ACCURACY OF INTRAOPERATIVE FROZEN SECTION DIAGNOSIS AND TOUCH IMPRINT CYTOLOGY: STUDY ON 1000 CONSECUTIVE CASES

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ABSTRACT

Frozen section and touch imprint cytology are important diagnostic procedures for surgeons during operation and must be accurate if the patient is to receive maximum benefit.

To assess the accuracy of intraoperative pathologic consultation including frozen section and touch imprint cytology during a five year period (1995-2000), a retrospective survey of 1000 consecutive cases of frozen sections performed by the staff pathologists of Shiraz Medical School and 211 touch imprint cytology cases related to some of these sections were studied focusing on accuracy.

Also some 462 cases of frozen sections related to the 1000 samples were reviewed by the staff pathologists without complete clinical data and without any data from the surgeon to determine the importance of the surgeon pathologist relationship.

The gold standard method for comparing the results of frozen section and cytology was permanent tissue diagnosis.

The overall accuracy of frozen section for the 1000 cases was 93.6%. The accuracy of cytology was 93.1%. Also the accuracy of 462 frozen sections which were reviewed without clinical data was 85%.

In conclusion, frozen section diagnosis is a highly accurate method. Touch imprint cytology is also a specific method and can be used in areas where facilities of frozen section studies are not available.

The frozen section method achieves its highest accuracy when there is cooperation between the surgeon and pathologist and when used in combination with touch imprint cytology.

Keywords: Frozen section, Intraoperative consultation, Accuracy.

INTRODUCTION

Intraoperative pathologic consultation including macroscopic examination of the tissues, touch imprint cytology and frozen section is the most important procedure...
Accuracy of Intraoperative Frozen Section 

to help intraoperative therapeutic decision making.
The principle use of the method is for diagnosing the.
malignant or benign nature of suspected tumors. Other
uses include determination of adequate excision of tis­
uue, confirming suspected metastasis, identifying small
structures and evaluating surgical margins.
The usefulness of frozen section diagnosis for a sur­
geon greatly depends upon the reliability and accuracy
of the information that he receives from the pathologist.
The low accuracy of the method may lead the surgeon to
inappropriate decision-making. Therefore a false posi­
tive diagnosis of a cancer may lead to unnecessary radical
surgery, e.g. radical mastectomy or even amputation
of a limb. On the other hand, false negative diagnosis
leads to inadequate surgical management, and these er­
rors are dangerous in the patient’s outcome.

MATERIAL AND METHODS

A retrospective survey of 1000 consecutive cases of
frozen section diagnosis, focusing on accuracy of the
method was performed by the staff pathologists of Shiraz
Medical School from 1995 to 2000 by comparison with
final permanent diagnosis. Although all ten staff patholo­
gists were involved in this study, each case was not seen
by all of them. Instead, as routine frozen section was
performed daily at the ward, the case was randomly stud­
ied by one of them.

Some 462 cases were studied again outside the oper­
atting room, without any previous clinical data. Their
results were then compared with the diagnoses made in
the operating room to determine the importance of clinical
data and the surgeon pathologist relationship for an
accurate result.

Also 211 cases of touch imprint cytology related to
the 1000 cases were studied to determine the accuracy
of cytology.

Material for frozen section was received from the
operating room and was examined immediately by the
pathologist. He performed touch imprints from the sus­
pected areas of fresh specimens in 211 cases and stained
it by Hematoxylin-Eosin method. The material was then
frozen by the use of a cryostat at -25 degrees centigrade,
and embedded in ethylene glycol based media (OCT). It
was then sectioned and stained by H&E method.

The final pathologic diagnosis from paraffin blocks
was recorded separately and at the end of the study it was
compared with the results of frozen sections and cytology.

The discrepancies between diagnosis by cytology and
frozen section were compared with the final tissue diag­
nosis and apparent errors were divided into three categ­
ories:
A) false positive (benign tumors called malignant)
B) false negative (malignant tumors called benign)
C) nonconclusive

The following major anatomic categories were used
in this study:

CNS, Breast, Lymph Node, Gastrointestinal Tract,
Soft Tissue, Bone and Miscellaneous organs.

Following this categorization errors in each organ
system were studied separately.

RESULTS

The anatomic origin of the frozen section specimen
and the results are given in Table I.

The total accuracy of frozen section in 1000 cases
was 93.6%. In the remaining 6.4%, 21 cases (2.1%) were
false positive and 42 cases (4.2%) were false negative.
The accuracy of frozen section in soft tissue and bone
lesions was 65.4% and 88.9% respectively which was
lower than other organ systems.

