Intraoperative Cytology of Ovarian Neoplasms with an Attempt to Grade Epithelial Tumors

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Abstract

Background: Intraoperative cytology (IOC) is a simple and quick technique with excellent preservation of cellular details. In the present study, we have evaluated the role of IOC by various methods of smear preparation and compared it with frozen section diagnosis. A scoring system was followed for epithelial tumors for characterization and grading on the basis of cellularity, pattern, nuclear, cytoplasmic features, and background details. Materials and Methods: The study was conducted during a time span of 2 years in total 48 cases of ovarian tumors. Fine-needle aspiration cytology, touch/imprint, scrape, and crush techniques were used. The smears so prepared were processed for toluidine blue and Giemsa and Papanicolaou staining. Cases were cytomorphologically categorized into four groups: Indeterminate; unequivocally benign; borderline tumor with equivocal morphology; and unequivocally malignant (graded into well, moderately, and poorly differentiated). Results: In our study, the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy of 88.88, 96, 96, 88.88, and 92.31%, respectively, were recorded. This was comparable to frozen section diagnosis with a sensitivity, specificity, PPV, NPV, and accuracy of 85.18, 96.15, 95.83, 86.21, and 90.56%, respectively. In epithelial tumors, cytological grading correlated with histopathological grading in 85.29% cases of epithelial tumors. Conclusion: IOC gives comparable results to frozen section and can be used for intraoperative assessment of ovarian tumors. Grading of epithelial tumors on IOC can be performed and may become an important step in intraoperative decision-making for better management and outcome of the patient.

Keywords: Cytology, frozen, grading, intraoperative, ovarian

Introduction

Intraoperative cytology (IOC) is increasingly being employed as a method of intraoperative consultation. It is a simple, quick, and inexpensive technique and shows excellent preservation of cellular details.[1] In spite of IOC being proved as an important diagnostic tool, cytomorphology of the ovarian tumors has been scantily described in the literature.

Even though ovarian masses could be approached by laparoscopy and ultrasound-guided aspiration, there are controversial views regarding their safety.[2,3] Ascitic fluid is submitted for cytology to stage ovarian neoplasms. A positive fluid cytology suggests an advanced stage, though the categorization of tumor may still be difficult for the cytopathologist.[4]

In the present study, we have evaluated the role of IOC taking into account the various methods of smear preparation, cytomorphological details, and tumor subtyping. We have compared IOC diagnosis with frozen section taking histopathology as the gold standard. An attempt has also been made to grade the epithelial tumors using a scoring system based chiefly on the cellularity, pattern, nuclear, cytoplasmic features, and background details.

Materials and Methods

The present study was conducted in our tertiary care center during a time span of 2 years after approval from the Ethical Committee and proper informed consent from the patients. Totally, 48 ovarian neoplasms that were sent for frozen section were included in the study. Fine-needle aspiration cytology (FNAC), touch/imprint, scrape, and crush techniques were used. The smears so prepared were processed for toluidine blue and Giemsa and Papanicolaou staining. Cases were cytomorphologically categorized into four groups: Indeterminate; unequivocally benign; borderline tumor with equivocal morphology; and unequivocally malignant (graded into well, moderately, and poorly differentiated).

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were used to prepare cytological smears. The IOC was done by taking imprints from the representative solid/papillary areas of the ovarian mass on cut section as soon as the specimen is received for frozen section. Scrape smears were prepared by the sharp corner of the slide, and the cytological material so obtained was smeared onto another slide. Crush preparations were done by compressing the tissue between two slides, and the material obtained was smeared by another slide. The smears so prepared were then wet-fixed for Papanicolaou (Pap); air dried and methanol fixed for Toluidine blue and Giemsa staining as per the standard techniques.

Cytological smears were studied in detail for the following features: cellularity, pattern, cell type, cytoplasmic features, nuclear details (degree of pleomorphism, nucleoli, grooves, and mitosis), background, and any other special feature. An attempt was made to type and grade the tumor. Based on the cytomorphology of the smears prepared, cases were categorized into four groups: Indeterminate due to low cellularity; unequivocally benign; borderline tumor (BL) with equivocal morphology; and unequivocally malignant. The malignant epithelial tumors were further graded into well (WD), moderately (MD), and poorly differentiated (PD).

