TO STUDY THE SPECTRUM OF SEROUS EFFUSIONS AND ANALYSE THEIR CYTOLOGICAL PATTERNS ALONG WITH CLINICAL CORRELATION

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Abstract:

Introduction:

Body cavity effusions are important diagnostic specimens that reflect a wide range of underlying conditions such as malignancy, infections, and systemic disorders. Cytological evaluation plays a key role in their assessment; however, interpretation can be challenging due to overlapping morphological features.

Aims and Objectives:

This study was designed to evaluate the cytomorphological spectrum of serous effusions, describe reactive mesothelial changes, and characterize neoplastic cell patterns across different cytopreparatory techniques.

Materials and Methods:

A hospital-based prospective cross-sectional study was conducted on 150 serous effusion samples, including ascitic (n=91), hemorrhagic peritoneal (n=4), pleural (n=53), and pericardial (n=2) fluids. Each specimen was processed using conventional smears, cytospin, and cell block techniques, followed by staining with MGG, H&E, and PAP. Descriptive statistical methods along with chi-square and Stuart–Maxwell tests were applied for analysis.

Results:

The study showed a female predominance (67.3%) with a mean age of 53.3 years. The cytological spectrum demonstrated variable cellularity and morphological patterns across preparation techniques, with cell block yielding the highest cellularity (93.97%), followed by cytospin and conventional smears. Malignant cytomorphological patterns were more clearly identified with advanced preparation techniques, resulting in improved detection yield compared to conventional smears.

Conclusion:

The study highlights a broad cytomorphological spectrum in serous effusions, with cell block and cytospin techniques providing enhanced visualization of cellular details and improved detection of diagnostically significant features compared to conventional smears.

Keywords: Effusion cytology, cytomorphology, cytospin, cell block, serous effusions, mesothelial changes.

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Introduction:

Serous membranes are thin, double-layered structures lining the major body cavities, composed of flattened mesothelial cells supported by delicate connective tissue. They form the pleura, pericardium, and peritoneum, each having visceral and parietal layers with a small amount of serous fluid in between. This fluid acts as a lubricant, allowing smooth movement of organs during respiration, cardiac activity, and intestinal motility [1].

Under normal conditions, serous fluid production and absorption remain in equilibrium through mesothelial secretion, lymphatic drainage, and hydrostatic forces. Disturbance of this balance leads to abnormal fluid accumulation, known as serous effusion [2].

Effusions are broadly classified into **transudates and exudates** based on their pathophysiology. Transudates occur due to systemic factors such as congestive heart failure, cirrhosis, nephrotic syndrome, and hypoalbuminemia, without structural damage to membranes and are typically low in protein and cells. In contrast, exudates result from local pathology such as infection, inflammation, malignancy, or injury, leading to increased vascular permeability and protein-rich fluid accumulation [3].

Although pleural effusion is most common, similar mechanisms occur in pericardial and peritoneal cavities. Pleural effusions may arise from systemic diseases or local causes such as infection, malignancy, or embolism. Pericardial effusions may result from inflammatory, infectious, or neoplastic conditions, while ascites commonly occurs due to cirrhosis but may also be caused by malignancy or infection [4].

Since effusions always reflect underlying disease, their evaluation is clinically important. Cytological and biochemical analysis helps differentiate transudates from exudates and guides further diagnosis and management [5].

Clinically, serous effusions represent a wide disease spectrum. Transudates are commonly associated with systemic disorders like heart failure, renal disease, and liver cirrhosis, whereas exudates are more often linked to infections, malignancies, and inflammatory conditions, usually indicating localized pathology [6].

The clinical burden is significant. In chronic kidney disease, effusions may result from fluid overload, infection, or malignancy. In liver cirrhosis, hepatic hydrothorax may occur even without significant ascites. Malignancies are a major cause, with metastatic tumors of lung, breast, gastrointestinal, or genitourinary origin often presenting as effusion, sometimes as the first manifestation of disease [7].

Advances in imaging and minimally invasive procedures have improved diagnosis, but effusions remain important clinical indicators requiring systematic evaluation, especially with the rising prevalence of chronic systemic diseases [8].

Physiologically, serous cavities contain minimal fluid maintained by a balance between production and lymphatic absorption. Disruption due to altered pressure, inflammation, or lymphatic obstruction leads to fluid accumulation. Mesothelial cells actively contribute through inflammatory mediator release, particularly in exudative conditions [9-10].

