Section: Pathology

Original Research Article

ORIGINAL ARTICLE-CORRELATION OF FROZEN SECTION STUDY AND HISTOPATHOLOGY IN FEMALE GENITAL TRACT LESIONS

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ABSTRACT

Background: Accurate intraoperative diagnosis of female genital tract (FGT) lesions is crucial for guiding surgical management, especially in cases involving suspected malignancy. Frozen section (FS) analysis offers rapid preliminary diagnosis; however, its reliability depends on its correlation with final histopathology (HP), the gold standard**.**

Materials and Methods: This retrospective study was conducted over 14 months at Siddhartha Medical College, Vijayawada, involving 31 cases of FGT lesions that underwent both FS and HP evaluation. Tissue samples were analyzed using standard cryostat and H&E staining techniques. Diagnostic concordance between FS and HP was assessed, and discrepancies were reviewed for contributing factors.

Results: FS and HP diagnoses were concordant in 28 out of 31 cases (90.3%). Discrepancies in three cases involved challenges in differentiating granulosa cell tumor from serous carcinoma, adenomatous polyp from endometrial hyperplasia with atypia, and borderline from malignant seromucinous tumors. Factors influencing diagnostic discordance included sampling limitations, freezing artifacts, and interpretative challenges.

Conclusion: FS is a highly effective intraoperative diagnostic tool for benign and borderline FGT lesions, showing strong concordance with HP. However, its limitations in identifying invasive malignancies necessitate cautious interpretation, particularly in complex or ambiguous cases. Incorporating adjunct techniques and expert consultation can enhance diagnostic accuracy and surgical outcomes.

Keywords: Frozen section, Histopathology, Female genital tract lesions, Diagnostic accuracy, Ovarian tumors, Endometrial pathology.

INTRODUCTION

Malignancies of the female genital tract (FGT) are prevalent, with ovarian cancers exhibiting particularly high rates of incidence and mortality. The asymptomatic nature of these cancers, their anatomically challenging location, and the absence of reliable screening methods contribute to the complexity of early detection. As a result, intraoperative frozen section (IFS) analysis has emerged as a valuable diagnostic tool, providing critical information to guide surgical decision-making during procedures.[1-3]

The accurate diagnosis of female genital tract lesions is crucial for effective patient management, particularly in cases where timely intervention can significantly impact outcomes. Frozen section (FS) analysis, a rapid intraoperative diagnostic technique, plays a pivotal role in guiding surgical decisions by providing preliminary histopathological information. This method involves the immediate freezing and microscopic examination of tissue samples, allowing

surgeons to make informed decisions during procedures. However, the reliability of frozen section analysis depends on its correlation with definitive histopathology, which remains the gold standard for diagnosis.[4-5]

Female genital tract lesions encompass a wide spectrum of conditions, including benign, premalignant, and malignant entities. The diagnostic accuracy of frozen sections in this context is influenced by factors such as tissue type, lesion characteristics, and the experience of the pathologist. While frozen sections are highly valuable in assessing ovarian masses, endometrial lesions, and cervical abnormalities, discrepancies between frozen section and final histopathology results can occur due to sampling errors, technical limitations, or interpretive challenges.[6-8]

Aim and objectives: The aim of this study is to evaluate the diagnostic accuracy and correlation between intraoperative frozen section (IFS) analysis and final histopathological examination in female genital tract (FGT) lesions. To assess the concordance and discrepancies between these two diagnostic modalities, this research seeks to identify the strengths and limitations of frozen section studies in guiding surgical management. To analyze the demographic and clinicopathological factors associated with female genital tract lesions and to identify the potential causes of diagnostic discrepancies between frozen section (FS) and histopathology. To study aims to explore factors influencing diagnostic accuracy, such as lesion type, sampling techniques, and pathological expertise, while providing insights to optimize the use of frozen sections in clinical practice

MATERIALS AND METHODS

This retrospective study was conducted at Department of Pathology, Siddhartha medical college, Vijayawada over a period of 14months from January 1st,2024 to March 1st 2025. The study included 31 cases of female genital tract (FGT) lesions that underwent both intraoperative frozen section (IFS) and histopathological examination. Ethical approval was obtained from the institutional review board, and patient consent was waived due to the retrospective nature of the study.

