FROZEN SECTION DIAGNOSIS: ACCURACY AND ERRORS; USES AND ABUSES.*†

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ABSTRACT.

In a series of 2,665 frozen sections, false-positive diagnoses of cancer occurred only four times (0.15 percent) and false-negative diagnoses of cancer 43 times (1.61 percent). In 46 instances, the diagnosis had to wait for paraffin sections.

Errors of three types: sampling, interpretive, and communicative — can occur, and sampling errors account for more than half of the errors. The types of lesions which lead to interpretive errors are the very well differentiated malignant tumors which are confused with benign proliferative conditions and the very poorly differentiated malignant tumors which are confused with inflammation. No significant errors of communication occurred in this series.

The only indication for a frozen section is the need for an immediate decision requiring immediate action. These decisions may revolve about the nature of the disease, the extent of the disease, biopsy technique, identification of tissue, viability of tissue, or even administrative matters. If a decision will be made or a course of action selected, regardless of the frozen section results, one should not get a frozen section.

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INTRODUCTION.

A decision requiring immediate action is the only indication for rapid frozen section. The type of decision and alternatives of action may vary, but in all cases the elements of decision, necessary action, and immediacy must be present before the additional expenditure of time, talent, effort, and money can be justified. Rapid frozen section diagnosis is a standard, accepted part of the surgical pathologist's armamentarium and is available

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at most hospitals. Numerous reports have well demonstrated the degree of accuracy obtainable and have discussed the ways that frozen section can be used; however, in all types of institutions, errors of both over-utilization and under-utilization occur.

While "frozen section" will be referred to as though it were solely a technical procedure, it is part of a medical consultation. The surgical pathologist, as a physician, is asked by another physician for his opinion about a particular patient. The surgical pathologist uses some or all of whatever special skills and techniques he may have available. The actual decision of whether or not to prepare a frozen section is up to the pathologist and not to the surgeon. If the surgical pathologist, in communication with the surgeon, can see no reason for utilizing the technique, there is no reason to use it; similarly, if the pathologist cannot render this opinion without frozen sections, he has the obligation to prepare them. The surgical pathologist's report carries the same weight as that of any other consulting physician. If the physician in charge of the patient's care chooses to disregard this opinion, he should seriously question why he requested it in the first place.

TECHNIQUE.

When the request for a frozen section is received in our surgical pathology office, a resident immediately goes to the main desk in the operating suite to pick up the unfixed tissue and the requisition. The requisition is designed to give the necessary clinical information about the patient and to define the decision to be made. If the resident has any question about the situation, he can talk directly with the surgeon over an intercom. If this still leaves any doubt, "jump suits" are available for the surgical pathology resident to pull on over his street clothes so that he can go right into the operating room for direct view of the problem and face-to-face conversation with the surgeon.

The resident then brings the tissue back to the surgical pathology gross room. This gross room is on the same floor and less than 150 feet from the operating suite so a "branch office" for frozen sections is not necessary. The tissue is examined, and portions for freezing are selected. Facilities for gross photography and for roentgenography (Faxitron®) are available in our gross room and used as appropriate. The actual frozen sections are cut at 6 μ by technicians, residents, or staff surgical pathologists on the two cryostats (Lab-Tek®) we have available. A rapid hematoxylin and eosin stain is used routinely. After examination of the sections, the resident (or if necessary, the staff surgical pathologist) goes back to the operating suite and reports the findings directly to the surgeon. If there is any question about what might be communicated over the intercom, or if face-to-face discussion is desirable, the pathologist goes right into the operating room.

TABLE I.

University Hospital-USCD Comparison of Frozen Section and Paraffin Section Diagnoses in 2,665 Consecutive Frozen Sections.

