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INTRAOPERATIVE SCRAPE CYTOLOGY IN DIAGNOSING OVARIAN NEOPLASMS AND ITS HISTOPATHOLOGICAL CORRELATION

Pathology

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ABSTRACT

Background- Ovarian neoplasms present unique challenges in both diagnosis and management due to their diverse histological subtypes and potential for malignancy. Intraoperative scrape cytology (ISC) has emerged as a valuable tool for rapid on-site assessment during surgical procedures. **Aim and objective-** To comprehensively review the utility of ISC in the intraoperative diagnosis of ovarian neoplasms and its correlation with histological findings. **Materials and methods-** This study was conducted in a tertiary care center over a period of 15 months. Intraoperative Scrape cytology (ISC) of ovarian masses was performed from the specimens received for ISC/frozen section and HPE. Smears were taken from representative areas of freshly cut specimens, fixed in 95% ethyl alcohol, stained with H and E, cytological diagnosis was made and conveyed to operating surgeon in 5-10 minutes. Later cytological diagnosis was compared with histopathological examination. **Results-** A total of 69 ovarian specimens were studied, out of which 54 cases were benign and 15 were malignant by ISC. As per final histological diagnosis 52 were benign, 2 were borderline and 15 were malignant tumors. The diagnostic accuracy was satisfactory with 92.7% correlating with final diagnosis. The correlation with final diagnosis of benign, and malignant tumors with final diagnosis was 98%, and 100% respectively. The sensitivity and specificity to detect malignant tumors is 100%. Frozen section was also done in 10 cases to which ISC and HPE was 100% concordant. **Conclusion-** The use of ISC in diagnosing ovarian neoplasms is a promising adjunct to traditional histopathology, as it offers immediate feedback during surgery. By providing rapid diagnostic insights, ISC empowers surgeons to make real-time decisions, potentially reducing the need for additional surgeries and enhancing patient outcomes.

KEYWORDS

INTRODUCTION

Diagnosing ovarian neoplasms can be challenging due to several factors. These factors include the intraperitoneal location of the ovaries, their small size, and the variety of histological subtypes that can present with similar clinical and morphological features. In addition, the limited accessibility of the ovaries for cytological techniques further complicates the diagnosis process. Using imaging techniques such as ultrasound and laparoscopy can aid in the diagnosis, but histopathological examinations remain the gold standard for definitive identification of ovarian neoplasms[1]

In recent years, the evaluation of the utility of scrape cytology in the intraoperative diagnosis of ovarian neoplasms has gained significant attention. The advantages of scrape cytology, such as being less time-consuming, easy to adopt, reliable, and not requiring special instruments, have made it a focus of various studies. While numerous studies have examined the role of imprint cytology and fine needle aspiration in intraoperative tumor diagnosis, there is a noticeable gap in the literature surrounding the use of scrape cytology for a wide range of neoplastic lesions.

MATERIALS AND METHODS

This study is comprised of 69 ovarian specimens studied over a period of 15 months that were submitted for intraoperative assessment by scrape cytology in a tertiary care center. Fresh gross specimens were immediately examined for presence of cysts, any capsular breach, papillary growth, or any solid tumor tissue. The material was obtained by scraping widely all the representative areas in the mass, that is, solid areas, papillary areas, hemorrhagic, necrotic, and other minor areas different from main mass from fresh cut surface of tumors and was directly deposited on a glass slide and then spread gently over another slide. The smears obtained were fixed in 95% ethyl alcohol, stained with Hematoxylin and Eosin stain, cytological diagnosis was made and conveyed to operating surgeon in 5-10 minutes. The results were categorized as benign or malignant on scrape cytology. The specimens were later fixed in 10% formalin and histopathological evaluation was done. In this study histopathological diagnosis was considered as gold standard and intraoperative scrape cytology diagnosis was compared to it. Cases were classified as concordant if the ISC diagnosis was in accordance with final histological diagnosis and **discordant** if the ISC diagnosis deferred from final histopathological diagnosis.

