Cost Effectiveness of Intraoperative Gross Examination in Colorectal Resections

A Retrospective Review of 200 Consecutive Cases

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• Context.—Intraoperative pathology consultation is an important tool for many surgical procedures and is deemed appropriate when the pathology result immediately alters surgical management.

Objective.—To evaluate the utility of intraoperative gross examinations of colorectal resections and to better understand the associated costs.

Design.—The pathology database of our institution was searched for colorectal resections for primary disease, and those cases were separated into 3 categories: frozen section performed, intraoperative gross examination performed, and no intraoperative consultation. We reviewed 270 cases during a 15-month period.

Results.—Of the 270 cases, 200 (74.1%) had an intraoperative gross examination. In 34 of the 200 cases (17%), additional specimens were taken and, therefore, required operative note review to ascertain whether the additional specimens taken were based on the findings from the intraoperative gross examination. After reviewing the operative notes for those 34 cases, none (0%) were a result of the gross findings reported. The average associated time for intraoperative gross examinations was 27.67 minutes (including transport). The billable costs exceeded $7000 during the study period, and the cost of the pathology assistant’s time per case was $22.10.

Conclusions.—Our study demonstrates that no change in surgical management was a result of gross examination of colorectal resection specimens and that the associated costs were significant. Decreasing unnecessary consultations will directly save the health care system money by eliminating billable services and will also increase the efficiency of the pathology department by reducing the opportunity costs for the time of the pathologist and the pathology staff.

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A prerequisite for some specimens. At our institution, colorectal resections, which can be performed for an array of both benign and malignant conditions are also often sent for intraoperative gross examination.

Gross examinations for colorectal resections generally include describing the mucosa, identifying any lesions, and measuring the distance of a lesion to the nearest margin. However, from our experience, many of those intraoperative consultations do not help dictate further management. Other studies have evaluated the use of frozen sections in colorectal resections.7 Our goal in this study was to evaluate the utility of intraoperative gross examinations of colorectal resections and their effect on immediate surgical management.

MATERIALS AND METHODS

The pathology database of our institution was retrospectively reviewed for cases in which an intraoperative gross examination for a colorectal resection was performed. The cases were filtered based on whether an extra specimen was received that could have been due to the gross findings reported back to the surgeon (extra segments of bowel, lymph nodes, soft tissue, among others). Next, operative notes for those cases were reviewed to determine whether the extra specimen received was actually due to the intraoperative pathology consultation. Colorectal resections during the same period were also searched for adenocarcinoma that had either a frozen section performed or no intraoperative pathology.
consultation requested. The distances to the nearest margin of all 3 types of cases (gross examination only, frozen section, and no pathology consultation) were then compared. The average turnaround time for the 30 most-recent gross examination-only cases was calculated using the time of accession and the callback time. At our institution, the pathology staff is responsible for retrieving specimens from the operating rooms; however, transport time is not well documented. To account for the added transport time and to better reflect the true costs associated with intraoperative gross examinations, the overall turnaround time was documented on 12 separate, prospective cases.

RESULTS

During a 15-month period (March 2014 to May 2015) we reviewed 270 colon resection cases. In 200 of these (74.1%), an intraoperative gross examination was performed for a variety of 21 distinct diagnoses (based on the associated surgical pathology report), with the 3 most-common diagnoses being adenocarcinoma (n = 95; 48%), inflammatory bowel disease (n = 42; 21%), and diverticular disease (n = 19; 9.5%; Table 1). Fourteen different surgeons requested intraoperative gross examinations with the top 6 pathologists accounting for more than 91% (183 of 200) of the requests and 40 requests (20%) made by a single surgeon (Table 2). In addition, during the same period frozen section microscopic examination was performed on 26 colon resection cases of adenocarcinoma, with an additional 44 colon resection cases of adenocarcinoma for which no intraoperative examination was requested.

In 188 of these 200 cases a distance to margin was noted in the pathology report. The median distances to the closest margins were 6.1, 5.0, and 3.0 cm for the no intraoperative examinations, gross examinations, and microscopic/frozen section examination groups, respectively. Using the median distance to closest margin of the frozen section group (3.0 cm) as a reference point, we observed a statistically significant increase in the percentage of cases in the gross examination group with a distance to the closest margin of more than 3.0 cm: 12 of 26 cases (46%) in the frozen section group, compared with 86 of 118 cases (73%) in the gross examination–only group (Fisher exact test, P = .01; Table 3). Importantly, we observed no significant difference when comparing the no intraoperative examination with the gross examination groups for the proportion of cases having a distance to the closest margin of greater than 3.0 cm: 35 of 44 cases (80%) in the no intraoperative consultation group as compared with the 86 of 118 cases (73%) in the gross examination–only group (Fisher exact test, P = .42). We also characterized the overall distribution of the distance to closest margin in the 3 subsets of colon resections for adenocarcinoma. Similar to the threshold-based approach above, we observed a statistically significant increase in the distribution of the distance to closest margin for the gross examination–only group, as compared with the frozen section group in the cases of adenocarcinoma (Kolmogorov-Smirnov test, P = .048). Again, no statistically significant difference in the distribution of distance to closest margin was found when comparing the gross examination–only group to the no intraoperative consultation group (Kolmogorov-Smirnov test, P = .13; Figure).

