 cases), while minimal retention was noted in 16 and 2 cases, respectively. [Table 2]

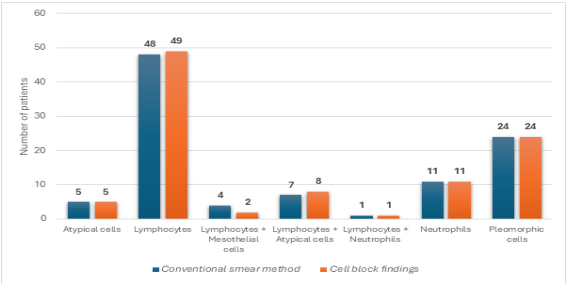

Figure 2: Predominant cells in study groups.

Table 2: Retention of architecture in the study groups

	Conventional smear (CS) method	Cell block (CB) findings
Minimal	16	2
Moderate	79	55
Excellent	5	43
P value	<0.01* considered significant by chi-square test	

Diagnostic outcomes based on cell block and conventional smear methods: Comparison of diagnostic outcomes showed that benign lesions were identified in 87 cases by the CB method and 85 cases by the CS method. Suspicious cases of malignancy were observed only in CS group (5 cases) and not in CB group. Malignant lesions were detected in 13 cases using CB method compared to 10 cases with CS. However, the overall difference in diagnostic distribution between the two methods was not statistically significant ($p>0.05$). [Table 3]

Table 3: Diagnosis of patients in the study groups

Diagnosis	Conventional smear (CS) method	Cell block (CB) findings
Benign	85	87
Suspicion of malignancy	5	0
Malignant	10	13
P value	0.07 considered NOT significant by chi-square test	

Cytological assessment findings: Cytological evaluation revealed 12 malignant and 88 benign cases among the 100 specimens. When compared with the final diagnosis, the CB method demonstrated 11 true positives and 88 true negatives, with only 1 false positive and no false negatives. In contrast, the CS method showed 7 true positives and 80 true negatives, along with 8 false positives and 5 false negatives. Overall diagnostic concordance with the final cytological diagnosis was higher for the CB method (99%) compared to the CS method (87%). Sensitivity, Specificity, positive and negative predictive values (PPV, NPV) for identification of malignancy in study groups are given below in [Table 4].

Table 4: Sensitivity, Specificity, PPV, NPV for identification of malignancy in study groups

	Conventional smear (CS) method	Cell block (CB) findings
Sensitivity	58.33%	100%
Specificity	90.90%	98.87%
Positive predictive value (PPV)	46.66%	91.66%
Negative predictive value (NPV)	94.11%	100%

DISCUSSION

Body fluid cytology has gained significant importance in recent decades due to its utility in diagnosing a wide range of benign and malignant conditions. However, distinguishing benign from malignant cells in CS preparations remains challenging and requires careful evaluation of cytomorphological features along with an understanding of reactive changes. Limitations of the CS method, such as cellular overlap, preparation artifacts, loss of material, and poor architectural preservation, can reduce diagnostic accuracy and sensitivity for malignancy.[6,7]

The CB technique, first introduced by Bahrenberg, has emerged as a valuable adjunct to CS in fluid cytology. It is simple, cost-effective, reproducible, and suitable even in resource-limited settings.8 CB provides superior morphological detail with better preservation of cellular architecture and reduced background staining, closely resembling histopathological sections.[9] Despite these advantages, comparative studies between CB and CS techniques remain limited, particularly in the Indian context, justifying the need for the present study.

In this study, 100 body fluid specimens (pleural, peritoneal, and pericardial) were evaluated using both CS and CB methods. Inclusion of fluids from multiple body cavities strengthens the study design. The plasma–thromboplastin method used for CB preparation was cost-effective and provided good cellular concentration and preservation, although it may cause background staining during immunohistochemistry. Similar methodologies have been reported by Kulkarni MB et al., while alternative techniques such as sediment method with alcohol–formalin fixation have also been described.[2,10]

The study population had a mean age of 44.97 ± 14.27 years, with a male predominance (56%). Most patients were in the fourth and fifth decades, consistent with previous studies. Pleural fluid was the most analyzed specimen, followed by ascitic and pericardial fluids. Congestive cardiac failure and pneumonia were the most frequent clinical diagnoses, followed by tuberculosis and malignancy.

