International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Available online on: https://ijmpr.in/

Original Article

Sensitivity And Specificity of Fine Needle Aspiration Cytology of Solid Mass Lesions and Its Correlation with Histopathology

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Received: 09-05-2026
Accepted: 05-06-2026
Available online: 30-06-2026

ABSTRACT

Background: Fine Needle Aspiration Cytology (FNAC) is a simple, rapid, minimally invasive, and cost-effective diagnostic procedure widely used in the evaluation of solid mass lesions. Histopathological examination remains the gold standard for definitive diagnosis; however, FNAC serves as an important first-line investigation because of its simplicity, safety, and diagnostic accuracy.
Aim: To evaluate the sensitivity, specificity, diagnostic accuracy, and cytohistopathological correlation of Fine Needle Aspiration Cytology in solid mass lesions.
Materials and Methods: A prospective observational study was conducted in the Department of Pathology, Jawaharlal Nehru Medical College and Associated Group of Hospitals, Ajmer, Rajasthan, from November 2023 to June 2025. A total of 230 cases involving breast, thyroid, salivary gland, and lymph node lesions were evaluated using FNAC and correlated with histopathological findings.
Results: Females constituted 76.96% of the study population, while males accounted for 23.04%. Breast lesions were the most common lesions encountered (58.70%), followed by thyroid lesions (29.57%), salivary gland lesions (6.96%), and lymph node lesions (4.78%). FNAC demonstrated a sensitivity of 77.36%, specificity of 89.83%, positive predictive value of 69.49%, negative predictive value of 92.98%, and overall diagnostic accuracy of 86.96%.
Conclusion: FNAC is a reliable, minimally invasive, rapid, and cost-effective diagnostic modality with high specificity and excellent cytohistopathological concordance. It remains a valuable first-line investigation for the evaluation of solid mass lesions.

Keywords: FNAC, Histopathology, Breast Lesions, Thyroid Lesions, Salivary Gland Lesions, Lymph Node Lesions, Diagnostic Accuracy.

INTRODUCTION

Solid mass lesions involving the breast, thyroid gland, lymph nodes, and salivary glands are among the most common clinical conditions encountered in surgical and cytopathology practice [1]. These lesions represent a wide spectrum of pathological conditions ranging from inflammatory and benign proliferative disorders to malignant neoplasms [1,2]. Accurate and early diagnosis of these lesions is essential for appropriate treatment planning and prognosis [1]. Traditionally, histopathological examination of surgically excised tissue has been regarded as the gold standard for diagnosis [2]. However, the critical need for minimally invasive, rapid, and cost-effective diagnostic techniques has led to the widespread use of cytological methods, particularly Fine Needle Aspiration Cytology (FNAC) [3].

FNAC is a simple, minimally invasive diagnostic procedure used for evaluating palpable and non-palpable masses. It involves the aspiration of cellular material using a fine needle followed by microscopic examination [3]. FNAC has become

an important first-line diagnostic investigation because it enables differentiation between benign and malignant lesions and helps guide subsequent clinical management [3, 4]. It is especially valuable in evaluating lesions of the breast, thyroid gland, lymph nodes, and salivary glands because of its safety, rapid turnaround time, cost-effectiveness, and high patient acceptability [3].

Breast lesions represent one of the most common indications for FNAC [5, 6]. Fibroadenoma is the predominant benign lesion, whereas breast carcinoma remains the most common malignant lesion [7]. Similarly, thyroid nodules are frequently encountered in clinical practice, the majority of which are benign [8]. However, distinguishing benign from malignant lesions is crucial for clinical patient management [9]. Salivary gland lesions and cervical lymphadenopathy also present significant diagnostic challenges because of their diverse etiologies and overlapping clinical features [10, 11].

Although FNAC provides a rapid and reliable preliminary diagnosis, histopathological examination remains the gold standard for confirming the true nature of lesions [2]. Cytohistopathological correlation helps identify false-positive and false-negative diagnoses, assess overall diagnostic accuracy, and improve the future interpretation of cytological findings. Several studies have demonstrated diagnostic accuracies ranging from 85% to 90% when primary FNAC findings are correlated directly with final histopathology [12, 13].