Organ	Number of Frozen Sections	Frozen Section Diagnosis "Benign"		Frozen Section Diagnosis "Wait"		Frozen Section Diagnosis "Malignant"	
		Paraffin Section Diagnosis "Benign"	Paraffin Section Diagnosis "Malignant" (False Negative)	Paraffin Section Diagnosis "Benign"	Paraffin Section Diagnosis "Malignant"	Paraffin Section Diagnosis "Benign" (False Positive)	Paraffin Section Diagnosis "Malignant"
Lymph nodes	479	332	8	1	5	0	133
Breast	441	336	2	4	9	1	89
G.I.	263	211	8	4	2	0	38
Soft tissue[1]	253	126	3	2	5	0	117
Skin and lips	240	214	2	1	1	0	22
Neurologic[2]	161	135	0	0	0	1	25
Gyn	127	92	8	0	1	0	26
Liver, B.D., pancreas[3]	123	66	3	3	1	0	50
Thyroid	115	101	1	3	0	0	10
Lung	107	53	3	0	1	1	49
G.U.[4]	103	65	5	0	1	0	32
Head and Neck[5]	96	73	0	0	0	1	22
Parathyroid	81	80	0	1	0	0	0
Other[6]	76	50	0	0	1	0	25
Total	2,665	1,934	43	19	27	4	638

1. Soft tissue, peritoneum, pleura, pericardium, omentum, mesentery, mesocolon, retroperitoneum, synovium.
2. Brain, spinal cord, cranial nerves, peripheral nerves, sympathetic nerves, meninges.
3. Liver, bile ducts, pancreas, gall bladder.
4. Urinary system, male reproductive system, adrenal.
5. Oral cavity, larynx, pharynx, tongue, salivary glands, tonsils, nasal cavity, nasopharynx, hypopharynx, mastoid.
6. Bone, nucleus pulposus, orbit, eye, vessels, spleen, etc.

The degree of freedom given the resident in this procedure varies with his stage of training, his knowledge, and his general reliability and judgment. In all situations, a staff surgical pathologist is available to aid the resident.

An attempt is made to be as specific about the diagnosis as is necessary under the circumstances. Often separating benign from malignant lesions suffices. If a carcinoma can be classified as epidermoid carcinoma or adenocarcinoma, and this will help in decision-making, it is done; similarly, in several instances, the surgeon has been told that a pulmonary lesion is coccidioidomycosis when the organism was identified on routine H and E

TABLE II.

Multiple Frozen Sections (Five or More Per Patient).

5 FS — 20 patients	10 FS — Three patients (parathyroid explorations)
6 FS — 11 patients	12 FS — Two patients (cx cones)
7 FS — Seven patients	16 FS — One patient (Whipple)
8 FS — Two patients	19 FS — One patient (skin lines of resection)
9 FS — Four patients	

frozen sections. There is no hesitation in asking for more tissue if it is needed or reluctance to say "We don't know — wait for paraffin sections."

The tissue used for frozen section is then processed in the usual manner for paraffin sections. Some freezing artifact has been introduced into these paraffin sections but rarely is this of an objectionable degree; nevertheless, if a portion of a biopsy can be reserved and not frozen, this is preferable. The frozen sections are kept at least until a comparison with the paraffin sections can be made. If there is any reason for keeping the frozen sections after this, they are of a permanent nature and can be filed along with the rest of the case.

RESULTS.

During the eight years from July 1, 1963, to June 30, 1971, 2,665 frozen sections were processed in this hospital (Table I). As might be expected, lymph nodes and breast were the tissues most often examined and together accounted for more than one-third of the frozen sections. Slightly more than one-fourth (708 or 26.6 percent) of the lesions proved to be malignant. These 2,665 frozen sections were from 1,681 patients. In 51 instances (Table II) five or more portions of tissue from a single patient were examined by frozen section. The operations requiring 10 or more frozen sections are identified in the table. The highest number of frozen sections in any one case was 19.

A frozen section diagnosis was considered correct if it agreed with the diagnosis made from paraffin sections of the same piece of tissue or if, on review, the actual frozen section was still felt to show a specific focal lesion which was not present on the paraffin section. For the purpose of reasonable tabulation, this accuracy has been measured only on the basis of benign versus malignant; obviously, important errors can be made if various lesions are confused even after separation into these two major categories. Counterbalancing this is an interesting observation that in some situations if certain malignancies can be excluded (*i.e.*, metastatic epidermoid carcinoma in a cervical lymph node), it makes little difference at the time of operation if others (*i.e.*, malignant lymphoma) are present.

