

Is endoscopic screening before major surgical procedures warranted?

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Background: Gastroenterologists are frequently requested to perform endoscopic procedures to rule out cancer or other serious GI disease before major surgical operations.

Objective: To assess whether such requests are warranted.

Design: Cost benefit analysis by using decision tree and threshold analysis.

Patients: Subjects scheduled for liver and kidney transplant or other major surgeries.

Main Outcome Measurements: Costs of medical and surgical procedures. The threshold value is defined as the a priori probability for a GI diagnosis, where the benefit of endoscopy changes from unfavorable to favorable as the diagnostic probability increases.

Results: For all types of organ transplants, the threshold probability for diagnosing a GI disease by endoscopy is lower than 1%. Such a low threshold suggests that if a disease cannot be ruled out with certainty before transplant operations or any other major surgical operation, endoscopic screening would be warranted. For lesser interventions, such as percutaneous transluminal coronary angioplasty and coronary bypass grafting, the threshold value varies between 3.2% and 6.5%, which suggests that endoscopic screening may be justified if there are sufficient grounds to suspect a comorbid medical condition that could compromise the success of the planned surgical intervention.

Limitations: The model only considers procedure costs and assumes no endoscopic complications.

Conclusions: Endoscopic screening before costly and invasive surgical or other medical interventions is justified. (*Gastrointest Endosc* 2006;64:375-8.)

Gastroenterologists are frequently asked to perform endoscopic procedures to rule out cancer or other serious GI disease before planned surgical operations. Typical scenarios include, for instance, colonoscopy scheduled routinely before kidney, liver, or heart transplant. An EGD is also frequently requested in patients scheduled for percutaneous transluminal coronary angioplasty (PTCA) or coronary bypass grafting (CABG) to rule out potential bleeding sites of the upper-GI tract. A CT before surgery may reveal pancreatic cysts that the surgeons may want to have evaluated by EUS before the surgery. Other scenarios abound. Is such common practice justified or should such requests for screening endoscopy be declined?

Several obvious clinical parameters influence the answer to this question, including the a priori probability of finding a serious diagnosis through endoscopy, the impact of such diagnosis on operative success, and the cost of the endoscopic procedure compared with the cost of the surgery itself. Based on the author's own past experience of large numbers of negative endoscopies in transplant candidates, it was hypothesized that the practice of presurgical endoscopic screening would not be warranted. A decision analysis was performed to test the hypothesis.

MATERIALS AND METHODS

Threshold analysis

The question of whether to perform endoscopy before surgery was modeled in terms of a decision tree, as shown in Figure 1. A physician can decide between surgery

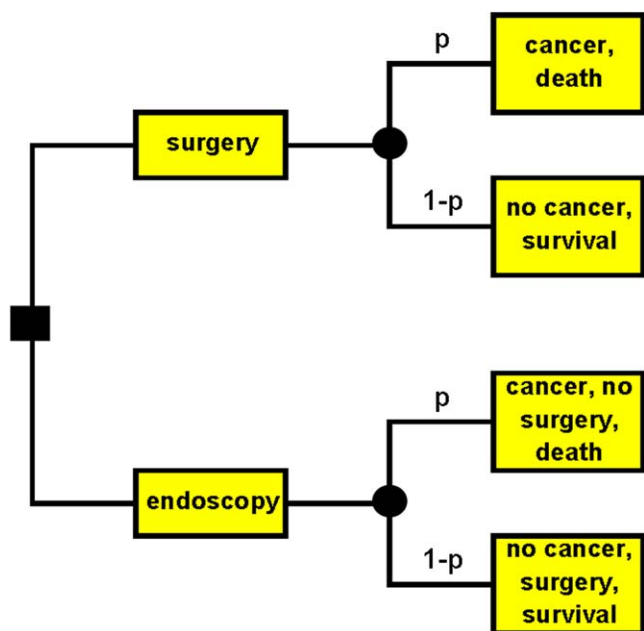


Figure 1. Decision tree of whether to perform a screening endoscopy before surgery to avoid the potential loss of surgical expenditures secondary to GI cancer.

without endoscopy (upper branch) or surgery preceded by endoscopy. Both decisions are associated with the same 2 probability values, p and $1-p$. First, with a probability of p , the patient may harbor cancer or another serious medical condition that will cut short the patient’s life expectancy. Second, with a probability $1-p$, the patient will be free of cancer or any other serious medical condition. The principal difference between the upper and the lower 2 outcomes relates to the time point and, consequently, the cost of surgery. Although everyone undergoes surgery according to the upper decision branch, with the lower decision branch, surgery is reserved for those patients who are cancer-free as evidenced by endoscopy. The decision tree models the basic question of whether saving futile surgery in a few subjects with cancer justifies the expense of endoscopy in all surgical candidates. In **Figure 1**, the model is depicted in terms of cancer and surgery. In principle, however, the same type of analysis applies if surgery is replaced by any other costly medical intervention and cancer is replaced by any other serious medical condition that would invalidate the outlays for the costly medical intervention.

