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Evaluation of Concordance Between Intraoperative Frozen Section and Final Histopathology in Adnexal Masses

Mustafa Gökkaya*, **Erkan Şimşek**

Division of Gynecological Oncology, Department of Obstetrics and Gynecology, Gaziantep City Hospital, University of Health Sciences Turkey, Gaziantep City Hospital, Gaziantep Turkey

ABSTRACT

The aim of this study was to evaluate the concordance between intraoperative frozen-section diagnosis and final paraffin-embedded histopathological examination in patients operated for adnexal masses, in order to assess the reliability of frozen-section analysis for intraoperative decision-making.

Data from 50 patients who underwent surgery between September 2024-November 2025, for adnexal masses at the Gynecology Department of Gaziantep City Hospital and had intraoperative frozen-section evaluation followed by final pathology were retrospectively analyzed. Demographic, clinical, radiological, laboratory (tumor markers), surgical (laparoscopy vs. laparotomy), and pathological data (frozen and final diagnoses) were collected.

The median age of patients was 47.8 years (range 34–74), and the median BMI was 32.4 kg/m² (range 24–42). The median preoperative blood CA-125 level was 86 U/mL (range 8–760), with 60% of patients exceeding 35 U/mL. Median tumor size was 13.7 cm (range 6–32), and 80% of masses were unilateral. Intraoperative frozen-section diagnosed 52% as benign, 20% as borderline ("most likely," borderline or "at least borderline"), and 16% as malignant. Final histopathology revealed 60% benign, 16% borderline, and 24% malignant tumors. The majority of surgeries were performed via laparotomy (72%).

In this cohort, frozen-section diagnosis demonstrated a high rate of agreement with final pathology for benign and malignant adnexal masses supporting its role as a valuable intraoperative tool for guiding surgical management.

Keywords: Adnexal Mass, Frozen Section, Gynecological Oncology, Histopathology, Ovarian Neoplasms

Introduction

Adnexal masses encompass a heterogeneous spectrum of benign, borderline, and malignant entities, and accurate intraoperative classification is pivotal for selecting the appropriate extent of surgery, fertility-sparing strategies, and staging procedures(1). Intraoperative frozen section (FS) remains a commonly used tool to guide operative decisions by providing a rapid histopathological impression that is subsequently verified on paraffin sections (2-3). Multiple studies and systematic reviews have shown that FS has high overall accuracy for distinguishing benign from malignant ovarian tumors, but performance is consistently lower for borderline tumors—particularly mucinous histotypes and larger lesions—necessitating cautious interpretation(1-6). FS accuracy is also influenced by tumor size, sampling adequacy, and institutional experience, all of which may contribute to under- or over-calling borderline disease and to discordance with final histopathology (3,7,8). These considerations underscore the clinical value of assessing FS–final pathology concordance in routine practice to define context-specific reliability and limitations in intraoperative decision-making for adnexal masses.

General gynecologists frequently encounter newly diagnosed adnexal masses as their initial patients. Considerations to account for include bothersome mass symptoms, fertility concerns, and the impact of potential surgical intervention on future fertility and ovarian follicular reserve (8). The crucial step is to exclude ovarian cancer, a condition with elevated mortality, or metastases to the ovary from another affected organ. Consequently, physicians should use the data acquired in this procedure to determine if no further action is necessary, the mass requires monitoring, or the patient should be transferred to a specialist gynecological oncologic surgeon (9).

*Corresponding Author: Mustafa Gökkaya, Department of Gynecological Oncology, Gaziantep City Hospital, İbn-i Sina Neighbourhood, 27470 Şahinbey, Gaziantep
Mail: mugokkaya@gmail.com, Phone: +90 536 677 55 10, Fax:+90 342 310 09 99
ORCID ID: Mustafa Gökkaya: 0000-0002-0477-157X, Erkan Şimşek: 0000-0002-6723-1773
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The study aims to assess our surgical methods and pathological outcomes within our institution and to compare our findings with the current literature.

