ORIGINAL ARTICLE

An Audit of Intraoperative Frozen Section in Johor

J J Khoo, MPath

Department of Pathology, Hospital Sultanah Aminah, 80100 Johor Bahru

Summary

A 4-year-review was carried out on intraoperative frozen section consultations in Sultanah Aminah Hospital, Johor Bahru. Two hundred and fifteen specimens were received from 79 patients in the period between January 1999 and December 2002. An average of 2.72 specimens per patient was received. The overall diagnostic accuracy was high, 97.56%. The diagnoses were deferred in 4.65% of the specimens. False positive diagnoses were made in 3 specimens (1.46%) and false negative diagnoses in 2 specimens (0.98%). This gave an error rate of 2.44%. The main cause of error was incorrect interpretation of the pathologic findings. In the present study, frozen sections showed good sensitivity (97.98%) and specificity (97.16%).

Despite its limitations, frozen section is still generally considered to be an accurate mode of intraoperative consultation to assist the surgeon in deciding the best therapeutic approach for his patient at the operating table. The use of frozen section with proper indications was cost-effective as it helped lower the number of reoperations.

An audit of intraoperative frozen section from time to time serves as part of an ongoing quality assurance program and should be recommended where the service is available.

Key Words: Intraoperative consultation, Frozen section, Accuracy, Quality assurance

Introduction

Intraoperative diagnostic consultation or "frozen section" (FS) is an integral part of surgical pathology. The main purpose of consultation is to help the surgeon make a therapeutic decision during the operation.

The technique of frozen sections dated back to 1818 and had been credited to the works of deRemier[1]. However, only in a few general hospitals in Malaysia intraoperative frozen section consultations have recently been made available. Sultanah Aminah Hospital, Johor Baru (HSAJB), was one of the first few hospitals to start this service in January 1994. A retrospective review of the cases performed in HSAJB between the years 1999 to 2002 was done. We present this series as a method of monitoring the quality assurance of intraoperative frozen section consultation in a government hospital in Malaysia.

Materials and Methods

We performed a retrospective review of all consecutive intraoperative pathologic consultations done between January 1999 and December 2002 in Sultanah Aminah Hospital, Johor Baru.

A total of 79 patients underwent surgery with intraoperative pathologic consultations on 215 specimens. All specimens were taken from the operating theatre. The attending on-call pathologist examined and selected the most suitable part for frozen section examination. The frozen section diagnoses were

This article was accepted: 10 August 2003
Corresponding Author: Khoo Joon Joon, Department of Pathology, Hospital Sultanah Aminah, 80100 Johor Bahru

rendered on Haematoxylin and eosin (H&E) stained sections of OCT compound-embedded, snap frozen tissue sectioned at 5 um intervals. The residual tissues were formalin fixed, paraffin embedded, sectioned and stained with H&E. The impression of the pathologist as given to the clinician at the time of surgery and documented on the form was compared to the outcome of the final pathology report of the permanent sections. The data in the medical records of these patients were reviewed. Their clinical diagnoses, indications for frozen sections and the management following frozen section reports were also noted.

The accuracy rates, sensitivity and specificity of intraoperative diagnostic consultations done in Sultanah Aminah Hospital, Johor Baru, were determined.

Results

In this group of 79 patients, there were 49 males (62.0%) and 30 females (38.0%). The age range was wide and varied from 1 month to 75 years old. There were 44 Malays, 21 Chinese, 12 Indians and 2 from other races. A large number of patients (30) were below the age of 10 years (Figure 1). They were mainly paediatric patients. Another 15 patients were from the Cardio-thoracic Department, 14 from the Surgery Department, 9 from the Ear, Nose and Throat Department and 6 from the Urology Department (Table I). Other departments that used this service infrequently were the Orthopaedics, Obstetrics and Gynaecology and Dentistry departments.

A total of 215 specimens were received from 79 patients for intraoperative diagnostic consultations. This yielded an average of 2.72 specimens per patient. 108 specimens (50.2%) were from the colon and 32 specimens of soft tissues (14.9%) were from the oro-pharyngeal area, upper or lower limbs (Table II). Specimens from the larynx, lung nodules and trachea made up another 10.2%. Other specimens came from the urinary tract, tongue, penis, ear, thyroid, lymph nodes, stomach, breast, mandible, parotid gland, parotid nerve and uterus.