The overall results are presented in Table I. There is no real difference

TABLE III.

Frozen Section: Sources of Error.

Sampling:	Surgeon
	Pathologist — Gross
	Pathologist — Micro
Interpretive:	
Communicative:	Asking the Question
	Giving the Answer
Technical:	(not a justifiable cause of error)

in the level of accuracy when one compares the figures for one organ with another. As would be hoped, false-positive diagnoses of cancer are almost non-existent (4/2,665 = 0.15 percent) and false-negative diagnoses are rare (43/2,665 = 1.61 percent). The total error of 1.76 percent is in the center of the range of 0.5 percent — 2.7 percent reported in the literature.[1,2,3,4] In 46 instances (1.72 percent) diagnoses were deferred until paraffin sections were available.

DISCUSSION.

Little would be gained by an elaborate comparison of results with those previously reported. Of much greater value are studies of the types and sources of errors in frozen section diagnosis and of the correct use of the procedure. From these studies both the surgeon and the surgical pathologist can attain that level of knowledge, skill, and teamwork which will best serve the interests of the patient.

Error, hopefully rare, is inherent in frozen section diagnosis. Because of the obvious therapeutic implications, the pathologist should be conservative and tend to err on the side of a benign diagnosis. Decisions should be delayed when this is appropriate, but this, too, should be a rare occurrence or the whole procedure becomes useless. There is no substitute for experience, and the critical decisions to be made should not be left to one with only casual acquaintance with the technique. Perhaps these ideas are best summarized by Ackerman: "The surgeon must have complete confidence in his pathologist, know that he is conservative, always conscious of the patient's welfare, and be certain in his mind that if the pathologist says it is cancer, it will prove to be so in almost 100 percent of the instances . . . but in practically all instances he [the pathologist] must arrive at a decision, otherwise his value to the surgeon is tremendously diminished. Because he is pushing his knowledge to the limits, he will, necessarily, make rare errors."[4]

Errors are caused by one or more identifiable factors (Table III). Sampling errors are those resulting from examining the wrong portion of tissue. The surgeon can give the pathologist a piece of tissue which does

not contain the lesion. Even if the piece of tissue given him does contain the lesion, the pathologist during his gross examination can select a portion of it for freezing which does not include the lesion. The particular microscopic sections which are prepared may not contain a lesion which lurks deeper in the block of tissue. Interpretive errors are those made when the lesion is present in the frozen sections, but the pathologist does not recognize it. Communicative errors are those resulting from the pathologist's not understanding the surgeon's question or the surgeon not understanding the pathologist's answer. Technical errors are those which lead to slides which are of poor quality. All except the sampling error of the surgeon are under the direct control of the surgical pathologist, and he can even influence this one by education and by going directly into the operating room. While technical factors can lead to errors, this should not be accepted as the sole cause of the errors. The surgical pathologist should be aware that he is having problems and either correct them if at all possible, or, if he is unable to correct them, report the situation to the surgeon. With the use of the cryostat and H and E stains rather than the older freezing microtomes and polychrome stains, these errors become rare.

Each of these types of errors can be illustrated by a specific case in our series.

1. Sampling error by surgeon (and useless frozen sections). A 60-year-old man underwent laparotomy because of increasing jaundice. A mass was noted in the head of the pancreas. A total of seven portions of tissue were submitted for frozen section. The last four of these were obtained from the pancreas itself by needle biopsy. In none of them was any tumor identified, and each time a request for more tissue was made by the pathologist. A Whipple operation was carried out without a tissue diagnosis of cancer. Examination of the pancreas disclosed a 2 cm. portion of the pancreatic duct 4.5 cm. from the duodenum in which the duct was narrowed to 3 mm. in diameter. This portion proved to be adenocarcinoma. The needle biopsy tracts were identified at some distance from this tumor.

2. Gross sampling error by pathologist. A 66-year-old man underwent thoracotomy for a coin lesion in the upper lobe of his right lung. Upon examination of the resected lobe a fibrotic lesion involving the pleura of the apex was seen. The frozen section proved to be chronic inflammation with considerable fibrosis. The next day when the lobe was more thoroughly studied a second lesion, 1.5 cm. in diameter, was noted in the posterior segment. Sections of this lesion demonstrated a broncho-alveolar carcinoma.

