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ÖZGÜN ARAŞTIRMA /ORIGINAL ARTICLE

Factors Predicting Inaccuracy Between Frozen Section Analysis and Postoperative Pathology Results: A Tertiary Center Experience

Frozen/Section Sonuçları ile Postoperatif Patoloji Sonuçları Arasındaki Uyumsuzluğu Öngören Faktörler: Tersiyer Merkez Sonuçları

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Abstract

Objective: To evaluate the diagnostic accuracy and to identify the factors determining the inaccuracy between Frozen/Section analysis and postoperative pathology results in our hospital.

Material and method: A total of 1435 patients who were operated on for a pelvic mass and underwent Frozen/Section consultation between January 2013 and January 2018 were included in this study.

Results: On univariate analysis, menopausal state, abnormal uterine bleeding, preoperative serum Ca125 level, preoperative leukocyte value, preoperative neutrophil value, tumor size, presence of cystic component, pathological findings in Doppler USG, ascites and cell type were found to have statistical significance for benign/borderline/malign discrimination. Menopausal state (p<0.0001), preoperative serum Ca125 level (p<0.0001), and tumor size (p<0.0001) were identified as independent predictors for determining inaccuracy between intraoperative and postoperative pathological evaluation. Inconsistency increased 2.5 times with a serum Ca125 > 35 IU/ml, 3.8 times with tumor size> 79 mm and 5 times in postmenopausal patients. For the discrimination of benign/borderline/malign definitions, Frozen/Section results and final pathology results were compatible in 1250 (87%) patients while it was not in 185 (13%) patients.

Conclusion: Increased preoperative serum Ca125 level was a predictor for inaccuracy between Frozen/Section examination and postoperative pathology results. Also, tumor size ≥80 mm and menopausal state were related to misdiagnosis in Frozen/Section results. Maximal effort should be done to minimize preventable errors during intraoperative Frozen/Section analysis.

Öz

Amaç: Bu çalışmada, intraoperatif Frozen/Section sonuçları ile postoperatif patoloji sonuçları arasındaki tanısal doğruluğu değerlendirmek ve uyumsuzluğu belirleyen faktörleri belirlemek amaçlanmıştır.

Gereç ve Yöntemler: Bu çalışmaya Ocak 2013-Ocak 2018 yılları arasında pelvik kitle nedeniyle opere olan ve Frozen/Section konsültasyonu uygulanan 1435 hasta dahil edildi.

Bulgular: Tek değişkenli analizde Benign/Borderline/Malign tanılarının ayırımında; menopoz durumu, anormal uterin kanama, ameliyat öncesi serum Ca125 seviyesi, ameliyat öncesi lökosit değeri, ameliyat öncesi nötrofil değeri, tümör boyutu, kistik komponent varlığı, Doppler USG'de patolojik bulgular, asit ve hücre tipi istatistiksel olarak anlamlı bulundu.

Menopoz durumu (p<0,0001), preoperatif serum Ca125 düzeyi (p<0,0001) ve tümör boyutu (p<0,0001), intraoperatif ve postoperatif patolojik değerlendirme arasındaki yanlışlığı belirlemede bağımsız faktörler olarak belirlendi. Uyumsuzluk serum Ca125 > 35 IU/ml olduğunda 2,5 kat, tümör boyutu > 79 mm olduğunda 3,8 kat ve postmenopozal hastalarda 5 kat arttı. Benign/borderline /malign tanılarının ayrımında Frozen/Section sonuçları ile nihai patoloji sonuçları 1250 (%87) hastada uyumluyken 185 (%13) hastada uyumlu değildi.

Sonuç: Artmış preoperatif serum Ca125 seviyesi, Frozen/Section sonuçları ile postoperatif patoloji sonuçları arasındaki yanlışlığı predikte eden bir faktördür. Ayrıca Frozen/Section sonuçlarında tümör boyutu ≥80 mm olduğunda ve menopozal durum yanlış tanı ile ilişkiliydi. İntraoperatif Frozen/Section analizi sırasında önlenebilir hataları en aza indirmek için azami çaba gösterilmelidir.

