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Role of Scrape Cytology in the Diagnosis of Malignancy Across Different Organs: A Prospective Diagnostic Accuracy Study

Dr Geeta Pachori[1], Dr Madhuri Verma[2], Dr Sikandar Singh[3], Dr Rashmi Gupta[4]

[1]Senior Professor, Department of Pathology, Jawahar Lal Nehru Medical College, Ajmer, Rajasthan, India
[2]Resident, Department of Pathology, Jawahar Lal Nehru Medical College, Ajmer, Rajasthan, India
[3]Independent Practitioner, Ajmer, Rajasthan, India
[4]Professor, Department of Preventive and Social Medicine, Jaipur, Rajasthan, India

Corresponding Author:

Dr Madhuri Verma
Resident, Department of Pathology, Jawahar Lal Nehru Medical College, Ajmer, Rajasthan, India - 305001;
Email:
vermamadhuri028@gmail.com

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ABSTRACT

Background: Scrape cytology is a rapid, inexpensive modification of imprint cytology that can support intraoperative assessment where frozen-section facilities are limited. This study evaluated its diagnostic performance across five organ systems.
Methods: In this prospective diagnostic-accuracy study, 200 suspected malignant surgical specimens from the breast, ovary, thyroid, testis and kidney were examined. Four scrape smears were prepared before formalin fixation; two were stained with May-Grunwald-Giemsa and two with haematoxylin and eosin. Cytological diagnoses were compared with final histopathology.
Results: The breast was the most frequently sampled organ (123/200; 61.5%), followed by the ovary (17.5%), thyroid (11.0%), testis (5.5%) and kidney (4.5%). Histopathology classified 148 lesions as malignant and 52 as non-malignant. Scrape cytology correctly identified 142 malignant and 50 non-malignant lesions, yielding a sensitivity of 95.95%, specificity of 96.15%, positive predictive value of 98.61%, negative predictive value of 89.29% and overall accuracy of 96.0%.
Conclusion: Scrape cytology is a rapid, simple and reliable adjunct for intraoperative evaluation of suspected malignancy. Its high accuracy supports use in resource-constrained settings, while final histopathology remains essential for definitive diagnosis and assessment of invasion.

Keywords*: scrape cytology; intraoperative diagnosis; histopathology; diagnostic accuracy; malignancy.*

INTRODUCTION

Cancer remains a major cause of morbidity and mortality worldwide, and timely tissue diagnosis is central to appropriate treatment planning.[1] Histopathology is the definitive diagnostic method, but routine processing cannot provide an immediate intraoperative opinion. Cytological methods such as fine-needle aspiration, imprint, squash and scrape preparations can provide rapid cellular assessment with minimal equipment.

Scrape cytology is performed by gently scraping the freshly cut surface of a surgical specimen and spreading the obtained material onto glass slides. Compared with touch imprints, it generally produces more cellular smears while preserving tissue for routine processing. Studies across mixed tumour types and ovarian and thyroid lesions have reported good concordance between scrape cytology and histopathology.[2-4] The method is particularly useful where frozen-section facilities are unavailable or when preoperative fine-needle aspiration is difficult, contraindicated or inconclusive.[5,6]

The present study aimed to evaluate the role of scrape cytology in diagnosing malignancy in breast, ovarian, thyroid, testicular and renal specimens and to compare cytological findings with final histopathological diagnosis.

MATERIALS AND METHODS

Study design and setting: This prospective diagnostic-accuracy study included surgical specimens received in the Department of Pathology, Jawahar Lal Nehru Medical College, Ajmer, from January 2024 to June 2025. The minimum sample size was 200, calculated using an anticipated diagnostic accuracy of 96%, a 95% confidence level and 4% absolute precision, based on prior published evidence.[6]

Eligibility criteria: Suspected malignant surgical specimens from the thyroid, ovary, breast, testis and kidney were included. Specimens from other organs and autolysed, inadequately fixed, over-fixed or otherwise unsuitable specimens were excluded.

Scrape-smear preparation: After gross examination, each specimen was bisected and a representative cut surface was gently scraped with the edge of a glass slide. The material was spread between two slides to prepare thin smears. Four smears were prepared per specimen: two air-dried smears for May-Grunwald-Giemsa staining and two ethanol-fixed smears for haematoxylin and eosin staining. Smears were assessed for cellularity, arrangement, cytomorphology and background.

Histopathology and comparison: After smear preparation, specimens were fixed in formalin, routinely processed, embedded in paraffin, sectioned at 3-5 micrometres, stained with haematoxylin and eosin, and examined microscopically. Histopathology was treated as the reference standard, and the scrape-cytology diagnosis was classified as concordant or discordant with the final diagnosis.