RESULTS

A total of 69 ovarian specimens were studied, out of which 54 cases were benign and 15 were malignant by ISC. As per final histological diagnosis 52 were benign, 2 were borderline and 15 were malignant tumors. 46 cases were surface epithelial tumors, out of which 26 were serous type and 18 were of mucinous type. 7 cases were sex cord stromal tumors. 6 cases were germ cell tumors. 1 case was struma ovarii. 7 cases were torsion cysts, 2 cases were metastatic adenocarcinoma deposits. The diagnostic accuracy was satisfactory with 92.7% correlating with final diagnosis. The correlation with final diagnosis of benign, and malignant tumors with final diagnosis was 98%, and 100% respectively. The sensitivity and specificity to detect malignant tumors is 100%. 1 case of infected serous cystadenoma was diagnosed as malignant surface epithelial tumor on ISC. One case of struma ovarii was diagnosed as benign surface epithelial tumor on scrape cytology. 2 borderline tumors were diagnosed as benign surface epithelial tumor on ISC, this can be attributed to heterogeneity of the tumor. One case of malignant mixed germ cell tumor was reported as malignant surface epithelial tumor on scrape cytology. Wherever possible frozen section was also done which included 10 cases, to which the scrape cytology and histopathology was 100% concordant. The age of the patients ranged from 11 years to 80 years.

Age Distribution

Table no. 1 – table showing age distribution of ovarian tumors

Age	Benign	Borderline	malignant	Sst	Gct	Tc	mets
11-20	0	0	1	1	3	2	0
21-30	0	0	1	1	0	1	0
31-40	5	1	1	1	1	2	1
41-50	7	0	2	2	1	0	1
51-60	10	2	4	1	0	2	0
61-70	7	0	2	1	1	0	0
71-80	3	0	1	0	1	0	0

SST- sex cord stromal tumors, GCT – germ cell tumors, TC – torsion cysts, METS – metastasis.

Laterality

Table no.2 – table showing laterality of ovarian tumors

Diagnosis	U/L	B/L
Serous cystadenoma	18	2
Serous cystadenocarcinoma	4	2
Mucinous cystadenoma	11	1
Mucinous cystadenocarcinoma	5	1
Borderline	1	1
Sex cord stromal tumors	6	1
Germ cell tumors	5	1
Torsion cysts	6	1
Metastasis	0	2

AS PER ISC

Table no. 3- table showing diagnosis of ovarian lesions as per IS

BENIGN	54
MALIGNANT	15
TOTAL	69

As Per Final Hpe

Table no. 4- table showing diagnosis of ovarian lesions as per HPE

BENIGN	52
BORDERLINE	02
MALIGNANT	15
TOTAL	69

Table no.5- table showing spectrumof ovarian lesions in the study as per final HPE

SURFACE EPITHELIAL TUMORS	46 (SEROUS – 26, MUCINOUS – 18)
SEX CORD STROMAL TUMORS	07
GERM CELL TUMORS	06
STRUMA OVARII	01
METASTASIS	02
TORSION CYSTS	07
TOTAL	69

The correlation with histopathological diagnosis is as follows

Table no. 6- table showing correlation ISC diagnosis of benign and malignant ovarian lesions with HPE

TUMOR	CONCORDANT(%)
BENIGN	98
MALIGNANT	100

Surface Epithelial Tumors

Table no. 7- table showing correlation of ISC and HPE of surface epithelial tumors

No. of cases	Final diagnosis	Scrape diagnosis	Cyto- histo correlation
21	Serous cystadenoma	20 1- malignant surface epithelial tumor	20/21
5	Serous cystadenocarcinoma	5	5/5
12	Mucinous cystadenoma	12	12/12
6	Mucinous cystadenocarcinoma	6	6/6
2	Borderline surface epithelial tumor	0 2 – benign surface epithelial tumor	0/2

Sex Cord Stromal Tumors

Table no. 8- table showing correlation of ISC and HPE of sex cord stromal tumors.

NO. OF CASES	FINAL DIAGNOSIS	SCRAPE DIAGNOSIS	CYTO-HISTO CORRELATION
2	FIBROMA	2	2/2
3	FIBRO THECOMA	3	3/3
2	GRANULOSA CELL TUMOR	2	2/2

Germ Cell Tumors

Table no. 9- table showing correlation of ISC and HPE of germ cell tumors.

