Journal of Carcinogenesis
Covering Genesis to Therapeutics

Journal of Carcinogenesis, ISSN: 1477-3163
2025; Vol 24: Issue 9s, https://carcinogenesis.com/

Diagnostic Utility Of Intraoperative Scrape Cytology Of Ovarian Mass Lesions: A Study Of 89 Cases From A Tertiary Care Centre

Dr. B. Deepthi[1], Dr. T. Uma[2], Dr. R. Thenmozhi[3], Dr. Aruna K. Prayaga[4], Dr. N. Rukmangadha[5]

[1]Associate Professor, Department of Pathology, Sri Venkateswara Institute of Medical Sciences

[2]Junior Resident, Department of Pathology, Sri Venkateswara Institute of Medical Sciences

[3]Senior Resident, Department of Pathology, Sri Venkateswara Institute of Medical Sciences

[4]Senior professor, Department of Pathology, Sri Venkateswara Institute of Medical Sciences

[5]Professor and Head, Department of Pathology, Sri Venkateswara Institute of Medical Sciences

Corresponding Author: Dr. B. Deepthi*

Associate Professor, Department of Pathology, Sri Venkateswara Institute of Medical Sciences

ABSTRACT

Background: Intraoperative evaluation of ovarian mass lesions plays a crucial role in guiding surgical decisions. Scrape cytology smears (SS) have gained popularity for intraoperative consultation due to their rapid turnaround time, simplicity, and excellent preservation of cytomorphological details, especially in settings where frozen section (FS) facilities are limited.

Aim: This study aims to assess the diagnostic utility of scrape cytology in the intraoperative assessment of ovarian masses and to compare its accuracy with frozen sections, using histopathology as the reference standard.

Materials and Methods: A prospective study was carried out over four years (2019–2024) at a tertiary care center involving freshly received ovarian mass specimens. Intraoperative scrape cytology smears and frozen sections were prepared and interpreted independently. Scrape smears were categorized cytologically into four groups: Indeterminate (low cellularity), Benign, Borderline (equivocal morphology), and Malignant. Diagnostic performance was evaluated against the final histopathological diagnosis.

Results: Scrape cytology demonstrated a sensitivity of 80.95%, specificity of 97.8%, positive predictive value of 97.1%, and negative predictive value of 85.1%. The overall diagnostic accuracy for identifying malignant lesions was 89.88%. Tumor subclassification was feasible in 66 of 89 cases (74%).

Conclusion: Scrape cytology is a reliable, rapid, and cost-effective technique for intraoperative diagnosis of ovarian tumors, particularly beneficial in resource-limited settings. With adequate training in sampling and interpretation, scrape cytology can serve as an effective adjunct or alternative to frozen sections for intraoperative evaluation of ovarian masses.

KEYWORDS: *Intraoperative evaluation, frozen section, scrape cytology, ovarian mass lesions.*

How to Cite: B. Deepthi, T. Uma, R. Thenmozhi, Aruna K. Prayaga, N. Rukmangadha., (2025) Diagnostic Utility Of Intraoperative Scrape Cytology Of Ovarian Mass Lesions: A Study Of 89 Cases From A Tertiary Care Centre, *Journal of Carcinogenesis*, *Vol.24, No.9s*, 254-267.

1. INTRODUCTION

Intraoperative evaluation of mass lesions is a crucial tool for optimizing patient management, tailoring surgical procedures, and avoiding unnecessary radical surgeries. Intraoperative cytology (IOC) is increasingly preferred over frozen section (FS) diagnosis, as crush or scrape cytology smears (SS) provide excellent preservation of cytomorphological details and, when combined with comprehensive clinical and gross pathological findings, can yield an accurate diagnosis within

minutes. [1–5] The rapidity, simplicity, and ability to obtain maximal cellular material from freshly submitted specimens make scrape cytology a cost-effective and valuable technique, particularly in resource-limited settings.[6]

Although several studies have compared the diagnostic efficacy of scrape cytology with frozen sections [4,7–10], most of these have primarily focused on overall diagnostic accuracy and concordance rates. Few studies have systematically described the wide spectrum of cytomorphological features of ovarian tumors or evaluated the potential of scrape cytology for tumor subtyping and triaging specimens for intraoperative consultation. . [11,12].. Consequently, there remains a lack of standardized guidelines on how scrape cytology can be effectively used to limit or replace frozen section evaluation, especially in heterogeneous tumors or borderline lesions.

The present study was therefore designed to address these gaps by evaluating the utility of scrape cytology in the intraoperative diagnosis of a variety of ovarian mass lesions, comparing the diagnostic accuracy of SS and FS with histopathology as the gold standard, detailing cytomorphological features for potential tumor subtyping, and proposing scenarios for judicious or limited use of cryostat evaluation in resource-constrained settings.

2. MATERIALS AND METHOD

The present prospective observational study was conducted at a tertiary care center over a period of four years. Ethical approval was obtained from the institutional review board, and informed consent was obtained from all participants prior to data collection. All freshly received ovarian mass lesions, clinically suspected to be neoplastic and submitted for intraoperative consultation, were included in the study.

Each specimen was subjected to meticulous gross examination, and representative areas were sampled for both scrape cytology smears and conventional frozen sections. The slides were examined independently to arrive at a diagnosis. Basic demographic and clinical details, hematological and radiological investigations, along with serum tumor marker results, were analyzed in correlation with macroscopic findings to finalize the intraoperative cytological report.

Gross examination included documentation of laterality, size, external surface (smooth or with ovarian surface involvement), overall appearance (solid, cystic, or mixed), nature of cysts (unilocular or multilocular), presence of variegated solid areas or papillary growths, consistency (soft, firm, or hard), and the presence of necrosis, calcification, or hemorrhage. Additional features such as mural nodules, capsular breach, or teratomatous components (e.g., hair shafts or keratinous material) were also noted. Representative areas, especially those showing papillary, solid, or heterogeneous features, were selected for further intraoperative evaluation.

Crush (Scrape) Smear Preparation

Scrapings were obtained from representative viable areas of the ovarian mass, including papillary excrescences, mural nodules, soft solid regions, and distinct cyst loculi, while avoiding grossly cauterized surfaces; necrotic areas were sampled only when clinically indicated. Using the sharp corner of a clean glass slide (or a scalpel edge for firm areas), a small tissue fragment measuring approximately 1–3 mm was collected and placed on a pre-labelled carrier slide. Fig 1. A second clean slide was then applied at a 30–45° angle, and the tissue was spread in a single smooth forward motion to produce a thin smear about 1–2 cm in length. Care was taken to use minimal pressure to reduce nuclear distortion or crush artefact. For each case, at least four smears were prepared: two from the most suspicious areas and one from each additional distinct region; in heterogeneous or large mucinous tumors, separate smears were obtained from different loculi to minimize sampling error. One smear per site was immediately fixed in 95% ethanol for rapid hematoxylin and eosin (H&E) staining, while at least one air-dried smear was prepared for Modified Ultrafast Giemsa stain[13] when required and stained as per protocols to study in detail the cytomorphological features Wet-fixed smears were placed directly into 95% ethanol to ensure immediate fixation, while air-dried smears were allowed to dry completely before staining. Whenever feasible, a rapid adequacy check was performed at low magnification to confirm representative cellularity; in cases with scant material, additional scrapings were taken promptly. Each slide was clearly labelled with specimen ID and sampling site, and areas sampled were recorded in the grossing notes. Rapid H&E was used for wet-fixed smears and MUFG for air-dried smears, with rapid H&E prioritized when an immediate intraoperative diagnosis was required. All cytological findings were interpreted in conjunction with gross and clinical data, and additional sampling or frozen sections were advised when necessary. Standard biosafety precautions were observed throughout, with proper disposal of sharps and decontamination of the grossing area after each procedure.