Comparable findings have been reported in earlier studies. Bhanvadia et al. observed a similar male predominance and age distribution, with pleural effusion being the most common specimen.[11] Sukladas et al. also reported a similar age distribution, though with a female predominance due to inclusion of gynecological samples.[12] Sujathan et al. reported a higher proportion of peritoneal effusions compared to pleural effusions.[13]

Comparison of cellularity between the two methods demonstrated significantly higher marked cellularity in the cell block (CB) group (37 cases) compared to the conventional smear (CS) group (14 cases) ($p<0.05$), indicating superior cellular yield with CB. Similar findings were reported by Castro Villebon D et al., although with slightly lower rates of abundant cellularity.[14] Moderate and mild cellularity were more frequently observed in the CS group. The distribution of predominant cell types was comparable between both methods ($p>0.05$), with lymphocytes being most common, followed by pleomorphic cells, while neutrophils, mesothelial, and atypical cells were seen less frequently. The predominance of inflammatory cells correlates with the higher proportion of benign lesions in the study.

Architectural preservation was significantly better in the CB group, with excellent retention in 43 cases compared to only 5 cases in the CS group ($p<0.05$), consistent with findings by Nathan et al. and Thapar et al., who reported superior cytomorphological preservation with CB.[4,15] In contrast, CS preparations often show overcrowding, reactive mesothelial cells, and loss of tissue architecture, which can mimic malignancy and reduce diagnostic accuracy.[16] The CB technique, by utilizing histopathological processing, allows for better morphological assessment and facilitates ancillary studies such as special stains and immunohistochemistry, thereby improving diagnostic confidence.[17]

Although overall diagnostic categorization between the two methods did not show a statistically significant difference ($p>0.05$), CB demonstrated clinical advantages by identifying more malignant cases (13 vs 10) and eliminating the "suspicious" category observed in CS (5 cases). These findings are comparable with studies by Bhanvadia et al,[11] and Sukladas et al,[12] where CB improved definitive diagnosis and reduced indeterminate cases. The summary of the diagnosis by CS and CB methods from various other studies have been summarized in [Table 5].

Table 5: Comparison of findings from CS and CB assessment in various studies

Study	No. of cases	Benign		Suspicious		Malignant	
		CS	CB	CS	CB	CS	CB
Present study	100						
Takagi et al. (1954)18	184	145 (79%)	129 (70%)	6 (3%)	4 (2%)	33 (18%)	51 (28%)
Sujathan et al. (2000)13	85	61 (72%)	63 (74%)	5 (6%)	1 (1%)	19 (22%)	21 (25%)
Bodele et al. (2003)3	150	118 (79%)	111 (74%)	3 (2%)	0	29 (19%)	39 (26%)
Shivkumar et al. (2012)16	60	54 (90%)	50 (83%)	5 (8%)	0	1 (2%)	10 (17%)
Bhanvadia et al. (2014)11	150	116 (77%)	117 (78%)	16 (11%)	0	18 (12%)	33 (22%)
Sukladas et al. (2018)12	80	55 (68.75%)	67 (83.75%)	11 (13.75%)	1 (1.25%)	14 (17.5%)	12 (15%)

On comparison with final cytological diagnosis, the CB method demonstrated superior diagnostic performance over the CS method. CB showed higher true positives (11 vs 7) and true negatives (88 vs 80),

with markedly fewer false positives (1 vs 8) and no false negatives compared to CS (5 cases). Accordingly, the sensitivity of CS for detecting malignancy was 58.33%, significantly lower than 100% with CB, while specificity was 90.9% for CS and 98.87% for CB. The positive predictive value was also higher with CB (91.66% vs 46.66%), as was the negative predictive value (100% vs 94.11%). These findings are comparable to the study by Sukladas et al,[12] which also reported higher sensitivity, specificity, and predictive values with the CB technique. Overall diagnostic accuracy was greater with CB (99%) compared to CS (87%), consistent with other similar studies [Table 6], thereby reinforcing the superior reliability of the cell block method in detecting malignant lesions. The CB method demonstrated an additional malignancy detection yield of 4% compared to the CS method. This finding is consistent with other similar studies and highlights the ability of CB to identify malignant cases that may be missed on CS. [Table 7]

Table 6: Accuracy in different studies by CS and CB methods

Study	CS method	CB method
Present study	87%	99%
Sukladas et al.12	75%	91.67%
Thapar et al.4	71.42%	85.72%
Ceelen et al.19	71%	89%

Table 7: Additional yield of malignancy in identical studies

Study	Percentage of additional yield
Present study	4%
Bodele et al.3	7%
Richardson et al.20	5%
Flint et al.21	9%

The study has certain limitations, including a relatively small sample size and its single-center design. Additionally, other body fluids such as cystic fluids were not included. Future studies involving larger, multicentric populations and a broader range of fluid specimens are recommended to further validate these findings.

CONCLUSION

The CB method was found to be superior to the CS technique for body fluid cytodiagnosis, demonstrating significantly better cellularity and preservation of cellular architecture. It also showed higher diagnostic concordance with the final cytological diagnosis (99% vs 87%). Additionally, CB exhibited improved sensitivity, specificity, positive predictive value, and negative predictive value for detecting malignant lesions. Notably, the CB method eliminated the "suspicious for malignancy" category, enabling more definitive diagnoses and contributing to an increased diagnostic yield of malignancy.