Materials and Methods

This retrospective observational study was conducted in the Department of Gynecology at Gaziantep City Hospital, Gaziantep, Turkey. The study included patients who underwent surgery for adnexal masses and for whom intraoperative frozen section examination was performed, followed by final histopathological evaluation. The aim was to determine the degree of concordance between frozen section diagnoses and final paraffin section results, thereby assessing the reliability of frozen section analysis in intraoperative decision-making. Patients eligible for inclusion were those who had surgery for an adnexal mass, were older than 18 years, had no preoperative histopathological diagnosis and underwent frozen section analysis during surgery. Individuals with a preoperative tissue diagnosis or younger than 18 years were excluded from the study. The patient had surgery following the determination that a subsequent operation may be required based on the final pathology results. Data were obtained retrospectively from hospital archives and pathology records. For each patient, demographic characteristics such as age, menopausal status, body mass index were recorded, along with presenting symptoms, preoperative radiological findings, and laboratory results including tumor marker (CA-125) values. Pathological findings from intraoperative frozen examination and final paraffin-embedded sections were collected and compared. All frozen examinations were performed by an experienced pathologist using standard frozen section techniques, and the diagnoses were classified as benign, borderline, or malignant. The study involved no additional risk to patients beyond standard clinical care. All data were anonymized and handled in accordance with ethical research standards. If a high level of agreement between frozen section and final pathology is confirmed, intraoperative decision-making during adnexal mass surgery can be made with greater confidence; if discordance is observed, further studies will be encouraged to improve intraoperative diagnostic accuracy.

Statistical Analyses: The data was performed using IBM SPSS Statistics for Windows, Version 24.0 (IBM Corp, Armonk, NY, USA). Descriptive statistics were expressed as frequency and percentage for categorical variables and as mean ± standard deviation or median (minimum–maximum) for continuous variables, depending on data distribution. In this study, independent samples t-test and univariate logistic regression analysis were used to evaluate the relationships and distributions between important variables. A p-value of less than 0,05 was considered statistically significant.

Results

Data from 50 patients who underwent surgery between September 2024-November 2025, for adnexal masses and intraoperative frozen section evaluation were included in the study. The median age of the participants was 47.8 years (range: 34–74), and the median body mass index (BMI) was 32.4 kg/m² (range: 24–42). The median serum CA-125 level was 86 U/mL, varying between 8 and 760 U/mL; 60% of the patients had CA-125 levels above 35 U/mL, while 40% had levels within the normal range. The median tumor diameter was 13.7 cm (range: 6–32). The majority of the adnexal masses were unilateral (80%), whereas 20% were bilateral. Intraoperative frozen section diagnoses revealed that 26 cases (52%) were benign, 4 cases (8%) were reported as "most likely borderline," 6 cases (12%) as borderline, another 6 cases (12%) as "at least borderline," and 8 cases (16%) as malignant. Final histopathological examination demonstrated 30 benign lesions (60%), 8 borderline tumors (16%), and 12 malignant tumors (24%). Surgical approach was laparoscopic in 14 patients (28%) and laparotomic in 36 patients (72%). The demographic information of the patients described above is summarized in Table 1.

In a comparison of parameters indicative of malignancy in adnexal masses, including serum CA-125 levels, mass bilaterality, patient age, and tumor size, it was found that only the bilaterality of the tumor was statistically significant in patients with malignant outcomes in the final pathology(respectively, p:0,159, p:0,016, p:0,642, p:0,183, p:0,436). Table 2 is a summary of the criteria that may suggest malignancy.

Table 1: Demographic Characteristics of Patients

	N or Median	Percentage or Range
Age (median, range) (years)	47.8	(34-74)
BMI* (Kg/m2)	32.4	(24-42)
CA-125 level (median, range) (U/mL)	86	(8-760)
≤35	20	40%
> 35	30	60%
Tumor Size (median, range) (cm)	13.7	(6-32)
Tumor Laterality		
Unilateral	40	80%
Bilateral	10	20%
Frozen Results		
Benign	26	52%
Most Borderline	4	8%
Borderline	6	12%
At Least Borderline	6	12%
Malign	8	16%
Final Pathology Results		
Benign	30	60%
Borderline	8	16%
Malign	12	24%
Laparoscopy	14	28%
Laparotomy	36	72%

†*BMI: Body Mass Index

The negative predictive value, assessed by the analysis of patients' final diseases and frozen sections, was established at 74.3%. This information is delineated in Table 3.