Of the 200 cases reviewed with gross examination only, 34 (17%) had additional specimens that had the potential to be the result of the findings from the intraoperative gross examination. After reviewing the operative notes for those

### Table 1. Final Diagnoses for Cases Sent for Intraoperative Gross Examination

| Diagnosis                                      | Cases, No. (%) | n = 200 |
|------------------------------------------------|----------------|---------|
| Adenocarcinoma                                 | 95 (47.5)      |         |
| Colitis                                        | 42 (21)        |         |
| Diverticular disease                           | 19 (9.5)       |         |
| Tubular adenoma                                | 8 (4)          |         |
| Biopsy site changes (history of adenocarcinoma)| 7 (3.5)        |         |
| Tubulovillous adenoma                         | 5 (2.5)        |         |
| Familial adenomatous polyposis                 | 3 (1.5)        |         |
| Fistula                                        | 3 (1.5)        |         |
| High grade dysplasia                          | 3 (1.5)        |         |
| Carcinoid                                      | 2 (1)          |         |
| Histologically unremarkable                    | 2 (1)          |         |
| Metastases                                     | 2 (1)          |         |
| Squamous cell carcinoma                       | 2 (1)          |         |
| Appendiceal mucinous neoplasm                  | 1 (0.5)        |         |
| Dysplasia                                      | 1 (0.5)        |         |
| Neuroendocrine tumor                           | 1 (0.5)        |         |
| Pancreatic cancer/Whipple disease              | 1 (0.5)        |         |
| Sessile serrated adenoma                       | 1 (0.5)        |         |
| Stricture                                      | 1 (0.5)        |         |
| Volvulus                                       | 1 (0.5)        |         |
| **Total cases**                                | **200 (100)**  |         |

### Table 2. Number of Cases by Surgeon

| Surgeon | Cases, No. (%) | n = 200 |
|---------|----------------|---------|
| A       | 40 (20)        |         |
| B       | 38 (19)        |         |
| C       | 33 (16.5)      |         |
| D       | 28 (14)        |         |
| E       | 28 (14)        |         |
| F       | 16 (8)         |         |
| G       | 3 (1.5)        |         |
| H       | 3 (1.5)        |         |
| I       | 3 (1.5)        |         |
| J       | 3 (1.5)        |         |
| K       | 3 (1.5)        |         |
| L       | 1 (0.5)        |         |
| M       | 1 (0.5)        |         |
| **Total cases**                               | **200 (100)**  |         |

### Table 3. Breakdown of Distance to Margin Stratified by Type of Intraoperative Consultation

| Distance to Margin, cm | None, n = 44 | Gross Only, n = 118 | Frozen Section, n = 26 |
|-----------------------|--------------|---------------------|------------------------|
| ≤3                    | 9 (20)       | 32 (27)             | 14 (54)                |
| >3                    | 35 (80)      | 86 (73)             | 12 (46)                |

*There is a statistically significant increase in the proportion of cases with distance to margin greater than 3.0 cm when comparing gross examination only to frozen section (Fisher exact test, P = .01). However, no statistical difference was observed for distance to margin greater than 3.0 cm when comparing the no intraoperative examination group to the gross examination only group (Fisher exact test, P = .42). The median distance to margin of 3.0 cm from the frozen section group was used as a reference point above.*
Intraoperative Examination

| None | Gross Only | Frozen Section |
|------|------------|--------------|
| None | NS         | $P = .05$    |

The distribution of the distance to nearest margin stratified by the type of intraoperative consultation for neoplasms in the colon. The histograms of distance to nearest margin via horizontal bar graphs are shown for no intraoperative consultation (none), gross examination (gross), and microscopic intraoperative consultations (frozen section). No significant difference (NS) was observed ($P = .13$) when comparing gross examination only to no intraoperative consultation. Cases with frozen sections were significantly ($P = .05$) enriched for smaller distances to nearest margin. Statistical tests above were 2-tailed, 2-sample Kolmogorov-Smirnov tests.