The present study was undertaken to evaluate the sensitivity and specificity of FNAC in solid mass lesions involving the breast, thyroid gland, salivary glands, and lymph nodes, and to correlate cytological findings with histopathological diagnoses. The study also aimed to assess the diagnostic utility of FNAC and compare the findings with those reported in contemporary national and international literature.

AIMS AND OBJECTIVES

1. To assess various solid mass lesions affecting the breast, thyroid gland, salivary glands, and lymph nodes using FNAC.
2. To assess the histopathological findings of the corresponding surgical specimens.
3. To correlate baseline FNAC findings with definitive histopathological diagnoses.
4. To assess the diagnostic utility of FNAC in terms of sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy.
5. To compare the findings of the present study with similar studies conducted in India and abroad.

MATERIALS AND METHODS

This prospective observational study was conducted in the Department of Pathology, Jawaharlal Nehru Medical College and Associated Group of Hospitals, Ajmer, Rajasthan, from November 2023 to June 2025, after obtaining formal approval from the Institutional Ethics Committee.

The minimum calculated sample size was 153 cases; however, a total of 230 eligible cases of solid mass lesions were included during the study period. All palpable solid masses that underwent FNAC followed by biopsy or excision and histopathological examination were included in the study. Cases with insufficient cellularity, inadequate smears, or poorly preserved specimens were excluded from the final analysis.

A detailed clinical history was obtained from all patients. FNAC was performed using a 22–23-gauge needle attached to a 10 mL disposable syringe under strict aseptic precautions. Smears were prepared and stained with Hematoxylin and Eosin (H&E) stain and May–Grünwald–Giemsa (MGG) stain. Histopathological examination was subsequently performed on formalin-fixed, paraffin-embedded tissue sections stained with H&E.

The cytological diagnoses were correlated directly with histopathological findings. Statistical analysis was performed using SPSS version 23.0. Qualitative variables were expressed as frequencies and percentages, whereas quantitative variables were expressed as mean ± standard deviation. Sensitivity, specificity, positive predictive value, negative predictive value, and overall diagnostic accuracy were calculated using standard statistical formulas. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 230 cases of solid mass lesions involving the breast, thyroid gland, salivary glands, and lymph nodes were included in the study. The cytological diagnoses obtained by FNAC were correlated with histopathological findings to evaluate the diagnostic utility of FNAC.

Table 1: Distribution of Cases According to Age Group (n=230)

Age Group (Years)	Number	Percentage (%)
21–30	78	33.91
31–40	53	23.05
41–50	44	19.13
51–60	25	10.87
61–70	24	10.43
>70	6	2.61
Total	**230**	**100.00**

The majority of cases were observed in the 21–30 years age group (33.91%), followed by the 31–40 years age group (23.05%). The mean age of the study population was 39.63 ± 15.49 years**.**

Table 2: Distribution of Cases According to Gender (n=230)

Gender	Number	Percentage (%)
Female	177	76.96
Male	53	23.04
Total	**230**	**100.00**

Out of 230 cases, females constituted the majority (76.96%), whereas males accounted for 23.04% of the study population. The male-to-female ratio was 0.29:1.

Table 3: Organ-wise Distribution of Cases (n=230)

Organ	Inflammatory n (%)	Benign n (%)	Malignant n (%)	Total n (%)
Breast	25 (18.52%)	64 (47.41%)	46 (34.07%)	135 (58.70%)
Thyroid	11 (16.18%)	47 (69.12%)	10 (14.71%)	68 (29.57%)
Salivary Gland	8 (50.00%)	8 (50.00%)	0 (0.00%)	16 (6.96%)
Lymph Node	2 (18.18%)	5 (45.45%)	4 (36.36%)	11 (4.78%)
Total	**46 (20.00%)**	**124 (53.91%)**	**60 (26.09%)**	**230 (100.00%)**

