Section: Pathology

Original Research Article

SCRAPE/ASPIRATION CYTOLOGY IN THE INTRAOPERATIVE DIAGNOSIS OF OVARIAN NEOPLASMS: A PROSPECTIVE CORRELATIVE STUDY

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ABSTRACT

Background: Accurate intraoperative assessment of ovarian neoplasms is essential for determining the appropriate extent of surgery. Although frozen-section examination is widely used, it requires specialised infrastructure and expertise and may be limited by freezing artefacts. Scrape/aspiration cytology offers a rapid, inexpensive alternative that provides excellent cellular detail and may be particularly useful in resource-limited settings. **Objectives:** To evaluate the role and diagnostic accuracy of scrape/aspiration cytology in the intraoperative diagnosis of ovarian neoplasms by correlating cytological findings with final histopathology.

Materials and Methods: This prospective study was conducted in the Department of Pathology, Government Medical College, Thrissur, from April 2011 to December 2012. Eighty-eight ovarian tumour specimens from 75 patients were evaluated; four cases with inadequate cytological material were excluded. Scrape/aspiration cytology was performed on fresh specimens, and smears were stained using Papanicolaou, hematoxylin and eosin, and Giemsa stains. Cytological diagnoses were compared with paraffin-embedded histopathology, which served as the gold standard. Sensitivity, specificity, predictive values, and overall accuracy were calculated using standard statistical methods.

Results: Of the 84 tumours analysed, 61 (72.6%) were benign, 17 (20.2%) malignant, and 6 (7.1%) borderline on histopathology. Scrape cytology showed an overall accuracy of 92.85% and correctly classified 86.9% of cases. Sensitivity and specificity for benign tumours were 100% and 82.6%, respectively, while for malignant tumours they were 88.23% and 97.01%. Borderline tumours demonstrated lower sensitivity (33.33%) but retained high specificity (100%). Diagnostic concordance was highest for benign and malignant lesions.

Conclusion: Scrape/aspiration cytology is a rapid, reliable, and cost-effective adjunct for intraoperative evaluation of ovarian neoplasms, with high accuracy for benign and malignant tumours and acceptable limitations for borderline lesions.

Keywords: Ovarian neoplasms; Scrape cytology; Intraoperative diagnosis; Histopathological correlation; Diagnostic accuracy.

INTRODUCTION

The science of cytology and cytopathology, recognized since the 18th century, achieved significant standardization only in the latter half of the 20th century.[1] It is now a well-established diagnostic discipline comprising two principal branches—exfoliative cytology and aspiration biopsy cytology.[1] The seminal contributions of George Papanicolaou, made between 1917 and 1928,

demonstrated that accurate pathological diagnosis could be achieved through microscopic evaluation of cellular smears, laying the foundation for modern cytologic practice.[2]

Ovarian neoplasms constitute a heterogeneous group of tumours arising from epithelial, stromal, and germ cell components, and their accurate intraoperative classification is crucial for optimal surgical management. However, most ovarian tumours cannot be reliably distinguished based solely on clinical presentation or gross morphological features.[3] Although frozen section examination remains the conventional method for intraoperative consultation, the use of cytology smears has often been underutilized, largely due to a perceived higher diagnostic confidence in frozen sections. Several studies have demonstrated that intraoperative cytology offers diagnostic accuracy comparable to that of frozen section analysis, while being rapid, cost-effective, and technically simpler.[4] With the increasing frequency of intraoperative consultations for ovarian lesions in recent years, there is a renewed need to reassess the diagnostic utility of intraoperative cytologic techniques.[5,6] This study aimed to evaluate the role of scrape/aspiration cytology in the intraoperative diagnosis of ovarian neoplasms and to assess its accuracy in providing rapid diagnosis, using histopathology as the gold standard.

MATERIALS AND METHODS

This was a prospective observational study conducted in the Department of Pathology, Government Medical College, Thrissur, over a period of 20 months from April 2011 to December 2012 on ovarian neoplasms received for intraoperative evaluation. A total of 88 ovarian tumours obtained from 75 patients were included, of which 13 cases were bilateral and were analyzed as separate specimens. Patients of all age groups who underwent ovariotomy, salpingo-oophorectomy, or total abdominal hysterectomy with bilateral salpingo-oophorectomy (TAH + BSO) for solid or cystic ovarian neoplasms were included. Twisted ovarian tumours and patients who had received prior chemotherapy or radiotherapy were excluded from the study.