For both decisions to be associated with the same expected outcome, the following equation must hold:

$$\begin{aligned} & \text{surgery} + p \cdot \text{death} + (1 - p) \cdot \text{survival} \\ & = \text{endoscopy} + p \cdot \text{death} + (1 - p) \cdot \text{survival} \quad [1] \\ & + (1 - p) \cdot \text{surgery} \end{aligned}$$

Because the terms involving death and survival are identical on both sides of the equation, they cancel out, and equation [1] can be simplified to:

Capsule Summary

What is already known on this topic

- Gastroenterologists are frequently asked to perform screening endoscopic procedures before planned surgery, but the cost-benefit relationship of this practice is unknown.

What this study adds to our knowledge

- When using a decision tree and threshold analysis of costs of complication-free endoscopic procedures, the probability for diagnosing GI disease before organ transplant is lower than 1%, suggesting that screening would be warranted if a disease could not be ruled out with certainty before surgery.
- For lesser interventions, such as PTCA and CABG, the threshold value ranges between 3.2% and 6.5%, suggesting that endoscopic screening may be justified if there are sufficient grounds to suspect a comorbid medical condition.

$$\text{surgery} = \text{endoscopy} + (1 - p) \cdot \text{surgery} \quad [2]$$

or

$$\text{\$surgery} = \text{\$endoscopy} + (1 - p) \cdot \text{\$surgery} \quad [3]$$

where $\text{\$surgery}$ and $\text{\$endoscopy}$ indicate the cost of these procedures. This equation can be solved for p :

$$p = \text{\$endoscopy} / \text{\$surgery} \quad [4]$$

The last equation provides the threshold probability for a GI diagnosis that would make the costs of both the upper and the lower decision branch be equal. If the probability of a serious GI diagnosis exceeds this threshold, presurgical endoscopy becomes the more favorable and less costly decision. The threshold value is, thus, defined as the a priori probability for a GI diagnosis where the potential benefit of endoscopy changes from unfavorable to favorable as the diagnostic probability increases. The threshold probability depends only on the financial costs of endoscopy and surgery. The costs of endoscopy, including the biopsy, were estimated from data provided by the U.S. Federal Center for Medicare Services (CMS). The costs of PTCA and CABG were taken from a publication by Weintraub et al.¹ Lastly, the Milliman report lists the costs of various types of organ transplants in the United States.²

RESULTS

Thresholds for common medical interventions

The costs and corresponding thresholds for 2 endoscopic procedures and various surgical interventions are shown in **Table 1**. For all 3 types of organ transplants, the thresholds were lower than 1%. These low thresholds suggest that endoscopy would be warranted before all transplant operations or any other expensive surgical

operation. In most elderly patients, it would be difficult to exclude the possibility of colorectal cancer or other serious colonic disease with a certainty of more than 99%.³ Such high certainty of exclusion would only apply to patients who had undergone a recent colonoscopy for other medical reasons or who are younger than 50 years old. The more expensive the operation, the more endoscopic screening becomes indicated. This general rule would apply similarly to other types of expensive and invasive types of surgery besides organ transplant, such as esophagectomy or pancreaticoduodenectomy. When considering the large costs of the planned surgery, endoscopy amounts to little additional expense to guarantee a successful outcome and to prevent an expensive medical intervention from going to waste on a poor operative candidate.

It has been reported that the price of endoscopy varies markedly among different medical centers.⁴ A lower cost would reduce and a higher cost would increase the threshold value. However, even with a 2- or 3-fold increase of endoscopy costs, presurgical screening would still seem justified in circumstances of a highly invasive and expensive surgical procedure.