3. Microscopic sampling error by pathologist. In the course of a parathyroid exploration performed on a 43-year-old man, a piece of tissue was submitted for identification. On frozen section only normal lymph node tissue was seen. Paraffin sections made from deeper portions of this same block of tissue contained metastatic papillary cancer from the thyroid. Review of the actual frozen sections again showed only normal lymph node.

TABLE IV.

Analysis of Errors — Four False Positives.

Sampling	0
Interpretive	4
Communicative	0
Technical (never a sole cause)	2

4. Interpretive error by pathologist. A 63-year-old man underwent surgical exploration for a bleeding lesion of the stomach. The interior of the stomach was examined through a gastrotomy; four biopsies of a lesion were submitted for frozen section. No evidence of malignancy was recognized in any of these. An infiltrate of what were interpreted as inflammatory cells was seen. A sub-total gastrectomy was then performed, and an extensive area of thickening was noted along the lesser curvature in the prepyloric region. Only superficial ulceration was noted. Two frozen sections were prepared from this thickened portion and again the inflammatory infiltrate was seen, but no tumor was recognized. On paraffin sections of the tissue used for all six frozen sections the infiltrate proved to be poorly-differentiated adenocarcinoma of the linitis plastica type.

5. Communicative error. Roentgenograms showed a mass in the posterior portion of the chest in a 44-year-old man. Considerable discussion ensued as to whether the mass was in the posterior mediastinum or in the right lung. A portion of this mass biopsied at thoracotomy was given to the pathologist and identified by the surgeon as "right retro-pleural mass." On frozen section the tumor was composed of small, dark cells and a diagnosis of malignant lymphoma was made. Only after the lobe was resected did it become apparent to the pathologists that the tissue came from an intrapulmonary tumor which proved to be an "oat-cell' carcinoma.

6. Technical error leading to microscopic sampling error by pathologist. A follicular carcinoma, confirmed by frozen section, was found in the right lobe of the thyroid in a 49-year-old woman. A large lymph node which had been palpable in the right side of the neck was then biopsied and submitted for frozen section. No tumor could be identified in the non-calcified portion, but it was remarked to the surgeon that much of the node was calcified. Paraffin sections of this portion of the node after decalcification showed metastatic follicular carcinoma.

Being fewest in number, the false-positive errors are easiest to summarize (Table IV). Every one was an interpretive error although in two, technical factors contributed. One of these four errors led to a pneumonectomy when a lobectomy would have sufficed; another led to a radical mastectomy in a man when simple excision of his breast would have been

TABLE V.

Analysis of Errors — 43 False Negatives.

Sampling — Surgeon		?
— Pathologist — Gross		7
— Pathologist — Micro		17
Interpretive		19
Very poorly differentiated Ca.	11	
Very well differentiated Ca.	5	
Communicative		0
Technical (never a sole case)		9

more appropriate. In the other two situations no direct harm to the patient resulted from the falsely positive diagnosis of cancer.

The 43 false-negative errors are tabulated in Table V. While it is obvious that sampling errors by the surgeon do occur (see No. 1 above) it would be impossible to quantitate this without complete follow-up information on all 1957 instances in which the final tissue diagnosis was a benign lesion. Sampling errors by the pathologist at both the gross and microscopic levels account for more than one-half of the false-negative errors. The gross sampling errors, which were scattered among the various organs, can be kept to a minimum by careful gross examination of the tissue and by willingness to freeze any suspicious portions. Use of specimen roentgenography of breast lesions also may help eliminate this error.[5] Most of the sampling errors at the microscopic level occurred in lymph nodes (if one cervical cone with error on multiple section is eliminated) and these all represent small metastases found in deeper paraffin sections of the nodes. This particular sampling problem exists with paraffin sections as well, and it is a matter of judgment as to how many sections should be examined. We examine at least two sections of each portion frozen. Perhaps more and especially deeper sections would reduce this error. Almost one-half of the false-negative diagnoses were interpretive errors. Interestingly, most of these were at the two extremes of differentiation: the very well differentiated tumors were mistaken for benign proliferative lesions, and the very poorly differentiated tumors were confused with inflammatory lesions. Only the experience of the surgical pathologist can reduce this error. Even then, because of the preference for conservatism in making a diagnosis of malignancy, this error always will occur. Errors (No. 5) relating to communication do occur, but there was no instance in which a diagnosis of a malignant tumor was misinterpreted by the surgeon as a benign lesion (or vice-versa). Insisting that a physician personally go to the operating suite or even into the operating room and talk directly with the surgeon is what makes this an insignificant cause of error; finally, technical factors contributed to the error in nine instances. Prior fixation in formalin with resulting poor adherence to the slide, necrosis, hemor-

