



CYTOLOGICAL EVALUATION OF BODY FLUIDS IN MALIGNANCY DETECTION

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ABSTRACT

Background: Cytological examination of body fluids is a simple, minimally invasive, rapid, and cost-effective diagnostic tool widely used in the evaluation of malignant and non-malignant effusions. Pleural fluid, ascitic fluid, and cerebrospinal fluid (CSF) cytology play an important role in identifying metastatic malignancies and primary neoplastic involvement.

Aim: To evaluate the cytological findings of pleural, ascitic, and cerebrospinal fluids in the detection of malignancy and to assess the diagnostic utility of body fluid cytology.

Materials and Methods: This prospective observational study was conducted in the Department of Pathology, Naraina Medical College and Research Centre, Kanpur, Uttar Pradesh, India, over a period of one year. A total of 180 body fluid samples including pleural fluid, ascitic fluid, and CSF were analyzed. Samples were processed using conventional centrifugation and smear preparation techniques followed by staining with May-Grünwald-Giemsa (MGG) and Papanicolaou stains. Cytological findings were categorized as benign, suspicious, or malignant. Statistical analysis was performed using SPSS version 25.

Results: Among 180 body fluid samples, pleural fluid constituted the majority of specimens followed by ascitic fluid and CSF. Malignant cells were detected in 38 cases (21.1%). Pleural effusions showed the highest rate of malignancy detection. Adenocarcinoma was the most common malignant cytological pattern identified. Reactive mesothelial proliferation was the most frequent benign finding.

Conclusion: Body fluid cytology remains an effective, economical, and minimally invasive diagnostic modality for malignancy detection. Pleural fluid cytology demonstrated the highest diagnostic yield among the studied fluids. Early cytological evaluation significantly contributes to patient diagnosis, staging, and therapeutic management.

Keywords: Cytology, Pleural Fluid, Ascitic Fluid, Cerebrospinal Fluid, Malignancy, Effusion Cytology.

INTRODUCTION

Body cavity fluid analysis is an important component of diagnostic pathology and provides valuable information regarding inflammatory, infectious, degenerative, and neoplastic conditions affecting serous cavities and the central nervous system [1].

Cytological examination of pleural fluid, ascitic fluid, and cerebrospinal fluid (CSF) is considered a rapid, economical, and minimally invasive diagnostic technique with high specificity for the detection of malignant cells [2].

Effusions may develop due to a wide range of pathological conditions including congestive cardiac failure, tuberculosis, liver cirrhosis, renal disorders, pulmonary infections, and malignancies [3]. Among these, malignant effusions are clinically significant because they are frequently associated with advanced-stage disease and poor prognosis [4]. Detection of malignant cells in body fluids not only confirms metastatic spread but also contributes significantly to tumor staging and therapeutic planning [5].



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Pleural effusion is one of the most common pathological effusions encountered in clinical practice. Lung carcinoma, breast carcinoma, ovarian carcinoma, and gastrointestinal malignancies are major causes of malignant pleural effusions [6]. Ascitic fluid cytology plays an important role in the diagnosis of peritoneal carcinomatosis, hepatobiliary malignancies, and ovarian tumors [7]. Similarly, CSF cytology is highly useful in detecting leukemic infiltration and metastatic involvement of the meninges and central nervous system [8]. Conventional smear cytology remains the cornerstone for evaluation of body fluids despite the development of advanced molecular and imaging techniques [9]. The diagnostic accuracy of fluid cytology depends upon proper specimen collection, prompt processing, adequate cellularity, and careful cytomorphological interpretation [10]. Reactive mesothelial cells, inflammatory changes, and degenerative alterations may occasionally mimic malignancy and create diagnostic difficulties [11]. Various staining techniques including May-Grünwald-Giemsa (MGG) stain and Papanicolaou stain are routinely employed for better cellular visualization and identification of malignant features such as pleomorphism, hyperchromasia, irregular nuclear membrane, and prominent nucleoli [12]. Ancillary techniques such as cell block preparation and immunocytochemistry may further improve diagnostic sensitivity in difficult cases [13]. The present study was undertaken to evaluate the cytological spectrum of pleural, ascitic, and cerebrospinal fluids in a tertiary care teaching hospital and to determine their role in the detection of malignancy [14,15].

Aim and Objectives

Aim: To study the cytological evaluation of body fluids (pleural, ascitic, and CSF) in malignancy detection.

Objectives

1. To analyze the cytomorphological patterns observed in pleural, ascitic, and CSF samples.
2. To determine the frequency of malignant lesions detected by body fluid cytology.
3. To compare the diagnostic yield among different body fluids.
4. To assess the utility of cytology in early malignancy detection.