For PTCA and CABG, the threshold values vary between 3.2% and 6.5%. The cumulative incidence and the mortality of colorectal cancer are lower than this threshold in any age group, even in the oldest one with the highest age-specific cancer incidence rate.^{3,5} Unless a patient presents with symptoms or signs suggestive of preexisting colonic disease, it does not make sense to routinely screen patients for colorectal cancer before PTCA or CABG. Moreover, if cancer occurred in such patients after a successful PTCA or CABG, it would not necessarily invalidate the original procedure. Surgery could still be performed on the cancer, albeit with an increased risk in patients with a severe comorbid condition, such as coronary artery disease. Because most patients undergoing PTCA or CABG are subsequently treated with anticoagulative medication, there is concern that any undetected peptic ulcer disease will result in bleeding. Because of declining infection rates with *Helicobacter pylori*, the prevalence of peptic ulcer has continued to decline during the past 3 decades.^{6,7} The prevalence of peptic ulcer disease in the general population is currently lower than the threshold of 3%.⁸ In a patient on chronic nonsteroidal anti-inflammatory drugs (NSAID), however, the risk for NSAID-induced ulceration could still exceed even the highest threshold of 6.5%. Similarly, the probability of a comorbid condition may well surpass such a high threshold in a patient with chronic liver disease or with a previous history of upper-intestinal bleeding from a Mallory-Weiss tear, esophageal varices, or some other upper-GI source.

DISCUSSION

Based on my own clinical experience of many negative screening endoscopies, I initially hypothesized that such

TABLE 1. Costs and thresholds associated with various medical interventions

Item	Cost, \$	EGD threshold, %	Colonoscopy threshold, %
EGD*	800	100.0	—
Colonoscopy*	1300	—	100.0
PTCA†	20,000	4.0	6.5
CABG†	25,000	3.2	5.2
Transplant‡			
Kidney	143,000	0.6	0.9
Liver	314,000	0.3	0.4
Heart	392,000	0.2	0.3

*Costs of endoscopy with biopsy obtained from CMS.

†Costs of PTCA and CABG taken from reference 1.

‡Costs of organ transplants in the United States taken from reference 2.

practice was not justified and that endoscopy resources were being wasted pursuing requests for screening endoscopy. The decision analysis indicates, however, that for major invasive medical procedures, such as most types of organ transplant, endoscopic screening is a feasible management strategy. Even for lesser interventions, such as PTCA and CABG, endoscopic screening may be justified, if there are sufficient grounds to suspect a comorbid medical condition that could compromise the success of the planned intervention.

The decision problem underlying the present study was tackled by using a relatively simple decision tree and by applying the concept of threshold analysis.⁹ All secondary outcomes and lesser probabilities were ignored and are omitted from the decision model. By focusing on the few main parameters that influence the decision, the analysis becomes transparent and easy to follow. In contrast with economic parameters or cost-effectiveness ratios, the threshold value represents a parameter that has direct relevance to clinical practice. Its calculation is based on the cost ratio of endoscopy to surgery. This ratio appeals to an intuitive approach on how to solve the problem. Even without deeper mathematical insight, in addressing the decision of whether to perform presurgical endoscopic screening, one would tend to balance the cost of endoscopy against that of surgery. The order of magnitude of the threshold value can be estimated in one's head without any mathematical aids. Moreover, this concept can be easily extended to a large variety of clinical scenarios that involve other endoscopic procedures and other types of surgical and nonsurgical interventions.

It is important to keep in mind the limitations of the present analysis. The analysis deals with the question of

whether it is beneficial to schedule an endoscopy before major surgical procedures. It does not address the issue of cost-effectiveness of such an approach or the overall cost-effectiveness of the surgical procedure itself. The cost-effectiveness of transplant surgery frequently exceeds the typical \$50,000 or \$100,000 per life year gained used as a benchmark for most clinical interventions. The analysis also does not take into account any of the possible harms that may be incurred through endoscopic screening. Treatment of benign lesions, such as polyps or arteriovenous malformations found incidentally during screening endoscopy, could result in bleeding or perforation. Patients with advanced liver, kidney, or heart disease are less likely to survive the major health risks of endoscopic complications. Because the risk for serious GI disease varies with age and sex, so does the potential benefit of endoscopic screening. The benefit of endoscopy also varies with the probability of its findings. The potential benefit of screening for colon cancer exceeds the benefit of screening for most other conditions, such as Barrett's esophagus, peptic ulcer disease, or even varices. Although the analysis provides varying threshold probabilities for various endoscopic interventions, in clinical practice, it may be difficult to reliably estimate the pretest probability of disease for a variety of patients and conditions.

In conclusion, a simple decision analysis that used threshold analysis revealed that the common practice of endoscopic screening for GI cancer and other serious GI disease before costly and invasive surgical and other medical interventions was justified. The model presented in this article can be easily used to address other similar scenarios of presurgical work-up involving endoscopy and other GI tests.

DISCLOSURE

The author attests that he has no commercial associations (eg, equity ownership or interest consultancy, pat-

ent and licensing agreement, or institutional and corporate associations) that might be a conflict of interest in relation to this article.

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Received January 13, 2006. Accepted April 7, 2006.

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