Cytological examination is a key, minimally invasive diagnostic tool that allows direct visualization of cells in effusion fluid. It helps differentiate reactive, inflammatory, and malignant processes and is especially useful for detecting metastatic malignancy [11].

Unlike imaging or biochemical tests, cytology provides direct morphological assessment and enables early detection of malignancy as well as infection and inflammation [12]. Its diagnostic utility has improved with techniques such as cytospin, cell block preparation, and immunocytochemistry [13].

However, interpretation remains challenging due to overlap between reactive and malignant features. Reactive mesothelial cells may mimic malignancy, while some tumors appear deceptively bland. Technical factors such as low cellularity, poor preservation, and sampling errors further affect accuracy [14]. Inter-observer variability also contributes to diagnostic inconsistency [15].

To improve accuracy, cytopathology has evolved. Conventional smears are simple and rapid but may lack architectural detail. Cytospin improves cellular yield and nuclear detail in low-cellularity samples. Cell block technique preserves tissue architecture and allows special stains and immunohistochemistry, significantly enhancing diagnostic accuracy [16].

With further advancements such as molecular testing and digital cytopathology, effusion cytology has become more comprehensive and precise [17].

Despite these developments, understanding the **spectrum of serous effusions along with their cytological patterns and clinical correlation** remains essential for accurate diagnosis and improved clinical interpretation.

MATERIALS AND METHODS

Study Design

This was a hospital-based prospective cross-sectional study conducted over a period of two years in the Department of Pathology at Maharishi Marakandeshwar Institute of Medical Sciences and Research. A consecutive sampling technique was employed. All eligible effusion cases received during the study period were included until the desired sample size was achieved.

The final sample size consisted of 150 cases. This number was considered sufficient to estimate cytological outcomes (including malignancy proportion) with a margin of error of ±8% at a 95% confidence level.

Inclusion Criteria

All patients presenting with pleural, peritoneal, or pericardial effusions whose samples were received in the pathology laboratory during the study period were included.

Exclusion Criteria

No specific exclusion criteria were applied. All adequate effusion samples were considered for analysis.

Procedure:

All effusion samples received in the pathology department were registered and included in the study. Immediately after collection, each sample underwent gross examination for assessment of volume, color, and clarity.

The fluid was then processed by dividing it into two aliquots. The first aliquot was used for smear and cytospin preparation. It was centrifuged using routine centrifugation and cytospin technique for 15 minutes, and smears were prepared and stained with Hematoxylin and Eosin (H&E), May-Grünwald Giemsa (MGG), and Papanicolaou (PAP) stains.

The second aliquot was utilized for cell block preparation. The sediment was fixed in a 1:1 solution of 10% formalin and alcohol, followed by centrifugation. The processed material was then subjected to routine histopathological processing using a histokinette, and paraffin blocks were prepared for sectioning.

A structured **case record form (CRF)** was used to collect clinical, demographic, radiological, and laboratory data for each patient.

The study was conducted in accordance with the Declaration of Helsinki (2013 revision) and the Indian Council of Medical Research (ICMR) National Ethical Guidelines (2017). Prior approval was obtained from the Institutional Ethics Committee. As the study involved routine diagnostic procedures only, no additional invasive interventions, risks, or costs were imposed on the patients.

A pilot study was conducted over the initial two months to standardize laboratory procedures, assess feasibility, and identify operational challenges. The first 20 consecutive effusion cases were included and analyzed separately, and were excluded from the final analysis to avoid bias due to procedural optimization.

Validity and Reliability

Internal validity was maintained through consecutive sampling to reduce selection bias, prospective and standardized data collection, and a within-subject design wherein each sample was evaluated using all three cytological techniques. Diagnostic assessment was performed in a blinded manner using standardized reporting criteria and uniform diagnostic definitions.

External validity is supported by inclusion of a diverse tertiary care patient population; however, generalization to primary care or resource-limited settings may be limited due to differences in case mix and availability of advanced cytological techniques.

Reliability of the study findings was high, demonstrated by strong inter-observer agreement (κ = 0.87) and excellent intra-observer agreement (κ = 0.92). The technical failure rate remained very low (0–1.3%), indicating good reproducibility and procedural consistency.

