Original Article

A Retrospective Analysis of Diagnostic Accuracy of Frozen Sections Compared to Permanent Sections: A 5 Years Study in A Single Tertiary Care Hospital In South Delhi

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Abstract

Introduction: Intraoperative frozen section pathology consultation has long been applied to verify/categorize a lesion, evaluate surgical margins, determine the organ of origin, and assess tissue adequacy for further diagnostic studies. Correlation of intraoperative frozen section diagnosis with final diagnosis can be an important component of an institution's quality assurance process. The aim of this study was to evaluate the concordance and discordance between frozen section and histopathology diagnosis and to assess the reliability and challenges associated with this rapid diagnostic method. **Materials and Methods:** A retrospective review of all intraoperative consultation in the Frozen Section and Histopathology Department of Pathology, Hamdard Institute of Medical Sciences and Research and Hospital, New Delhi from 1st January 2018 to 31st December 2022 was performed. During this five-year study period, a total of 185 patients from surgical departments underwent intraoperative consultation. The final diagnosis from the surgical pathology report was compared to the intraoperative consultation diagnosis. **Results:** Frozen section diagnoses were evaluated on all the 185 cases, with 88 cases identified as positive for malignancy and 97 cases as negative for malignancy. On subsequent histopathology paraffin sections, 92 cases were positive and 93 negative for malignancy. The comparison revealed an approximate result concordance of 97.0% and a discordance of 3.0%. **Conclusion:** Frozen section intraoperative consultation is a reliable rapid method for patient diagnosis and management. Monitoring diagnostic accuracy of intraoperative consultation provides substantial information towards the causes of the errors. Our study suggests that more accurate sampling, and knowledge about clinical history and presentation can reduce the limitation and increase the diagnostic accuracy thus avoiding technical errors and reducing result discordance.

Keywords: Frozen section, histopathological, intraoperative

Introduction

Frozen sections have a crucial role to play in surgical pathology facilitating the surgeons with a rapid intra-operative diagnosis and patient management. The use of intraoperative consultation has spectacularly increased in the recent years providing with important diagnostic information when the patient is on the operating table. However, indications of frozen sections must be used prudently to avoid its desultory usage. Intraoperative consultations are frequently used in surgical pathology for confirming a benign or a malignant lesion, arriving at a definitive diagnosis, evaluation of surgical margin of tumor, and identification of metastasis in lymph nodes.[1] Other lesser used indications include immunohistochemistry, enzyme histochemistry, and immunofluorescence.[2] Frozen sections are always compared with the paraffin sections to evaluate for the diagnostic accuracy, specificity, and sensitivity.[3] Evaluation of the discrepancies in tissue sampling, technical issues and interpretation errors. Besides this accomplishment of intraoperative consultations demands whole relevant clinical

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history, familiarity of techniques of surgical procedures, hands on gross and microscopic pathology of the lab. The two main determining Quality indicators of a frozen section are diagnostic accuracy and turn-around time (TAT).[4] TAT is defined as the time at which frozen section specimens is received to the time results are verbally communicated to the surgeon. TAT of frozen sections is of significance and is one of the main quality indicators in surgical pathology. Identifying all the limitations and drawbacks significantly improves the accuracy of the frozen section and constraints compared to the paraffin embedded tissue sections. Our study aims to analyze the accuracy/correlation of frozen sections with permanent sections and highlighting here the principles of intra-operative consultation as well as the limitations involved with this technique.

Materials and Methods

Study design and study settings

A 5-year retrospective study was done in the Department of Pathology, Hamdard Institute of Medical Sciences and Research and Hospital, New Delhi, from January 1, 2018 to December 31, 2022.

Sample size

A total of 185 patients from surgery departments underwent intraoperative consultation were included in our study.

Inadequate specimens and inconclusive cases were excluded from our study and accuracy rate, sensitivity, and specificity of the frozen section reporting were compared to the routine histopathology reporting.

Method of collection of data

The specimens were received fresh without any fixatives with requisition form having detailed clinical information from the surgical departments. Gross examination and thin sections were taken from the representative area.

Cryostat was set at ideal temperature and sections were frozen and blocks were cut by cryostat (Thermoscientific HM525NX) using tissue freezing medium as embedding medium.

Sections were cut at 4–5 μ thickness and were immediately fixed in 95% isopropyl alcohol. After that rapid hematoxylin and eosin staining was done. Reporting was done and informed telephonically with the turn-around-time of 20 min that fulfilled quality assurance of our laboratory. Remaining specimen were fixed in 10% buffered formalin and routinely processed and stained for final histopathological examination.

Statistical analysis

Data were entered using Microsoft Excel and exported to Jamovi 2.0. The categorical variables were expressed using percentages.