Table 4: Histopathological Spectrum of Lesions According to Organ

Organ System	Histopathological Diagnosis	Number (n)	Percentage (%)
Breast (n=135)	Fibroadenoma	41	30.37
	Ductal carcinoma in situ (DCIS)	16	11.85

Organ System	Histopathological Diagnosis	Number (n)	Percentage (%)
	Invasive breast carcinoma NST	14	10.37
	Invasive lobular carcinoma	5	3.70
	Mucinous carcinoma	4	2.96
	Invasive solid papillary carcinoma	4	2.96
	Benign phyllodes tumour	4	2.96
	Tubular adenoma	4	2.96
	Granulomatous mastitis	4	2.96
	Others (Benign / Malignant)	39	28.89
Thyroid (n=68)	Colloid goitre	20	29.41
	Papillary thyroid carcinoma	10	14.71
	Benign follicular lesion	5	7.35
	Hashimoto thyroiditis	4	5.88
	Chronic thyroiditis	3	4.41
	Adenomatous goitre	2	2.94
	Follicular adenoma	2	2.94
	Others	22	32.35
Salivary Gland (n=16)	Pleomorphic adenoma	4	25.00
	Lymphoepithelial sialadenitis	4	25.00
	Warthin tumour	2	12.50
	Haemangioma	2	12.50
	Granulomatous inflammatory lesion	4	25.00
Lymph Node (n=11)	Non-Hodgkin lymphoma	3	27.27
	Reactive lymphadenitis	2	18.18
	Tuberculous lymphadenitis	2	18.18
	Reactive follicular hyperplasia	2	18.18

Organ System	Histopathological Diagnosis	Number (n)	Percentage (%)
	Hodgkin lymphoma	2	18.18

Table 5: Cytohistopathological Correlation

Parameter	Case Count (n)	Percentage (%)
Concordant Cases	200	86.96
Discordant Cases	30	13.04
Total Cases	**230**	**100.00**

The overall cytohistopathological concordance was 86.96%, whereas discordance was observed in 13.04% of cases.

Table 6: Diagnostic Performance of FNAC

Parameter	Value (%)
Sensitivity	77.36
Specificity	89.83
Positive Predictive Value (PPV)	69.49
Negative Predictive Value (NPV)	92.98
Diagnostic Accuracy	86.96

FNAC demonstrated high specificity (89.83%) and excellent overall diagnostic accuracy (86.96%) in the evaluation of solid mass lesions.