A scoring system was used for grading of the epithelial ovarian tumors [Table 1]. Gross inspection was done and representative sections were taken. The unfixed tissue sections were then laid on tissue holders over liquid freezing medium for taking sections in the cryostat (Leica CM1900) set between −25°C and −30°C, and 5 µm thin sections are taken on a clean slide and stained with toluidine blue and hematoxylin and eosin (H and E) stain as per the standard frozen section staining technique. The frozen section slides were studied and characterized as benign or malignant. For the final histopathology, all specimens were fixed in 10% buffered formalin. Histological diagnosis of paraffin-embedded tissue was considered as the gold standard for statistical evaluation of cytological diagnosis. For statistical purposes, all malignant lesions and borderline ovarian tumors were taken as a positive control and all benign lesions were taken as a negative control. Cytology and histology-positive cases were labeled true positive, histology-positive and cytology-negative cases were labeled as false negative, histology and cytology-negative cases were labeled as true negative, and histology-negative and cytology-positive cases were labeled as false positive. Sensitivity, specificity, and diagnostic accuracy were calculated using descriptive statistics.

**Results**

The total number of ovarian tumors studied was 48, and age ranged from 14 to 70 years (mean age = 36.44 years). Out of these 48 tumors, there were 34 epithelial tumors (70.83%), 11 germ cell tumors (22.92%), and 3 sex cord stromal tumors (6.25%). Among the epithelial tumors, 17 benign, 2 borderline, and 15 malignant epithelial tumors were seen. There were 4 benign and 7 malignant germ cell tumors. The sex cord stromal tumors comprised 1 case of fibroma and 2 cases of adult granulosa cell tumor. The scrape technique was found to be the best method for preparing the smears. Adequate cellularity was seen in all of the cases (100%) in both crush and scrape smears. Cellularity was highest in scrape smears compared to other techniques and morphological preservation was also better. Among the 48 cases, FNAC was indeterminate in 2 cases (4.17%) comprising serous cystadenofibroma and fibroma. Imprint smears were indeterminate in 5 cases (10.41%) comprising 2 cases of serous cystadenofibroma and 1 case each of mature cystic teratoma, fibroma, and grade 1 immature teratoma, respectively. All of these indeterminate cases were due to low cellularity.

Toluidine blue stain took less than 1 min and was able to show comparable cytoplasmic and nuclear differentiation. The stromal fragments were also beautifully highlighted.

| Table 1: Scoring system used for grading ovarian epithelial tumors |
|-----------------------------------------------|
| Score 0       | Score 1       | Score 2       | Score 3       |
| 1. Cellularity | Very low      | Low           | Adequate      | High          |
| 2. Pattern (honeycombing) | Pronounced | Occasional | Rare          | Absent        |
| 3. Cellular discohesiveness | Absent | Mild       | Moderate      | Marked        |
| 4. Microadenomatous | Absent | Occasional | Plenty        | Rare          |
| 5. Nuclear enlargement | Absent | Mild       | Moderate      | Marked        |
| 6. Nuclear pleomorphism | Absent | Mild       | Moderate      | Marked        |
| 7. Nuclear overlapping | Absent | Mild       | Moderate      | Marked        |
| 8. Nuclear chromatin | Homogenous | Mild Heterogenous | Moderate Heterogenous | Marked        |
| 9. Nuclear membrane irregularity | Absent | Mild       | Moderate      | Marked        |
| 10. Nucleoli | Absent, Rare, barely visible, single | Occasional, prominent, single | Frequent, prominent, multiple |
| 11. Atypical bare nuclei | Absent | Few        | Occasional    | Plenty        |
| 12. Mitosis | Absent | Rare       | Occasional    | Frequent      |
| 13. Cytoplasm | Abundant | Moderate | Scanty        | Very scant, fragile |
| 14. Tumor necrosis | Absent | Mild       | Moderate      | Marked        |
| 15. Tumor giant cells | Absent | Rare       | Occasional    | Frequent      |

After adding individual score of 15 characteristics GRADE. 0-5: Benign; 6-15: Borderline (BL); 16-25: Well-differentiated (WD) carcinoma; 26-35: Moderately differentiated (MD) carcinoma; 36-45: Poorly differentiated (PD) carcinoma
Borderline mucinous tumor was reported as mucinous cystadenoma (false negative) in 1 case in IOC and both the cases in frozen section. Mucinous cystadenoma was also incorrectly reported as borderline tumor (false positive) in a single case. Immature teratoma grade 1 was incorrectly reported as mature in 2 cases (false negative) in both IOC and frozen section.