The smears were extensively examined for the following features: Cellularity, pattern of arrangement (honeycomb sheets, papillary, micropapillary, cellular dyscohesiveness, acinar/glandular, pleomorphic bare nuclei), Architectural complexity, Cell Type (cuboidal, mucinous cells with apical mucin, clear cells), Cytoplasmic Features (abundant, scant, clear, vacuolated, fragile), Nuclear Details (Pleomorphism, nuclear overlapping with crowding n chromatin details, Nucleoli,

Grooves, And Mitosis, bizarre tumor giant cells), Background details, presence of necrosis and for any specific features like hyaline globules, matrix material, psammomatous calcifications. The smears were categorized into four groups: Indeterminate (Low cellularity), unequivocally Benign, Borderline with equivocal morphology and unequivocally Malignant.

Cytomorphological criteria

All scrape smears were assessed for adequacy (representative epithelial or stromal fragments sufficient to assess architecture and nuclear details), cellularity, pattern of arrangement, cell type, cytoplasmic features, nuclear details, mitotic activity and background elements. Smears with scant or degenerate cells, predominance of blood or debris, or otherwise insufficient material were designated **Indeterminate** (low cellularity). **Benign** smears were characterized by cohesive monolayered sheets or honeycomb patterns, uniform nuclei with smooth contours, fine evenly distributed chromatin, inconspicuous nucleoli, absent or rare mitoses and clean or mucinous background as appropriate. **Borderline** lesions demonstrated architectural complexity (papillary fronds with epithelial stratification or multilayering, increased cellular crowding), mild-to-moderate nuclear atypia, occasional nucleoli and low mitotic activity but lacked unequivocal invasive features or tumour necrosis. **Malignant** smears exhibited one or more major malignant features: marked nuclear pleomorphism (typically >3-fold variation in nuclear size), coarse/irregular chromatin, high nuclear:cytoplasmic ratio, prominent macronucleoli, frequent or atypical mitoses, necrotic background, discohesion with numerous singly dispersed atypical cells, or complex three-dimensional papillary/solid clusters. In this study, smears showing two or more major malignant features, or any single unequivocal malignant feature (for example, atypical mitoses with necrosis), were categorized as malignant. Tumour-specific cytologic clues (e.g., apical mucin in mucinous tumours, psammoma bodies in serous lesions, hobnailing and hyaline globules in clear cell carcinoma, nuclear grooves in granulosa cell tumours, keratinous debris in teratoma) were used to support subtype assignment where present.

An attempt was made to subtype the tumor based on the cytomorphology. Representaive areas were selected and subjected to frozen sections, thin sections were taken and stained with hematoxylin and eosin stain as per the standard frozen section staining protocols. The frozen sections were examined microscopically and categorized into Benign, Borderline and Malignant categories. After the telephonic communication of Intraoperative diagnosis to the operating clinician, the specimens were immediately fixed in 10 % neutral buffered formalin. Histological diagnosis of formalin fixed paraffin embedded sections were considered as gold standard for statistical evaluation of scrape cytological diagnosis. All malignant lesions and borderline ovarian tumors were considered as Positive category and all benign lesions as negative category. Sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy were calculated using descriptive statistics.

3. RESULTS

A total of 89 ovarian lesions were subjected to intraoperative consultation during the study period. Patient age ranged from 18 to 70 years, with a mean age of 48.4 years. Scrape cytology provided adequate cellular material in all cases (100%), allowing a diagnostic interpretation. Of these, 54 were diagnosed as benign, 14 as borderline, and 21 as malignant by scrape cytology. Correlation with final histopathology was observed in 80 cases, yielding an overall diagnostic accuracy of **89.88%**. In comparison, frozen section diagnosis showed 100% concordance with histopathology across all categories. Some air-dried smears additionally stained with Modified Ultrafast Giemsa (MUG) provided enhanced cytoplasmic detail, stromal fragments, and background features.

On routine histopathological analysis, 73 cases (82%) were epithelial tumors (serous, mucinous, clear cell) further subcategorized into benign, borderline, and malignant. Nine cases (10.1%) were sex cord-stromal tumors (fibroma, Sertoli-Leydig cell tumors, and granulosa cell tumors), two cases (2.2%) were germ cell tumors, four were non-neoplastic cystic lesions, and one was a metastatic Krukenberg tumor. Cytohistological correlation (Table 1) showed 34 true positives, 46 true negatives, 2 false positives, and 7 false negatives. The nine discordant cases included: one low-grade papillary serous carcinoma misdiagnosed as papillary serous cystadenoma, one serous cystadenoma reported as borderline serous tumor, two borderline serous tumors diagnosed as benign cystadenoma, one mucinous carcinoma reported as benign mucinous cystadenoma, three borderline mucinous tumors misdiagnosed as benign mucinous cystadenoma, and one poorly differentiated Sertoli-Leydig cell tumor diagnosed as benign. The sensitivity, specificity, positive predictive value, negative predictive value, and overall diagnostic accuracy of scrape cytology for detecting malignancy were **82.9%, 95.8%, 94.4%, 86.8%, and 89.9%**, respectively. Histopathological tumor subclassification was possible in 66 out of 89 cases (74%). Table 2

Gross findings -The ovarian tumors exhibited distinct gross features according to their histological type. Benign epithelial tumors were predominantly cystic, usually uniloculated with smooth surfaces, although some benign mucinous tumors were multiloculated, displaying a honeycomb appearance without solid areas. Borderline tumors often demonstrated

heterogeneous architecture, with admixtures of thin-walled cystic regions and friable papillary or polypoid projections, either projecting into cystic spaces (endophytic) or arising from the ovarian surface (exophytic). Malignant epithelial tumors were primarily solid or solid-cystic, frequently exhibiting papillary excrescences, variegated solid areas, necrosis, hemorrhage, and focal calcifications. Sex cord-stromal tumors, including fibromas, granulosa cell tumors, and Sertoli-Leydig cell tumors, were solid or solid-cystic, firm, and nodular. Teratomas were characterized by keratinous debris entangled with tufts of hair, sometimes accompanied by sebaceous material. Clear cell carcinomas showed solid-cystic architecture with firm, yellow to gray-white areas, often with papillary nodules. Metastatic lesions, such as the Krukenberg tumor in our series, were bilaterally involved, solid, globular, maintaining ovarian shape with smooth, bosselated surfaces and a firm, homogenous cut surface. These macroscopic observations guided targeted scraping of representative viable, variegated, and papillary areas for cytological evaluation.