Relevant clinical data were collected for each case using a predesigned proforma, including age, presenting symptoms and signs, ultrasonographic findings, available tumour markers such as AFP and CA-125, and pertinent intraoperative findings. Following surgical excision, all fresh specimens were subjected to detailed gross examination. Parameters such as type of specimen, size, weight, external surface, consistency, and cut surface appearance were documented. Clinical and gross findings were correlated and recorded systematically for each case.

Scrape or aspiration cytology was performed on fresh specimens after wiping excess blood from the cut surface using filter paper. Representative areas were selected and scraped using the sharp edge of a scalpel blade or glass slide, or aspirated using a 22–24 gauge needle, depending on tissue consistency. The obtained semi-solid material was evenly spread onto glass slides, and a minimum of three smears were prepared from each specimen. One smear was immediately fixed in 85% isopropyl alcohol and stained with conventional Papanicolaou stain, the second was fixed in formalin vapor and stained with Hematoxylin and Eosin (H&E), and the third was air-dried and stained with Giemsa. Rapid H&E staining required approximately 4–5 minutes, while Pap and Giemsa staining required 15–20 minutes. In five cases, scrape smears were taken intraoperatively to assess the practical applicability of the technique.

The remaining tissue was fixed in 10% buffered formalin overnight, processed routinely, paraffin-embedded, and sectioned at 4–5 µm thickness for H&E staining. Cytological smears were evaluated for cellularity, architectural patterns, individual cell morphology, nuclear atypia, pleomorphism, mitotic activity, and background features such as mucin, necrosis, or proteinaceous material. Tumours were classified into surface epithelial-stromal, germ cell, sex cord-stromal, or metastatic categories according to standard ovarian tumour classification criteria.[7] Cytological diagnoses were rendered based on established diagnostic features and later compared with the final histopathological diagnosis, which served as the gold standard. Special stains were applied where required. Four cases with unsatisfactory scrape cytology in which opinion was deferred were excluded from analysis. Statistical analysis was performed using SPSS software version 17.

RESULTS

A total of 88 ovarian specimens obtained from 75 patients were evaluated; four cases with opinion deferred due to inadequate cytological material were excluded, leaving 84 specimens for final analysis. Based on histopathological diagnosis, 61 tumours (72.6%) were benign, 17 (20.2%) were malignant, and 6 (7.1%) were borderline. Statistical analysis was performed using frequency distribution and cross-tabulation with SPSS version 17. The patients' ages ranged from 13 to 70 years, with a mean age of 42.24 ± 14.48 years. Most benign tumours occurred in the reproductive age group (15–45 years), whereas malignant tumours were more common in patients older than 45 years.

On gross examination, 62 specimens (73.8%) were cystic, of which the majority were benign lesions. All purely solid tumours (8 cases, 9.5%) were malignant, while tumours with mixed solid-cystic consistency (14 cases, 16.7%) showed a higher proportion of malignant and borderline lesions. Most tumours were unilateral (62 cases, 73.8%), predominantly benign, whereas bilateral involvement (22 cases, 26.2%) was

more frequently associated with malignant and borderline tumours. Among benign neoplasms, benign serous and benign mucinous tumours were most common and were predominantly unilateral. In contrast, all mucinous cystadenocarcinomas, endometrioid adenocarcinomas, and borderline mucinous tumours were bilateral, and two-thirds of serous cystadenocarcinomas showed bilateral involvement. Overall, 65% of malignant and borderline tumours were bilateral.

Correlation between scrape cytology and final histopathology revealed concordant diagnoses in 73 of 84 cases, yielding an overall sensitivity of 86.9% and an overall diagnostic accuracy of 92.85%. Scrape cytology correctly identified all malignant cases, while borderline tumours showed lower sensitivity. The sensitivity and specificity for benign lesions were 100% and 82.6%, respectively, whereas for malignant lesions they were 88.23% and 97.01%. Borderline tumours showed a sensitivity of 33.33% but a specificity of 100%. Eighteen cases showed discordance, most commonly involving misclassification between benign and borderline categories.