FIGURES

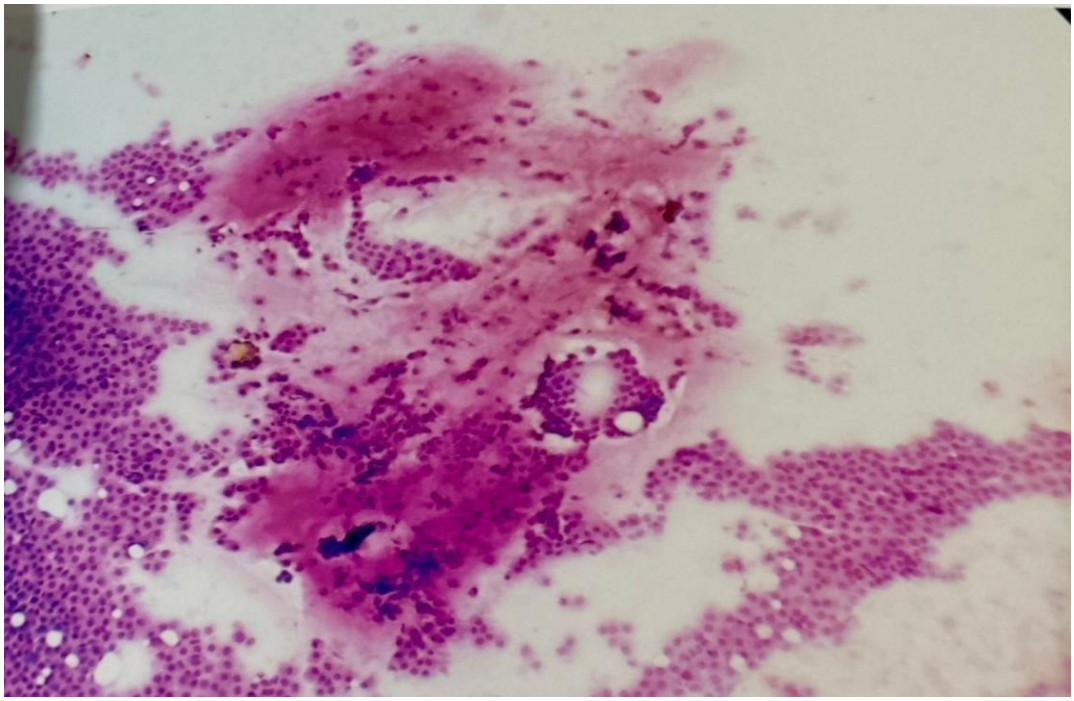

Figure 1: FNAC from Breast smear, shows malignant epithelial cells lying singly and in sheets with abundant extracellular mucin - Mucinous Carcinoma (H&E stain, 100X)

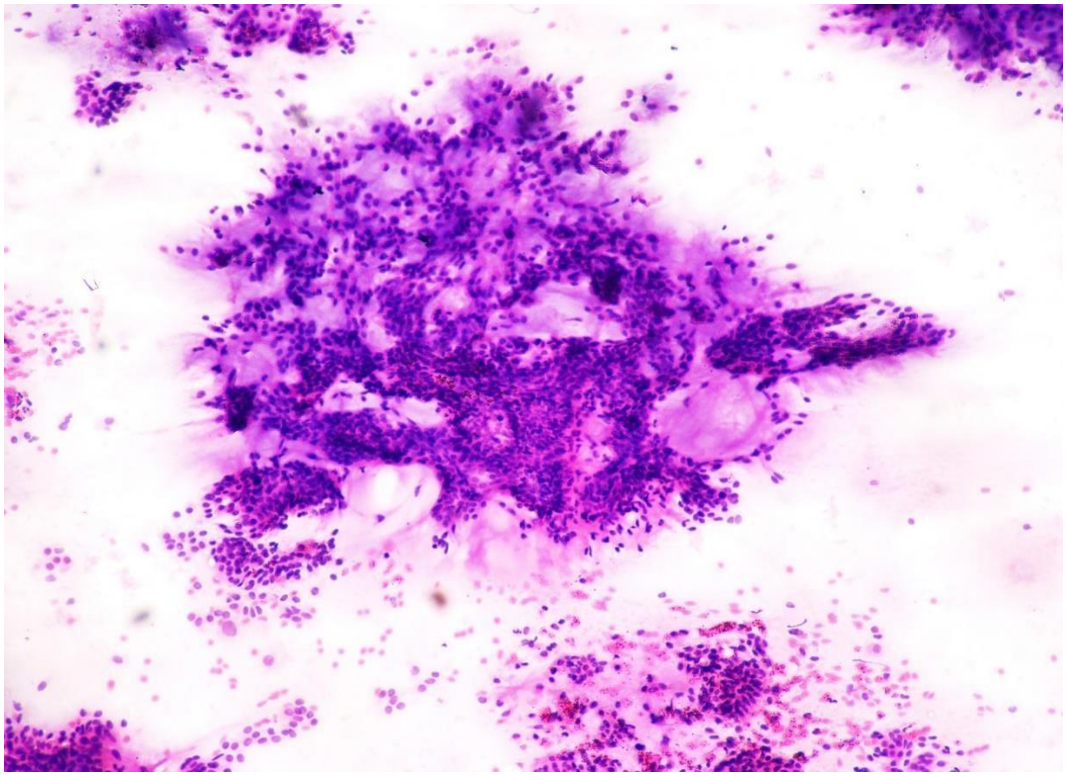

Figure 2. Fine needle aspiration cytology smear showing epithelial and myoepithelial cell clusters embedded in a fibro myxoid stromal background, consistent with pleomorphic adenoma (H&E stain, ×10).