Statistical analysis: Data were analysed using IBM SPSS Statistics version 23.0. Categorical variables are presented as frequencies and percentages. Association between age group and sex was assessed using the chi-square test. Sensitivity, specificity, positive predictive value, negative predictive value and overall diagnostic accuracy were calculated from the 2 x 2 table using histopathology as the reference standard. A two-sided p value <0.05 was considered statistically significant.

Ethical considerations: The study was approved by the Institutional Ethics Committee of JLN Medical College, Ajmer.

RESULTS

A total of 200 specimens were analysed. Breast specimens predominated (61.5%), followed by ovarian (17.5%), thyroid (11.0%), testicular (5.5%) and renal (4.5%) specimens (Table 1). Of the 200 patients, 179 (89.5%) were female and 21 (10.5%) were male. The 51-60-year age group contained the largest proportion (24.5%). Age-group distribution did not differ significantly by sex (chi-square=6.62, df=6, p=0.357) (Table 2). Histopathology identified 148 malignant and 52 non-malignant lesions. Based on the reported cytology-histology classification, 142 malignant lesions were true positive and 50 non-malignant lesions were true negative; six malignant lesions were false negative and two non-malignant lesions were false positive. Sensitivity was 95.95%, specificity 96.15%, positive predictive value 98.61%, negative predictive value 89.29% and overall accuracy 96.0%.

Table 1: Organ-wise distribution of specimens (n=200)

Organ	n (%)
Breast	123 (61.5)
Ovary	35 (17.5)
Thyroid	22 (11.0)
Testis	11 (5.5)
Kidney	9 (4.5)
Total	200 (100.0)

Table 2: Age- and sex-wise distribution of cases (n=200)

Age group (years)	Female, n (%)	Male, n (%)	Total, n (%)
11-20	7 (3.91)	2 (9.52)	9 (4.5)
21-30	21 (11.73)	5 (23.81)	26 (13.0)
31-40	31 (17.32)	5 (23.81)	36 (18.0)
41-50	30 (16.76)	1 (4.76)	31 (15.5)
51-60	44 (24.58)	5 (23.81)	49 (24.5)
61-70	29 (16.20)	2 (9.52)	31 (15.5)
>70	17 (9.50)	1 (4.76)	18 (9.0)
Total	179 (100.0)	21 (100.0)	200 (100.0)

Table 3: Histopathological distribution of breast lesions (n=123)

Category	Histopathological Diagnosis	Number (%)
Normal (n = 2)	Normal breast tissue	2 (100.0)
Inflammatory (n = 8)	Chronic mastitis	2 (25.0)
Inflammatory (n = 8)	Granulomatous mastitis	2 (25.0)
Inflammatory (n = 8)	Duct ectasia	2 (25.0)
Inflammatory (n = 8)	Fibrocystic disease	2 (25.0)
Benign (n = 10)	Fibroadenoma	6 (60.0)
Benign (n = 10)	Usual ductal hyperplasia	1 (10.0)
Benign (n = 10)	Benign phyllodes tumour	1 (10.0)
Benign (n = 10)	Lactating adenoma	1 (10.0)
Benign (n = 10)	Gynecomastia	1 (10.0)
Malignant (n = 103)	Invasive breast carcinoma, NST	54 (52.43)
Malignant (n = 103)	Ductal carcinoma in situ (DCIS)	29 (28.16)
Malignant (n = 103)	Mucinous carcinoma	11 (10.68)
Malignant (n = 103)	Encapsulated papillary carcinoma	9 (8.74)
Total (n=123)		**123 (100)**

Table 4: Histopathological distribution of ovarian lesions (n=35)

Category	Histopathological Diagnosis	Number (%)
Benign (n = 9)	Teratoma	4 (11.43)
Benign (n = 9)	Mucinous cystadenoma	3 (8.57)
Benign (n = 9)	Serous cystadenoma	2 (5.71)
Borderline (n = 3)	Brenner tumour	3 (8.57)
Malignant (n = 23)	Adenocarcinoma of ovary	9 (25.71)
Malignant (n = 23)	Germ cell tumour	3 (8.57)
Malignant (n = 23)	Adult granulosa cell tumour	3 (8.57)
Malignant (n = 23)	Dysgerminoma	2 (5.71)
Malignant (n = 23)	serous carcinoma ovary	2 (5.71)
Malignant (n = 23)	Mucinous carcinoma ovary	2 (5.71)
Malignant (n = 23)	Papillary carcinoma ovary	2 (5.71)
Total (n = 35)		**35 (100)**

Table 5: Histopathological distribution of thyroid lesions (n=22)