The benign mucinous tumors were cystic (13/13). IOC showed tall columnar cells forming honeycomb-like clusters [Figure 1a] with basally placed nuclei and empty looking cytoplasm in a mucinous background [Figure 1a, inset].

Both the borderline mucinous tumors were complex cysts comprising multiloculated cysts on cut section. Smears from 1 borderline mucinous tumor which was picked up on cytology demonstrated cohesive sheets of mucin-secreting columnar cells with moderate degree of cell overlapping and many dispersed cells. There was mild to moderate degree of nuclear atypia and pleomorphism [Figure 1b]. On histopathology, nuclear stratification and atypia was noted with abundant apical mucin.

The mucinous adenocarcinoma were mostly solid cystic (4/6). The smears showed dirty mucinous background and discohesive clusters as well as dispersed moderately pleomorphic cells [Figure 1c]. Few of the cells also showed mucin vacuoles [Figure 1d].

All the benign serous tumors (n = 4) were predominantly cystic filled with pale straw-colored fluid. Smears comprised papillaroid clusters as well as monomorphic sheets of epithelial cells with small dark, bland nuclei, and moderate to abundant cytoplasm. The background was clean in 75% cases [Figure 2a, inset].

There were 8 cases of serous adenocarcinoma, all of which were solid cystic in 50% cases and predominantly solid in the rest of the cases. The IOC smears were richly cellular showing cells with a high nucleocytoplasmic ratio present in papillary clusters as well as dispersed singly [Figure 2b, inset]. Background showed necrosis and foamy macrophages. Psammoma bodies were seen only in a single case.

A single case of malignant Brenner tumor was predominantly solid with few cystic areas filled with fluid. Tumor typing was not possible on cytology, and tumor grading revealed well-differentiated carcinoma. The smears were cellular showing mild nuclear pleomorphism [Figure 3a], prominent nucleoli [Figure 3b], and occasional nuclear grooves [Figure 3b, inset], giving an impression of low-grade malignant tumor of epithelial type, and possibility of granulosa cell tumor could not be ruled out.

There were 3 cases of dermoid cyst, all of which were cystic. Smears revealed anucleate squames and amorphous dirty material. All the immature teratomas were solid cystic. In 2 cases of immature teratoma grade 1, mature glial tissue and chondroid material were predominantly seen. However, in case of immature teratoma grade 3, we noted the presence of round cells in acinar to rosettoid pattern.

A single case of yolk sac tumor was predominantly solid with many friable necrotic areas. It was accurately diagnosed and showed discohesive sheets of pleomorphic cells with moderate amount of vacuolated cytoplasm in a mucoid background. Occasional cells also showed pink hyaline globules on Giemsa stain. All 3 cases of dysgerminoma were unilateral and predominantly solid in consistency. Smears showed richly cellular discohesive sheets of cells with abundant pale staining.
vacuolated cytoplasm. The nuclei were large with clumped and irregularly distributed chromatin. The background was tigroid and showed few mature lymphocytes.

All the stromal tumors were solid in consistency. In 2 cases of granulosa cell tumor, IOC smears showed high cellularity with cells in groups and monolayered sheets. The nuclei were round to oval with granular evenly dispersed chromatin and small to inconspicuous nuclei. One of the two cases showed an occasional acinar structure with amorphous reddish violet bodies (Call-Exner bodies). In a single case of fibroma, cellularity was inadequate in FNAC, imprint, and crush smears, however, scrape smears showed occasional fragment of tightly packed benign appearing spindle-shaped cells and few scattered oval to spindle-shaped cells in the background.

In IOC, we recorded sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy of 88.88, 96, 96, 88.88, and 92.31%, respectively, on the basis of cytohistological diagnosis [Table 2]. This was comparable to frozen section diagnosis with a sensitivity, specificity, PPV, NPV, and accuracy of 85.18, 96.15, 95.83, 86.21, and 90.56%, respectively. Tumor subtyping could be done in 39/48 cases (81.25%). Cytological grading (on the basis of scoring system) correlated with the histopathological grading.[5] [Table 3] in 29 cases of epithelial tumors (29/34, 85.29%).