Introduction

Pelvic masses are one of the most frequent conditions that can be seen in all ages among women worldwide. The majority of cases are thought to be benign, but malignancy should be ruled out (1). The main symptoms are pelvic pain, abnormal uterine bleeding, dysmenorrhea, and pelvic pressure. However, they may be detected incidentally during pelvic examination (2). Adnexal masses generally tend to be cystic in nature and 85% of them are benign (3). Gynecological pelvic masses include physiological cysts, ectopic pregnancy, tubo-ovarian abscess, hydrosalpinx, endometriotic cysts, benign and malign neoplasms (1).

In women under age of 20, 64% of pelvic masses are non-neoplastic, functional, and benign cysts. The incidence of epithelial ovarian cancer is 0.4-8.9/100.000 under age of 40 while it increases to 60/100.000 between ages 60 and 80 (4). For the diagnosis of ovarian tumors, gynecological examination, imaging modalities and tumor markers are used for preoperative assessment (5). Ultrasonography (USG) is a useful and feasible method for discrimination of benign and malign masses. Tumor size, solitary-cystic nature, bilaterality, presence of papillary formations, thickness of septations and abdominal ascites can be detected with ultrasonographic examination (1). Also, Doppler USG can be performed for differential diagnosis of benign or malign lesions. Pulsatility index (PI) <1 and Resistance index (RI) <0.4 are considered high risk features of malignancy (6). However, exact diagnosis of ovarian masses is made by intraoperative or postoperative pathological evaluation (7). Intraoperative frozen section (FS) evaluation is essential for choosing proper treatment options for the patient. Sensitivity and specificity rates of FS analysis were reported as 65-97% and 97-100% in different studies (8). In addition, consistency between FS analysis and final pathology results are of paramount importance. Thus the accuracy rates should be established retrospectively for quality assessment of healthcare system. Inaccuracy rates between intraoperative and final pathology results were reported as 1.8%-3.7%. Irrepressible errors are caused by focal disease in tissues and misinterpretation (9). Insufficient or excessive tissue sample, necrosis within the tumoral lesion or misdiagnosis may lead to avoidable errors. Also, unclear capsular and vascular invasion, freezing artifacts, heterogeneous tumors (soft tissue sarcoma, hemangiopericytoma), mixed tumors, biphasic tumors (teratoma, synovial sarcoma, mesothelioma) and differentiated tumors (glioma, chondrosarcoma) are other reasons for misinterpretation in FS analysis (10).

The aim of this study is to evaluate the diagnostic accuracy and to identify the factors determining the inaccuracy between FS analysis and postoperative pathology results in our hospital.

Material and Methods

Data related to patients with pelvic masses who underwent surgical intervention and FS consultation between January 2013 and January 2018 were obtained from retrospective research in Gynecology Clinic's and Gynecologic Oncology Clinic's electronic database system, patients' files and pathology reports. Patients who were not diagnosed as benign or malign with the use of FS analysis were excluded. As a result, a study cohort composed of 1435 patients was obtained. Local Ethics Committee approval was obtained before the study (90057706-900).

The patients with pelvic masses are assessed by performing pelvic examination and by the use of abdominal and transvaginal USG, serum tumor marker screening before the initiation of treatment in our institution. All pathologic specimens were evaluated by gyneco-pathologists. The patients were classified according to symptoms (asymptomatic detected incidentally on pelvic examination, and symptomatic vaginal bleeding, abdominal pain, urinary incontinence and abdominal swelling) and USG reports.

