Error Reduction in Surgical Pathology

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Context.—Because of its complex nature, surgical pathology practice is inherently error prone. Currently, there is pressure to reduce errors in medicine, including pathology.

Objective.—To review factors that contribute to errors and to discuss error-reduction strategies.

Design.—Literature review.

Results.—Multiple factors contribute to errors in medicine, including variable input, complexity, inconsistency, tight coupling, human intervention, time constraints, and a hierarchical culture. Strategies that may reduce errors include reducing reliance on memory, improving information access, error-proofing processes, decreasing reliance on vigilance, standardizing tasks and language, reducing the number of handoffs, simplifying processes, adjusting work schedules and environment, providing adequate training, and placing the correct people in the correct jobs.

Conclusions.—Surgical pathology is a complex system with ample opportunity for error. Significant error reduction is unlikely to occur without a sustained comprehensive program of quality control and quality assurance. Incremental adoption of information technology and automation along with improved training in patient safety and quality management can help reduce errors.

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Error reduction in surgical pathology is dependent on our understanding of how errors occur and applying to surgical pathology error-reduction strategies that have been developed and tested in other industries and areas of medicine. Our view of surgical pathology determines, to a great degree, how extensively the problem should be addressed. Surgical pathology can be defined very narrowly as the analytic process of interpretation of tissue findings. In this view, errors are only those that occur as a result of diagnostic misinterpretation. On a broader level, surgical pathology may be considered an industrial unit that receives, processes, and reports on thousands of specimens annually, an inherently complex process with ample opportunity for error. On that level, tissue interpretation is only a small step in the process, albeit a very important one. Deleterious patient effects may occur when things go wrong at any point in the process. A recent study determined that diagnostic misinterpretation accounts for only approximately 25% of all surgical pathology errors. Defective specimens accounted for 4% to 10%, wrong identification for 27% to 38%, and defective reports for 28% to 44% of cases. This reinforces the need for effective quality control and quality assurance at all steps in surgical pathology.

In this article, factors that contribute to errors will be presented, followed by a discussion of error-reduction strategies combined with an attempt to apply these strategies to surgical pathology.

Factors That Contribute to Errors

1. Variable input.—There are at least 2 aspects of variable input in surgical pathology that may contribute to errors. First, incorrect or improper patient identification leads to errors by incorrectly assigning a pathology result to a patient. Second, incomplete or incorrect clinical history may also lead to errors. For example, the handling of a biopsy from the lung, colon, kidney, or liver accompanied by a history of inflammatory disease will be completely different than the same specimen with a history of “mass, rule out malignancy.”

2. Complexity.—The chance of error increases with every additional step in a process. If a step has a 1% chance of error and there are 25 steps, the chance of error increases to 22%. With 50 steps, the chance of error is 39%. The number of steps in the surgical pathology test cycle increases the chance of error.

3. Inconsistency.—The most dramatic example of how this leads to errors in surgical pathology is the inconsistent use of diagnostic criteria for the diagnosis of cancer and other conditions. This creates confusion and reduces the level of confidence in pathology. Schnitt et al demonstrated how the use of standard criteria for the diagnosis of ductal proliferative breast lesions improves diagnostic agreement.

4. Tight coupling.—Processes that are tightly integrated may leave no room to recognize subtle differences and react to those differences.

5. Human intervention.—Machines perform very well with routine tasks, whereas humans perform best with unanticipated or unpredicted occurrences. Errors may occur if an unanticipated situation is presented to a machine.
However, humans are prone to errors in routine work situations because of boredom or distraction.  

6. **Time constraints**—Many surgical pathology laboratories have time constraints, primarily because of batch work, and a shortage of workers or a sudden increase in workload can magnify these time constraints. At times of stress, workers are more prone to commit errors.  

7. **Hierarchical culture**—A hierarchical culture within a department tends to lead to dogmatic or inflexible thinking, which reduces the ability of workers to consider unexpected or uncommon possibilities.  

**ERROR-REDUCTION STRATEGIES**

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**Reduce Reliance on Memory**

Errors are consistently reduced when systems are modified to reduce reliance on memory. One of the simplest ways to accomplish this is to introduce checklists. Examples in surgical pathology include reporting checklists and daily worksheets to assure that routine tasks are completed, including preparation of the histology laboratory and gross room, and daily maintenance of tissue processors, cryostats, and other equipment. Checklists have also been shown to improve pathology report quality for cancer resections. Automation at any point in the process is not a memory aid, but does eliminate the need to remember multistep procedures and, therefore, reduces reliance on memory.

**Improve Information Access**

Timely, accurate information is vital to decision making; this is particularly critical at the time of diagnosis. Two moments in surgical pathology when this is crucial are at the time of frozen section and final sign-out. At frozen section, knowledge of the patient’s history, including previous pathology reports and radiographic studies, allows the pathologist to focus on the question at hand: margins, lymph node metastasis, etc. At final sign-out, particularly with biopsies, cases are addressed differently depending on the history given. Although clinical information is required for specimen submission, it is often incomplete or inaccurate. Access to an electronic medical record greatly enhances the prospects of having the correct clinical information at the correct time. It also saves time spent having to find the clinician to get answers.