The main reason for frozen section was to assess the margins of resection (Table III). A total of 107 specimens were sent for assessment of the margins to ensure a clear resection for a benign lesion. These specimens were from cases in the paediatric age group who were diagnosed as Hirschsprung's Disease. Another 62 specimens were sent for assessment of the margin for a known malignant tumour to assist in achieving clear resection margins. A further 40 specimens were sent for intraoperative diagnoses. They consisted of undiagnosed lung masses, thyroid nodules, breast tumours, parotid and ear canal tumours. Two specimens were received from suspected infected total knee replacement to assess the severity of inflammation present[2]. Four lymph nodes were received for assessment of involvement by tumour.

The diagnosis of malignancy was established by intraoperative FS examination in 27 specimens (Table IV), one of which was conveyed to the surgeon as a lymphoma and another as a sarcoma. Sixty-six specimens were reported not to have any malignancy. Twelve other specimens showed inflammation (acute, chronic or granulomatous inflammation). Seventy-four specimens showed presence of ganglia and 26 specimens were reported to have no ganglia. This helped the surgeon to achieve complete resection for the surgical treatment of Hirschsprung's disease[3]. Diagnoses were deferred in 10 cases (4.65%), 2 of which were due to inadequate specimen received. Thus, a total number of 205 specimens had intraoperative diagnoses reported.

During the period studied, 5 qualified histopathologists performed the intraoperative diagnostic consultation at various times of their call-duty at HSAJB. The frozen section reports of 205 specimens, when compared to the permanent sections reports showed 3 false positive cases and 2 false negative cases. This gave an error rate of 2.44%. The review of these five frozen sections showed all except one case to be due to misinterpretation. In that one case, there was tumour present in the permanent section of the residual tissue sent for FS when the frozen section was negative (sampling error).

An overall accuracy rate of 97.56% was obtained with sensitivity (true positive/true positive + false negative) of 97.98% and specificity (true negative/true negative + false positive) of 97.16%. No attempt was made to assess the difference in accuracy rate of the various pathologists but it was observed that there was a trend associating a higher deferral rate with a lower error rate.