During ultrasonographic examination; laterality of pelvic mass (uni-/bilateral), mass size (height and width), structure of pelvic mass (cystic/solid; presence of papillary formation; presence of septation formation; presence of multilocularity) and presence of ascites were recorded. Pelvic masses were divided into simple or complex cystic subgroups according to USG examination. Cysts without septation formation, solid component, pathological Doppler USG report and ascites were described as simple cyst. Pathological Doppler USG report was admitted as PI <1 and RI <0.4. On preoperative period; serum cancer antigen 125 (CA125), carbohydrate antigen 19-9 (CA19-9), carbohydrate antigen 15-3 (CA15-3), carcinoembriyonic antigen (CEA), human chorionic gonadotropin (β-hCG) ve alfa fetoprotein (α-FP) levels were detected as serum tumor markers; leukocyte, neutrophil, platelet and hemoglobin levels were detected as inflammatory markers in complete blood count just one week before surgery. Adolescent period with specific physical, social, psychological and reproductive features was defined as years between 10 and 19 (11).

For FS analysis, pathologic examination of the material was performed with cutout sections containing at least 10 mm width and a total number of 2 and 5 pieces. Solid areas were described macroscopically. Tissue samples were frozen up to -25 centigrade degrees and cut into 8 μ sections. These sections were stained with hematoxylin and eosin (H&E) and microscopic evaluation was carried out. According to intraoperative pathology consultation reports; FS results were classified as benign / rule out borderline / borderline / at least borderline / malign; final pathology reports were classified as benign / malign / borderline. For the decision of surgery type to be performed, rule out borderline tumors in FS analysis were admitted as benign; whereas at least borderline tumors were admitted as malign intraoperatively. The reason for this type of classification can be explained by treating rule out borderline and benign tumors reported by intraoperative pathological consultation with the same surgical procedures. Likewise at least borderline and malign tumors were treated with the same surgical procedures intraoperatively. Finally; FS evaluation and postoperative pathology reports were compared to detect the accuracy performance of FS analysis with the use of benign/ borderline/ malign tumor definitions.

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Cell type was classified as epithelial (serous, mucinous, clear cell, endometrioid type, brenner) and non-epithelial (sex cord stromal tumors, granulosa cell tumors and uterine mesenchymal tumors) according to paraffin-embedded block results.

Parameters were determined by using the Shapiro Wilk test. On univariate analysis, quantitative parameters between two groups were calculated with Student T-Test and Mann Whitney U test, while qualitative parameters were calculated with Chi-Square test. Multivariate analysis was performed using a Cox's proportional hazards models. Variables identified as risk factors in univariate analysis ($p < 0.25$) were used to create an exact logistic regression model. Odds ratios with 95% confidence intervals were calculated. A p-value of less than 0.05 was considered as statistically significant. Statistical analyses were performed using SPSS (SPSS Inc, Chicago IL, USA) version 22.0.

Results

The mean age of study cohort was 40.5 years and ranged between 13 and 84 years. Seventy patients (7.4%) were adolescent, 1003 (69.9%) were premenopausal and 432 (30.1%) were postmenopausal. One hundred and seventy nine (12.5%) patients had bilateral pelvic masses and 123 (8.6%) patients had abnormal Doppler USG findings. Pelvic mass was cystic in 819 (57.1%) patients, solid in 225 (15.7%) patients and solid and cystic in 204 (14.2%) patients. Septation formation was detected in 236 (16.4%) patients. Intraoperatively, ascites was positive in 76 (5.3%) patients and mean ascites volume was 2329 cc (range: 40-9000). Mean preoperative serum Ca125 level was 148 IU/ml (range: 0.9-21.841 IU/ml). Mean pelvic mass size was 91.5 mm and ranged between 10 and 500 mm. Tumor type was epithelial in 1145 (79.8%) patients. Clinical, surgical and pathological features of study population were summarized in Table 1 and 2.

Histopathological diagnosis of FS analysis was reported as benign in 1073 (74.8%) patients, rule out borderline in 125 (8.7%), borderline in 50 (3.5%), at least borderline in 28 (2%) and malign in 159 (11.1%) patients. However, it was reported as benign in 1064 (74.1%) patients, borderline in 222 (15.5%) patients and malign in 149 (10.4%) patients on final pathology reports. For the discrimination of benign / borderline / malign definitions, FS results and final pathology results were compatible in 1250 (87%) patients while it was not in 185 (13%) patients. (Table 3).