**Error-Proof Processes: Use Constraints and Forcing Functions**

This is an attempt to reduce variation by minimizing choices so that processes move in only one direction. The best example of this is the use of computers to assure that all required elements are entered before a task is complete. Examples of this in surgical pathology include accessioning and reporting of certain cases, such as cancer resection specimens. Computerized forms have been shown to improve the completeness of cancer pathology reporting.

**Decrease Reliance on Vigilance**

This refers to having stringent quality control built into all steps of a process so that nothing is left to chance or an individual’s vigilance. This works best if it is made part of the daily routine. Examples of this in surgical pathology include accessioning and block preparation of certain cases, such as cancer resection specimens. Computerized forms have been shown to improve the completeness of cancer pathology reporting.

**Standardize Tasks and Language**

It is best to have only one standard operating procedure for each process. This eliminates confusion as to which procedure should be used and saves time and effort in training individuals in 2 or more methods. Standardized terminology is also imperative at many levels. First, standardized diagnostic terminology is necessary to assure that patients are getting the correct treatments as prescribed by clinical trials. Although a national consensus on all diagnostic terminology is unlikely in the near future, pathologists and clinicians in the same institution should agree on diagnostic terminology and other parameters necessary for the proper determination of patient therapy. Pathologists should also agree with histotechnologists on the meaning of common everyday terms, such as levels or recuts.

**Reduce the Number of Handoffs, Simplify the Process**

Surgical pathology has multiple handoffs and these focal points are potentially problematic and error prone. Handoffs occur starting with labeling of the specimen that is delivered to the laboratory, accessioned, grossly examined, placed in a cassette, embedded, cut, transferred to a slide, interpreted, dictated, transcribed, and reported. Each of these steps represents a handoff with the potential for mishap. No single technological aid can eliminate all of these handoffs, but there are ways to safeguard the system, including adequate training of personnel, particularly with regard to the pitfalls present at handoffs, use of strict labeling requirements, use of barcode technology to input information whenever possible, and removing distractions.

**Design for Errors**

A system should be designed with timely secondary checks that allow for identification of errors and correction before final sign-out. In surgical pathology, this may include case review before final sign-out of a case, which many institutions require on selected malignancies or certain types of cases. Report proof reading and other audits have been shown to detect errors beyond simple typographical errors. In histology, careful checking of block content versus gross dictation versus slide content serves as a safety net to ensure that tissue blocks and slides have been labeled correctly.

**Adjust the Work Schedule**

Traditionally, surgical pathology tissue processing occurs as batch work. This results in work processes that ebb and flow. Batch work typically puts periodic strains on the system, which can result in errors when people try to work faster and cut corners, particularly if there is a perceived deadline. Therefore, a good understanding of the workflow in the laboratory is essential so that schedules can be adjusted to handle increased work in a timely and appropriate way.

**Adjust the Environment**

The physical and psychologic environments are equally important. The physical environment should include reasonably comfortable furniture in sufficient, well-lit space. Attention should be paid to areas in which specimens or slides are gathered. Inadequate space may lead to specimen mix-ups, particularly at accessioning, at the grossing stations, and during block cutting. A healthy, nurturing,
low-stress psychologic environment is also desirable. When errors occur, care must be taken to avoid blame and shame, which may lead to self-protective behavior that is ultimately detrimental to improvement. Error analysis should be performed objectively, based on data. A healthy nurturing environment that is open to new ideas is optimal.

**Provide Adequate Training**

Although most people applying for a job are qualified through their education and experience, most institutions are fairly unique in their physical plant and procedures. Therefore, individuals must be trained in the idiosyncrasies of each institution or department. In addition, individuals must be trained in safety protocols, quality assurance, and in the management of problematic cases. With adequate training, workers are better able to recognize situations that can lead to errors and can address errors more easily when they occur.

**Choose the Correct Staff for the Correct Job**

An individual job title usually includes multiple duties and responsibilities. People with that job title would have the same basic qualification; however, individuals will have strengths and weaknesses with respect to their various duties and responsibilities. It is optimal that individuals be placed in jobs in which they are strong. Without adequate training, assigning individuals to duties in their areas of weakness is a set-up for failure and may result in errors.

**COMMENT**

Unless there is a dramatic paradigm shift in the processing of tissue specimens in surgical pathology, significant error reduction is unlikely to occur without a sustained comprehensive effort addressing all areas of the test cycle. In this article, we listed factors that contribute to errors and general principles that may reduce errors. The adoption of new technologies as they become available is key to addressing many of these strategies. A comprehensive computer system may facilitate many of these issues, particularly if the system includes features such as remote order entry, barcode technology, facilitates block and slide labelers, automatic order-generating capabilities for histology and other ancillary studies, and synchronization with an electronic medical record. If possible, use of automated instruments, such as stainers and block and slide labelers, is desirable and eliminates error-prone tasks. Other important aspects of reducing errors include a comprehensive, meaningful training and educational program for workers, one that addresses the skills and knowledge necessary to complete work, but also addresses training in error reduction, quality assurance, and actions when mishaps occur. Finally, it is important to remind workers, particularly those doing routine tasks, of the relevance of their jobs to patient care. People have pride in their work and are more likely to accept changes aimed at error reduction if they know it will improve patient care.

**References**