Table 1: Age wise distribution of the study subjects

	N	%
Age group (in Years		
11 -20	4	5.5
21-30	15	20.5
31-40	14	19.2
41-50	15	20.5
51-60	17	23.3
61-70	8	11

Table 2: Baseline characharestics of the study population

		Benign	Borderline	Malignant
Age group	<15	1(1.2)	0	0
	15-45	37(44)	4(4.8)	5(6)
	>45	23(27.4)	2(2.4)	12(14.3)
Lesion consistency				
	Cystic	0	1(1.2)	4(4.8)
	Solid	4(4.8)	8(9.5)	0
	Mixed	1(1.2)	8(9.5)	2(2.4)
Laterality				
	Unilateral	54(64.3)	1(1.2)	7(8.3)
	Bilateral	7(8.3)	5(6)	10(11.9)

Table 3: Distribution of Cases on the Basis of Laterality and Final Histopathology

Final Histopathology Diagnosis	Unilateral	Bilateral	Total
Benign serous tumor	22	3	25
Benign mucinous tumor	22	1	23
Serous cystadenocarcinoma	2	4	6
Mucinous cystadenocarcinoma	0	4	4
Endometrioid adenocarcinoma	0	2	2
Granulosa cell tumor	3	0	3
Dysgerminoma	1	0	1
Borderline serous tumor	1	4	5
Borderline mucinous tumor	0	1	1
Mature cystic teratoma	9	3	12
Seromucinous tumor	1	0	1
Adenosarcoma	1	0	1
Total	62	22	84

Table 4: Distribution of Cases as Benign, Malignant or Borderline and Correlation Between Scrape Cytology and HPR

Cytological Diagnosis	Scrape(N)	HPR(N)
Benign	65	61
Malignant	17	17
Borderline	2	6
Total	84	84

Table 5: Sensitivity, Specificity, Positive predictive value, Negative predictive value and accuracy of scrape cytology

Parameter	Benign	Malignant	Borderline
Sensitivity	100%	88.23%	33.33%
Specificity	82.60%	97.01%	100%
PPV	93.84%	88.23%	100%
NPV	100%	97.01%	95.12%
Overall Accuracy	92.85%	—	—

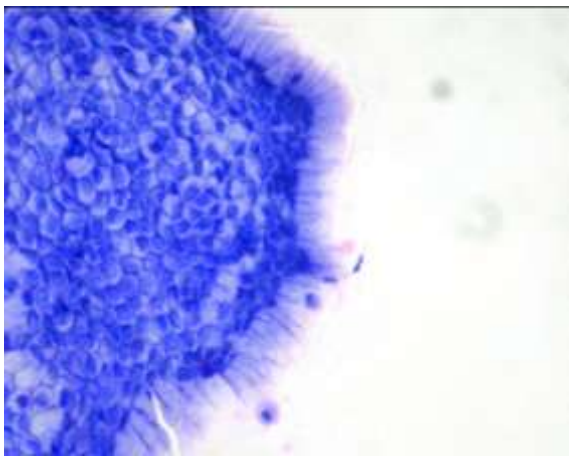

Figure 1: Intraoperative scrape smear of mucinous cystadenoma showing a monolayered sheet of mucinous epithelial cells. (Giemsa stain, ×400)

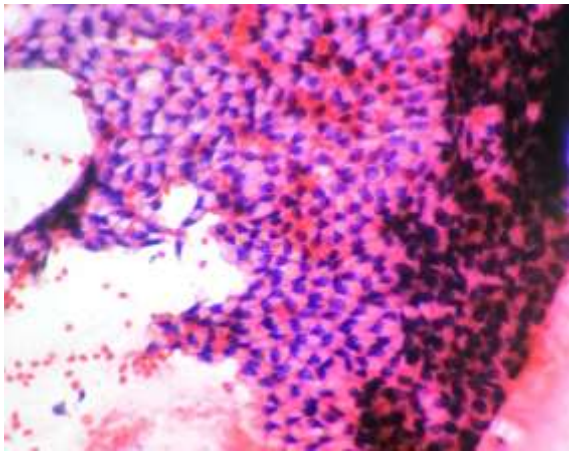

Figure 2: Mucinous cystadenoma showing sheets of monomorphic epithelial cells with abundant intracytoplasmic mucin. (Papanicolaou stain, ×400)