88.7% of benign cases according to FS analysis (benign + rule out borderline) were identified as benign and 96% of borderline in FS analysis were identified as borderline in final pathology results. Intraoperative malignancy diagnosis (at least borderline + malign) was confirmed as malign by final pathology results with a rate of 74.3% ($p<0.001$) (Table 4). However, remaining 25.7% (n: 48) of these patients underwent unnecessary surgical staging procedures. Only ten of 1248 (0.8%) patients diagnosed as benign + rule out borderline + borderline in FS analysis were assessed as malign in final pathology reports. Additionally, 126 (10.5%) of 1198 patients diagnosed as benign + rule out borderline in FS analysis were reported as borderline in final pathology reports. Finally 3.4% of patients (n: 48/1435) underwent unnecessary surgery and 9.4% of patients (n: 136/1435) underwent incomplete surgery in entire cohort.

On univariate analysis, menopausal state, abnormal uterine bleeding, preoperative serum Ca125 level, preoperative leukocyte value, preoperative neutrophil value, tumor size, presence of cystic component, pathological findings in Doppler USG, ascites and cell type were found to have statistical significance for benign / borderline / malign discrimination (Table 5). For multivariate analysis, a model was created by using the factors with statistical significance on univariate analysis. These factors were adjusted for this new model and menopausal state ($p<0.0001$), preoperative serum Ca125 level ($p<0.0001$) and tumor size ($p<0.0001$) were identified as independent predictors for determining inaccuracy between intraoperative and postoperative pathological evaluation (Table 6). Inconsistency increased 2.5 times with a serum Ca125 > 35 IU/ml, 3.8 times with tumor size> 79 mm and 5 times in postmenopausal patients.

Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were 99.9%, 63.6%, 88.7% and 99.5%, respectively for benign tumors; these rates were 27%, 99%, 96% and 87.4%, respectively for borderline tumors and they were 93.2%, 96.2%, 74.3% and 99.1%, respectively for malign tumors. Tumors reported as 'rule out borderline' and 'at least borderline' in FS analysis were confirmed as borderline for most of the cases in final pathology reports. This could be the reason for lack of sensitivity in borderline tumors. When borderline and malign tumors assessed together, total sensitivity was 58%, specificity was 95.5%, PPV was 78.9% and NPV was 88.7%.

Table I. Clinical and Demographical Features

Features		**Mean±SD**	**Median (Range)**
Age (year)		40.5±13.93	40 (13-84)
Body Mass Index (kg/m^2)		27.2±5.58	27 (15-48)
Gravida		3.4±2.23	3 (1-15)
Alive Child		2.4±1.35	2 (1-10)
Preoperative Leukocyte (n/mm^3)		7301±2283	6840 (1000-67.400)
Preoperative Neutrophil (n/mm^3)		4661±2111	4255 (730-21.230)
Preoperative Hemoglobin (gr/dl)		12.6±1.43	12.8 (6.7-16)
Preoperative Platelet (n/mm^3)		288.105±89.138	273.000 (49.000-951.000)
Time period from initial surgery(month)		107.6±94.1	84 (2-480)
		n	**%**
Adolescent Group	No (age >19 years)	1319	91.9
	Yes (age ≤19 years)	70	4.9
	Not reported	46	3.2
Menopausal State	Premenopausal	1003	69.9
	Menopausal	432	30.1
Gravida	No	319	22.3
	Yes	929	64.7
	Not reported	187	13
Abortus	No	649	45.2
	Yes	280	19.5
	Not reported	506	35.3
Abnormal Uterine Bleeding	No	1132	78.9
	Yes	303	21.1
Contraception Use	No	822	57.3
	Yes	426	29.7
	Not reported	187	13
Comorbidity	No	971	67.7
	Yes	277	19.3
	Not reported	187	13
Previous Surgery	No	781	54.4
	Yes	467	32.5
	Not reported	187	13
Familial Cancer History	Negative	1182	82.4
	Positive	66	4.6
	Not reported	187	13
Tobacco Use	No	948	66.1
	Yes	300	20.9