NO. OF CASES	FINAL DIAGNOSIS	SCRAPE DIAGNOSIS	CYTO-HISTO CORRELATION
5	MATURE TERATOMA	5	5/5
1	MALIGNANT MIXED GERM CELL TUMOUR	0 1-MALIGNANT SURFACE EPITHELIAL TUMOR	0/1

Others

Table No. 10 Table Showing Correlation Of Isc And Hpe Of Other Ovarian Tumors.

NO. OF CASES	FINAL DIAGNOSIS	SCRAPE DIAGNOSIS	CYTO-HISTO CORRELATION
1	STRUMA OVARII	BENIGN SURFACE EPITHELIAL TUMOR	0

TORSION CYSTS (corpus luteal cysts, hemorrhagic cysts, etc)

Table no. 11- table showing correlation of ISC and HPE torsion cysts of ovary.

NO. OF CASES	FINAL DIAGNOSIS	SCRAPE DIAGNOSIS	CYTO-HISTO CORRELATION
1	STRUMA OVARII	BENIGN SURFACE EPITHELIAL TUMOR	0

Metastatic

Table no.12- table showing correlation of ISC and HPE of metastatic tumors in ovary

NO. OF CASES	FINAL DIAGNOSIS	SCRAPE DIAGNOSIS	CYTO-HISTO CORRELATION
2	METASTATIC ADENOCARCINOMA DEPOSITS	2	2/2

Table no. 13- table showing gross and cytological features of various ovarian lesions in the study.

Histological type	Gross and cytological features
Serous cystadenoma	Gross – cystic masses, containing serous fluid, mostly uniloculated, with few were multiloculated. Microscopy – They showed monolayered sheets and small cohesive groups of uniform cuboidal cells with round to oval nuclei; amphophilic cytoplasm in a clean background in the absence of necrosis. There was absence of atypia
Mucinous cystadenoma	Gross - cysts were multiloculated with papery thin walls or uni loculated with mucinous fluid. Microscopy - The benign cysts showed presence of columnar, mucus-containing cells with small, basally located nuclei, similar to endocervical cells arranged in a honeycomb pattern in a mucinous background giving a pale pink hue to the smear. There was absence of necrosis or mitosis
Serous cystadenocarcinoma	Microscopy - Papillary groups with hyperchromatic nuclei and irregular coarsely granular chromatin. Occasional psammoma bodies may be seen
Mucinous cystadenocarcinoma	Microscopy - Clusters and monolayaered sheets, single cells with pleomorphic nuclei and vacuolated cytoplasm with background mucin.
Granulosa cell tumors	Severe nuclear atypia and overlapping tumor cell clusters .

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Histological	Gross and cytological features
	Gross – solid mass with smooth, lobulated surface. On cut surface predominantly solid areas are seen, some areas are yellow colored, areas of necrosis were seen. Microscopy - Tumors showed small to medium sized cells with scant cytoplasm arranged in nests or trabecular or follicular patterns, with cells showing nuclear grooves and cells in acinar arrangement with central acellular eosinophilic material – Call Exner bodies.
Mature teratomas	Gross - showed cystic mass, on cut surface pultaceous material along with hair and Rokitansky protuberence was seen. Microscopy - anucleate and nucleate squames in singles and clusters along with components of ectoderm, endoderm and mesoderm were seen in a necrotic and dirty background.
Fibromas and Fibrothecomas	Fibroma cases showed scanty cellularity comprising spindled out cells in compact clusters and bundles, also dispersed singly with elongated bland nucleus, coarsely granular chromatin with no or minimal pleomorphism, and inconspicuous nucleoli
Metastasis	Gross - ovaries maintained its shape, solid mass were seen. On cut surface, predominantly solid, homogenous grey white areas were seen along with few cystic spaces. Microscopy - Two populations of cell were seen. One is low columnar to cuboidal cells in honeycombing pattern. Other population show irregular cluster of round to oval epithelial cells seen in papillae and discohesive cells with cytoplasmic vacuolation. Many scattered signet ring cells were also seen.