Data Collection Procedure

A standardized **seven-step protocol** was followed:

1. Patient registration, informed consent, and assignment of unique study ID
2. Recording of demographic, clinical, and laboratory data
3. Review of radiological findings (effusion characteristics, masses, metastasis, etc.)
4. Documentation of sample collection, transport, and processing details
5. Blinded cytological evaluation of conventional smear, cytospin, and cell block preparations; reporting included cellularity, cell morphology, mesothelial changes, malignancy status, and TIS classification. A second cytopathologist reviewed 20% of cases
6. Six-month follow-up to establish final reference diagnosis using histopathology or clinical-radiological correlation
7. Data entry into Excel with double-check validation, consistency checks, and missing data correction

Statistical Analysis:

Data were analyzed using appropriate standard statistical methods. Descriptive statistics were used to summarize demographic and clinical variables, including measures of central tendency (mean, median), dispersion (standard deviation), and categorical data expressed as frequencies and percentages.

Comparative analysis was performed to evaluate differences between various effusion types as well as between benign and malignant categories. Depending on the nature of the data, appropriate statistical tests were applied, including the Chi-square test for categorical variables and Student's t-test, ANOVA, and Mann–Whitney U test for continuous variables. A p-value of less than 0.05 was considered statistically significant**.**

Result:

The study population showed a marked female predominance, with females comprising 67.3% of cases and males 32.7%. The mean age was comparable between genders, being slightly higher in males (55.5 years) than females (53.3 years). Overall, effusions were more frequently observed in females, while age distribution remained largely similar across both sexes.

The age-wise distribution showed that most effusion cases occurred in middle-aged and older individuals. The 41–60 years age group constituted the largest proportion (44.7%), followed by the 61–80 years group (34.0%). Patients aged 21–40 years accounted for 18.7% of cases, whereas the youngest (≤20 years) and oldest (>80 years) age groups were least represented, each contributing only 1.3% of cases as shown in table 1.

Table 1: **Age-group distribution of effusion cases (N = 150)**

Age group	**n**	**%**
≤20	2	1.3
21–40	28	18.7
41–60	67	44.7
61–80	51	34
>80	2	1.3

Ascitic/peritoneal fluid constituted the largest proportion of specimens (63.3%), followed by pleural fluid (35.3%), whereas pericardial fluid accounted for only a small fraction (1.3%) as shown in Table 2. These findings indicate that abdominal effusions formed the major component of the study population, with very few pericardial fluid samples encountered.

Table 2: **Distribution of Cases According to Sample Type (N = 150)**

Sample Type		**Number of Cases (n)**	**%**
Peritoneal Fluid	Ascitic Fluid	91	60.7%
	Hemorrhagic Peritoneal Fluid	4	2.7%
Pericardial Fluid		2	1.3%
Pleural Fluid		53	35.3%
Total		**150**	**100%**

Our study revealed that abdominal distension was the most frequent clinical presentation (44%), followed by respiratory symptoms (33.3%). Less common presentations included abdominal distension with fever (14%) and abdominal distension with dyspnea (5.3%), while isolated fever (2%) and other rare symptom combinations, including TB/inflammatory presentations (0.7% each), were observed infrequently as depicted in Table 3. Overall, the data indicate that abdominal and respiratory complaints constitute the predominant clinical manifestations among patients with effusions.

Table 3: Clinical presentation profile (N = 150)

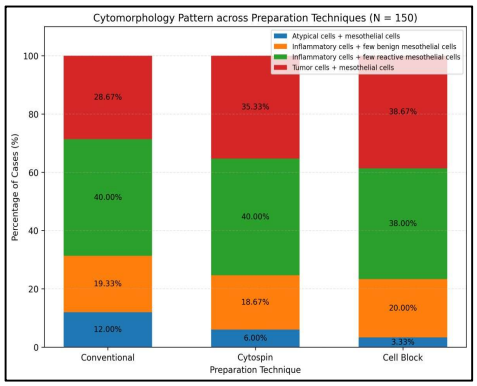
Clinical presentation	**n**	**%**
Abdominal distension	66	44
Respiratory symptoms	50	33.3
Abdominal distension + fever	21	14
Abdominal distension + dyspnea	8	5.3
Fever only	3	2
Mixed abdominal/respiratory	1	0.7
TB/inflammation	1	0.7

The bar chart Figure 1 and table 4 shows that inflammatory cells with reactive mesothelial cells were the predominant cytomorphological pattern across all techniques, accounting for 40.0% of cases on conventional smear and cytospin, and 38.0% on cell block. Inflammatory cells with benign mesothelial cells were also observed with comparable frequencies across methods (18–20%). The proportion of atypical cells progressively decreased from 12.0% on conventional smear to 6.0% on cytospin and 3.3% on cell block, reflecting improved diagnostic categorization. Conversely, tumor cell detection increased from 28.7% on conventional smear to 35.3% on cytospin and 38.7% on cell block, indicating enhanced identification of malignant cells with advanced preparation techniques. Overall, inflammatory patterns predominated, while cytospin and particularly cell block provided better tumor yield and reduced diagnostic ambiguity.