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Table II. Clinical, Imaging and Pathological Features of Pelvic Masses

Features		**Mean±SD**	**Median (Range)**
Tumor Size (mm)		91.5±54.54	79 (10-500)
Ascites Volume (cc)		2329±2735	1100 (40-9000)
Preoperative CA 125 (IU/ml)		148.4±806.90	19 (0.9-21.841)
		n	**%**
Tumor type	Epithelial	1145	79.8
	Non-epithelial	285	19.9
	Not reported	5	0.3
Laterality	Unilateral	1256	87.5
	Bilateral	179	12.5
Tumor structure	Cystic	819	57.1
	Solid	225	15.7
	Cystic and solid	204	14.2
	Not reported	187	13
Septation	Negative	1012	70.5
	Positive	236	16.4
	Not reported	187	13
Preoperative Ascites Diagnosis	Negative	1205	84
	Positive	43	3
	Not reported	187	13
Intraoperative Ascites Diagnosis	Negative	1172	81.7
	Positive	76	5.3
	Not reported	187	13
Preoperative CA 125 (IU/ml)	≤35	876	61
	>35	437	30.5
	Not reported	122	8.5
Doppler Ultrasonography	Normal	1125	78.4
	Pathologic	123	8.6
	Not reported	187	13
Simple Cyst	No	641	44.7
	Yes	607	42.3
	Not reported	187	13

Pathologic Doppler Ultrasonography: Pulsatility index <1 and Resistance index <0.4
Simple Cyst: No ascites and No septation and No solid area and No pathologic Doppler ultrasonography

Table III. Frozen Section and Paraffin Block Results

Features		n	%
Frozen Section Results	Benign	1073	74.8
	Rule out borderline	125	8.7
	Borderline	50	3.5
	At least borderline	28	2
	Malign	159	11.1
Paraffin Block Results	Benign	1064	74.1
	Borderline	222	15.5
	Malign	149	10.4
Frozen Section – Paraffin Block Results Consistency	Inconsistent	185	13
	Consistent	1250	87

Table IV. Frozen Section and Paraffin Block Consistency

	Definition	Paraffin Block Results			P Value
		Benign	Borderline	Malign	
		n (%)	n (%)	n (%)	
Frozen/Section Results	Benign	1061 (98.9)	4 (0.4)	8 (0.7)	<0.0001
	Rule out borderline	2 (1.6)	122 (97.6)	1 (0.8)	
	Borderline	1 (2)	48 (96)	1 (2)	
	At least borderline	0 (0)	23 (82.1)	5 (17.9)	
	Malign	0 (0)	25 (15.7)	134 (84.3)	
Frozen/Section Results	Benign + rule out borderline	1063 (88.7)	126 (10.5)	9 (0.8)	<0.0001
	Borderline	1 (2)	48 (96)	1 (2)	
	Malign + at least borderline	0 (0)	48 (25.7)	139 (74.3)	