Scrape cytological features varied across categories:

- *Benign serous tumors* (n = 15) appeared grossly as unilocular cysts with clear to pale yellow fluid. Smears showed honeycomb sheets and small cohesive clusters of uniform cuboidal cells with round-to-oval benign nuclei, moderate cytoplasm, and clean to proteinaceous background. Fig2
- *High-grade serous carcinomas* (n = 5) were grossly solid-cystic with papillary excrescences, necrosis, and hemorrhage. Smears were highly cellular, showing three-dimensional clusters and papillary fronds with fibrovascular cores, lined by pleomorphic cells with marked anisonucleosis, hyperchromasia, high N:C ratio, irregular nuclear membranes, prominent nucleoli, brisk mitoses, and necrotic background (Fig. 3).
- *Low-grade serous carcinomas* were predominantly solid tumors with focal cystic areas, papillary/nodular cut surface, and calcifications. Smears revealed glandular cells in tight clusters and papillary fronds with central cores, vacuolated cytoplasm, enlarged hyperchromatic nuclei without marked pleomorphism (<3× variation), prominent nucleoli, and psammoma bodies (Fig. 4).
- *Benign mucinous tumors* were multiloculated cysts with gelatinous mucinous contents. Smears showed benign columnar cells with apical mucin, basally located uniform nuclei, honeycomb sheets, and picket-fence arrangement against a mucoid background. (Fig. 5).
- *Borderline serous tumors* showed mixed benign and borderline areas, with friable papillary excrescences projecting into cysts (endophytic pattern) or arising from the surface (exophytic pattern). Smears from papillary areas revealed complex architecture, large cohesive sheets, papillary clusters, dispersed cells, and mild-to-moderate atypia with occasional mitoses (Fig. 6).
- *Borderline mucinous tumors* were large multicystic masses with smooth external surfaces and mucin-filled cysts showing papillary excrescences. Cytology showed cohesive sheets of mucin-secreting cells with overlapping, dispersed cells, and mild-to-moderate atypia (Fig. 7). Misinterpretation as benign occurred in three borderline and one mucinous carcinoma due to sampling error and lack of overt stromal invasion, a limitation of scrape smears in assessing microinvasion.
- *Benign Brenner tumors* appeared grossly solid and firm. Smears showed tight clusters of transitional-like cells with ovoid “coffee-bean” nuclei, fine chromatin, small nucleoli, and moderate cytoplasm, occasionally admixed with mucinous cells. (Fig. 8).
- *Mature teratomas* showed keratinous debris and hair macroscopically, with smears containing keratinous flakes, anucleate squames, and debris. Multiple areas were sampled to exclude immature components . (Fig. 9).
- *Metastatic Krukenberg tumor* presented bilaterally as solid, globular ovarian masses with bosselated external surfaces. Smears were paucicellular but showed occasional clusters of signet-ring cells with hyperchromatic eccentric nuclei and abundant vacuolated cytoplasm . (Fig. 10).
- *Clear cell carcinomas* appeared solid-cystic with papillary nodules and hemorrhagic areas. Smears showed papillary clusters with fibrovascular cores, cell balls, glandular structures, and hobnailing. Tumor cells were large polygonal with abundant clear cytoplasm, prominent nucleoli, and variable anisonucleosis. Eosinophilic hyaline globules (“raspberry bodies”) were striking, seen within papillary cores and acinar structures, often surrounded by tumor cells (Fig. 6). MUG staining highlighted dyshesive clusters and fine vacuolations, with nuclei showing distinct membranes and prominent inclusion-like nucleoli. (Fig. 11).

Overall, scrape cytology demonstrated high sensitivity and specificity in diagnosing ovarian tumors. Subtyping was possible in nearly three-quarters of cases (74%). Effective integration of cytological features with clinical, radiological, and macroscopic findings enhanced intraoperative accuracy and facilitated conclusive diagnosis.

4. DISCUSSION

Ovarian tumors are frequently subjected to intraoperative consultation because preoperative diagnosis is often inconclusive due to their inaccessibility, which may require invasive image-guided biopsies or laparoscopy. Intraoperative pathological

evaluation provides critical information for surgical decision-making, including the extent of resection and the need for lymphadenectomy, potentially avoiding unnecessary radical procedures. This is particularly valuable in resource-limited settings where frozen section facilities may not be available, and reliance on cytology may significantly influence intraoperative management.

Intraoperative cytology, first introduced by Dudgeon and Patrick in 1927, has since been validated in several studies as a reliable adjunct for rapid diagnosis.[4-7,13-27] Scrape cytology offers multiple advantages over frozen section, including rapid preparation, simplicity, cost-effectiveness, and excellent preservation of cellular and nuclear details without freezing artifacts. It also allows examination of multiple heterogeneous tumor areas with minimal tissue requirement, and adipose or necrotic regions that are technically difficult for cryosectioning are easily visualized. In the present study, preparation of multiple slides (minimum of four, including from heterogeneous or variegated regions) resulted in 100% adequacy of smears, and crush preparations yielded high cellularity that facilitated detailed assessment of cytoarchitectural features. Modified Ultrafast Giemsa staining was also useful in highlighting stromal and extracellular matrix components, especially in clear cell carcinomas.

The overall diagnostic accuracy of scrape cytology in this study was 80.95%, which is comparable to other published series reporting concordance rates of 85–93%.[8,16,21] The specificity and positive predictive value were high, demonstrating its reliability in ruling in malignancy. However, sensitivity was relatively lower, attributable mainly to false-negative cases. Among the nine discordant cases, eight were false negatives, predominantly borderline tumors misclassified as benign. These included three borderline serous tumors, three borderline mucinous tumors, one mucinous carcinoma, and one malignant Sertoli-Leydig cell tumor. Only one case was a false positive.

Borderline tumors: Diagnostic challenges

The greatest diagnostic challenge in this study was encountered with borderline ovarian tumors. Out of nine discordant cases, six involved borderline lesions that were misdiagnosed as benign cystadenomas on scrape cytology. The main reasons were sampling error and the subtlety of cytological atypia. Borderline tumors, by nature, exhibit histological heterogeneity and frequently harbor areas resembling benign epithelium. In mucinous tumors, abundant extracellular mucin can obscure nuclear details and dilute atypical cell clusters, while borderline serous tumors often show complex papillary fronds and nuclear stratification with only mild-to-moderate atypia, features easily overlooked in limited smears. In our experience, misclassification occurred when smears were taken from grossly unremarkable cystic regions, whereas the borderline component resided in small papillary excrescences or microcystic areas that were under-sampled or not apparent intraoperatively.

Our findings are in line with previous reports. Shidham et al. [15] and Rao et al. [18] highlighted borderline mucinous tumors as the most common cause of false negatives in intraoperative cytology, significantly reducing diagnostic accuracy compared to benign and frankly malignant tumors. Stewart et al. [19] similarly noted that borderline serous tumors may be indistinguishable from serous cystadenomas when smears lack representative papillary or stratified epithelial fragments. Importantly, these diagnostic limitations are not exclusive to cytology, as frozen sections too have reduced accuracy in borderline mucinous tumors due to tumor size and heterogeneity. Targeted sampling from papillary, solid, or microcystic areas has been recommended by several authors to improve detection, a strategy that may enhance the yield of both cytology and frozen sections.

Cost Analysis: In our institution, the estimated cost per case for scrape cytology is approximately INR 50–100, covering slides, staining reagents, and minimal consumables. In contrast, frozen section requires additional specialized equipment such as a cryostat, microtome, and associated consumables, with a per-case cost of roughly INR 500–800—making it nearly 8–10 times more expensive than scrape cytology. Scrape cytology also requires fewer personnel and less preparation time (10–15 minutes per case) compared to frozen section (20–30 minutes). This cost-effectiveness is particularly advantageous when multiple areas of heterogeneous or borderline tumors need evaluation, as multiple scrape smears can be prepared rapidly without significant tissue loss, reducing both material costs and operative time. Consequently, scrape cytology serves as a practical and economical adjunct for intraoperative decision-making, especially in resource-limited settings.

Strengths and limitations

Despite these pitfalls, scrape cytology remains a rapid, cost-effective, and reproducible technique. It demonstrates high specificity and positive predictive value, ensuring that malignant diagnoses are seldom overcalled. The technique is particularly advantageous in resource-limited settings where frozen section facilities may be unavailable. However, its limitations must be acknowledged: (i) diagnostic accuracy in borderline tumors remains suboptimal, (ii) interpretation may be challenging if smears are non-representative, and (iii) experience of the reporting pathologist plays a crucial role. Even cellular benign lesions may be over-interpreted if clinical and macroscopic correlation is not carefully integrated.