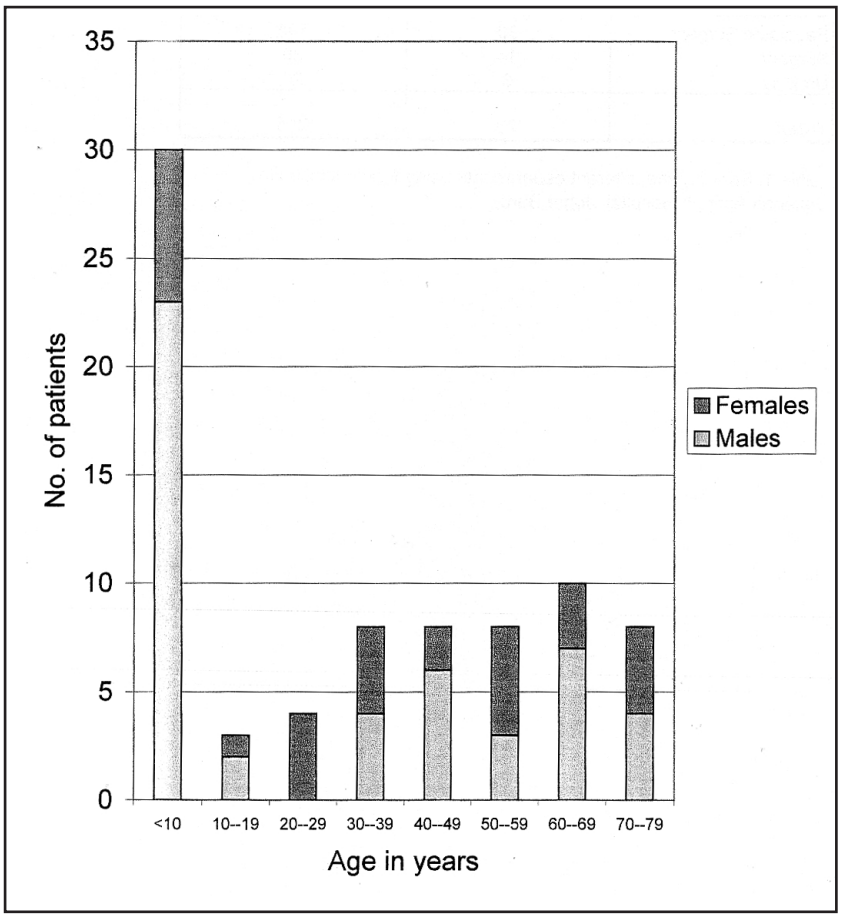

Fig. 1: Age distribution of patients with frozen section

Table I: Showing the different departments using frozen section in Sultanah Aminah Hospital, Johor Baru

Department	Number of patients	Number of specimens
Cardiothoracic	15	20
Dental	1	1
ENT	9	32
O & G	1	1
Orthopaedics	3	3
Paediatric Surgery	30	108
Surgery	14	30
Urology	6	20
Total:	**79**	**215**

Table II: Showing the various specimens received for frozen section

Nature of specimens	Number of specimens	Percentage
Bladder, ureter	11	5.1
Breast	2	0.9
Colon	108	50.2
Ear	6	2.8
Larynx, trachea, lung mass	22	10.2
Lymph nodes	5	2.3
Penis	7	3.3
Soft tissue	32	14.9
Stomach	3	1.4
Thyroid	6	2.8
Tongue	8	3.7
Others	5	2.3
Total:	**215**	**~100**

Table III: Showing the indications for frozen section

Indication	Number of specimens	Percentage (%)
Diagnosis	40	18.6
Margins of malignant tumour	62	28.8
Margins of benign lesion	107	49.8
Nodes assessment	4	1.9
Severity of acute inflammation	2	0.9
Total:	**215**	**100**

Table IV: Showing the intraoperative frozen section diagnoses reported

Frozen section diagnoses	Number of specimens	Percentage (%)
Aganglionic segment	26	12.09
Ganglionic segment	74	34.41
Carcinoma	25	11.63
Lymphoma	1	0.47
Sarcoma	1	0.47
No malignancy	66	30.70.
Inflammation / granuloma	12	5.58
Deferred diagnosis	10	4.65
Total:	**215**	**100**

Discussion

Frozen section is generally considered an accurate and reliable mode of diagnosis to assist the surgeon on the surgical procedure performed during the surgery itself. However, it is costly and technically limited; and thus available only in major hospitals that house sufficient staff who have the technical knowledge, skill and adequate equipment to perform the service. Frozen section is also more difficult to interpret than examination of paraffin-embedded sections. The procedure itself, even in the best hands of the medical laboratory technicians, makes the lesion appear worse than a paraffin section of the fixed tissue would. Thus, a good and competent pathologist should know what to expect, what to look for and make a reasonable conclusion without being overly "clever". A general diagnosis rather than an exact diagnosis should be given to assist the surgeon to proceed in choosing the best therapeutic approach for his patient. The pathologist should also know the limitations of frozen section, the ability of his or her technicians in the respective laboratory and be wary of various problematic cases such as papillary lesions of breast tumours. He or she should not be afraid to defer in his or her diagnosis when the situation warrants it. The deferral rate ranges from 0 to 6.1% in various reported series[4]. Our series noted a deferral rate of 4.65%. Whenever a deferred diagnosis is made, it should be ignored and the surgeon should proceed as though the FS had never been performed.

The accuracy of FS diagnoses reported in the literature varies from 88.9 to 98.9%[4]. Our study shows an accuracy rate of 97.56%. This falls within the range reported. Our percentage of errors in all reported cases is 2.44%. This is also within the range reported in literature of 0.7 to 2.5%[5]. Two main types of error are interpretive and sampling errors. While errors in interpretation attribute solely to the pathologist, sampling errors may be the responsibility of either the pathologist or the surgeon. It is thus as important for the pathologist to see the specimen macroscopically and sample the area himself, as it is to see and interpret the lesion microscopically. On the other hand, the surgeon should also keep the pathologist informed of his relevant findings at the operating table as well as the nature of the tumour or lesion in question.