**DISCUSSION**

Traditionally, intraoperative pathological assessment was based on frozen sections. In 1927, Dudgeon and Patrick[5] introduced cytology as a method of intraoperative pathological evaluation. In ovarian lesions, IOC has been reported to have comparable diagnostic accuracy to frozen sections.[6]

Different authors have reported several advantages of IOC[7–10] such as: (1) rapidity of preparation with preserved accuracy; (2) simple and inexpensive method; (3) preservation of cellular details with no problems of freezing artefact; (4) no tissue loss; (5) possible identification of focal neoplastic lesions or variable elements in large tissue fragments; (6) can be done even when only limited tissue is available; and (7) minimal contamination with safe handling.

Among the several cytological techniques applied to ovarian specimens, scrape cytology is often considered the most suitable.[1,6,11] In our study, we obtained FNAC from the tumor and imprints from the cut surface of tumor, scrape, and crush cytology to maximize the cell harvest. Although all three revealed similar cytomorphology in all the cases, scrape and crush smears showed high cellularity and was extremely helpful in not even characterizing the nature of the tumor but also helped us to subtype the tumor in 81.25% cases. We have used Toluidine blue staining for both cytology smears as well as frozen section staining, with which results could be visible within a minute. We have also used pap and Giemsa stained slides simultaneously for getting good cytomorphological details and better preservation of slides. Many other studies have found rapid H and E staining better in providing quick and good cytomorphological details.[1,8]

In a study by Khunamornpong and Siriaunkgul,[11] the histological subtypes were correctly predicted in 78% cases and the role of scrape cytology was found to be very limited in the diagnosis of borderline and mucinous ovarian tumors, as also seen in our study.

In epithelial tumors, we have done the cytological grading, which accurately correlated with histopathological grading in 29/34 cases of epithelial tumors (85.29%). Cytomorphological grading of epithelial ovarian tumors has not been attempted before. During intraoperative assessment, this helped us in supporting the cytological diagnosis since there was a preset score for every significant cytomorphological feature. We have taken only epithelial tumors as they form the bulk of the ovarian tumors. In a study by Shimizu et al.,[12] histopathological tumor grade based on architecture, nuclear pleomorphism, and mitotic counts correlates with survival in both early and advanced

### Table 2: Cytohistological correlation of ovarian tumors

| Histopathological diagnosis | Cases (n) | Negative | Positive |
|----------------------------|----------|----------|----------|
| Serous cystadenoma         | 2        | 2        |          |
| Serous cystadenofibroma    | 2        | 2        |          |
| Serous adenocarcinoma      | 8        |          |          |
| Mucinous cystadenoma       | 13       | 12       | 1 (FP)   |
| Borderline mucinous tumor  | 2        | 1 (FN)   | 1        |
| Mucinous adenocarcinoma    | 6        |          | 6        |
| Malignant Brenner tumor    | 1        |          | 1        |
| Dermoid cyst               | 3        |          | 3        |
| Mature cystic teratoma     | 1        |          | 1        |
| Immature teratoma          | 3        | 2 (FN)   | 1        |
| Dysgerminoma               | 3        |          | 3        |
| Yolk sac tumor             | 1        |          | 1        |
| Granulosa cell tumor       | 2        |          | 2        |
| Fibroma                    | 1        |          | 1        |
| Total                      | 48       | 24       | 24       |

FN: False negative, FP: False positive
Table 3: Cytohistological grade and features (age and gross consistency) of each case included in the study