Category	Histopathological Diagnosis	Number (%)
Inflammatory (n = 1)	Hashimoto thyroiditis	1 (4.55)
Benign (n = 9)	Colloid goitre	6 (27.27)
Benign (n = 9)	Multinodular goitre	3 (13.64)
Malignant (n = 12)	Papillary thyroid carcinoma	9 (40.91)
Malignant (n = 12)	Medullary carcinoma	2 (9.09)
Malignant (n = 12)	Follicular thyroid carcinoma	1 (4.55)
Total (n = 22)		**22 (100)**

Table 6: Histopathological distribution of testicular lesions (n=11)

Testicular Lesions	Histopathological Diagnosis	Number (%)
Inflammatory (n = 2)	Orchitis	1 (9.09)
Inflammatory (n = 2)	Tubercular epididymo-orchitis	1 (9.09)
Benign (n = 3)	Torsion testis	2 (18.18)
Benign (n = 3)	Sertoli cell-only syndrome	1 (9.09)
Malignant (n = 6)	Seminoma	4 (36.36)
Malignant (n = 6)	Testicular lymphoma	1 (9.09)
Malignant (n = 6)	Spindle cell carcinoma	1 (9.09)
Total (n = 11)		**11 (100)**

Table 7: Histopathological distribution of renal lesions (n=9)

Category	Histopathological Diagnosis	Number (%)
Inflammatory (n = 2)	Inflammatory lesion	2 (22.22)
Benign (n = 3)	Pyelonephritis	3 (33.33)
Malignant (n = 4)	Clear cell renal cell carcinoma	4 (44.44)
Total (n = 9)		**9 (100)**