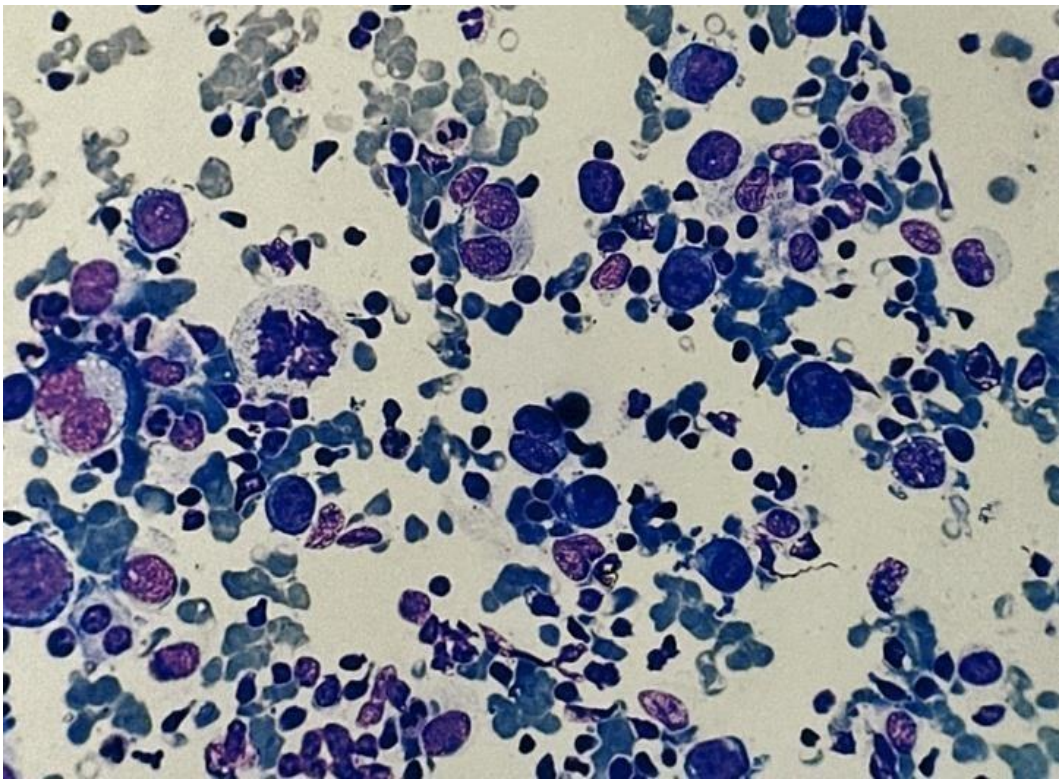

Figure 3. Fine needle aspiration cytology smear showing Reed–Sternberg cells with bilobed nuclei and prominent nucleoli in a polymorphous inflammatory background, suggestive of Hodgkin lymphoma (H&E stain, ×40).