5. CONCLUSION

Intraoperative scrape cytology is a rapid, cost-effective, and reliable diagnostic tool for evaluating ovarian lesions, particularly in resource-limited settings where frozen section facilities may not be available. It demonstrates high specificity and reasonable sensitivity, enabling accurate differentiation of benign and malignant lesions in most cases. While borderline tumors remain a diagnostic challenge, careful sampling from papillary, solid, or heterogeneous areas, combined with clinical and macroscopic correlation, can improve accuracy and help triage cases for selective frozen section evaluation. With adequate training and experience, scrape cytology can serve as an effective alternative to frozen section, optimizing intraoperative decision-making, conserving resources, and guiding appropriate surgical management. Further studies are recommended to standardize reporting criteria and establish uniform guidelines for intraoperative scrape cytology of ovarian neoplasms.

REFERENCES

[1] Cytology in the diagnostic evaluation of ovarian neoplasms. Acta Cytol 2012;56:467-73.
[2] Anila KR, Krishna G. Role of imprint cytology in intra-operative diagnosis of thyroid lesions. Gulf J Oncolg 2014;1:73-8.
[3] Mangia A, Chiriatti A, Chiarappa P, Incalza MA, Antonaci G, Pilato B, *et al*. Touch imprint cytology in tumor tissue banks for the confirmation of neoplastic cellularity and for DNA extraction. Arch Pathol Lab Med 2008;132:974-78.
[4] Stewart CJ, Brennan BA, Koay E, Naran A, Ruba S. Value of cytology in the intraoperative assessment of ovarian tumors: A review of 402 cases and comparison with frozen section diagnosis. Cancer Cytopathol 2010;118:127-36.
[5] Shirley SE, Escoffery CT. Usefulness of touch preparation cytology in postmortem diagnosis: A study from the university hospital of the West Indies. Int J Pathol 2005;3:2.
[6] Nagai Y, Tanaka N, Horiuchi F, Ohki S, Seki K, Sekiya S, *et al* .Diagnostic accuracy of intraoperative imprint cytology in ovarian epithelial tumors. Int J Gynaecol Obstet 2001;72:159-64.
[7] Michael CW, Lawrence WD, Bedrossian CW. Intraoperative consultation in ovarian lesions: A comparison between cytology and frozen section. Diagn Cytopathol 1996;15:387-94.
[8] Gupta AJ, Singh M, Bhattacharya JB, Anusha S, Jain S, Khurana N. Intraoperative scrape cytology from ovarian masss lesions: A study of 81 cases. J Cytol 2019;36:174-9.
[9] Bohara S, Jain S, Khurana N, Shangpliang DM, Agarwal S, Gandhi G. Intraoperative cytology of ovarian neoplasms with an attempt to grade epithelial tumors. J Cytol 2018;35:1-7.
[10] Agarwal S, Bohara S, Luthra S. Role of scrape cytology smear preparation in the diagnosis of ovarian masses-utility and pitfalls. Diagn Cytopathol. 2023 Oct;51(10):639-645.
[11] Deepthi B, Prayaga AK, Rukmangadha N. Comparison of modified ultrafast giemsa stain with the standard may grunwald giemsa stain in FNAC of various organs. J Cytol 2022;39:174-9
[12] Dudgeon LS, Patrick CV. A new method for rapid microscopical diagnosis of tumors: With an account of 200 cases so examined. Br J Surg 1927;15:250-61.
[13] Shidham VB, Dravid NV, Grover S, Kher AV. Role of scrape cytology in rapid intraoperative diagnosis. Value and limitations. Acta Cytol 1984;28:477-82.
[14] Orki A, Tezel C, Kosar A, Ersev AA, Dudu C, Arman B. Feasibility of imprint cytology for evaluation of mediastinal lymph nodes in lung cancer. Jpn J Clin Oncol 2006;36:76-9.
[15] Taneri F, Poyraz A, Salman B, Tekin E, Akyuerek N, Bayram O, *et al.* Using imprint and frozen sections in determining the surgical strategies for thyroid pathologies. Endocr Regul 2001;35:71-4.
[16] Rao S, Sadiya N, Joseph LD, Rajendiran S. Role of scrape cytology in ovarian neoplasms. J Cytol 2009;26:26-9.
[17] Açikalin A, Torun G, Bağir E, Bayram F, Zeren H, Güleç U, *et al.* Intraoperative frozen section in ovarian neoplasms; a tertiary center experience. Turk Patoloji Derg 2014;30:184-8.
[18] Vijayakumar A. The diagnostic utility of intraoperative cytology in the management of ovarian tumours. J Clin Diagn Res 2013;7:1047-50.
[19] Gultekin E, Gultekin OE, Cingillioglu B, Sayhan S, Sanci M, Yildirim Y. The value of frozen section evaluation in the management of borderline ovarian tumors. J Cancer Res Ther 2011;7:416-20.
[20] Khunamornpong S, Siriaunkgul S. Scrape cytology of the ovaries: Potential role in intraoperative consultation of ovarian lesions. Diagn Cytopathol 2003;28:250-7.
[21] Bhardwaj S, Ahluwalia C, Yadav AK, Zaheer S, Kolte S, Arora R. Comparative diagnostic accuracy of frozen sections and scrape cytology in ovarian neoplasms. J Mid-Life Health. 2019;10:89-92.
[22] Hirachand S, Lakhey M, Singha AK, Devkota S, Akhter J. Accuracy of intraoperative cytology in diagnosis of ovarian tumors. Nepal Med Coll J. 2009;11(3):207–9.

[23] Mondal SK, Bhattacharya S, Ray S, Roy A. Intraoperative cytology of ovarian neoplasms. J Cytol. 2012;29(1):35–9.
[24] Das DK. Value and limitations of intra-operative cytology. Diagn Cytopathol. 2000;23(3):137–41.
[25] Kim JW, Cho KS, Park SH, Lee HY, Kim YT, Lee KW. Diagnostic accuracy of frozen section analysis in ovarian tumors. J Obstet Gynaecol Res. 2004;30(1):68–72.
[26] Geetha V, Chitra T, Doreswamy A, Krishnamurthy J. Intraoperative cytology: a reliable tool for evaluation of ovarian neoplasms. J Obstet Gynaecol India. 2015;65(Suppl 1):32–6.
[27] Vardar MA, Yilmaz A, Gursan N. Value of scrape cytology in intraoperative diagnosis of female pelvic tumors. Diagn Cytopathol. 2002;26(5):284–7.

Table 1. Cyto-histologic correlation of intraoperative scrape smears with final histopathology in ovarian tumors (n=89).