| Histopathological diagnosis | Age (years) | Gross consistency | Score | Cytological grade | Histological grade |
|----------------------------|-------------|-------------------|-------|------------------|-------------------|
| Mucinous cystadenoma       | 35          | Cystic            | 3     | Benign           | Benign            |
| Mucinous cystadenoma       | 18          | Cystic            | 2     | Benign           | Benign            |
| Mucinous cystadenoma       | 60          | Cystic            | 2     | Benign           | Benign            |
| Mucinous cystadenoma       | 24          | Complex cystic    | 3     | Benign           | Benign            |
| Mucinous cystadenoma       | 26          | Cystic            | 4     | Benign           | Benign            |
| Mucinous cystadenoma       | 23          | Cystic            | 3     | Benign           | Benign            |
| Mucinous cystadenoma       | 43          | Cystic            | 2     | Benign           | Benign            |
| Mucinous cystadenoma       | 16          | Complex cystic    | 2     | Benign           | Benign            |
| Mucinous cystadenoma       | 25          | Cystic            | 3     | Benign           | Benign            |
| Mucinous cystadenoma       | 60          | Cystic            | 3     | Benign           | Benign            |
| Mucinous cystadenoma       | 27          | Complex cystic    | 4     | Benign           | Benign            |
| Mucinous cystadenoma       | 60          | Complex cystic    | 6     | BL               | Benign            |
| Mucinous cystadenoma       | 40          | Predominantly cystic | 2  | Benign           | Benign            |
| Serous cystadenoma         | 66          | Predominantly cystic | 3  | Benign           | Benign            |
| Serous cystadenoma         | 20          | Predominantly cystic | 2  | Benign           | Benign            |
| Serous cystadenoma         | 27          | Cystic with firm areas | 2 | Benign           | Benign            |
| Serous cystadenoma         | 70          | Cystic with focal firm areas | 2 | Benign           | Benign            |
| Borderline mucinous tumor  | 16          | Complex cystic    | 9     | Benign           | BL                |
| Borderline mucinous tumor  | 25          | Complex cystic with solid areas | 15 | BL               | BL                |
| Mucinous cystadenocarcinoma| 28          | Solid cystic      | 20    | WD carcinoma     | WD carcinoma      |
| Mucinous cystadenocarcinoma| 32          | Solid cystic      | 31    | MD carcinoma     | WD carcinoma      |
| Mucinous cystadenocarcinoma| 62          | Solid cystic      | 28    | MD carcinoma     | MD carcinoma      |
| Mucinous cystadenocarcinoma| 26          | Complex cystic    | 23    | WD carcinoma     | WD carcinoma      |
| Mucinous adenocarcinoma    | 60          | Predominantly solid | 21 | WD carcinoma     | WD carcinoma      |
| Mucinous adenocarcinoma    | 40          | Solid cystic      | 33    | MD carcinoma     | MD carcinoma      |
| Serous cystadenocarcinoma  | 30          | Solid cystic      | 35    | MD carcinoma     | MD carcinoma      |
| Serous cystadenocarcinoma  | 27          | Solid cystic      | 32    | MD carcinoma     | WD carcinoma      |
| Serous adenocarcinoma      | 40          | Predominantly solid | 33 | MD carcinoma     | MD carcinoma      |
| Serous adenocarcinoma      | 45          | Solid cystic      | 28    | MD carcinoma     | MD carcinoma      |
| Serous adenocarcinoma      | 50          | Predominantly solid | 33 | MD carcinoma     | MD carcinoma      |
| Serous adenocarcinoma      | 65          | Solid cystic      | 34    | MD carcinoma     | MD carcinoma      |
| Serous adenocarcinoma      | 50          | Predominantly solid | 39 | PD carcinoma     | MD carcinoma      |
| Serous adenocarcinoma      | 65          | Predominantly solid | 40 | PD carcinoma     | PD carcinoma      |
| Malignant Brenner tumor    | 50          | Predominantly solid | 19 | WD carcinoma     | WD carcinoma      |

stages for all major histologic types of ovarian carcinoma except clear cell carcinoma.

The maximum number of cases in our study were of mucinous tumors (21/48, 43.75%), unlike other studies in which serous group of epithelial tumors were the major group.¹¹,¹³ In our study, borderline mucinous tumor and immature teratoma comprised the false negative cases. This may be due to the large size of the tumors and inability to sample the representative area. Mucinous ovarian tumors have been the most difficult ovarian neoplasms for surgical pathologists to interpret. Their frequently heterogeneous composition with coexisting elements of cystadenoma, stromal microinvasion, noninvasive carcinoma, and invasive carcinoma requires careful gross examination and extensive sampling of the tumors. Prognosis of mucinous tumors depends on the stage and histologic composition. Borderline tumors, noninvasive carcinomas, microinvasive tumors, and invasive carcinomas with an expansile growth pattern are generally stage I and have an excellent prognosis with only occasional examples of metastatic spread.¹⁴ One case of mucinous cystadenoma was incorrectly labeled as mucinous borderline tumor in our study due to the presence of focal mild nuclear atypia and epithelial crowding. Although nuclear crowding may suggest atypical proliferation,¹¹ mucinous borderline tumors should have nuclear atypia in significant number of cells. A 10% minimum involvement of the material may be applied.¹¹ Similarly, grade 1 immature teratoma was missed, but grade 3 immature teratoma was correctly reported in IOC and frozen section. This may be possibly due to inability to sample the representative immature neuroectodermal elements.