Discussion

In this single-center cohort, FS assignments (benign, “most likely borderline,” borderline or “at least borderline,” and malignant) were compared with definitive paraffin diagnoses (benign, borderline, malignant) to appraise diagnostic concordance in real-world gynecologic oncology practice. Our distribution of final pathology (60% benign, 16% borderline, 24% malignant) is broadly aligned with prior hospital-based series of surgically managed adnexal masses(1,11). Consistent with the literature, FS appeared to provide clinically actionable guidance for most cases, reflecting the well-documented high accuracy of FS for benign and overtly malignant ovarian tumors(1,3,5,12). Where discrepancies typically arise is the borderline category, especially mucinous borderline tumors and larger masses, in which architectural complexity and tumor heterogeneity increase sampling error; these patterns have been repeatedly identified as drivers of misclassification at FS(3,5-7,13,14). In such scenarios, many authors recommend conservative intraoperative decisions (e.g., avoiding full staging for mucinous borderline patterns suspicious but not definitive

Table 2: The Correlation Between Age, BMI, CA-125 Levels, Tumor Bilaterality, Tumor Size, and Malignancy

	Malign n:12	Non-Malign n:38	P value*
CA-125 level (median, range) (U/mL)	120	87	0.159
Bilaterality	5	5	0.016
BMI†	33.92	31.83	0.642
Age	48.67	47.47	0.183
Tumor Size (median, range) (cm)	13.25 cm	13.86	0.436

†BMI: Body Mass Index
* P values <0.05 were regarded as statistically significant

Table 3: Comparison of Our Frozen Section and Definitive Pathological Findings with Our Accuracy Rates

	Frozen section n:50	Final Pathology N:50
Benign	26	30
Most borderline	4	
Borderlıne	6	8
At least borderlıne	6	
Malign	8	12

Parameter Value
Sensitivity75%
Specificity72.2%
Positive Predictive Value (PPV) 73.1%
Negative Predictive Value (NPV) 74.3%
Overall Accuracy: 60.4%

for invasion) until permanent sections are available(2,6).

The practical implications are two-fold. First, when FS suggests clear benignity or frank malignancy, concordance with final histology is usually high and supports proceeding with the planned limited surgery or comprehensive staging, respectively(1,3,12). Second, when FS indicates "borderline," "at least borderline," or "suspicious," surgeons should account for known pitfalls, mucinous histology, large tumor size, and limited sampling, and consider staging deferral or tailored sampling strategies(3,5,7,13). The literature indicates that the bilateral presence of adnexal masses in our study elevates the probability of malignancy (15). It is important to note that malignant disorders of the gastrointestinal system and ovarian metastatic lesions may also present bilaterally(16). Unlike the literature, the mean age of the patients in our study was determined to be close to each other in malignant and benign patients(17). Strengthening surgeon–pathologist communication and optimizing grossing protocols (e.g., additional sections from large or heterogeneous areas) can mitigate under-diagnosis at FS and improve concordance(13-18). These points align with our experience and help contextualize any discordant cases in the present series.

Although our final pathology results and negative sensitivity rates of frozen section outcomes align with existing literature(19), the patients' aspirations for fertility and the surgical approach must still be considered, as previously articulated in the literature(20). Our investigation revealed that, as previously indicated in the literature, patient management should incorporate both guideline adherence and individual circumstances, including reproductive desires and early menopause(9).

The study's strength lies in its single-center design and our meticulous monitoring of our patients. The study's weaknesses are its retrospective design and the limited patient sample size.

Intraoperative FS is a valuable adjunct for guiding surgical management of adnexal masses, with high reliability for benign and malignant tumors but recognized limitations for borderline lesions and larger masses. Incorporating these constraints into intraoperative decisions and emphasizing adequate sampling and multidisciplinary communication may enhance FS–final pathology concordance. The present study adds center-specific evidence to the established literature and supports continued quality monitoring of FS performance in adnexal surgery.

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