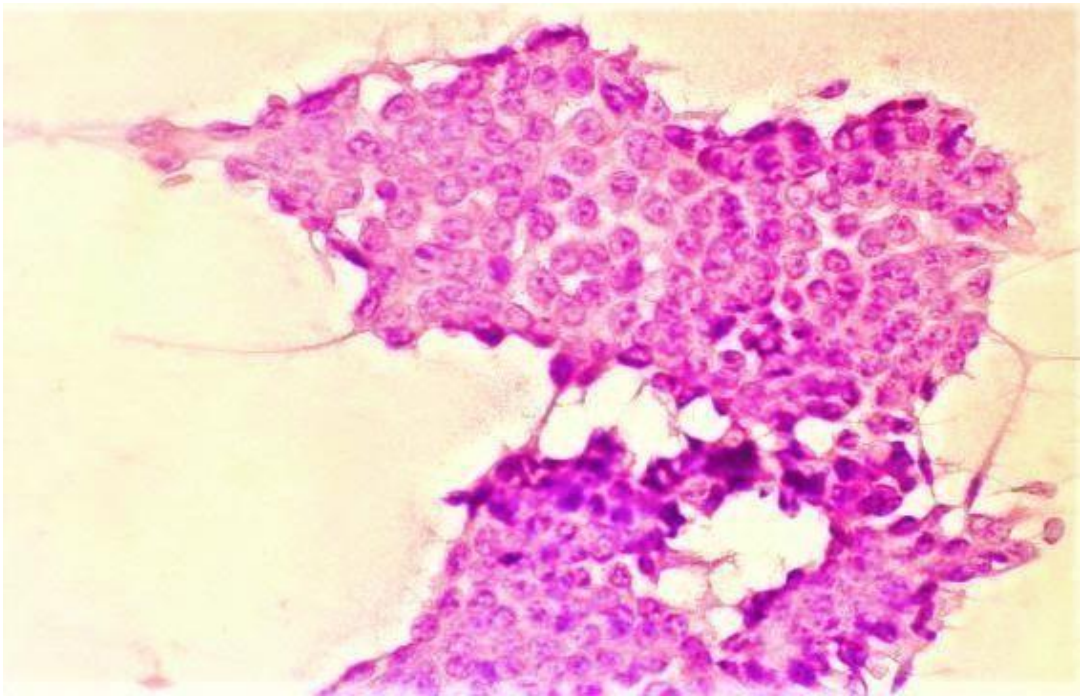

Figure 4. Fine needle aspiration cytology smear showing papillary fragments composed of follicular epithelial cells exhibiting nuclear grooves and powdery chromatin, consistent with papillary thyroid carcinoma (H&E stain, ×400).

DISCUSSION

Fine Needle Aspiration Cytology (FNAC) is a minimally invasive, rapid, cost-effective, and reliable diagnostic technique widely used for the evaluation of palpable and deep-seated mass lesions [3]. It serves as an important preoperative investigation and assists clinicians in differentiating benign from malignant lesions, thereby guiding appropriate patient management [3, 4]. Histopathology remains the gold standard for definitive diagnosis; however, FNAC continues to play a crucial role as a first-line diagnostic modality because of its simplicity, safety, and high diagnostic yield [2].

The present study included 230 cases of solid mass lesions involving the breast, thyroid gland, salivary glands, and lymph nodes. The majority of patients belonged to the 21–30 years age group (33.91%), followed by the 31–40 years age group (23.05%). Similar findings have been reported in previous studies, where benign breast and thyroid lesions predominated in younger and middle-aged individuals [6, 8]. Females constituted 76.96% of the study population, reflecting the high prevalence of breast and thyroid lesions among women [6].

Breast lesions constituted the largest proportion of cases (58.70%), followed by thyroid lesions (29.57%), salivary gland lesions (6.96%), and lymph node lesions (4.78%). Similar organ-wise distributions have been documented in previous studies, indicating that breast and thyroid lesions account for the majority of FNAC specimens in routine pathology practice [6, 12].

Among breast lesions, benign lesions were the most common category. Fibroadenoma emerged as the predominant benign lesion, accounting for 64.06% of benign breast lesions. This observation is consistent with the findings of Nwafor et al. [14], Manasa et al.[5], Embaye et al. [6], and Bisht et al. [7], all of whom identified fibroadenoma as the most common benign breast lesion. Among malignant lesions, ductal carcinoma in situ (DCIS) and invasive breast carcinoma NST were the most frequent diagnoses [7, 15].

Thyroid lesions represented the second largest group. Benign thyroid lesions predominated, with colloid goitre being the most common diagnosis [8, 16]. Papillary thyroid carcinoma was the most frequent malignant thyroid lesion. Similar findings have been reported by Jeelani et al. [8], Bista et al. [17], and Osseis et al. [9], highlighting the utility of FNAC in the evaluation of thyroid nodules.

Salivary gland lesions constituted a relatively small proportion of cases. Pleomorphic adenoma was the most common benign salivary gland neoplasm. FNAC demonstrated excellent utility in distinguishing inflammatory lesions from neoplastic lesions because of the characteristic cytomorphological features of pleomorphic adenoma [10, 11].