Because most of our cases were from the CNS, breast
and lymph nodes (67% of cases) and our staff patholo­
gists are possibly more experienced in those organ sys­
tems, the accuracy in such cases was relatively higher
than other organs.

Table II shows the accuracy of touch imprint cytol­
ogy. Most of the cases were CNS tumors with high accu­

<table>
<thead>
<tr>
<th>Organ</th>
<th>Total cases</th>
<th>False positive</th>
<th>False negative</th>
<th>Total errors</th>
<th>Accuracy</th>
<th>Inconclusive</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNS</td>
<td>483</td>
<td>8</td>
<td>12</td>
<td>4.2%</td>
<td>95.8%</td>
<td>5</td>
</tr>
<tr>
<td>GI</td>
<td>123</td>
<td>3</td>
<td>8</td>
<td>9%</td>
<td>91%</td>
<td>1</td>
</tr>
<tr>
<td>Breast</td>
<td>109</td>
<td>1</td>
<td>6</td>
<td>6.4%</td>
<td>93.6%</td>
<td>1</td>
</tr>
<tr>
<td>LN</td>
<td>77</td>
<td>1</td>
<td>3</td>
<td>5.3%</td>
<td>94.7%</td>
<td>2</td>
</tr>
<tr>
<td>Bone</td>
<td>30</td>
<td>-</td>
<td>3</td>
<td>11.1%</td>
<td>88.9%</td>
<td>3</td>
</tr>
<tr>
<td>Soft t.</td>
<td>26</td>
<td>3</td>
<td>6</td>
<td>34.6%</td>
<td>65.4%</td>
<td>-</td>
</tr>
<tr>
<td>Other</td>
<td>152</td>
<td>5</td>
<td>4</td>
<td>6.2%</td>
<td>93.8%</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>1000</td>
<td>21</td>
<td>42</td>
<td>6.4%</td>
<td>93.6%</td>
<td>21</td>
</tr>
</tbody>
</table>
Table II. Results of touch imprint cytology in 211 cases.

<table>
<thead>
<tr>
<th>Organ</th>
<th>Total cases</th>
<th>False positive</th>
<th>False negative</th>
<th>Total errors</th>
<th>Accuracy</th>
<th>Inconclusive</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNS</td>
<td>91</td>
<td>3</td>
<td>1</td>
<td>5%</td>
<td>95%</td>
<td>12</td>
</tr>
<tr>
<td>LN</td>
<td>30</td>
<td>1</td>
<td>3</td>
<td>14%</td>
<td>86%</td>
<td>2</td>
</tr>
<tr>
<td>Breast</td>
<td>29</td>
<td>-</td>
<td>-</td>
<td>0%</td>
<td>100%</td>
<td>1</td>
</tr>
<tr>
<td>GI</td>
<td>23</td>
<td>2</td>
<td>-</td>
<td>9.5%</td>
<td>90.5%</td>
<td>2</td>
</tr>
<tr>
<td>Others</td>
<td>38</td>
<td>2</td>
<td>-</td>
<td>9.3%</td>
<td>90.7%</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>211</td>
<td>8</td>
<td>5</td>
<td>6.9%</td>
<td>93.15</td>
<td>23</td>
</tr>
</tbody>
</table>

Table III. Results of 462 frozen sections related to the 1000 cases performed without clinical data.

<table>
<thead>
<tr>
<th>Organ</th>
<th>Total cases</th>
<th>False positive</th>
<th>False negative</th>
<th>Total errors</th>
<th>Accuracy</th>
<th>Inconclusive</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNS</td>
<td>201</td>
<td>8</td>
<td>8</td>
<td>11%</td>
<td>89%</td>
<td>25</td>
</tr>
<tr>
<td>Breast</td>
<td>65</td>
<td>3</td>
<td>4</td>
<td>7.9%</td>
<td>92%</td>
<td>10</td>
</tr>
<tr>
<td>GI</td>
<td>53</td>
<td>6</td>
<td>5</td>
<td>22%</td>
<td>78%</td>
<td>3</td>
</tr>
<tr>
<td>LN</td>
<td>37</td>
<td>5</td>
<td>6</td>
<td>37%</td>
<td>63%</td>
<td>8</td>
</tr>
<tr>
<td>Others</td>
<td>106</td>
<td>7</td>
<td>9</td>
<td>17%</td>
<td>83%</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>462</td>
<td>29</td>
<td>32</td>
<td>15%</td>
<td>85%</td>
<td>58</td>
</tr>
</tbody>
</table>

racy. The lymph node cytological study is overall more difficult for interpretation and as shown had a relatively lower accuracy.