Table 4: **Cytomorphology Pattern across Preparation Techniques (N = 150)**

Cytomorphology Pattern	**Conventional (n, %)**	**Cytospin (n, %)**	**Cell Block (n, %)**
Atypical cells + mesothelial cells	18 (12.00%)	9 (6.00%)	5 (3.33%)
Inflammatory cells + few benign mesothelial cells	29 (19.33%)	28 (18.67%)	30 (20.00%)
Inflammatory cells + few reactive mesothelial cells	60 (40.00%)	60 (40.00%)	57 (38.00%)
Tumor cells + mesothelial cells	43 (28.67%)	53 (35.33%)	58 (38.67%)
Total	**150 (100.00%)**	**150 (100.00%)**	**150 (100.00%)**

Figure1: **Cytomorphology Pattern Across Preparation Techniques (N = 150)**



Our study also found that windowing associated with binucleation/multinucleation is the most frequently observed mesothelial cell feature in non-malignant cases, accounting for 92.78% of samples. In comparison, windowing with vacuolation (6.19%) and windowing with skirting (1.03%) are seen only occasionally. Overall, this indicates that multinucleation-related windowing is the dominant benign mesothelial feature in this study cohort a shown in table 5.

Table 5: **Mesothelial Cell Features as per Cytospin Technique (N = 97)**

Mesothelial-cell Feature	**Cases (n)**	**%**
Windowing + binucleation/multinucleation	90	92.78%
Windowing + vacuolation	6	6.19%
Windowing + skirting	1	1.03%
Total	**97**	**100.00%**

Our study also indicates that ascites is the most prevalent radiological finding (58.00%), followed by pleural effusion (34.67%), reflecting a clear dominance of fluid-associated pathologies. Less frequent patterns include mass lesions (3.33%), infective etiologies (2.00%), and pericardial effusion (1.33%), while metastasis is the least common (0.67%) a depicted in Table 6. Overall, the data

demonstrate that effusion-related findings form the major component of the radiological spectrum in this cohort.

Table 6: Radiological Pattern Distribution (N = 150)

Radiological Pattern	Cases (n)	%
Ascites	87	58.00%
Mass	5	3.33%
Metastasis	1	0.67%
Pericardial effusion	2	1.33%
Pleural effusion	52	34.67%
Infective Etiology	3	2.00%
Total	**150**	**100.00%**

Our study also found that during distribution of TIS categories using the cytospin technique, with Category II being the most common (58.67%), followed by Category V (35.33%). Categories III (2.67%) and IV (3.33%) are rare, while Category I is not observed in any case a shown in table 7. Overall, the data indicate a clear predominance of Category II, along with a substantial proportion of Category V cases.

Table 7: **Distribution of TIS Categories as per Cytospin Technique (N = 150)**

TIS Category	Cases (n)	%
Category I	0	0.00%
Category II	88	58.67%
Category III	4	2.67%
Category IV	5	3.33%
Category V	53	35.33%
Total	**150**	**100.00%**

Our study found significant associations were observed for TIS category, mesothelial-cell features, and cytomorphological patterns across different preparation techniques, indicating their strong diagnostic relevance. Cellularity also showed a statistically significant association across techniques, while age demonstrated a weaker but still significant relationship (p = 0.0182) as shown in table 8. Overall, the findings highlight that cytological and classification-based parameters form the core of the diagnostic spectrum in this study.

Table 8: Summary of statistically significant findings

Parameter / Comparison	Statistically significant finding	Test used	p-value
Age	Older age was associated with malignant diagnosis	Mann–Whitney U test	0.0182
Gender	Female sex showed higher malignant yield than male sex	Chi-square test	0.0014
Radiological pattern	Radiology category differed significantly by malignancy status	Chi-square test	0.0084
Conventional smear morphology	Tumor/atypical morphology strongly tracked malignant diagnosis	Chi-square test	<0.001
Mesothelial reactive features	Mesothelial feature pattern varied significantly with malignancy status	Chi-square test	<0.001
TIS category	TIS categories showed very strong association with final diagnosis	Chi-square test	<0.001

Discussion:

Serous effusions are abnormal fluid accumulations in the pleural, peritoneal, and pericardial cavities and have been recognized since ancient medical literature. Hippocrates (460–370 BC) described pleural effusion as "water in the chest," with early treatment limited to open drainage, associated with high morbidity. Understanding and management gradually improved over time [18].