Lymph node lesions comprised a small proportion of the study population. Reactive and granulomatous lesions represented the majority of non-neoplastic diagnoses, whereas Hodgkin lymphoma and non-Hodgkin lymphoma constituted the malignant lesions [18, 19]. FNAC proved useful in differentiating inflammatory from neoplastic lymph node lesions [11, 20].

The overall cytohistopathological concordance observed in the present study was 86.96%. FNAC demonstrated a sensitivity of 77.36%, specificity of 89.83%, positive predictive value of 69.49%, negative predictive value of 92.98%, and overall diagnostic accuracy of 86.96%. These findings are comparable to those reported in previous studies and reaffirm the diagnostic reliability of FNAC [12, 13, 21].

Table 7: Comparison of Diagnostic Performance of FNAC with Previous Studies

Study	Sensitivity (%)	Specificity (%)	Diagnostic Accuracy (%)
Jeelani et al. (2018) [8]	83.50	92.00	88.00
Bisht et al. (2022) [7]	81.80	95.00	89.20
Salaria et al. (2024) [21]	84.30	93.60	90.10
Present Study	**77.36**	**89.83**	**86.96**

The diagnostic performance observed in the present study was comparable with previous published studies. Although the sensitivity was slightly lower than that reported by Jeelani et al. [8], Bisht et al. [7], and Salaria et al. [21], the specificity and overall diagnostic accuracy remained within the acceptable range. Minor discrepancies may be attributed to sampling errors, lesion heterogeneity, and overlapping cytomorphological features [13, 22, 23].

The findings of the present study further emphasize the role of FNAC as an effective screening and diagnostic tool in routine clinical practice. The high specificity observed in the present study indicates that FNAC is particularly useful in confirming neoplastic lesions and reducing unnecessary surgical interventions. Furthermore, the procedure is economical, minimally invasive, and well tolerated by patients, making it especially valuable in resource-limited healthcare settings.
The major strengths of the present study include its prospective design, relatively large sample size of 230 cases, inclusion of multiple organ systems, and cytohistopathological correlation in all analysed cases. These factors enhance the reliability of the findings and provide a comprehensive assessment of the diagnostic utility of FNAC in routine pathology practice.
The findings of the present study support the role of FNAC as a simple, rapid, minimally invasive, and cost-effective diagnostic modality for the evaluation of solid mass lesions. When interpreted in conjunction with clinical and radiological findings, FNAC provides valuable information that assists clinicians in diagnosis, treatment planning, and patient management.

LIMITATIONS

The present study was conducted at a single tertiary care centre and may not fully represent the disease spectrum of the general population. Histopathological correlation was available only in cases undergoing biopsy or surgical excision. Immunohistochemistry and molecular studies were not performed in all cases. Larger multicentric studies with longer follow-up are recommended to further validate the diagnostic utility of FNAC in solid mass lesions.

CONCLUSION

Fine Needle Aspiration Cytology is a simple, rapid, minimally invasive, and cost-effective diagnostic modality for the evaluation of solid mass lesions. In the present study, FNAC demonstrated high specificity (89.83%) and excellent diagnostic accuracy (86.96%), with substantial cytohistopathological concordance. Breast lesions constituted the most common category of lesions, followed by thyroid, salivary gland, and lymph node lesions. The findings support the use of FNAC as a reliable first-line diagnostic investigation. When combined with clinical and radiological findings, FNAC facilitates early diagnosis, appropriate therapeutic planning, and reduction of unnecessary surgical interventions.

ACKNOWLEDGEMENT

The authors express their sincere gratitude to the Department of Pathology, Jawaharlal Nehru Medical College and Associated Group of Hospitals, Ajmer, Rajasthan, for providing the facilities and support required for conducting this study. The authors are also thankful to all faculty members, technical staff, and patients who contributed directly or indirectly to the successful completion of this research work.

ETHICAL APPROVAL

The study was conducted after obtaining approval from the Institutional Ethics Committee of Jawaharlal Nehru Medical College and Associated Group of Hospitals, Ajmer, Rajasthan. All procedures performed in the study were in accordance with institutional ethical standards.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this article.

FUNDING
No external funding was received for this study.

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