Tumor Category	No. of Cases	Final Histopathology Diagnosis	Scrape Cytology Diagnosis	Correlated Cases	Discordant Cases (False + / False -)
Epithelial tumors					
Serous cystadenoma	14	Serous cystadenoma	Serous cystadenoma (13), Borderline tumor (1)	13/14	1 FP
Serous cystadenofibroma	3	Serous cystadenofibroma	Serous cystadenofibroma (3)	3/3	–
Papillary serous carcinoma	7	Papillary serous carcinoma	Serous carcinoma (6), Benign cystadenoma (1)	6/7	1 FN
Serous borderline tumor	6	Borderline serous tumor	Borderline (4), Serous cystadenoma (2)	4/6	2 FN
Endometrioid carcinoma	3	Endometrioid carcinoma	Malignant adenocarcinoma (3)	3/3	–
Mucinous cystadenoma	19	Mucinous cystadenoma	Mucinous cystadenoma (19)	19/19	–
Mucinous borderline tumor	12	Borderline mucinous tumor	Borderline (9), Mucinous cystadenoma (3)	9/12	3 FN
Mucinous carcinoma	6	Mucinous carcinoma	Mucinous carcinoma (5), Benign cyst (1)	5/6	1 FN
Clear cell carcinoma	2	Clear cell carcinoma	Clear cell carcinoma (2)	2/2	–
Brenner tumor	1	Brenner tumor	Brenner tumor (1)	1/1	–
Germ Cell Tumors					
Mature teratoma	2	Mature teratoma	Mature teratoma (2)	2/2	–
Sex Cord-Stromal Tumors					
Sertoli-Leydig cell tumor	3	Well differentiated (2), Poorly differentiated (1)	Sex cord stromal (2), Benign (1)	2/3	1 FN
Granulosa cell tumor	2	Granulosa cell tumor	Granulosa cell tumor (2)	2/2	–
Fibroma	4	Fibroma	Fibroma / benign spindle cell tumor (4)	4/4	–
Secondary Tumors					
Metastatic adenocarcinoma	1	Metastatic adenocarcinoma	Metastatic adenocarcinoma (1)	1/1	–
Miscellaneous					
Endometriotic / hemorrhagic / corpus luteal cysts	4	Benign cysts	Benign cysts (4)	4/4	–

Total	**89**			**80/89**	**2 FP, 7 FN**

Table 2. Diagnostic performance of intraoperative scrape cytology in ovarian tumors (n=89).

Parameter	**Value (%)**
Sensitivity	82.9
Specificity	95.8
Positive Predictive Value (PPV)	94.4
Negative Predictive Value (NPV)	86.8
Overall Diagnostic Accuracy	89.9

Figure 1: Crush preparation: Gently compress the scraped material between the two slides and spreading onto the other slide over an area of 1-3 mm^2 gently with a thin and even spread. The smears are then immediately fixed in alcohol for Rapid H and E preparation

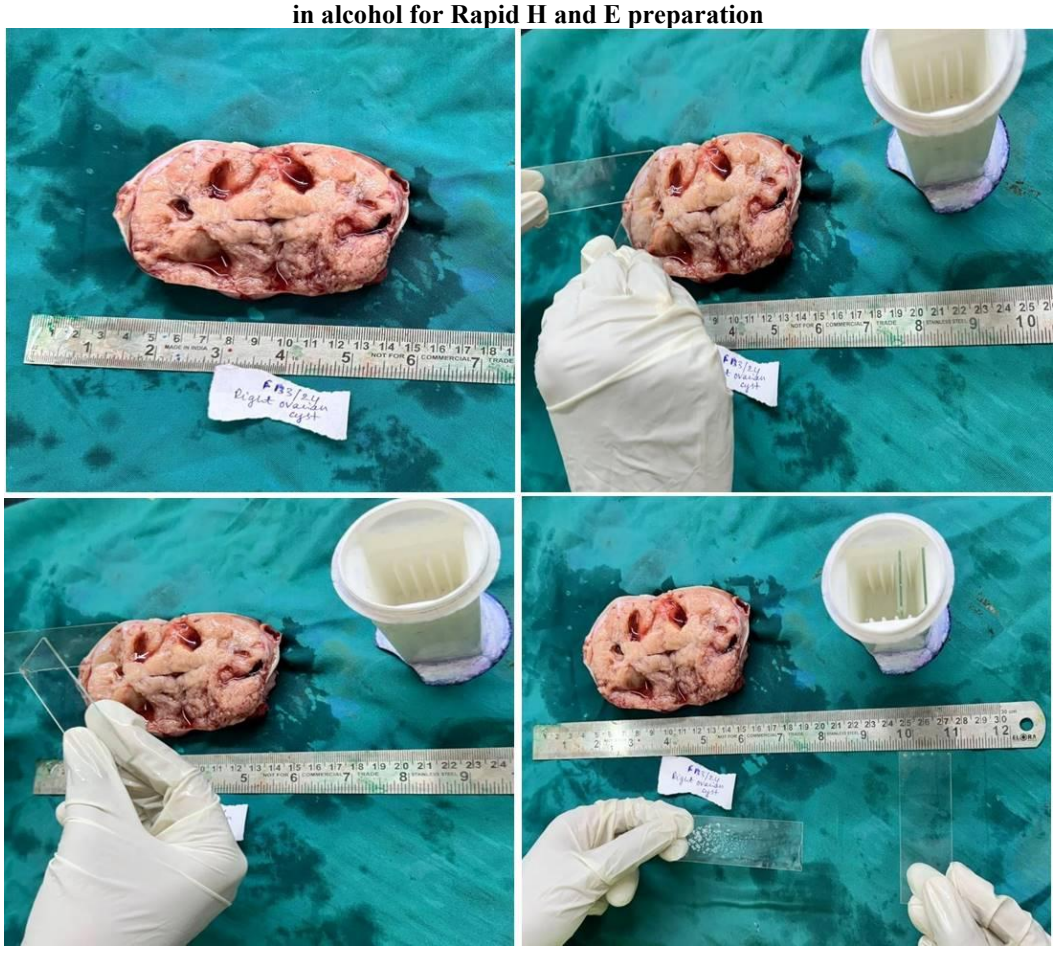

Figure 2: Figure2. Benign Serous Cystadenoma – Gross and Cytological Features
(A) Gross appearance of a uniloculated cystic ovarian lesion with copious drainage of clear to pale yellow, straw-colored fluid, characteristic of serous cystadenoma.((B, C) Scrape cytology smears show honeycomb-like arrangements, small clusters, and monolayered cohesive sheets of uniform cuboidal epithelial cells. The nuclei are round to oval, dark, and benign-appearing with moderate cytoplasm. The background is clean to proteinaceous. (H&E stain; original magnification ×200, ×400).

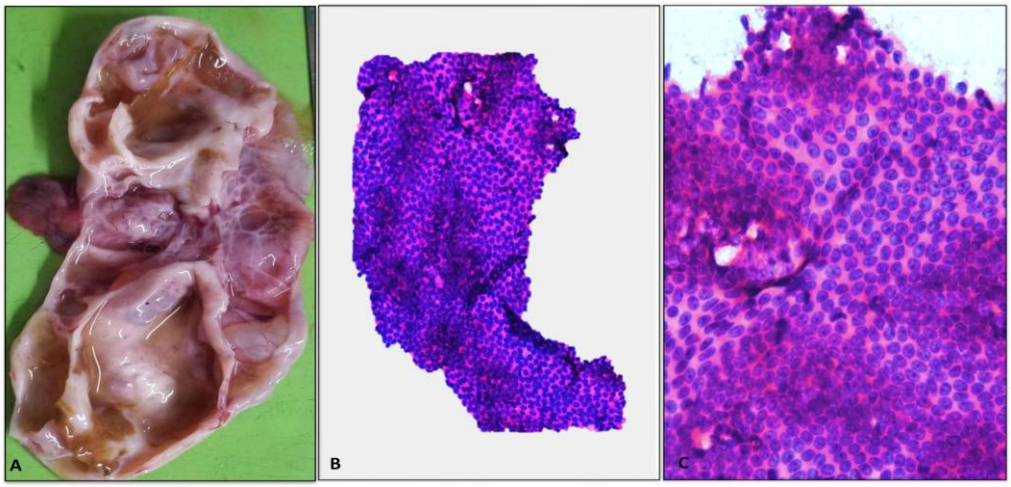

Figure 3: High-Grade Serous Carcinoma – Gross and Cytological Features
(A) Gross specimen shows a predominantly solid ovarian mass with tiny papillary excrescences and variegated areas of necrosis and hemorrhage, suggestive of malignancy. (B, C) Scrape cytology smears are richly cellular, displaying three-dimensional cellular clusters and papillary fronds with identifiable fibrovascular cores. (H&E stain; original magnification ×200) (C, D) Higher magnification reveals papillary clusters lined by highly pleomorphic tumor cells demonstrating marked anisonucleosis, nuclear hyperchromasia, high nuclear-to-cytoplasmic (N:C) ratio, irregular nuclear contours, and prominent nucleoli. Numerous brisk mitoses are evident. (H&E stain; original magnification ×400)