TABLE VI.

Analysis of "Wait for Permanent Sections."

Oddities	12	(Four malignant, eight benign)
Consultation needed	8	(Three malignant, five benign)
Malignant lymphoma	7	
Poorly differentiated malignancies Four poorly differentiated carcinoma Two unclassifiable malignancies	6	
No special features	13	(Seven malginant, six benign)

rhage, and calcification were the factors leading to the preparation of technically poor slides.

While not representing errors, the 46 instances in which the diagnosis had to be deferred until paraffin sections were prepared do represent failures of frozen section to yield useful information. These are summarized in Table VI. Twelve of these instances represented very unusual lesions such as retention polyps of the small intestine in an infant[6] or parathyroiditis histologically resembling Hashimoto's disease. In eight the diagnosis was so obscure that consultation was necessary even after paraffin sections were available, and the various consultants did not always agree with each other. Seven others proved to be malignant lymphomas and six more were very poorly differentiated tumors. As can be seen from Table I, diagnoses were deferred in almost every organ examined and roughly in proportion to the number of frozen sections performed on that organ. Of the 46 deferred diagnoses, 19 proved benign and 27 malignant.

The frequency of malignant lymphomas as sources of both false-negative and deferred diagnoses warrants special mention. Adequate tissue is necessary to document architectural changes. Reed-Sternberg cells have been surprisingly difficult to identify on frozen section. Because all cells tend to appear larger and thus more malignant on frozen section than on paraffin section, a rightfully conservative pathologist tends to overcompensate. Many nodes which finally proved to contain a malignant lymphoma thus were interpreted as benign hyperplasia on frozen section, or the diagnosis was deferred until paraffin sections were available.

Special difficulties have been experienced with the use of frozen section after radiotherapy. Radiation can both alter pre-existing tumor cells and cause cellular changes resembling malignant in non-neoplastic cells; moreover, in tissue biopsied within a few weeks after completion of radiotherapy, it may be difficult or even impossible to tell whether tumor cells which are still present are capable of continued growth or reproduction. These problems are not restricted to frozen sections, but hopefully the slightly better quality, multiple levels, and time for thorough study of paraffin sections will help resolve them.

TABLE VII.

Cost of Frozen Sections, University Hospital-UCSD.

Organ	Extra Time Needed for Frozen Section (Including Extras)	Cost			
		Frozen Section	Operating Room	Anesthesia	Total
Breast	30 Minutes	$25.00	$ 78.75	$25.00	$128.75
Node	30 Minutes	$25.00	$ 44.00	$25.00	$ 94.00
	15 Minutes	$25.00	$ 22.00	$12.50	$ 59.50
CX cone (12 blocks)	45 Minutes	$75.00	$120.00	$37.50	$232.50