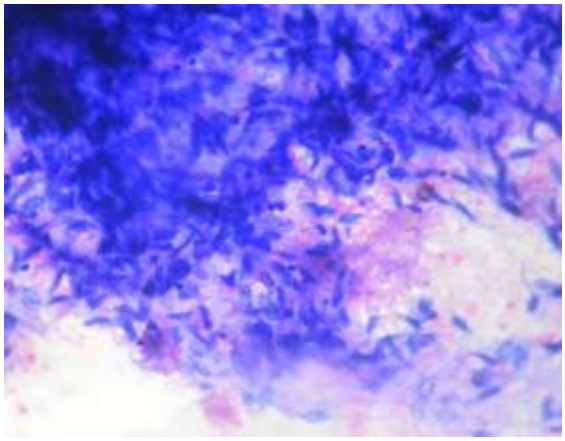

Figure 3: Adenosarcoma showing sheets of bland-appearing spindle cells. In the absence of mitotic activity or cytological atypia, the lesion was underdiagnosed as serous cystadenofibroma on scrape smear. (Giemsa stain, ×400)

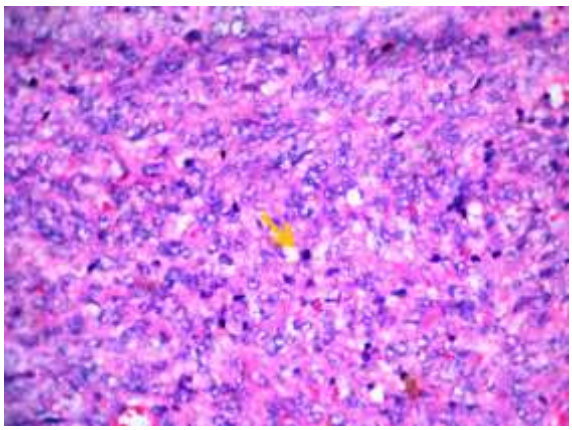

Figure 4: Adenosarcoma showing sheets of spindle cells with cytological atypia and mitotic activity (arrow). (Hematoxylin and Eosin stain, ×400)

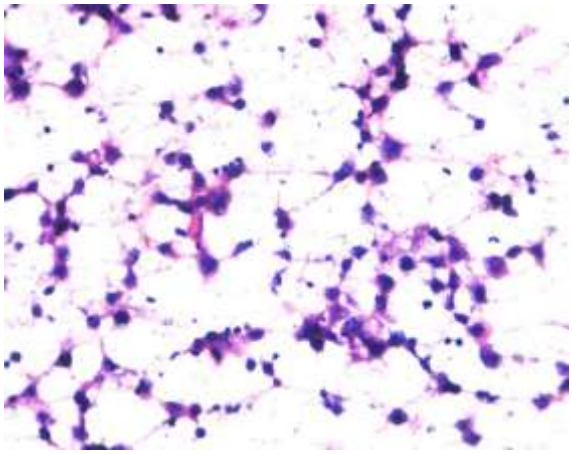

Figure 5: Dysgerminoma showing dispersed tumor cells in a characteristic tigroid background, with fragile cytoplasm and nuclei exhibiting nuclear trails. The background shows scattered lymphocytes. (Hematoxylin and Eosin stain, ×100)

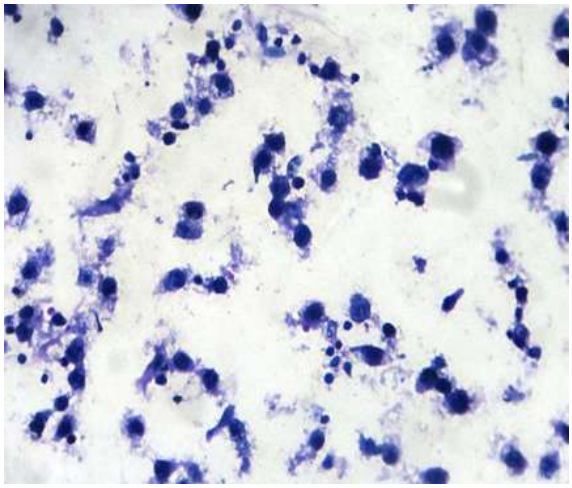

Figure 6: Scrape smear of dysgerminoma showing cells having fragile cytoplasm, vesicular nucleus and prominent nucleoli. Background shows lymphocytes. (PAP, ×400)