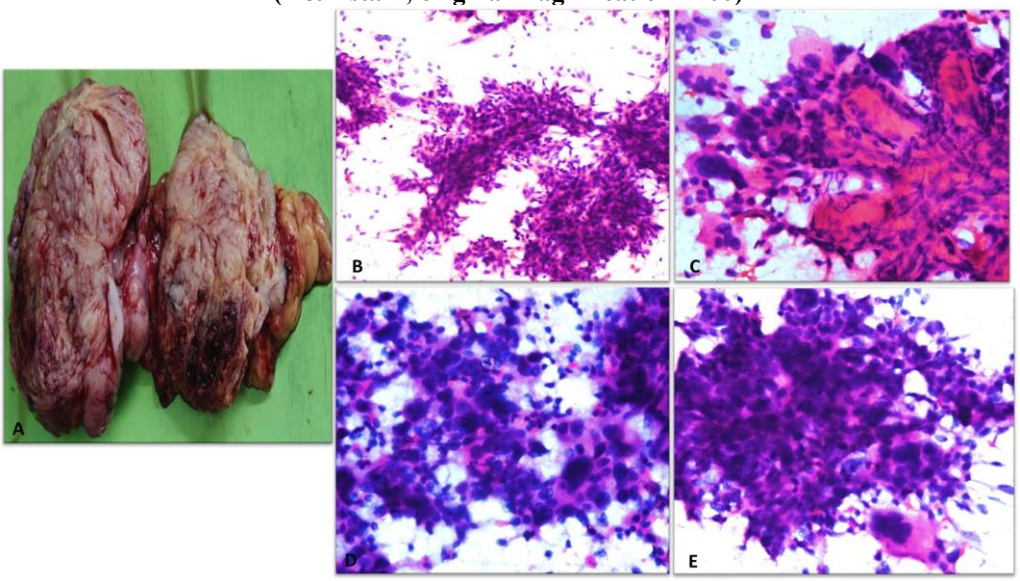

Figure 4. Low-Grade Serous Carcinoma – Gross and Cytological Features
(A) Gross image shows a predominantly solid ovarian tumor with focal cystic areas. The cut surface is papillary and nodular, homogeneous, with visible foci of calcifications—features suggestive of low-grade serous carcinoma. (B, C, D) Scrape cytology smears reveal tight cell clusters and well-formed papillary fronds with central fibrovascular cores. The tumor cells display moderate amounts of finely vacuolated cytoplasm and enlarged hyperchromatic nuclei. Notably, there is an absence of significant nuclear pleomorphism (variation <3× in size) and no prominent nucleoli. (H&E stain; original magnifications ×40, ×200, ×400) (E) Definite foci of psammomatous calcifications are observed. (H&E stain; original magnification ×200)

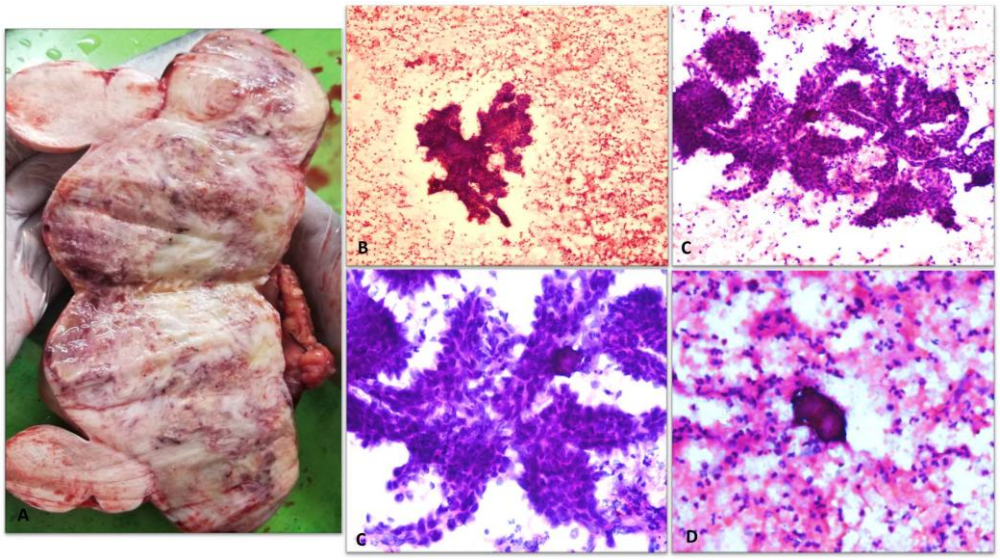

Figure 5. Benign Mucinous Cystadenoma – Gross and Cytological Features
(A) Gross specimen shows a thin-walled, multiloculated cystic ovarian mass that yielded thick, gelatinous mucoid material upon sectioning—typical of mucinous cystadenoma. (B, C) Scrape cytology smears demonstrate benign-appearing, low columnar epithelial cells with apically placed mucin and small, uniform basally located dark nuclei. The cells are arranged in honeycomb sheets and display a characteristic picket-fence appearance against a prominent mucinous background. (H&E stain; original magnification ×200)

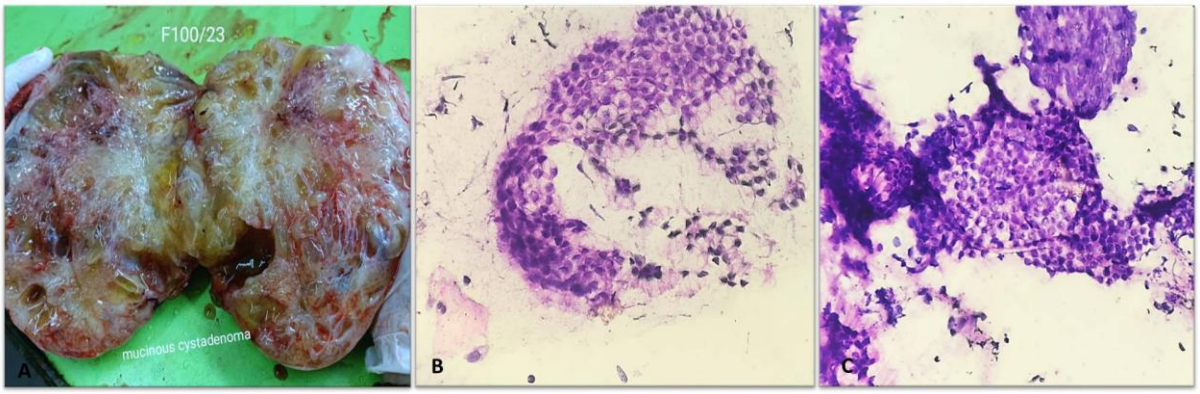

Figure 6. Borderline Serous Tumor – Gross and Cytological Features
(A) Gross specimen of a borderline serous tumor shows an enlarged ovarian mass with solid and multiloculated cystic areas. Benign regions present as thin-walled cysts, while borderline components appear as friable, polypoid, or papillary excrescences. (B, C, D) Scrape cytology smears from solid and papillary regions reveal complex architectural patterns with large cohesive sheets of cuboidal to columnar epithelial cells. Papillary clusters exhibit moderate cellular overlapping. Nuclei show moderate atypia and pleomorphism, some with prominent nucleoli and occasional mitotic figures. (H&E stain; original magnifications ×100, ×200)