REFERENCES

1. Kushwaha R, Shashikala P, Hiremath S, Basavaraj HG. The cells in the pleural fluid and their value in the differential diagnosis. J Cytol 2008;25:138-43.
2. Shivakumarswamy U, Arakeri SU, Mahesh H Karigowdar MH, Yelikar BR. Diagnostic utility of the cell block method versus the conventional smear study in pleural fluid cytology. J Cytol 2012;29:11-15.
3. Bodele AK, Parate SN, Wadadekar AA, Bobhate SK, Munshi MM. Diagnostic utility of cell block preparation in reporting of fluid cytology. Journal of Cytology 2003;20(3):133-35.
4. Thapar M, Mishra RK, Sharma A, Goyal V, Goyal V. Critical analysis of cell block versus smear examination in effusions Journal of Cytology. 2009;26(2):60-64.
5. Dekker A, Bupp PA. Cytology of serous effusions. An investigation into the usefulness of cellblocks versus smears. Am J Clin Pathol 1978;70 (6):855-60.
6. Kung IT, Yuen RW, Chan JK. Technical notes. Optimal formalin fixation and processing schedule of cell blocks from the fine needle aspirates. Pathology 1989;21:143–45.
7. Mezger J, Stotzer O, Schilli G, Bauer S, Wilmanns W. Identification of carcinoma cells in ascitic and pleural fluid. Comparison of four panepithelial antigens with carcinoembryonic antigen. Acta Cytol. 1992;36:75–81.
8. Ghosh I, Dey SK, Das A, Bhattacharjee D, Gangopadhyay S, Cell block cytology in pleural effusion. Journal of the Indian Medical Association. 2012;110(6):390-96.
9. Fetsch PA, Simsir A, Brosky K, Abati A. Comparison of three commonly used cytologic preparations in effusion immunocytochemistry. Diagn Cytopathol, 2002;26:61-66.
10. Kulkarni, SB Desai, RF Chinoy. Utility of thromboplastin-plasma cell block technique for fine needle aspiration and serous effusions. Diag Cytopathol. 2009;37(2):86-90.
11. Bhanvadia VM, Santwani PM, Vachhani JH. Analysis of diagnostic value of cytological smear method versus cell block method in body fluid cytology: study of 150 cases. Ethiop J Health Sci. 2014; 24(2):125-31.
12. Sukladas S, Shanmugapriya M, Eswari V. Evaluation of Cell Block Techniques in the Cytodiagnosis of Body Fluids in Meenakshi Medical College and Research Institute, Kanchipuram. JMSCR. 2018;6(9):457-67.
13. Sujathan K, Pillai KR, Chandralekha B, Kannan S, Mathew A, Nair MK. Cytodiagnosis of serous effusions: A combined approach to morphological features papanicolaou and Nay-Grunwald Giemsa stained smears and modified cell block technique. Journal of cytology 2000;17(2):89-95.
14. Castro-Villabon D, Avello Y, Ruiz N, A Rodriguez-Urrego P. Implementation of routine thromboplastin-plasma cell block technique in the evaluation of non-gynecologic specimens: A methodologic comparison with conventional cytology. J Microsc Ultrastruct 2014;2:177-81.
15. Nathan HA, Narayan E, Smith MM, Horn MJ. Cell Block Cytology. Improved Preparation and its Efficacy in Diagnostic Cytology. Am J Clin Pathol. 2000;114:599-606.
16. Shivakumarswamy U, Arakeri SU, Mahesh H, Karigowdar MH, Yelikar BR. The role of the cell block method in the diagnosis of malignant ascitic fluid effusions. Journal of Clinical and Diagnostic Research 2012;6:1280-3.
17. Keyhani-Rofagha S, Vesey-Shecket M. Diagnostic value, feasibility, and validity of preparing cell blocks from fluid-

based gynecologic cytology specimens. Cancer Cytopathol, 2002;96:204–09.
18. Takagi F. Studies on tumor cells in serious effusion, Am J Clin Pathol.1954;24:663-75.
19. Ceelen GH. The cytologic diagnosis of ascetic fluid. Acta cytol 1964; 8:175-183.
20. Richardson HL, Koss LG, Simon TR. An evaluation of the concomitant use of cytological and histological techniques in the recognition of cancer in exfoliated material from various sources. Cancer.1995;8:948-50.
21. Flint A. Detection of pulmonary neoplasms by bronchial washings Are cell blocks a diagnostic aid? Acta Cytologica.1993;37(1):21-23.