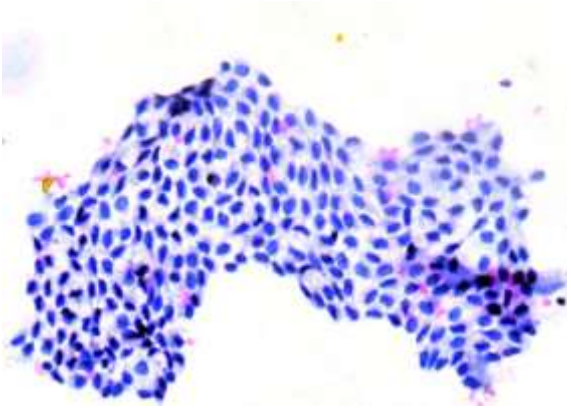

Figure 7: Intraoperative scrape smear of serous cystadenoma showing a monolayered sheet of serous epithelial cells with no evidence of atypia or mitosis. (H&E stain, ×400)

DISCUSSION

Accurate intraoperative evaluation of ovarian masses is critical for guiding the extent of surgery, particularly in distinguishing benign, borderline, and malignant tumours. Frozen section examination remains the conventional modality for this purpose, offering assessment of tumour type and invasiveness.[8] However, freezing artifacts may obscure fine architectural and cytological details, limiting accurate interpretation when high-power microscopic evaluation is essential.[9] In contrast, cytological techniques provide superior cellular detail without freezing artifacts and allow rapid assessment using minimal tissue, making them especially useful in settings where frozen section facilities or technical expertise are limited.[6,10,11]

Scrape cytology represents a simple and efficient modification of imprint cytology and can be performed easily on fresh, fixed, or partially fixed specimens. Compared with frozen section and fine-needle aspiration cytology (FNAC), scrape cytology is faster, less resource-intensive, and yields higher cellularity with better preservation of cytomorphology.[9] FNAC has been discouraged in ovarian tumours due to the risk of tumour spillage and loss of architectural context, whereas scrape cytology does not compromise subsequent histopathological examination.[11-13] Our findings support earlier observations that intraoperative scrapes provide reliable diagnostic material and are superior to imprint smears, which are often bloodier and thicker.[9]

The clinicopathological profile observed in this study is comparable to previously published data. Benign tumours predominated in the reproductive age group, while malignant tumours were more frequent in older patients, consistent with reports by Sood et al. and population-based cancer statistics.[14] Gross features such as cystic consistency and unilateral involvement were strongly associated with benign lesions, whereas solid and bilateral tumours were more likely malignant, in agreement with studies by Lim et al. and Kar et al.[15,16] Serous tumours constituted the most common epithelial neoplasms, followed by mucinous tumours, similar to findings by Pravakar and Maingi.[17] Diagnostic challenges were most frequently encountered in borderline tumours, where under- and over-diagnosis occurred due to overlapping cytological features, a limitation also noted in previous studies using imprint cytology.[16]

Overall, scrape cytology demonstrated high diagnostic performance, with an overall accuracy of 92.85% and correct classification in 86.9% of cases, comparable to results reported by Kar et al. and Spann et al.[16,18] Sensitivity and specificity for benign and malignant tumors were comparable to those reported for frozen section in multiple studies, while borderline tumors consistently showed lower sensitivity but retained high specificity, a well-recognized limitation across intraoperative diagnostic modalities.[5,19,20] The lack of a statistically significant difference between scrape cytology and histopathology ($p>0.05$) underscores the diagnostic reliability of scrape cytology. Taken together, these findings reaffirm that scrape cytology is a rapid, accurate, cost-effective, and practical adjunct to intraoperative consultation, particularly valuable in resource-limited settings.

CONCLUSION

Scrape/aspiration cytology is a rapid, simple, and cost-effective intraoperative diagnostic technique that demonstrates high accuracy in distinguishing benign and malignant ovarian neoplasms. Although its sensitivity is limited in borderline tumours, scrape cytology shows excellent specificity and reliable correlation with final histopathology. This technique serves as a valuable adjunct to frozen section, particularly in resource-limited settings where it can effectively guide intraoperative surgical decision-making.

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