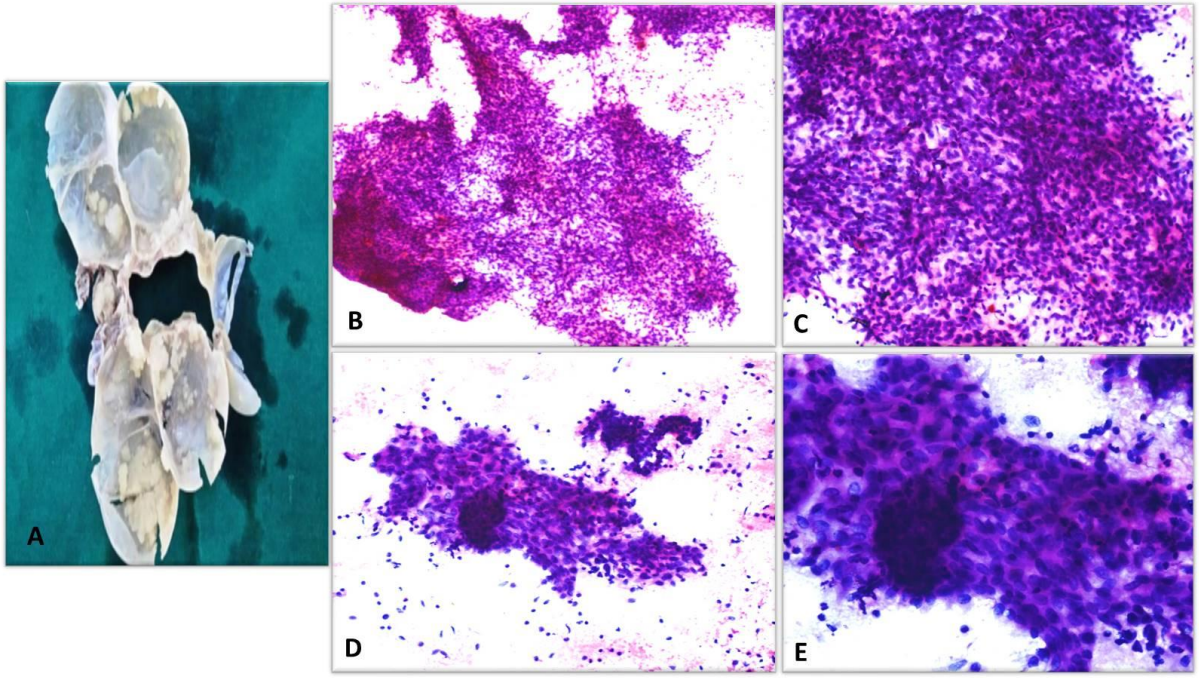

Figure 7. Mucinous Borderline Tumor – Gross and Cytological Features
(A) Gross appearance of a large ovarian tumor predominantly solid with multicystic areas. The external surface is smooth, while the internal surface reveals solid regions interspersed with variably sized cysts filled with viscous or gelatinous mucin. (B, C, D) Scrape cytology smears demonstrate complex architectural patterns with cohesive sheets of mucin-secreting columnar epithelial cells. Moderate cellular overlapping is present along with numerous dispersed cells. Mild to moderate nuclear atypia, pleomorphism, and occasional mitotic figures are observed. (H&E stain; original magnifications ×100, ×200)

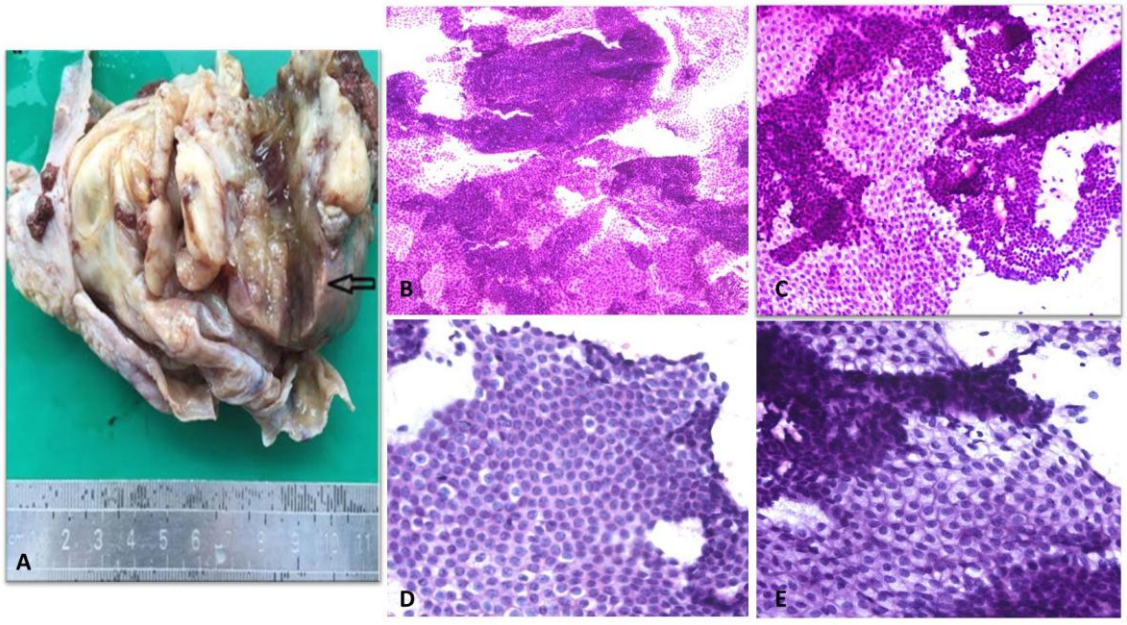

Figure 8. Benign Brenner Tumor – Gross and Cytological Features
(A) Gross image of a benign Brenner tumor showing a solid, multinodular, firm ovarian mass with a sharply demarcated nodular gray-white cut surface. (B, C, D) Scrape cytology smears reveal cellular sheets of tight, cohesive epithelial cells resembling transitional cells. These benign-appearing cells have ovoid nuclei with characteristic "coffee-bean" nuclear grooves, fine granular chromatin, small prominent nucleoli, and moderate amounts of cytoplasm. Some clusters show admixture with mucinous columnar cells. (H&E stain; original magnifications ×100, ×200)