All of the cases of breast cytology were diagnosed correctly.

Table III shows the accuracy of 462 cases of frozen sections performed in a special situation (without clinical data and outside the operating room without any relationship with the surgeon).

Table IV shows the accuracy of 462 cases of frozen section which was performed in the operating room with complete clinical and radiological data and operative findings.

By comparing Table III and IV the difference between the accuracy of frozen section with and without clinical data is statistically significant ($p<0.05\%$).

DISCUSSION

The frozen section technique was first performed by Welch on a benign breast lesion removed by Halsted in 1891. The real development of the method, however, was mainly the work of MacCarty at the Mayo Clinic, beginning in 1905.\(^{12}\)

A number of studies from 1929 to date comparing the accuracy of frozen section diagnosis indicate that the error rate averages about 1% to 6%, but others have found an error rate up to 11%.\(^{2,10,11}\) In 1927 Dudgeon and Patrick introduced touch imprint cytology for examination of tumors and inflammatory tissues.\(^{14}\) In 1969 Sakai showed that the accuracy of cytologic examination was 95.5% and that of frozen section 95.7%, almost identical.\(^{12}\)

This study represents quality assurance in a series of 1000 consecutive cases of frozen sections and 211 touch imprint cytologies performed at Shiraz Medical School during a five year period (1995-2000).

The overall accuracy of frozen section was 93.6%. The accuracy of touch imprint cytology was 93.1%. Compared to frozen section, touch imprint cytology is a very simple and low cost method for intraoperative pathologic consultation, however it requires experience in cytopathology for interpretation in order to have more accurate results. This method can be used in areas where facilities for frozen section are not easily available.\(^{14}\)

The combination of the two methods is very important and necessary for an accurate diagnosis. On the other hand, an appropriate surgeon-pathologist relationship and responsibility acceptance is important for increasing the accuracy of the method.

The surgeon and pathologist must each accept certain responsibilities if the patient is to receive maximum benefit from the intraoperative pathologic consultation.

The surgeon must first understand the limitations of the method and must not ask for more information which
Accuracy of Intraoperative Frozen Section

Table IV. Results of the same 462 cases performed with complete clinical data.

<table>
<thead>
<tr>
<th>Organ</th>
<th>Total cases</th>
<th>False positive</th>
<th>False negative</th>
<th>Total errors</th>
<th>Accuracy</th>
<th>Inconclusive</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNS</td>
<td>201</td>
<td>3</td>
<td>5</td>
<td>4.1%</td>
<td>95.9%</td>
<td>8</td>
</tr>
<tr>
<td>Breast</td>
<td>65</td>
<td>0</td>
<td>4</td>
<td>6.2%</td>
<td>93.8%</td>
<td>1</td>
</tr>
<tr>
<td>GI</td>
<td>53</td>
<td>0</td>
<td>5</td>
<td>9.4%</td>
<td>90.6%</td>
<td>0</td>
</tr>
<tr>
<td>LN</td>
<td>37</td>
<td>0</td>
<td>0</td>
<td>0%</td>
<td>100%</td>
<td>1</td>
</tr>
<tr>
<td>Others</td>
<td>106</td>
<td>3</td>
<td>1</td>
<td>3.9%</td>
<td>96.1%</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>462</td>
<td>6</td>
<td>15</td>
<td>4.6%</td>
<td>95.4%</td>
<td>15</td>
</tr>
</tbody>
</table>

the method is not capable of giving, e.g. the proper determination of the grading of the tumor.

The surgeon must accept the pathologist's refusal to make a diagnosis in doubtful cases, he must also submit an adequate biopsy, representative of the lesion and if possible of sufficient size for both gross and microscopic examination. Finally he must supply the pathologist with all pertinent clinical information.

On the other hand the frozen section method is one of the most difficult procedures that the pathologist performs during his practice. It requires experience, knowledge of clinical medicine and pathology, the capacity to make a quick decision under pressure, good judgment and an attitude that is conservative but not excessively so and a keen awareness of the limitations of the method. Careful gross examination of the specimen is necessary both for selecting the proper area for sectioning and because gross examination has some influence on the final decision.

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REFERENCES