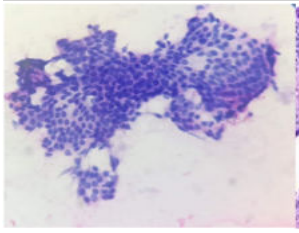

Figure 1 – cytology of serous cystadenoma showing cells in uniform monolayered sheets

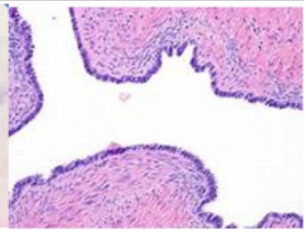

Figure 2 -H&E of serous cystadenoma

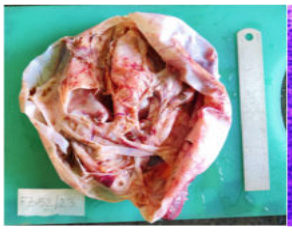

Figure3- gross image of mucinous cystadenoma showing multiloculation.

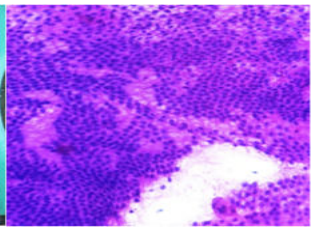

Figure4- cytology of mucinous cystadenoma showing mucinous background and honeycombing pattern

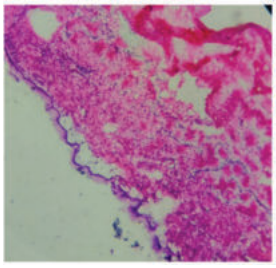

Figure 5

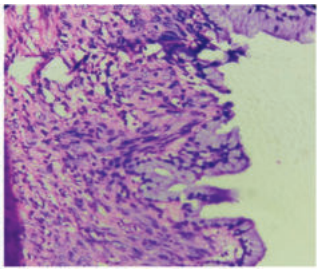

Figure 6

Figure 5 and 6 showing frozen section and H&E image of mucinous cystadenoma.

Some borderline tumors in the study were missed due to largely heterogeneous areas as detailed sampling was not possible in rapid analysis . They were classified as benign surface epithelial tumor on ISC. They showed slight overcrowding with atypia, but not sufficient enough to be classified as malignant lesion, they were suspicious of borderline tumors. A case of malignant mixed germ cell tumor was diagnosed as malignant surface epithelial tumor on ISC ,this has been mainly based on the sampling error that is due to multiplicity of heterogeneous areas. multiple smears from heterogeneous areas on gross should be sampled

Figure 7 – gross image of granulosa cell tumor

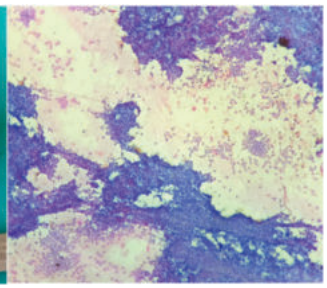

Figure 8 – cytology of granulosa cell tumor showing trabecular and nesting pattern

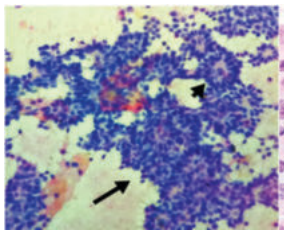

Figure 9 – call Exner bodies

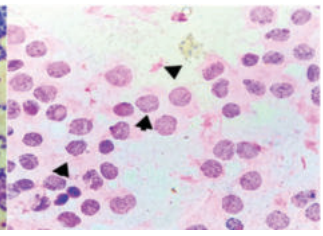

Figure 10 – nuclear grooves

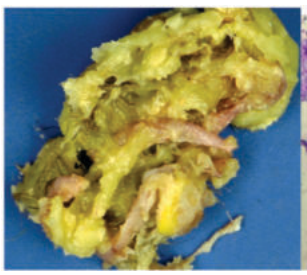

Figure 11 – gross image of mature teratoma

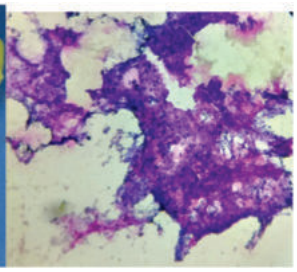

Figure 12 – cytology of mature teratoma showing squames in dirty background

An infected benign surface epithelial tumor was diagnosed as malignant surface epithelial tumor on ISC, owing to the large areas of necrosis and degenerative changes in the lining epithelium. 2 borderline tumors were diagnosed as benign surface epithelial tumors on ISC. A case of malignant mixed germ cell tumor was diagnosed as malignant surface epithelial tumor on ISC, this has been mainly based on the sampling error that is due to multiplicity of heterogeneous areas. multiple smears from heterogeneous areas on gross should be sampled.