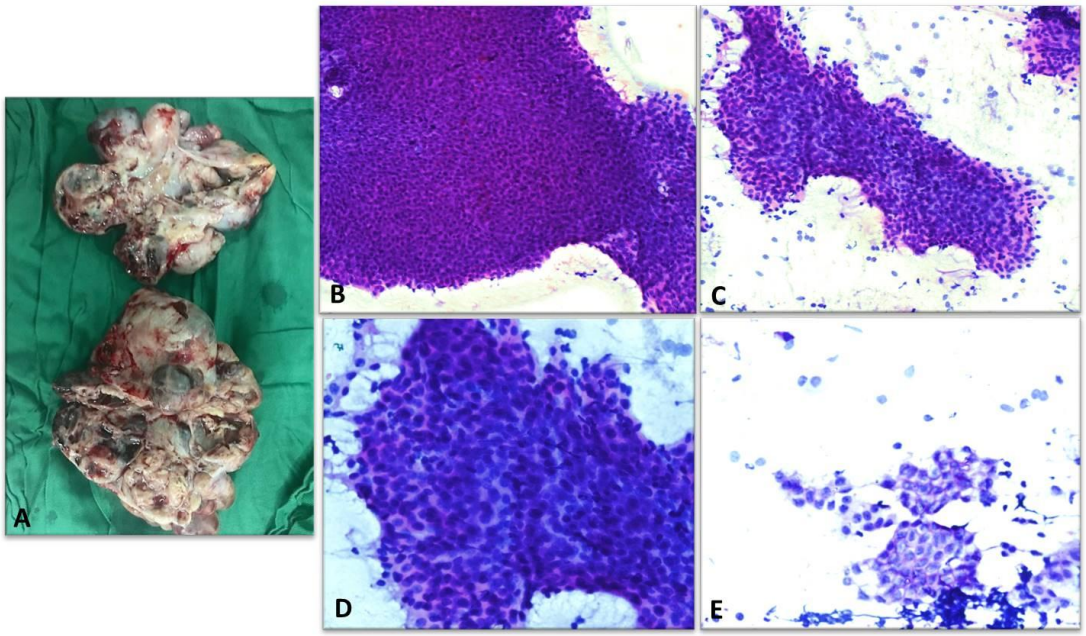

Figure 9. Mature Cystic Teratoma – Gross and Cytological Features
(A) Gross specimen showing a mass composed of a ball of keratinous debris entangled with tufts of hair shafts, typical of a mature cystic teratoma. (B, C, D) Scrape cytology smears reveal abundant keratinous debris and sheets of anucleate squamous cells (squames) with keratin flakes. (H&E stain; original magnifications ×100, ×200)

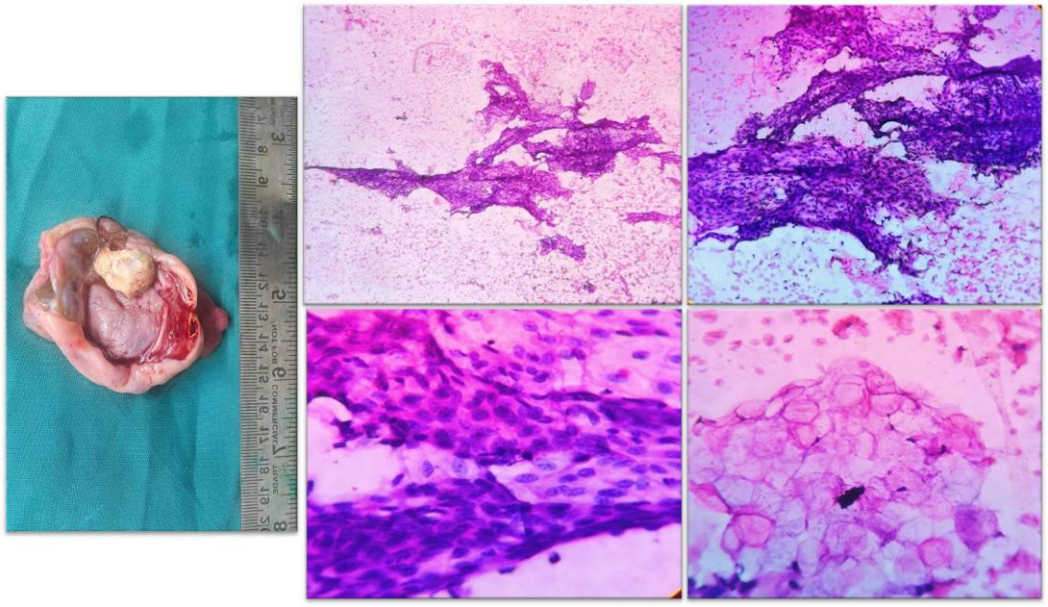

Figure 10. Metastatic Krukenberg Tumor – Gross and Cytological Features
(A) Gross appearance of a metastatic Krukenberg tumor showing a solid, globular ovarian neoplasm that maintains the overall ovarian shape. The tumor has bosselated outer contours with a smooth capsule and a pale to white homogeneous, solid, firm, and gelatinous cut surface. (B, C, D) Scrape cytology smears from the firm mass are paucicellular, showing occasional small clusters of polygonal to round cells with eccentrically placed, peripherally compressed hyperchromatic nuclei and abundant vacuolated to clear cytoplasm, characteristic of signet ring cells. (H&E stain; original magnifications ×200, ×400)

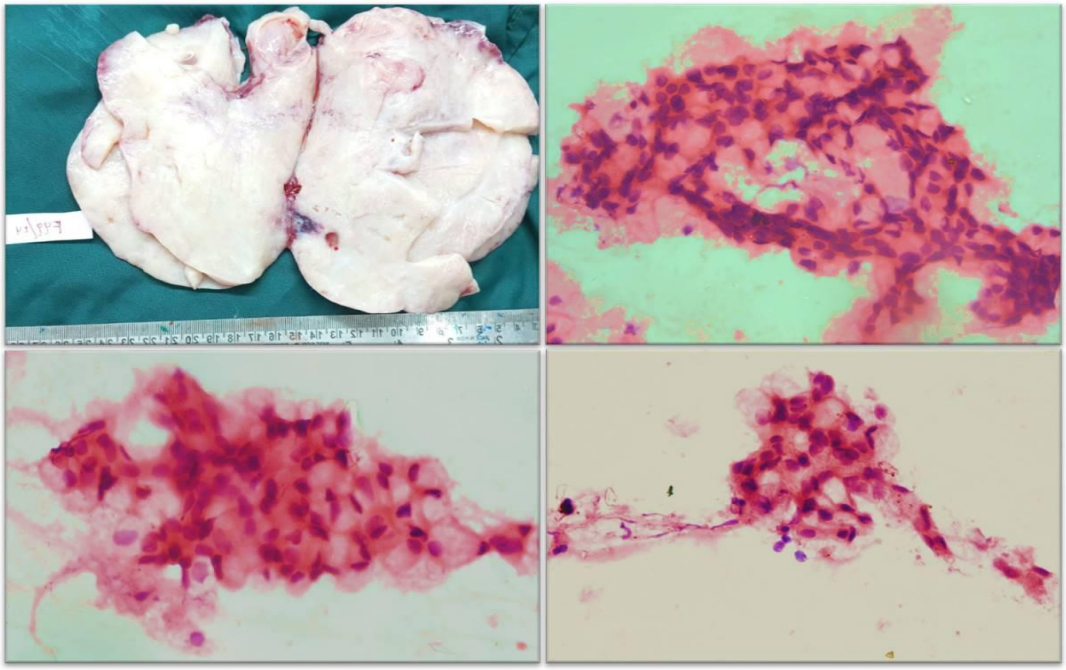

Figure 11. Ovarian Clear Cell Carcinoma – Gross and Cytological Features
Gross appearance of ovarian clear cell carcinoma showing a solid-cystic mass with solid nodules on the internal surface, displaying yellow to gray-white and hemorrhagic areas along with papillary excrescences. (B, D, E) Microphotographs reveal distinct papillary clusters with central fibrovascular cores and hobnailing of tumor cells over vascular fragments. Sheets, clusters, and acinar/glandular arrangements of neoplastic cells are evident. High-power views demonstrate large polygonal to round cells with abundant pale cytoplasm, vesicular nuclei, and marked anisonucleosis. (D, E) Prominent central nucleoli and pale globoid extracellular eosinophilic hyaline material surrounded by tumor cells are characteristic findings. (B, E) The abundant extracellular eosinophilic, globular basement membrane-like hyaline material ("raspberry bodies") is located within papillary cores, sheets, and centrally within acinar/glandular structures.