Not only must the surgeon and pathologist be aware of the accuracy and errors of frozen section diagnosis, but both also must know when to use the procedure and when not to use it. The information to be gained must outweigh the risks, costs, and other inconveniences inherent in the procedure. The risks of dissemination of the tumor or inflammatory disease, fistulas, hemorrhage, etc., are the risks of biopsy and not of frozen sections and will not be discussed further in this report. The cost of frozen section frequently is disregarded. As can be seen from Table VII, the least of the cost to the patient is that which the pathologist charges. The times allotted for the various examinations are based on experience and include the additional time associated with frozen section diagnosis (re-prepping, re-draping, changing instruments, etc.) as well as the time spent on the frozen section itself.[7] Although not a problem in our particular hospital, in many places the additional operating time would add even more expense because of the surgeon's and assistants' fees. Because frozen section is a medical consultation, the patient is not charged by the individual slide or piece of tissue. An attempt is made to relate charges to the amount of time expended. Alternatives to frozen section, such as needle biopsy of breast tumors in the outpatient clinic, physician's office, or immediately on admission to the hospital should be considered.[7] The ability to prepare the patient psychologically in advance of treatment and to be able to know exactly the contemplated operation for both medical and medico-legal purposes are additional benefits of this alternate technique.

Additional expense is not the only reason to avoid frozen section diagnosis when it is not indicated. Expenditure of time, effort, and talent on obtaining useless data dulls the enthusiasm and desire of those who have to obtain the data and makes them less willing and able to perform the procedure when it is needed. Interruption of other necessary and pressing work by needless frozen sections delays completion of this other work. The pathologist can do only one thing at a time: if he is performing a useless frozen section, he is not "signing out" surgical pathology reports or participating in teaching conferences.

One can state and hold as an axiom that the only indication for rapid

TABLE VIII.

Indication for Frozen Section: Immediate Decision Requiring Immediate Action.

Types of Decisions.
I. Nature of disease process
A. Malignant vs. benign
B. Type of malignant or benign process
II. Extent of disease process
A. Margins of resection
B. Disease outside of planned operative procedure
III. Biopsy technique
A. Adequacy of specimen
B. Appropriate ancillary studies (culture, EM, etc.)
IV. Identification of tissue
V. Viability of tissue
VI. Administrative
A. Admit patient to hospital
B. Save hospitalization time

frozen section diagnosis is the need for an immediate decision requiring immediate action. This extension of Ackerman's "therapeutic decision" is needed, because some of the immediate decisions and immediate actions are not of a therapeutic nature.[4] Therapeutic action itself is not restricted to further surgery, but may be immediate radiotherapy, chemotherapy, antibiotic therapy, etc., or not to perform further surgery. The last four frozen sections in No. 1 demonstrates violation of a corollary to the above axiom: if a decision will be made and a course of action undertaken, regardless of the frozen section results, one should not get a frozen section.

The surgeon must be aware of the possible results he may receive when he requests a frozen section and must be prepared with plans of action based upon each of these possibilities. Prudence also requires that the patient be made aware of various courses in advance and that an operative permit be obtained to allow for these various possibilities so that more extensive or otherwise modified surgical procedures can be carried out immediately when this is appropriate.

The actual decisions and the resulting courses of action may vary. These are summarized in Table VIII. Probably the most frequent use of frozen section is to identify the nature of the disease process in a patient. This usually boils down to deciding whether a lesion is benign or malignant, and is followed immediately by appropriate surgical treatment; however, if the surgical treatment would be the same regardless of the nature of the lesion or of other information gained, there is no justification for a frozen section. On the other hand, if knowledge of the specific type of neoplastic or inflammatory disease can change the immediate therapy, every attempt should be made by the pathologist to supply this knowledge.

As alluded to previously, the surgical procedure at the time of biopsy of a cervical lymph node containing metastatic epidermoid carcinoma may differ from that for one with malignant lymphoma. Certainly the treatment of Ewing's sarcoma differs from that of osteosarcoma. Identification of Coccidioides immitis in a granuloma may lead to earlier treatment with appropriate antifungal agents. The various entities leading to hyperparathyroidism must be distinguished from each other so that the correct operative procedure can be accomplished.

The extent of the disease process frequently dictates the procedure carried out at the time. Lines of resection should be free of the lesion whether the lesion is adenocarcinoma of the colon or ulcerative colitis; frozen section may help decide this. A widely neglected use of frozen section is to prove the "inoperability" or "incurability" of a particular tumor. Before doing a less-than-curative operation, it should be proven at the time that tumor is present in places which make a curative operation unwarranted. Large lymph nodes may be hyperplastic, omental nodules may represent fat necrosis, and masses in the liver may be granulomas. To find out a day or two after performing a less-than-curative operation that biopsies of the obviously disseminated tumor did not show tumor, is to do a disservice to the patient; the reverse of this is also true. Biopsies and frozen sections of appropriate lymph nodes or other tissues may prevent a useless pelvic evisceration or Whipple operation.