Results

A total of 185 cases were studied during the 5 years retrospective study for frozen and permanent sections analysis. Out of the total 185 cases, slight female preponderance was noted in our study. Ninety-five (51.3%) were female and 90 (48.6%) were male. The age range was 1st–6th decade. The most common indication for ordering a frozen section from various departments that was maximum from ENT department followed by surgery department was the assessment of margins of tumor excision (52.0%), to rule out malignancy (35.6%) followed by definitive diagnosis (8.1%) and remaining for the assessment of nodal status (4.3%) [Table 1].

Table 1: Number of cases according to the indications of frozen section diagnosis

Indication of frozen section	Total number of cases (%)
Assessment of margins of tumor excision	96 (52.0)
To rule out malignancy	65 (35.6)
Definitive diagnosis	15 (8.1)
Assessment of nodal status	8 (4.3)

On the basis of site of frozen sections, the most common site of tissue received was oral cavity, female genital tract followed by bone, gall bladder, lymph node, soft tissue, breast, and parathyroid gland.

All the cases in our study were analyzed based on the diagnosis given on frozen sections and conventional histopathology and were compared.

Oral cavity

The sample received for frozen section from oral mucosal biopsy 76 (41.1%) included sites buccal mucosa (27 cases, 35.5%), [Figure 1] tongue (26 cases, 34.2%), gingiva-buccal sulcus (8 cases, 10.5%), mandible (7 cases, 9.2%), hard palate (4 cases, 5.2%), and salivary gland (4 cases, 5.2%) [Table 2].

Female genital tract

A total 50 frozen cases from the female genital tract (27.0%) included masses mainly from the ovary (46 cases, 92.0%) [Figure 2], fallopian tube (3 cases, 6.0%), and vagina (1 case, 2.0%).

Bone

A total of 19 frozen cases from the bone included masses mainly from femur (10 cases, 53.5%), humerus (5 cases, 26.3%), tibia (3 cases, 16.0%), and fibula (1 case, 5.2%).

Gall bladder

We received 17 frozen cases (9.1%) from the gall bladder with indication of all the cases to rule out malignancy.

Lymph node

A total of 8 frozen cases (4.3%) were sent from the lymph nodes of various site with the indication to assess the nodal metastasis status.

Soft tissue

All the seven cases (4.0%) sent for intraoperative consultations had indication for a definitive diagnosis.

Table 2: Concordant and discordant cases according to the sites

Site	Number of cases	Concordant cases	Discordant cases	Accuracy (%)
Oral cavity	76	76	0	100
Female genital tract	50	46	4	92
Bone	19	19	0	100
Gall bladder	17	17	0	100
Lymph nodes	8	8	0	100
Soft tissue	7	7	0	100
Breast	4	4	0	100
Parathyroid gland	4	4	0	100

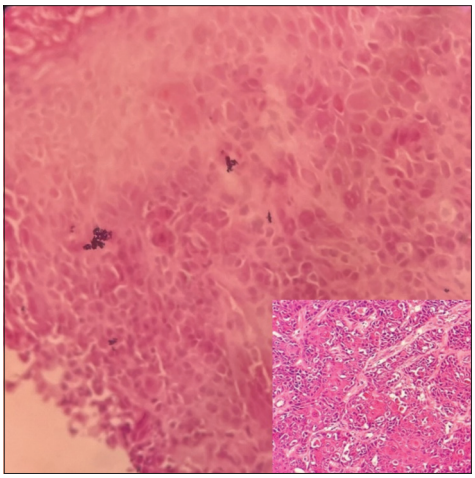

Figure 1: Photomicrograph of frozen section of oral squamous cell carcinoma (Rapid H and E, ×40) Inset showing permanent section of oral squamous cell carcinoma (H and E, ×40)

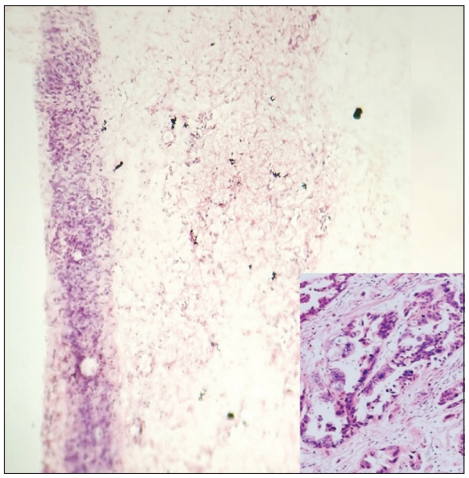

Figure 2: Photomicrograph of frozen section of mucinous cystadenoma of the ovary (Rapid H and E, ×40) Inset showing permanent section which revealed foci of invasion and was given a diagnosis of mucinous cystadenocarcinoma (H and E, ×40)

Breast

All the four cases (2.1%) sent for intraoperative consultations had indication for a definitive diagnosis.