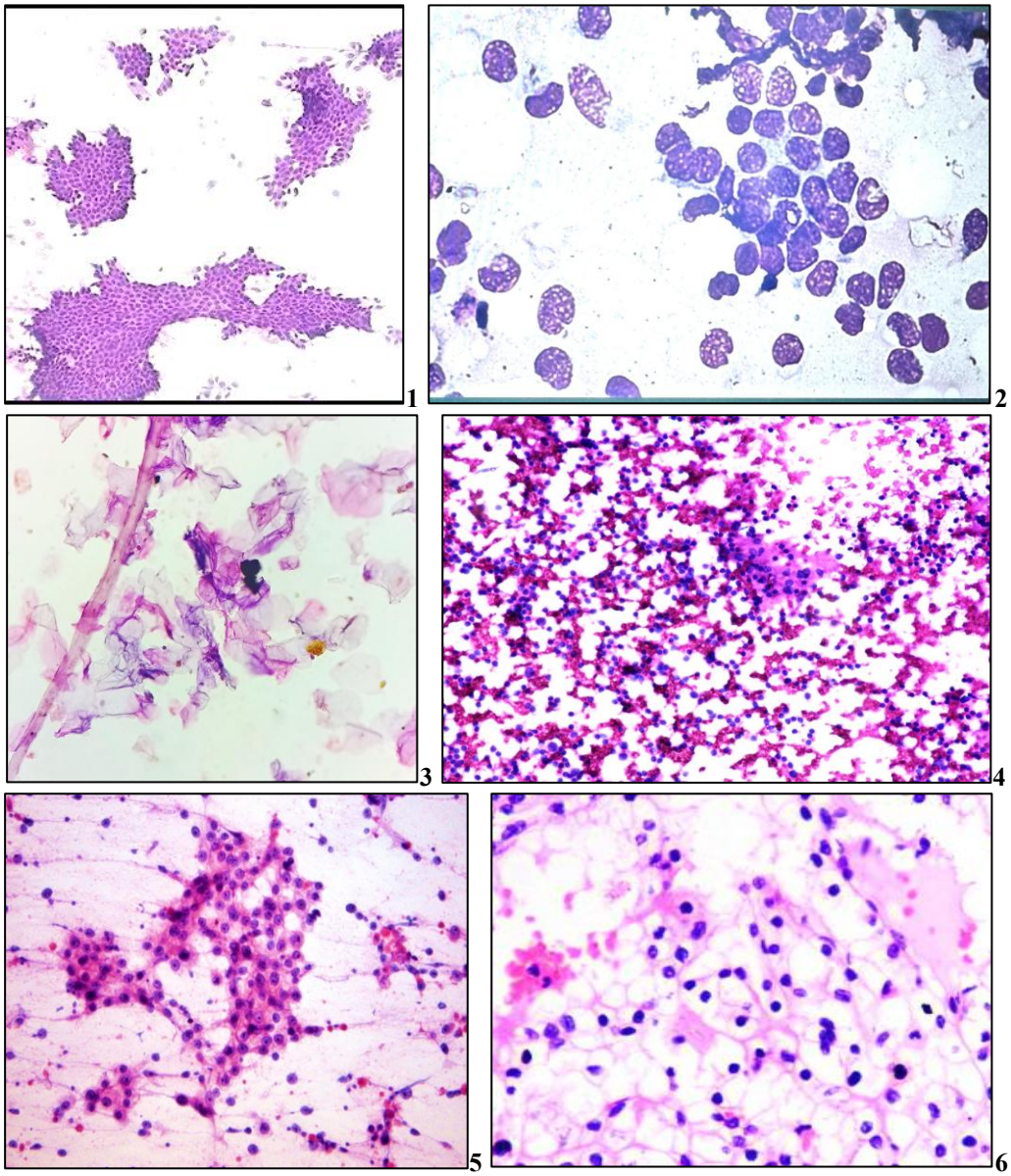

Figure 1*: Breast scrape smear showing staghorn-like cohesive clusters of ductal epithelial cells, consistent with fibroadenoma (H&E, x40).* ***Figure 2****: Breast scrape smear showing clustered and singly dispersed malignant epithelial cells with nuclear enlargement and atypia and absence of bipolar nuclei, consistent with lobular carcinoma (MGG, x40).* ***Figure 3****: Ovarian scrape smear showing anucleate squames and a hair shaft, consistent with mature cystic teratoma (H&E, x40).* ***Figure 4****: Thyroid scrape smear showing numerous small mature lymphocytes dispersed throughout the smear and infiltrating thyroid follicular cell clusters, consistent with Hashimoto thyroiditis (H&E, x10).* ***Figure 5****: Testicular scrape smear showing cohesive cells with pale cytoplasm, large nuclei and prominent nucleoli, with scattered background lymphocytes, consistent with seminoma (H&E, x40).* ***Figure 6****: Renal histopathology showing nests and tubules of polygonal cells with clear cytoplasm, irregular hyperchromatic nuclei and branching vasculature, consistent with clear-cell renal cell carcinoma (H&E, x40).*

DISCUSSION

This prospective study evaluated scrape cytology in 200 suspected malignant specimens across five organ systems. The technique achieved an overall diagnostic accuracy of 96.0%, with balanced sensitivity and specificity. These findings support scrape cytology as a rapid adjunct to histopathology, particularly where frozen-section infrastructure is unavailable.

Breast specimens formed the largest group, reflecting the case mix and the female predominance of the cohort. Invasive breast carcinoma of no special type was the commonest malignant breast diagnosis. Kolte and Satarkar reported high diagnostic accuracy across surgically resected tumours, while Mahore et al. reported 93.49% accuracy in 169 specimens and documented reliable performance in breast, renal and testicular lesions.[2,7]

Ovarian lesions comprised 17.5% of the cohort. The present findings reinforce the value of intraoperative cytology for rapid categorisation of ovarian lesions. Vijayakumar reported 90% concordance for intraoperative ovarian cytology, while Gupta et al. described 91% diagnostic accuracy for malignant ovarian lesions in a series of 81 cases.[8,9] Cytology may nevertheless under-sample focal immature or borderline components; adequate sampling and final histological assessment remain essential.

Papillary thyroid carcinoma was the predominant malignant thyroid lesion. Khuroo et al. similarly demonstrated useful diagnostic performance of scrape cytology as an adjunct to fine-needle aspiration in thyroid lesions, with particularly strong specificity.[4] Testicular and renal specimens were fewer, but scrape cytology provided useful rapid categorisation when correlated with gross findings and clinical information.

The observed 96.0% accuracy is identical to that reported by Sharma et al., who found scrape cytology concordant with final histopathology in 48 of 50 cases.[6] Scrape preparations are attractive because they are inexpensive, rapidly prepared, cellular and do not consume tissue needed for histology or ancillary testing. However, they cannot reliably assess capsular or stromal invasion, tumour depth, architectural criteria or resection margins in every setting. Histopathology therefore remains the definitive method.

Limitations

This was a single-centre study with unequal organ distribution and small renal and testicular subgroups. The analysis grouped heterogeneous benign, inflammatory, borderline and malignant entities, and organ-specific sensitivity and specificity were not available. Interobserver agreement, turnaround time and comparison with frozen section were not assessed. Larger multicentre studies with prespecified organ-specific diagnostic criteria are warranted.

CONCLUSION

Scrape cytology is a rapid, simple, cost-effective and reliable technique for intraoperative assessment of suspected malignancy. In this cohort it achieved 96.0% overall diagnostic accuracy and performed well across breast, ovarian, thyroid, testicular and renal specimens. It can provide timely preliminary guidance in resource-limited settings, but discordant or architecture-dependent lesions require definitive histopathological evaluation.

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ABBREVIATIONS USED

DCIS, ductal carcinoma in situ; DPX, dibutyl phthalate polystyrene xylene; H&E, haematoxylin and eosin; IEC, Institutional Ethics Committee; MGG, May-Grunwald-Giemsa; NPV, negative predictive value; NST, no special type; PPV, positive predictive value; SPSS, Statistical Package for the Social Sciences.

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