Table V. Frozen Section and Paraffin Block Consistency

Factor		Inconsistency (%)	Consistency (%)	P value
Age (year) †	≤40	8.5	91.5	0.066
	>40	11.5	88.5	
Adolescent Group	Yes (age ≤19 yıl)	7.1	92.9	0.423
	No (age >19 yıl)	10.1	89.9	
Menopausal State	Premenopause	6.2	93.8	<0.0001
	Menopause	27.3	72.7	
Body Mass Index (kg/m2) †	≤27	1.8	98.2	0.232
	>27	1	99	
Gravida †	≤3	1.9	98.1	0.373
	>3	2.8	97.2	
Abnormal Uterine Bleeding	Negative	14.4	85.6	<0.0001
	Positive	5.6	94.4	
Weigth Loss	Negative	12.8	87.2	0.113
	Positive	4.7	95.3	
Kontraception Use	No	1.6	98.4	0.353
	Yes	0.9	99.1	
Comorbidity	Negative	1.6	8.4	0.103
	Positive	0.4	99.6	
Previous Surgery	Negative	1.3	98.7	0.747
	Positive	1.5	98.5	
Previous Surgery Count †	≤1	1.3	98.7	0.605
	>1	1.9	98.1	
Time Period from Previous Surgery (month) †	≤84	2	98	0.365
	>84	0.9	99.1	
Familial Cancer History	Negative	1.4	98.6	0.327
	Positive	0	100	
Tobacco Use	No	1.2	98.8	0.274
	Yes	2	98	

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Preoperative CA 125 Level (IU/ml) †	≤19	7.3	92.7	<0.0001
	>19	15.1	84.9	
Preoperative CA 125 Level (IU/ml)	≤35	8	92	<0.0001
	>35	17.8	82.2	
Preoperative Leukocyte Value (n/mm3) †	≤6830	1.5	98.5	0.804
	>6830	1.3	98.7	
Preoperative Leukocyte Value (n/mm3)	≤10.000	1.1	98.9	0.016
	>10.000	3.6	96.4	
Preoperative Neutrophil Value (n/mm3) †	≤4200	1.2	98.8	0.557
	>4200	1.6	98.4	
Preoperative Neutrophil Value (n/mm3)	≤7000	1	99	0.001
	>7000	4.5	95.5	
Preoperative Hemoglobin Value (g/dl) †	≤12.8	1.7	98.3	0.266
	>12.8	1	99	
Preoperative Hemoglobin Value (g/dl)	≤14	1.5	98.5	0.335
	>14	0.6	99.4	
Preoperative Platelet Value (n/mm3) †	≤273.000	1.3	98.7	0.804
	>273.000	1.5	95.5	
Preoperative Platelet Value (n/mm3)	≤400.000	1.3	98.7	0.522
	>400.000	2.1	97.9	
Preoperative Tumor Size †	≤79 mm	6	94	<0.0001
	>79 mm	18.1	81.9	
Simple Cystic Structure	Negative	2.2	97.8	0.010
	Positive	0.5	99.5	
Laterality	Unilateral	12.2	87.8	0.273
	Bilateral	15.1	84.9	
Mass Structure	Cystic	1	99	0.224
	Solid	1.8	98.2	
	Solid and cystic	2.5	97.5	
Solid Patten	Negative	1	99	0.105
	Positive	2.1	97.9	
Septation	Negative	1.2	98.8	0.266
	Positive	2.1	97.1	
Doppler Ultrasonography	Normal	1	99	<0.0001
	Pathologic	4.9	95.1	
Presence of Ascites‡	Negative	1.1	98.9	0.002
	Positive	5.3	94.7	
Ascites Volume (cc) †	≤1100	5.3	94.7	0.978
	>1100	5.4	64.6	
Cell Type §	Epithelial	15.5	84.5	<0.0001
	Non-epithelial ¶	1.1	98.9	

†: Median value
‡: İntraoperative finding
§: Paraffin block result
¶: Sex cord stromal tumors, germ cell tumors, uterine mesenchymal tumors
Simple Cyst: No ascites and No septation and No solid area and No pathologic Doppler ultrasonography
Pathologic Doppler Ultrasonography: Pulsatility index <1 and Resistance index <0.4

Table VI. Factors Predicting Inaccuracy in Frozen Section Analysis, Multivariate Analysis

Factor	Odds Ratio	95% Confidence Interval	P Value
CA 125 Level (>35 IU/ml vs. ≤35 IU/ml)	2.570	1.769-3.732	<0.0001
Preoperatifve Tumor Size (>79 mm vs. ≤79 mm) †	3.806	2.501-5.792	<0.0001
Menopausal State (Menopause vs. Premenopause)	5.055	3.473-7.356	<0.0001