Parathyroid gland

All the four cases (4.0%) sent for intraoperative consultations had indication for a definitive diagnosis.

Frozen section diagnosis was evaluated on all the 185 cases, with 88 cases identified as positive for malignancy and 97 cases as negative for malignancy. Subsequently, the same cases were diagnosed using histopathology, yielding 92 positive and 93 negative cases. The concordance and discordance values were calculated based on the comparison of these diagnoses. The results revealed a concordance of approximately 97.0% and a discordance of approximately 3.0% [Table 2].

Discussion

Frozen sections resulted from the need for rapid intra-operative diagnosis. Mayo Clinic Chief of Pathology Louis B. Wilson pioneered the frozen section at the Rochester, Minnesota clinic in 1905 for the immediate evaluation of frozen tissue.[5] A valuable rapid diagnostic tool used in The intraoperative management of surgical procedures preventing repeated surgeries. It is of great help for the operating surgeon in understanding the surgical implications of the case. It is quite exorbitant procedure requiring expertise not only in the technique but accurate interpretation as well.

Frozen sections should not be replaced over conventional paraffin-embedded tissue sections as it has many pitfalls from limited specimen, freezing artifacts, sampling to section cutting, staining quality, and interpretation. Frozen sections are always followed by corresponding permanent paraffin sections to give a final histopathological diagnosis. Permanent sections also have the edge of extensive sampling including adjacent areas and application of special histochemical stains/immunohistochemistry whenever indicated.[6]

In the present study, we retrospectively reviewed the frozen sections performed in Pathology Department of Hamdard Institute of Medical Science and Research in the last 5 years to evaluate the diagnostic accuracy of the frozen sections compared to the permanent sections.

The analysis of the present study with a total of 185 cases that underwent frozen section diagnosis, with 88 cases being identified as positive and 97 cases as negative.

Subsequently, the same cases were subjected to histopathological evaluation, resulting in 92 positive and 93 negative diagnosis.

Table 3: Comparison of diagnostic accuracy of different studies

Authors (studies)	Diagnostic accuracy (discordance rate) (%)
Saumya Mishra *et al*.[8]	3.8
Patil *et al*.[9]	3.1
Ahmed Z *et al*.[10]	2.9
Roy S *et al*.[11]	2.4
Shrestha *et al*.[12]	5.4
Mourouguessine Vimal *et al*.[15]	2.2

The data were analyzed to calculate concordance and discordance values and it was found in the present study a concordance of approximately 97.0% and a discordance of approximately 3.0%. Any higher discordance values indicates presence of discrepancies between the two diagnostic techniques leading to potential challenges in interpretation and reporting. The only discordant result in our study was false negative diagnosis. On reviewing literature, discordance rate ranged from 1.4% to 12.9% from all the anatomical sites.[7] Mishra *et al*.,[8] Patil *et al*.,[9] Ahmad *et al*.,[10] Roy *et al*.,[11] and Shrestha *et al*.[12] reported 3.8%, 3.1%, 2.9%, 2.4%, and 5.4% discordance rates, respectively.

In our study, false-negative cases from the female genital tract all four cases were ovarian mucinous cystadenocarcinoma that were signed out as borderline mucinous neoplasm possibly because of tissue sampling or any technical shortcomings causing loss of architectural pattern or definite invasion and improper visualization leading to indefinite interpretation of invasion by tumor cells. Sahu *et al*.[13] in their study reported a case of misinterpretation of ovarian tumor due to the presence of freezing artefacts. Other studies also reported discrepancy on interpretation on frozen sections due to such artefacts. The accuracy of diagnosing of ovarian masses on frozen sections in a study by Ratnavelu *et al*. was 90%–97%.[14] In our study, discrepancies in diagnosing ovarian masses were the reason of all false negatives and interpretation was the actual cause of the discordance comparing frozen with permanent sections. Other indications for ordering frozen sections, i.e. oral cavity margins assessment, nodal metastasis status, the diagnosis of benign versus malignant lesions were diagnosed correctly (100% D.A). Mourouguessive in their 1 year study of 140 frozen section biopsies reported a concordance rate of 97.8% and a discordant rate of 2.2% [Table 3].[15]

Conclusion

To conclude, our study emphasizes on the need for critically assessing the diagnostic accuracy of frozen sections and discerning its potential limitations and drawbacks. The discordance observed in the present study highlights the need for research to greater extent to identify the crucial causes of disparity. The factors from specimen preparation, interobserver variation, tissue quality contribute to the higher discordance between intraoperative and histological diagnosis. Hence, emphasis should be given on the periodic review of the frozen section diagnosis and correlation with the final permanent section diagnosis and to identify the errors and measures. Extensive frozen-permanent section correlation can aid in remarkable improvement in the diagnosis.

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Conflicts of interest

There are no conflicts of interest.

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