34 cases, none (0%) of the additional specimens were a result of the gross findings reported to the surgeons. The average turnaround time for the 30 most-recent cases was 14.44 minutes (not including transportation to and from the operating rooms). The average turnaround time, including transport, of the 12 prospectively evaluated intraoperative gross examination cases was 27.67 minutes.

**DISCUSSION**

Surgeons request intraoperative consultations (both microscopic frozen sections and gross examinations) for many reasons, including the need to guide further surgical therapy, personal curiosity, and the ability to give patients and their families immediate results. In academic medical centers, it also serves as an opportunity for clinicians to more reliably harvest tissue for research purposes. However, pathology consultations during surgery should only be used when results will immediately alter surgical management. Our study showed that no change in management was the result of an intraoperative gross examination of colorectal resection specimens.

The most applicable use of intraoperative gross examinations for colorectal resections is margin status evaluation, and the most recent National Cancer Institute guidelines recommend 5 cm of clearance to minimize anastomotic recurrence. For rectal tumors, some have deemed less than 5 cm of clearance as acceptable. In our study, extra margins were not received for the cases with less than 5 cm of margin clearance reported during intraoperative gross examination, signifying pathology consultation during surgery for margin status was not crucial for surgical decisions. Interestingly, cases sent for frozen section had tumors that were closer to the margin when compared with cases not sent for frozen section ($P < .05$). Thus, it can be concluded that surgeons are clinically aware when there is a true concern for margin status, and they send those cases for intraoperative microscopic examination rather than just gross examination. When lateral margin status is not as concerning, some surgeons have been opening specimens on the back table of the operating room, which allows surgeons to provide information to the patient and his or her family. However, specimen integrity is crucial for proper examination by pathology. Having surgeons open specimens in the operating room can lead to compromised margin status because tumors are often transected during opening and before specimen inking, particularly for anorectal cancers in which there is a true circumferential soft tissue margin. To avoid that problem, a more viable solution is examining specimens in the pathology department with the surgeon after completion of the case and without a formal intraoperative consultation. The findings from this study are provocative but are limited because they were focused on the particular clinical/pathologic context of colon resections. Additional specimens examining more tumor types along with different clinical/pathologic contexts will need to be examined in a similar manner to better characterize this important issue.

Patients are often referred to surgeons from gastroenterologists who have detected malignant lesions. Often, surgeons will not have performed the preoperative colonoscopy and must rely on a colonoscopy report and tattoo ink for the location of a lesion. Some lesions may not be palpable intraoperatively and tattoo ink may not be readily identified. In such cases, surgeons may resect blindly based solely on the reported location of the lesion. In that situation, opening the specimen to identify the lesion and confirm adequate resection may be useful, which can be performed without a formal consultation.

Although the direct costs (reimbursement and pathology staff time) are not particularly high for intraoperative gross examinations, indirect costs can make them low-yield procedures. From our study, the average time committed to these gross examinations was nearly 30 minutes. This is a significant opportunity cost—the loss of potential gain from the next-best alternative (ie, time that could have been spent by pathology assistants examining other gross specimens and generating revenue). Furthermore, intraoperative pathology consultations may increase operating times, leading
to less efficient use of operating rooms and unnecessarily prolonged patient exposure to anesthetic agents, all of which can contribute to the potential for intraoperative pathologic examination to negatively affect patients.\textsuperscript{12–15}

The US health care system is at a crossroads because the current rate of growth in expenditures versus reimbursements is not sustainable. From 2009 to 2013, health care expenditures accounted for 17.4% of the gross domestic product and in 2013 health care expenditure per capita was slightly more than $9000.\textsuperscript{16} However, the system continues to underperform on measures of health outcomes, quality, and efficiency when compared with other developed countries.\textsuperscript{17} In an attempt to increase quality and bend the health care cost curve, the Affordable Care Act was passed in 2010, with reimbursements being more closely tied to outcomes. Several national initiatives have been started, most notably the Choosing Wisely campaign launched by the American Board of Internal Medicine, which aims to reduce unnecessary medical tests and procedures.\textsuperscript{18} Finding ways to drive value (defined in health care as outcomes divided by costs) and to eliminate excess use within an organization will become imperative as reimbursements become further tied to quality of care.\textsuperscript{19} Decreasing unnecessary consultations will save the health care system money directly by eliminating billable services and will also increase the pathology department’s efficiency by reducing the opportunity costs of the time of the pathologist and the pathology staff.\textsuperscript{20–22}

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