MATERIALS AND METHODS

Study Design: The present study was a hospital-based prospective observational study conducted in the Department of Pathology, Naraina Medical College and Research Centre, Kanpur, Uttar Pradesh, India.

Study Duration: The study was carried out over a period of one year.

Study Population: All patients clinically suspected of pleural effusion, ascites, or neurological disorders requiring CSF examination and referred to the

pathology department for cytological analysis during the study period were included in the study.

Sample Size: A total of 180 body fluid samples were analyzed, comprising:

- Pleural fluid: 90 cases
- Ascitic fluid: 65 cases
- Cerebrospinal fluid (CSF): 25 cases

Inclusion Criteria

1. All freshly collected pleural, ascitic, and CSF samples received during the study period.
2. Adequate samples with sufficient cellularity for cytological examination.
3. Patients of all age groups and both sexes.

Exclusion Criteria

1. Inadequate or poorly preserved specimens.
2. Hemorrhagic or contaminated samples unsuitable for interpretation.
3. Repeated samples from previously diagnosed cases without additional clinical indication.

Sample Collection and Processing: Body fluid samples were collected under strict aseptic precautions in sterile containers and transported immediately to the pathology laboratory for processing. Gross examination of each specimen was performed to assess volume, color, turbidity, viscosity, and presence of blood clots.

The specimens were centrifuged at 2500 rpm for 10 minutes. Supernatant fluid was discarded and smears were prepared from the sediment. Both air-dried and wet-fixed smears were prepared for staining.

Air-dried smears were stained with May-Grünwald-Giemsa (MGG) stain while alcohol-fixed smears were stained with Papanicolaou stain. Special stains were applied whenever clinically indicated.

Cytological Evaluation: Detailed microscopic examination was carried out to identify:

- Inflammatory cells
- Reactive mesothelial cells
- Degenerative changes
- Atypical cells
- Malignant cells

The cytological findings were categorized into:

1. Negative for malignancy (benign/inflammatory)
2. Suspicious for malignancy
3. Positive for malignancy

Malignant diagnosis was based on cytomorphological features including:

- Increased nuclear-cytoplasmic ratio
- Nuclear pleomorphism
- Hyperchromatic nuclei
- Irregular nuclear membrane
- Prominent nucleoli
- Abnormal mitotic figures
- Cell clustering and acinar formation

Statistical Analysis: All data were entered into Microsoft Excel and statistically analyzed using SPSS software version 25. Descriptive statistical

methods such as percentages, proportions, mean values, and frequency distribution were used for analysis and interpretation of results.

A total of 180 body fluid samples were analyzed during the study period. Among these, pleural fluid specimens constituted the majority with 90 cases (50%), followed by ascitic fluid with 65 cases (36.1%) and CSF with 25 cases (13.9%).

RESULTS

Table 1: Distribution of Body Fluid Samples

Type of Fluid	Number of Cases	Percentage
Pleural Fluid	90	50.0%
Ascitic Fluid	65	36.1%
CSF	25	13.9%
Total	180	100%

The age of patients ranged from 5 years to 82 years. The highest number of cases belonged to the 41-60 years age group accounting for 39.4% of total cases,

followed by the 21-40 years age group. Malignant effusions were predominantly observed among middle-aged and elderly patients.

Table 2: Age-wise Distribution of Cases

Age Group (Years)	Number of Cases	Percentage
0-20	18	10.0%
21-40	52	28.9%
41-60	71	39.4%
>60	39	21.7%
Total	180	100%

Among the study population, males constituted 57.8% while females accounted for 42.2%, showing

a male predominance with a male-to-female ratio of approximately 1.4:1.

Table 3: Gender Distribution

Gender	Number of Cases	Percentage
Male	104	57.8%
Female	76	42.2%
Total	180	100%

Cytological examination revealed that benign and inflammatory lesions were the most common findings observed in 126 cases (70%). Suspicious

cytology was identified in 16 cases (8.9%), while definite malignant cells were detected in 38 cases (21.1%).

Table 4: Cytological Diagnosis in Body Fluids

Cytological Diagnosis	Number of Cases	Percentage
Benign/Inflammatory	126	70.0%
Suspicious for Malignancy	16	8.9%
Malignant	38	21.1%
Total	180	100%

Among malignant effusions, pleural fluid showed the highest positivity for malignant cells accounting for 57.9% of all malignant cases. Ascitic fluid

contributed 31.6%, while CSF represented 10.5% of malignant diagnoses.