Sample Collection and Processing: Tissue samples were obtained during surgical procedures and divided into two parts: one for frozen section analysis and the other for permanent section processing. Frozen sections were prepared using standard cryostat techniques, stained with hematoxylin and eosin (H&E), and examined under a light microscope. Permanent sections were fixed in formalin, embedded in paraffin, sectioned, and stained with H&E for detailed histopathological evaluation.

Demographic details, including age, clinical presentation, and preoperative diagnosis, were collected from medical records. Clinicopathological features, such as lesion type, size, and location, were documented. The frozen section diagnoses were categorized as benign, borderline, or malignant, and these findings were compared with the final histopathology reports. Discordant cases were reviewed to identify potential causes of discrepancies, including sampling errors, technical limitations, or interpretive challenges. Chi-square or Fisher's exact tests were used to assess associations between demographic/clinicopathological factors and diagnostic concordance. A p-value of <0.05 was considered statistically significant. To ensure consistency, all frozen and permanent sections were reviewed by at least two senior pathologists, and discrepancies were resolved through consensus. Percentage (%) analysis was done for the complete collected data.

RESULTS

During the study period, a total of 31 biopsy specimens were received for frozen section analysis and subsequently processed for routine histopathology examination. Among these cases, 28 (90.3%) showed complete concordance between the frozen section diagnosis and the final histopathology report. However, discrepancies were noted in three cases.

One discordant case involved a tumor initially diagnosed as a granulosa cell tumor on frozen section, which was later confirmed as a serous carcinoma on histopathology. This discrepancy may have resulted from the solid pattern of the tumor, which posed diagnostic challenges due to sectional artifacts commonly encountered in frozen section analysis.

In another case, a lesion initially identified as an adenomatous polyp on frozen section was later diagnosed as endometrial hyperplasia with atypia upon further histopathological evaluation. The variation in diagnosis may have been influenced by the limited tissue sampling and morphological overlap between these conditions.

The third discordant case involved a diagnosis of a borderline seromucinous tumor on frozen section, which was later reclassified as a high-grade seromucinous carcinoma on routine histopathology. Such discrepancies are often attributed to interpretation errors, technical limitations of the freezing method, and the intrinsic heterogeneity of the lesion. The accuracy of frozen section diagnosis can be influenced by factors such as the type of procedure performed, the nature of the lesion, and the characteristics of the tissue being examined.

Table 1

Tissue	On Frozen section	On Histopathology
Ovary	Borderline mucinous tumor	Borderline mucinous tumor

Ovary	Fibrothecoma with leutenization	Fibrothecoma
Hysterectomy	Endometrial polyp	Endometrial polyp
Ovary	Borderline seromucinous tumor	Borderline seromucinous tumor
Ovary	Mucinous cystadenoma	Mucinous cystadenoma
Ovary	Torsion	Torsion
Ovary	Mucinous cystadenoma	Mucinous cystadenoma
Ovary	Benign cystic tumor with torsion	Benign serous cystadenoma with torsion
Ovary	Benign simple cyst of ovary	Benign simple cyst of ovary
Ovary	Dermoid	Dermoid