Another excellent use of frozen section is to improve biopsy technique. To perform a surgical procedure solely for the purpose of establishing a diagnosis, and then to fail in this goal because one does not biopsy the correct piece of tissue is an error all would like to avoid. One lymph node may contain a lesion and its immediate neighbor may not. Large portions of many tumors are necrotic. Surrounding inflammation may be difficult to tell by gross inspection from extension of a tumor. If the surgeon knows that a particular piece of tissue, as shown by frozen section, does not contain a lesion which can explain the clinical situation, he will be in a position to obtain more tissue right away. With knowledge of the nature of a lesion, ancillary studies can be carried out in a better manner. Knowing that a lesion is inflammatory in nature will encourage bacteriologic studies and the further knowledge that it is granulomatous would help the microbiologist in setting up proper cultures. If the lesion suggests a viral etiology, sterile frozen tissue can be saved for possible viral cultures. Electron microscopy is too elaborate and too expensive to use on every case or even on every tumor. Knowing that a lesion is appropriate for electron microscopy will aid in correct selection of material for this facility and in correct fixation of that material. Identical comments can be made regarding immunofluorescent studies.

If the surgeon has any question in his mind about identification of tissue, frozen section can help him. The pathologist frequently confirms the

identity of vagus nerves, sympathetic ganglia, or all four parathyroids in secondary hyperplasia. Some more unusual identifications have been confirmation that a percutaneous needle biopsy did indeed biopsy the liver and that a tubular structure in the right lower quadrant of the abdomen was the appendix and not the ureter.

At times it becomes necessary to know whether an organ, or a part of it, is viable. This can be difficult in the early stages of necrosis, but frozen section may be of help. The obvious use of this is with necrotic lesions of the intenstinal tract. Recently a urologist was helped in his decision to do bilateral renal artery surgery rather than bilateral nephrectomy because viable glomeruli and tubules were seen on frozen section of biopsies of both kidneys.

The concept of using a medical consultation to make administrative decisions may seem strange, but it is useful. Because of the large geographic area (including an international border) from which we draw patients, at times it becomes appropriate to do frozen sections on biopsies from outpatients. If the lesion proves to be one requiring hospitalization, admission can be arranged without further long distance travel and without the chance of a patient's not returning for further treatment. In a large governmental hospital in this area the number of women with breast masses requiring biopsy is too great to admit all the women to the hospital. Breast masses are biopsied as an outpatient procedure and if a lesion proves malignant on frozen section, the patient is admitted immediately for appropriate therapy the next day. While perhaps not the ideal procedure, this does allow triage of a large number of women and rapid treatment of those few needing it. In both of these situations, the decision is the nature of the disease and the immediate action is admission to the hospital. The argument for using frozen section diagnosis to reduce hospitalization time and thus save money rarely is valid. When one adds up all of the costs related to frozen section (Table VII), they come close to or exceed the costs of another day in the hospital. The tissue from cervical conization is not routinely handled by frozen section at University Hospital because high-quality paraffin sections are available and interpreted by 10:00 A.M. on the day after conization. If the gynecologist correctly organizes his time, the patient already has been scheduled as the second or third operation of the day, and the hysterectomy or other procedure is performed within 18 or 20 hours of conization. This is well within the usually preferred "safe interval" of 48 hours between conization and hysterectomy, and the diagnosis is based on the best material available. False-positive and false-negative errors are reported too frequently with the use of frozen sections on cervical cones for one to be satisfied with it;[8,9,10,11] on the other hand, the frozen section technique has been used on a few cervical cones when some specific problem requiring immediate decision and immediate action has arisen.

TABLE IX.

Not Indications for Frozen Section.