Figure13 – krukenberg tumor gross

Figure14 – cut surface

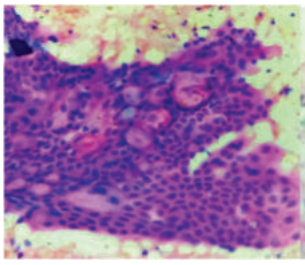

Figure 15 - Cytology of Krukrnberg tumor showing 2 population of cells

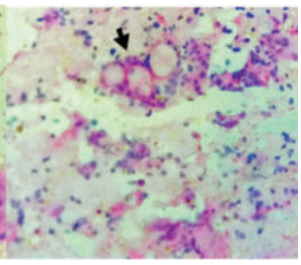

Figure 16- Signet ring cells

A case of struma ovarii which was missed on ISC , grossly had nodular grey white surface. On cut surface - Multiple solid Grey brown nodules largest measuring 3x1.5x1cm separated by thick fibrous septa and multiple cystic area containing mucoid material. Outer capsule showed focal calcification and areas of haemorrhage. On scrape cytology showed round to columnar cells arranged in monolayered sheets and tubular pattern and in singles. These cells had uniform basophilic nucleus, fine chromatin, inconspicuous nuclei and moderate amount of eosinophilic cytoplasm. Background proteinaceous material and cystic macrophages- suggestive of malignant surface epithelial tumour. On histopathology it showed ovarian stroma with multiple nodules separated by fibro collagenous tissue with areas of haemorrhage and nodules containing thyroid follicles with variable sizes lined by flattened columnar epithelium filled with colloid. Suggestive of struma ovarii – nodular goitre.

DISCUSSION

Ovarian masses are frequently being subjected to SS and FS examination so as to determine the extent of surgery required, and complete resection along with removal of draining lymph nodes can be done in a single operation. Also in cases which are benign, the extensive surgical resection can thus be avoided. Cytomorphological examination of SS alone along with appropriate clinical details can play a crucial role in resource-limited setting where FS is not possible as part of intraoperative consultation. Dudgeon and Patrick were first to describe the use of imprint smears of fresh tissues in rapid microscopic diagnosis of tumors[7]. various other studies have evaluated the role of ISC and compared it to histopathological diagnosis.

Shalinee at al conducted a study on role of scrape cytology in ovarian neoplasms and found that the overall diagnostic accuracy of scrape cytology was satisfactory with 92% of cases correlating with final histopathological diagnosis[8]. Amit Jain et al conducted a study on Intraoperative Scrape Cytology from Ovarian Masses Lesions which included, 81 Cases found that SS and FS were 100% concordant. There were 61 benign, 2 borderline, and 18 malignant cases on FS and scrape. Combining all the values, sensitivity and specificity were 76% and 98.21%, respectively. The diagnostic accuracy in diagnosing malignant lesions was 91%[9]. Stewart *et al.* in their study found that FSs are more sensitive (97%) compared with cytology diagnosis (93%), whereas both modalities yielded similar specificity (100%) compared with histopathological diagnosis[6]. Rao *et al.* (50 cases each) found an accuracy of 92%[6]. Whereas Vijayakumar found a diagnostic accuracy of 90%[1]. Khunamornpong *et al.* examined 131 cases with a diagnostic accuracy maximum for malignant (98%) > benign (95%) > borderline cases (47%)[10].

CONCLUSION

ISC are less time-consuming, inexpensive, and lack freezing artefacts; various heterogeneous areas can be examined in little time and tissue loss can be avoided.[1] The use of ISC in diagnosing ovarian neoplasms is a promising adjunct to traditional histopathology, as it offers immediate feedback during surgery, although HPE remains the gold standard. By providing rapid diagnostic insights, ISC empowers surgeons to make real-time decisions, potentially reducing the need for additional surgeries and enhancing patient outcomes.

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