Of all the ovarian neoplasms, there were 12 cases of serous tumors and all were correctly characterized. There was not a single case of borderline serous tumor. These borderline tumors have been misdiagnosed in many other studies.¹¹,¹³ A case of malignant Brenner tumor was a solid cyst and showed cells with mild to moderate nuclear pleomorphism, prominent
nucleoli, and occasional nuclear grooves, giving an impression of low-grade malignant tumor of epithelial type, but possibility of granulosa cell tumor could not be ruled out. Further tumor typing was not possible in cytology smears. Malignant Brenner tumors are large tumors with solid and cystic areas. Histologically, the diagnosis depends upon the presence of stromal invasion, usually with background of borderline and benign areas. Mucinous differentiation and rarely squamoid differentiation can also be seen. In germ cell tumors, all tumors were accurately characterized except 2 cases of immature teratoma of grade 1. Tumor typing was possible in all the 11 cases. The findings in case of mature cystic teratoma were similar to Ganji et al. and the dermoid cyst showed the typical cytomorphology. The cytologic features include cellular smears, small round cells with coarse chromatin, rosettes, neuropil/glia, and primitive mesenchyme. Less common findings include giant cells, bare nuclei, and squamous and glandular elements. The 3 cases of immature teratomas in our study showed all of these features except the giant cells and squamous nuclei. The small round cells with coarse chromatin and acinar rosetted formation in grade 3 teratoma was accompanied by occasional glial elements. The 3 cases of dysgerminomas on FNAC showed typical cytomorphology, as also reported by Chakrabarti et al. except the presence of few syncytiotrophoblastic giant cells which were seen in their case with elevated beta-human chorionic gonadotropin (β-hCG) levels. A case of yolk sac tumor showed small flat sheets of cells with moderate amount of vacuolated clear granular cytoplasm. Few intracellular and extracellular eosinophilic hyaline globules were also identified. The characteristic cytologic features and elevated alpha fetoprotein levels helped to reach the diagnosis.

Among the stromal tumors, granulosa cell tumor yielded high cellularity and was correctly typed. Most of the cells showed prominent nuclear grooves. Occasional Call-Exner bodies were also identified. The cytological features were similar to those found by Ali et al. in their study on FNAC of 10 cases of adult granulosa cell tumor. Adequate cellularity, in fibroma, could only be achieved in scrape and crush smears. On aspirates, fibromas are reported to yield scant material and comprised oval to spindle-shaped cells with elongated hyperchromatic nuclei and scant cytoplasm.

In frozen section examination, cytological atypia as a criterion of malignancy in the absence of invasion is less reliable. In one series, approximately 25% of women had their diagnosis changed from a benign to a borderline tumor in the final diagnosis, and this occurring more frequently in mucinous tumors. In our study, the false negative results were seen in borderline mucinous tumors and low-grade immature teratomas.

In a meta-analysis of 18 studies comparing frozen section diagnosis of ovarian pathology with the final histopathology showed that its sensitivity to detect benign and malignant lesions varies from 65 to 97% and 71 to 100%, respectively, and specificity from 97 to 100 and 98.3 to 100%, respectively. The diagnostic accuracy of IOC has been reported to be as high as 97%, sensitivity 93%, specificity 98%, PPV 91%, and NPV 96%. In our study, the sensitivity, specificity, PPV, NPV, and accuracy of 88.88, 96, 88.88, and 92.31%, respectively, were recorded. This was comparable to frozen section diagnosis with a sensitivity, specificity, PPV, NPV, and accuracy of 85.18, 96.15, 95.83, 86.21, and 90.56%, respectively.

**Conclusion**

In conclusion, IOC is an excellent method of giving a quick and reliable diagnosis with comparable results to frozen section examination. It can also be used as a quick complementary examination, even before the frozen sections could be seen. IOC can also be conveniently used as a substitute for frozen sections in developing countries, where this facility is not available. Gross examination and proper representation to select the tissue bit for frozen section as well as crush smears is indispensable to avoid missing out on adequate diagnosis. Frozen section examination as well as IOC may not be very reliable in cases of borderline mucinous tumors as well as low-grade immature teratomas. Grading of epithelial tumors could be done on IOC and may become an important step in intraoperative decision making for better management and outcome of the patient.

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**Conflicts of Interest**

There are no conflicts of interest.

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