Table 5: Distribution of Malignant Cases According to Fluid Type

Type of Fluid	Malignant Cases	Percentage
Pleural Fluid	22	57.9%
Ascitic Fluid	12	31.6%
CSF	4	10.5%
Total	38	100%

Detailed cytomorphological analysis demonstrated adenocarcinoma as the most common malignant lesion identified in body fluid cytology, accounting for 52.6% of malignant cases. Metastatic carcinoma,

squamous cell carcinoma, hematolymphoid malignancies, and small cell carcinoma were also observed.

Table 6: Cytomorphological Types of Malignancy

Type of Malignancy	Number of Cases	Percentage
Adenocarcinoma	20	52.6%
Metastatic Carcinoma	8	21.1%
Squamous Cell Carcinoma	4	10.5%
Hematolymphoid Malignancy	4	10.5%
Small Cell Carcinoma	2	5.3%
Total	38	100%

Reactive mesothelial proliferation represented the most common benign cytological finding followed by chronic inflammatory effusions. Tubercular

effusions were identified in a smaller proportion of cases.

Table 7: Benign Cytological Findings

Cytological Finding	Number of Cases	Percentage
Reactive Mesothelial Cells	52	41.3%
Chronic Inflammatory Effusion	39	31.0%
Acute Inflammatory Effusion	21	16.7%
Tubercular Effusion	14	11.0%
Total	126	100%

DISCUSSION

Cytological examination of body fluids plays a vital role in the diagnosis of both benign and malignant lesions involving serous cavities and the central nervous system [1]. It is widely accepted as a rapid, safe, economical, and minimally invasive diagnostic modality with considerable utility in routine pathological practice [2].

In the present study, pleural fluid constituted the majority of samples received for cytological analysis. Similar observations have been reported in previous studies where pleural effusions represented the most common body cavity fluid evaluated in pathology laboratories [3,4]. The increased frequency of pleural effusions may be attributed to the high prevalence of pulmonary infections, tuberculosis, chronic systemic diseases, and thoracic malignancies.

The majority of cases in the present study belonged to the 41-60 years age group, which correlates with the higher incidence of malignancies in middle-aged and elderly populations [5]. Male predominance observed in this study is also comparable with previous studies and may be related to higher exposure to smoking and occupational risk factors among males [6].

Benign and inflammatory lesions accounted for the majority of body fluid samples. Reactive mesothelial cells were the most frequently encountered benign finding. Reactive mesothelial proliferation often poses diagnostic challenges because of overlapping cytological features with malignant cells [7]. Careful evaluation of nuclear

morphology, chromatin pattern, and cell arrangement is therefore essential for accurate interpretation.

Malignant cells were detected in 21.1% of total cases in the present study. Pleural fluid demonstrated the highest diagnostic yield for malignancy detection, similar to observations reported by Johnston et al. and Motherby et al. [8,9]. The high positivity rate in pleural effusions may be explained by the common occurrence of metastatic spread to pleural surfaces.

Adenocarcinoma was identified as the most common malignant lesion in the present study, accounting for more than half of malignant cases. This finding is consistent with previous studies showing adenocarcinoma as the predominant tumor type causing malignant effusions because of its tendency for exfoliation into body cavities [10,11]. Ascitic fluid cytology proved useful in detecting metastatic abdominal malignancies and ovarian carcinomas. Malignant cells in ascitic fluid commonly appeared in clusters, papillary fragments, and acinar formations with marked pleomorphism and prominent nucleoli [12].

CSF cytology, although comprising fewer cases, was valuable in identifying leukemic infiltration and metastatic involvement of the meninges. Early diagnosis of malignant cells in CSF is important for staging, prognosis, and therapeutic planning in central nervous system malignancies [13].

The present study highlights the significance of conventional cytology as an effective screening and diagnostic method for malignancy detection in body

fluids. Ancillary techniques such as cell block preparation and immunocytochemistry may further improve sensitivity and diagnostic accuracy in difficult cases [14,15].

CONCLUSION

Cytological examination of body fluids is an effective and reliable diagnostic technique for detecting malignant lesions. Pleural fluid showed the highest frequency of malignancy among the studied specimens. Adenocarcinoma was the most commonly identified malignancy, while reactive mesothelial proliferation was the most frequent benign finding.

Body fluid cytology provides rapid and minimally invasive diagnostic information with significant clinical utility in patient management. Proper sample collection, timely processing, and experienced cytomorphological interpretation significantly enhance diagnostic accuracy.

Limitations of the Study

1. Histopathological correlation was not available in all cases.
2. Ancillary techniques such as immunocytochemistry were not routinely performed.
3. The study was conducted at a single tertiary care center with a limited sample size.

Recommendations

1. Routine cytological examination should be performed in all clinically significant effusions.
2. Cell block preparation and immunocytochemistry should be utilized in suspicious cases for better diagnostic accuracy.
3. Larger multicentric studies are recommended to further validate the findings.

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