†: Median Value

Discussion

FS analysis is accepted as an essential option for deciding proper surgical treatment of pelvic masses. However, false positivity and false negativity can cause incomplete or unnecessary surgical procedures. Complementary surgery is related to increased morbidity and mortality (12). In our study, 3.4% of patients underwent unnecessary surgery and 9.4% of patients underwent incomplete surgery. In another study by Huang et al. incomplete surgery rate was 14.2% and excessive surgery rate was 3.9% (13). In FS analysis results of benign tumors, sensitivity, specificity, NPV and PPV rates were reported as 99.2%, 96.5%, 99.1% and 96.7%, respectively (12). For diagnosis of borderline tumors, they were found as 88.4%, 93.2%, 98.4% and 62.1%, respectively. In addition, for malign tumors they were 82.9%, 99.3%, 90.5% and 98.6%, respectively. Geomini et al. stated that FS analysis sensitivity was 65-97% for benign tumors and 71-100% for malign tumors (8). Additionally, specificity was 90-100% for benign tumors and 98.3-100% for malign tumors in this meta-analysis. In a review article, the investigators concluded sensitivity of FS analysis was 71.1% and positive PPV was 84.3% in borderline ovarian tumors (14). Ismiil et al. compared FS examination and postoperative pathology results and found 89.7% consistency between them (15). In presented study, we found an accuracy rate of 87%. In addition, sensitivity, specificity, PPV and NPV were 99.9%, 63.6%, 88.7% and 99.5%, respectively for benign tumors; these rates were 27%, 99%, 96% and 87.4%, respectively for borderline tumors and 93.2%, 96.2%, 74.3% and 99.1%, respectively for malign tumors.

Some investigators concluded sensitivity of FS analysis was found to have superiority in benign and malign tumors than borderline tumors (16). They also demonstrated that discrimination between benign and borderline tumors was performed more accurately than between malign and borderline tumors. Histological cell type (mucinous), tumor size, presence of borderline component less than 10% and experience of pathologist were established as main causes of inaccuracy in borderline tumors. On multivariate analysis, menopausal state (*premenopause vs. postmenopause*), preoperative serum Ca125 level (≤35 IU/ml vs. >35 IU/ml) and tumor size (≤79 mm vs. >79 mm) were independent factors for benign/borderline/malign discrimination in our study group. Zhang et al. stated that increased preoperative Ca125, CEA and Ca19-9 levels, bilateral adnexal masses and presence of specific histopathological features effect the inaccuracy between FS and postoperative pathology results on univariate analysis (17). But on multivariate analysis, only presence of specific histopathological features was an independent factor for determining inaccuracy rates. Unlikely, in a study by Huang et al. tumor size (≤10 cm vs. >10 cm) and type of surgical procedure (laparotomy vs. laparoscopy) had statistical significance (13). Furthermore, mucinous cell type and unilateral adnexal masses were factors effecting inconsistency in borderline tumors.

The most important limitation of this study is its retrospective design. But in prospective studies evaluating FS analysis, there may be a tendency to minimize preventable errors. Pathologists could behave more carefully during intraoperative FS consultation. Therefore we prefer not to admit this situation as an exact limitation. On the other hand high number of patients is an advantage. In addition; entire cohort was evaluated by experienced gyneco-pathologists working at the same institution for a long period of time. Besides, there are different studies reporting the accuracy rates between FS analysis and postoperative pathology results of our institution (18,19).

In conclusion; increased preoperative serum Ca125 level was a predictor for inaccuracy between FS examination and postoperative pathology results. Also, tumor size ≥80 mm and menopausal state were related to misdiagnosis in FS results. Maximal effort should be done to minimize preventable errors during intraoperative FS analysis. For more accurate results more studies are needed.

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