Imprint and smear cytology can be a useful adjunct to frozen section. A few reports[6,7] that have compared intraoperative cytologic techniques with frozen sections have noted similar accuracy rates. Undoubtedly, cytologic preparations can assist the pathologist in interpretation and help reduce errors. However, we did not use this technique in our interpretation of FS in this series.

Frozen sections must be 'quick'. Speed depends on various factors: transport time, pathological technique used that includes the staining methods[8,9] and the skill of the laboratory technicians; and on the experience of the pathologist. The intraoperative turnaround time for performing a frozen section was not analysed in our retrospective series, as no records of the turnaround time were available. However, in one large series[10], 700 institutions were prospectively studied to compare the FS turnaround times. Their data suggested that 90% of FS block turnaround times could be performed within 20 minutes. The turnaround time was measured from the time the pathologists receive the specimen to the time the report was given. This would be an acceptable time for most centres.

Conclusion

Both the surgeon and the pathologist must understand the limitations of frozen section and attempt to use it properly. Frozen section is never 100% accurate. Technical skill and diagnostic expertise are essential for frozen section. Although it is costly, when used properly it is a cost-effective way of avoiding a second surgical procedure in many cases[11,12].

We suggest that an accuracy survey of intraoperative frozen section be performed in those pathology departments with this service as part of its ongoing quality assurance program. It will also serve to improve the understanding of the capabilities and limitations of the FS procedure in the respective hospitals.

Acknowledgements

I would like to thank Miss Chin Cheau Wern and Mr Low Seng Hock for their advice in data analysis, all the medical laboratory technicians in Histopathology Unit, all the histopathologists in Department of Pathology and the clinicians from various departments of Sultanah Aminah Hospital, Johor Bahru for their kind co-operation and assistance.

References

1. Krumbhaar EB. Clio Med 19, Pathology. New York: PB Hoeber, Inc., 1937: 171.
2. Abdul-Karim FW, McGinnis MG, Kraay M, Emancipator SN, Goldberg V. Frozen section biopsy assessment for the presence of polymorphonuclear leukocytes in patients undergoing revision of arthroplasties. Mod Pathol 1998; 11(5): 427-31.
3. Maia DM. The Reliability of Frozen-section Diagnosis in the Pathologic Evaluation of Hirschsprung's disease. Am J Surg Pathol 2000; 24(12): 1675-7.
4. Oneson RH, Minke JA, Silverberg SG. Intraoperative Pathologic Consultation. An audit of 1000 recent consecutive cases. Am J Surg Pathol 1989; 13(3): 237-43.
5. Rogers C, Klatt EC, Chandrasoma P. Accuracy of frozen section diagnosis in a teaching hospital. Arch Pathol Lab Med 1987; 111: 514.
6. Sakai Y, Lauslahti K. Comparison and analysis of the results of cytodiagnosis and frozen sections during operation. Acta Cytol 1969; 13: 359-68.
7. Suen KC, Wood WS, Syed AA, Quenville NF, Clement PB. Role of imprint cytology in intraoperative diagnosis: value and limitations. J Clin Pathol 1978; 31: 328-37.
8. Busing CM, Pfiester P. Permanent staining of rapid frozen section with toluidine blue. Pathol Res Pract 1981; 172: 211-5.
9. Humphreys TR, Nemeth A, McCrevey S, Baer SC, Goldberg LH. A pilot study comparing toluidine blue and hematoxylin and eosin staining of basal cell and squamous cell carcinoma during Mohs surgery. Dermatol Surg 1996; 22: 693-7.
10. Novis DA, Zarbo RJ. Interinstitutional comparison of frozen section turnaround time. A College of American Pathologists Q-Probes study of 32,868 frozen sections in 700 hospitals. Arch Pathol Lab Med 1997; 121(6): 559-67.
11. Caraci P, Aversa S, Mussa A, Pancani G, Ondolo C, Conticello S. Role of fine-needle aspiration biopsy and frozen-section evaluation in the surgical management of thyroid nodules. Br J Surg 2002; 89(6): 797-801.
12. Jeffrey CR, Keith SH, Sanford D, Laura AS. The value of frozen section examinations in determining the extent of thyroid surgery in patients with indeterminate fine-needle aspiration cytology. Arch Otolaryngol Head Neck Surg 2002; 128: 263-7.