A key advancement in the nineteenth century was the development of safer drainage techniques. Playfair introduced water-seal drainage in 1873, followed by Bülau's closed intercostal drainage system in 1875, forming the basis of modern pleural management [19]. Concurrently, early cytological studies demonstrated that serous fluids contain diagnostically important cells, including malignant cells, establishing cytology as a diagnostic tool [20].

In the twentieth century, effusions were classified into **transudates and exudates**, providing a structured diagnostic framework. Transudates result from systemic hydrostatic or oncotic imbalance, whereas exudates arise from infection, inflammation, or malignancy. This distinction remains fundamental in routine evaluation.

Effusion cytology plays a pivotal role in the evaluation of abnormal fluid accumulation within serous cavities, including pleural, peritoneal, and pericardial spaces. These effusions arise from a wide spectrum of benign and malignant conditions such as infections, inflammatory diseases, organ failure states, tuberculosis, trauma, and metastatic malignancies [21]. Since these fluids are easily accessible through minimally invasive procedures, cytological examination serves as a rapid and cost-effective tool for initial disease assessment and often provides the first clue to an underlying systemic or neoplastic process [22].

Clinico-cytological interpretation of effusions requires integration of clinical history, radiological findings, biochemical parameters, and morphological patterns. Variables such as age, sex, site of effusion, recurrence, and associated systemic symptoms provide important contextual information for narrowing differential diagnoses [21]. Cytologically, effusions demonstrate a broad spectrum ranging from reactive mesothelial changes and inflammatory patterns to clearly malignant cellular populations. However, overlap in morphological features between reactive and neoplastic mesothelial proliferations often makes interpretation challenging [5].

In the present study, effusion cases showed a clear female predominance with a higher proportion of patients in the middle-aged and elderly groups. This demographic pattern is consistent with published literature, where effusion samples are more frequently encountered in adults due to the higher burden of chronic systemic diseases, infections, and malignancies with advancing age [23]. The low frequency in extremes of age further reflects the clinical referral pattern for cytological evaluation.

Peritoneal (ascitic) fluid constituted the majority of samples, followed by pleural effusions, while pericardial effusions were rare. This distribution closely mirrors other studies, where ascitic and pleural fluids consistently represent the dominant specimens in routine cytology practice. The predominance of ascitic fluid likely reflects the high prevalence of hepatic, infectious, and intra-abdominal pathological conditions, whereas pleural effusions are commonly associated with respiratory, inflammatory, and metastatic diseases [23].

Serous effusions commonly involve pleural and peritoneal cavities, while pericardial effusions are less frequent. Most cases are benign, although a subset is malignant with important diagnostic and prognostic implications. Lung carcinoma is the most common source in males, while breast and Müllerian tumors predominate in females [24]. Indian studies show a higher proportion of benign effusions, with ascitic fluid being more common than pleural effusions [25]. Chronic kidney disease and tuberculosis are also important causes, particularly for pericardial effusions [26]. Globally, major causes include cardiac failure, infections, malignancy, and tuberculosis, with variation based on geography and healthcare settings [27].

Clinically, abdominal distension was the most frequent presentation, followed by respiratory symptoms such as dyspnea and cough. These findings correspond to the underlying distribution of ascitic and pleural effusions and highlight the heterogeneous clinical manifestation of serous fluid accumulation depending on organ system involvement. Similar symptom patterns have been reported in other studies, reinforcing the nonspecific nature of effusion presentation.

Cytomorphologically, effusions demonstrated a spectrum of patterns ranging from inflammatory backgrounds with reactive mesothelial cells to cases showing atypical or overtly malignant cells. Reactive mesothelial cells often exhibited clustering, binucleation, and multinucleation, which may mimic neoplastic processes, underscoring the diagnostic complexity of effusion cytology [28].