I.	Drama
	A. Ease surgeon's conscience
	B. Idle curiosity
	C. Tell patient sooner (without corresponding need for action)
	D. Jehovah Complex (Surgeon or Pathologist)
II.	Anti-drama
	A. Cigarette or coffee break
III.	Financial
	A. Increase pathologist's income
	B. Increase hospital's income
	C. Increase surgeon's income
IV.	Gamesmanship
	A. Prove that the hospital has a pathologist (especially at 3 A.M.)
V.	Proceeding by rote
VI.	All examinations by frozen section

Other specific indications for rapid frozen section diagnosis undoubtedly exist. In every one the common features must be decision, action, and immediacy.

What then are not indications for frozen section? In simplest terms, these are situations in which one or more of the three necessary factors of decision, action, and immediacy which justify a frozen section are absent (Table IX).

The first particular occasion in which we feel that the effort and expense of frozen section are not warranted is that which accomplished nothing but increasing the drama of an already overly dramatic situation. After the surgeon has completed an operation we can see nothing to gain by learning at the time what will be learned the next day, solely to confirm in the surgeon's mind that his judgment was correct. Idle curiosity about a lesion with no contemplated immediate action is an identical situation. Patients do need to know about their disease as soon as possible; but again, unless some type of immediate action is needed, the surgeon usually can give sufficient information to the patient on the basis of his operative findings until thorough study of paraffin sections has been accomplished. The desire to be an Omniscient Deity affects both Surgeons and Pathologists, but this does not justify the expenditure of time, effort, and money associated with frozen section.

Frozen section as a means of easing the tension can be abused in the operating room. The time necessary for the section gives the surgeon an excuse to relax for a few minutes or even to "break scrub" and smoke a cigarette or drink a cup of coffee. If a surgeon needs a break this badly he

should be honest with himself and admit it rather than justifying it as time necessary for some other procedure.

Pathologists, hospital administrators, and surgeons all are looking for ways to make more money. Unjustified frozen sections should be passed over in favor of legitimate means.

At times the surgeon feels that because the hospital has a pathologist, he should be made to come to the operating room as often as possible. This feeling reaches its highest level at 3:00 A.M. and on holiday weekends. The pathologist must always be willing to perform frozen sections at any time providing he can aid in a decision requiring immediate action.

All too often physicians proceed by rote and do not really think of what they are doing; for example, the dictum of breast mass — biopsy — frozen section — radical mastectomy is so firmly planted in many minds that often pathologists are asked to perform frozen sections of breast masses removed from teenaged girls. Carcinoma is so rare in these girls that one would be reluctant to make the diagnosis on frozen section and would want paraffin sections and time to study them thoroughly.[12] Biopsy or excision of these masses is entirely appropriate; it is the frozen section which is not.

In some institutions all surgical pathology is done by frozen section; paraffin sections are made only for special studies. Intellectually there is no argument against this; but it seems to be an unnecessarily expensive alternate to the usual method of paraffin sections. After one completes his examination on the basis of frozen section, he is left with the choices of embedding the pieces of tissue used from frozen section and not looking at slides from them, preparing and examining slides from these blocks, or storing large amounts of fixed, wet tissue. The first alternative may lead to legal problems, the second simply duplicates all of the expensive frozen section examination, and the third requires storage facilities beyond the reach of most institutions. The questions of added technician time and extra equipment also must be studied thoroughly before one can accept the idea of doing all surgical pathology examinations by frozen section.

Still other occasions arise in which frozen section is considered but is not justified. As a rule these are situations in which one or more of the criteria of decision, action, and immediacy are not met.

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SYMPOSIUM.

The Second International Symposium on Impedance Measurement will be held September 13-14, 1973, at the Marriott Hotel, Houston, Tex.

The symposium will be sponsored jointly by Baylor College of Medicine and The Methodist Hospital, Texas Medical Center. A distinguished international guest faculty will consider recent developments in both clinical and research applications of acoustic impedance measurement.

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SEVENTEENTH ANNUAL MEETING, COMMITTEE FOR RESEARCH IN OTOLARYNGOLOGY.

The 17th Annual Meeting of the Committee for Research in Otolaryngology, AAOO, will be held at the Fairmont Hotel in Dallas, Tex., September 21-22, 1973. A formidable program is scheduled for this meeting. [7,8]