Table 2

Ovary	**Granulosa cell tumor**	**Serous carcinoma**
Ovary	Serous cystadenofibroma	Serous cystadenofibroma
Hysterectomy	Endometriod carcinoma	Endometriod carcinoma
Ovary	Teratoma	Teratoma
Ovary	Torsion	Torsion
Hysterectomy	Adenomyomatous polyp with atypia	Adenomyomatous polyp with atypia
Ovary	Borderline malignancy	Borderline malignancy Seromucinous tumor
Ovary	Benign serous cystadenoma	Benign serous cystadenoma
Ovary	Benign simple cyst of ovary	Benign simple cyst of ovary
Ovary	Benign cystic teratoma	Benign cystic teratoma
Hysterectomy	Endometrial hyperplasia with atypia	Endometrial hyperplasia with atypia
Hysterectomy	Serous carcinoma	Serous carcinoma
Hysterectomy	Endometrial hyperplasia without atypia	Endometrial hyperplasia without atypia
Ovary	Borderline seromucinous tumor	seromucinous carcinoma
Ovary	Fibrothecoma	Fibrothecoma
Ovary	Serous carcinoma	Serous carcinoma
Hysterectomy	Adenomatous polyp	Endometrial hyperplasia with atypia
Ovary	Dermoid cyst	Dermoid cyst
Hysterectomy	Endometrial polyp	Endometrial polyp
Ovary	Benign serous cyst	Serous cystadenoma
Ovary	Dermoid cyst	Dermoid cyst
Ovary	Benign serous cyst	Serous cystadenoma

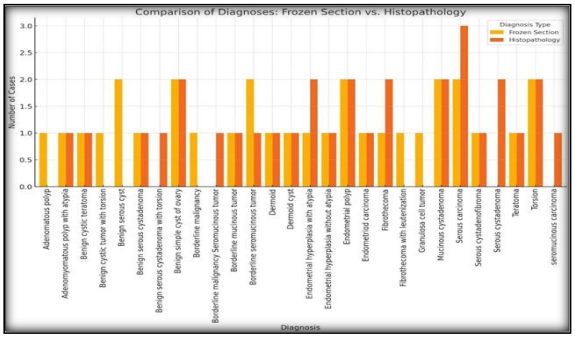

Figure 1

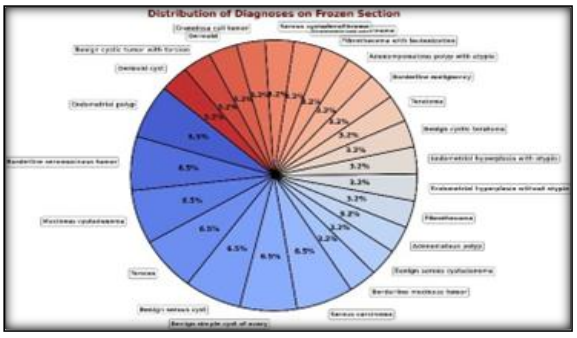

Figure 2

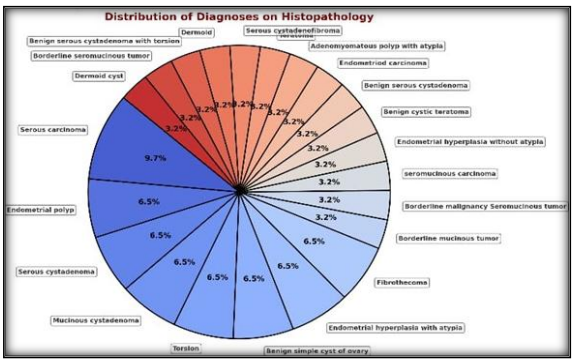

Figure 3

DISCUSSION

The accurate intraoperative diagnosis of female genital tract lesions is critical in guiding surgical decision-making, particularly in gynecologic oncology where the extent of resection depends on the nature of the lesion. Frozen section (FS) analysis serves as a rapid diagnostic tool, allowing surgeons to modify their approach based on preliminary findings. However, its reliability must be continually assessed against final histopathology (HP), which remains the gold standard for definitive diagnosis. This study evaluates the concordance and discrepancies between FS and HP in female genital tract lesions, with a focus on ovarian and endometrial pathologies, while also discussing clinical implications and future directions for improving diagnostic accuracy.[9-12]

1. High Concordance Between Frozen section and Histopathology

Our study demonstrates a strong concordance between FS and HP in diagnosing benign ovarian lesions, including:

- Mucinous cystadenoma
- Benign serous cystadenoma
- Benign simple cysts
- Dermoid cysts (mature cystic teratomas)
- Fibrothecomas
- Torsion of Cystic lesions

Similarly, borderline ovarian tumors (BOTs)—particularly seromucinous and mucinous subtypes—showed high diagnostic agreement. In endometrial pathologies, Frozen section reliably is identified in:

- Endometrial polyps
- Endometrial hyperplasia (with and without atypia)
- Adenomyomatous polyps with atypia

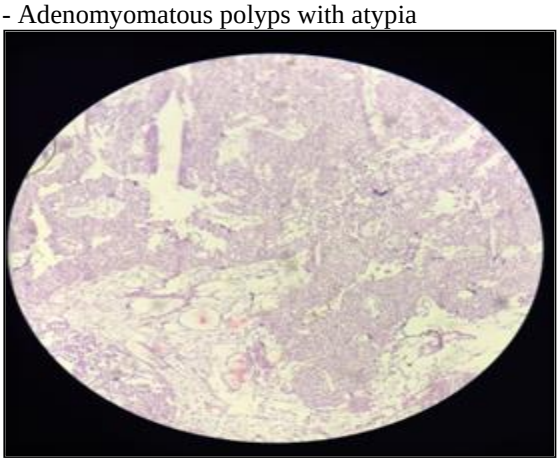

Figure 4: Frozen section of serous carcinoma of ovary 40x- Showing papillary structures with cells showing atypia(Left)

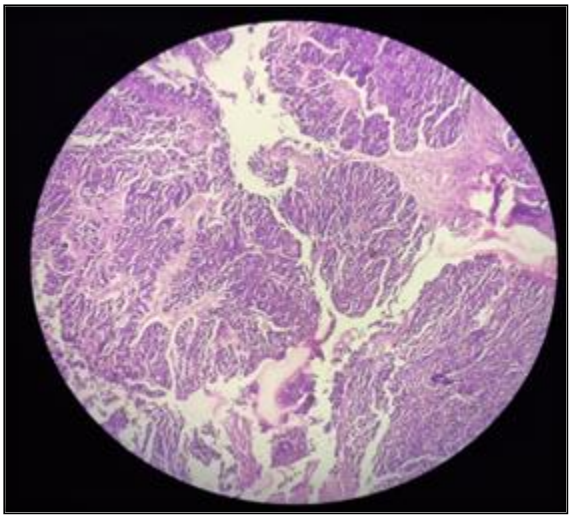

Figure 5: Histopathology of serous carcinoma of ovary 10x- Showing papillary structures and solid areas

These findings align with previous studies reporting >90% accuracy for Frozen Section in diagnosing benign and borderline ovarian tumors (Cheng et al., 2021; Garg et al., 2022). The high concordance in these categories reinforces the utility of FS in intraoperative decision-making, allowing for conservative surgical approaches when benign or borderline pathology is confirmed.[13,14]

Frozen Section is Highly Accurate in These Cases because of Distinct Morphological Features: Benign serous/mucinous cystadenomas and dermoid cysts have characteristic histological patterns that are easily recognizable even in frozen sections. Low Diagnostic Ambiguity: Unlike malignant tumors, benign and borderline lesions often lack significant nuclear atypia or stromal invasion, reducing interpretative variability. Established Diagnostic Criteria: Well-defined cytological and architectural features (e.g., hierarchical branching in serous BOTs) aid in accurate FS diagnosis (Kurman et al., 2014).[15]

Discrepancies Between Frozen Section and Histopathology: Diagnostic Challenges: Despite high overall concordance, several cases exhibited discrepancies, particularly in distinguishing borderline from malignant tumors and in subtyping benign lesions. Key diagnostic pitfalls included:

A. Misclassification of Malignant Tumors

1. Granulosa Cell Tumor (FS) vs. Serous Carcinoma (HP) - FS initially suggested a granulosa cell tumor (GCT), but HP confirmed high-grade serous carcinoma (HGSC). The Reason for Error is GCTs and poorly differentiated carcinomas can share trabecular growth patterns and nuclear grooves, leading to misinterpretation (Kim et al., 2019).[16]
2. Borderline Seromucinous Tumor (FS) vs. Seromucinous Carcinoma (HP) - FS classified a lesion as borderline Seromucinous Tumor, but HP revealed microinvasive carcinoma. The Reason was FS has limited ability to detect focal stromal invasion, a key criterion for malignancy (Tempfer et al., 2018).[17]
3. In one case it was adenomatous polyp on frozen section which was later diagnosed to be endometrial hyperplasia with atypia on histopathology. FS only evaluates a small portion of the lesion, whereas HP examines the entire specimen. The frozen sample may have captured only polypoid fragments without representative areas of background endometrial hyperplasia. Focal atypia may have been missed due to sampling bias. Adenomatous polyps can exhibit crowded glands resembling hyperplasia. Atypical hyperplasia may form polypoid structures, mimicking a true polyp. Without clear stromal invasion or marked nuclear atypia, FS may not reliably distinguish between the two (Mittal & Barroeta, 2018).[18]

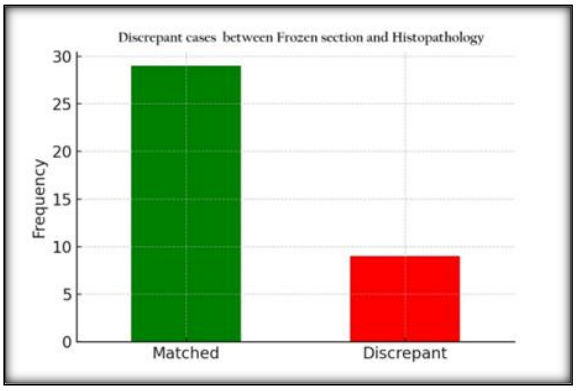

Figure 6

In few case there was less specific Diagnosis on frozen section. It was diagnosed as Benign Cystic Tumor on FS and it was specifically identified to be Serous Cystadenoma on HP. FS provided a generic diagnosis, whereas HP specified the subtype. The reason was Freezing artifacts can obscure epithelial lining details, making subtyping difficult. While both are benign, precise classification aids in long-term follow-up strategies. In Borderline vs. Benign/Malignant Lesions FS has a higher error rate in distinguishing BOTs from invasive carcinomas due to Sampling limitations (only a small portion is frozen), Artifactual distortion(ice crystals, crush artifacts). Subjectivity in interpreting mild atypia (Lu & Bell, 2020). FS is Most Reliable in Benign lesions. FS is highly accurate, allowing for conservative surgery(cystectomy instead of oophorectomy). In Borderline tumors FS can guide fertility-sparing surgery but should be interpreted cautiously due to the risk of underdiagnosing malignancy.[19] FS Should Be Used with Caution in Suspected malignant tumors as FS sensitivity drops to 50-80% for invasive carcinomas (Basaran et al., 2020). Cases with ambiguous morphology: If FS is inconclusive, deferring to permanent sections is prudent. The Diagnostic Accuracy Be Improved by Intraoperative Consultation and with the diagnostic opinion of a group of Expert pathologists as it Reduces the interobserver variability. Adjunct Techniques Touch prep cytology helps assess nuclear features when FS is equivocal. Immunohistochemistry (IHC): Rapid ER/PR, p53, or WT-1 staining can aid in difficult cases.

CONCLUSION

While FS is a valuable tool for intraoperative diagnosis of female genital tract lesions, its accuracy varies by tumor type. It is highly reliable for benign and borderline lesions but has limitations in distinguishing borderline from malignant tumors. Surgeons should be aware of these pitfalls of Frozen section and consider it as a adjunct technique to histopathology as the results are ambiguous if certain cases. However in some cases IHC could be helpful for arriving to a definitive opinion.

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