In the present study, windowing associated with binucleation/multinucleation was the predominant mesothelial cell feature I Awsznnon-malignant effusions (92.78%), whereas windowing with vacuolation (6.19%) and skirting (1.03%) were infrequent. These findings indicate that reactive mesothelial proliferation with multinucleation represents the most common benign cytomorphological pattern in our cohort. Reactive mesothelial cells are well known to exhibit intercellular windows, binucleation, and multinucleation secondary to regenerative and inflammatory stimuli. Similar observations have been reported in effusion cytology studies, where multinucleated mesothelial cells constituted a characteristic feature of reactive effusions. Awareness of these benign reactive changes is important to avoid misinterpretation as malignant atypia and to improve diagnostic accuracy in serous effusion cytology [29-30].

In contrast, inflammatory effusions showed predominantly mixed inflammatory cells with mesothelial components, reflecting benign or infectious etiologies.

Cytologically, transudates show low cellularity with few mesothelial cells, while exudates show increased inflammatory cells and reactive mesothelial proliferation [31]. Hemorrhagic and chylous effusions exhibit distinct backgrounds that assist in classification [32]. Interpretation requires correlation with clinical and biochemical findings for accuracy.

Reactive mesothelial proliferation is common and may mimic malignancy due to clustering and nuclear enlargement, creating diagnostic difficulty. Mesothelial cells often show a “two-zone” cytoplasm and mild atypia, but morphological overlap limits definitive distinction [33].

Malignant effusions show diverse cytomorphology depending on tumor type. Squamous cell carcinoma is rare and may mimic benign cells, while hematolymphoid malignancies present as dispersed populations. Melanoma and sarcomas show marked variability and often require ancillary testing for confirmation [34].

Low cellularity is a major limitation, and negative cytology does not exclude malignancy, particularly in poorly exfoliative tumors. Overall sensitivity ranges from 58–60%, higher in adenocarcinomas due to better shedding patterns.[20]

Immunocytochemistry and molecular techniques aid in the differentiation of reactive and malignant cells.

No single diagnostic modality is sufficient on its own; therefore, an integrated approach remains essential for accurate interpretation of serous effusions. Clinico-cytological correlation, incorporating clinical, radiological, and biochemical findings, further enhances diagnostic accuracy. Combined evaluation helps in better characterization of benign and malignant effusions. In cases with persistent diagnostic uncertainty, repeat sampling or ancillary investigations may be required for definitive diagnosis.

Overall, the study highlights that serous effusions represent a morphologically diverse spectrum rather than a uniform entity. Their interpretation depends on a combination of clinical context, radiological findings, and cytomorphological patterns. The predominance of ascitic and pleural effusions, middle-aged and elderly patients, and reactive mesothelial changes reflects the typical clinico-pathological spectrum encountered in routine diagnostic practice.

In conclusion, effusion cytology remains a valuable diagnostic modality for understanding the spectrum of serous cavity diseases. A systematic approach integrating clinical, radiological, and cytological findings allows accurate categorization of effusions into benign, reactive, and malignant spectra, thereby improving overall diagnostic confidence and clinical correlation.

Conclusion:

This study provides a comprehensive overview of the cytological spectrum of serous effusions, highlighting their diverse clinical, radiological, and cytomorphological presentations. Effusions were predominantly observed in middle-aged and elderly patients, with a clear female preponderance. Ascitic fluid was the most common type, followed by pleural effusions, while pericardial and hemorrhagic peritoneal effusions were relatively uncommon.

The clinical presentation varied widely, with abdominal distension and respiratory symptoms being the most frequent manifestations, reflecting the underlying systemic and local disease processes. Radiological findings showed meaningful correlation with cytological diagnosis, particularly in cases associated with mass lesions and metastatic disease.

Cytomorphological evaluation demonstrated a wide spectrum ranging from benign transudative and reactive inflammatory patterns to malignant effusions. Reactive mesothelial changes, including binucleation, multinucleation, and window formation, were commonly observed in non-neoplastic conditions and formed an important diagnostic background for interpretation.

Overall, serous effusions represent a heterogeneous group of pathological conditions with overlapping clinical and cytological features. Accurate interpretation requires integration of cytomorphological patterns with clinical and radiological context to understand the underlying disease spectrum.

Limitations:

This was a single-center study; therefore, the spectrum of effusion types and their etiological distribution may reflect local patient population and institutional referral patterns, which may limit wider generalizability.

In addition, the small number of uncommon effusions, particularly pericardial and hemorrhagic peritoneal fluids, restricts detailed interpretation of the cytological spectrum in these categories. However, findings related to pleural and ascitic effusions, which formed the major proportion of cases, remain reliable for assessing the overall spectrum of serous effusions.

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