

Operating Room Cost versus Outcome in Elective Colectomy

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Abstract

Objectives: Surgeons and health systems face challenges in achieving healthcare cost containment without compromising patient outcome. This study objective was to correlate operating room costs of elective colectomies with their outcome.

Design: Retrospective observational study. Statistical analysis included t-test, ANOVA and Spearman correlation between continuous variables.

Setting: Tertiary care medical center.

Patients: 114 consecutive patients who underwent an elective colectomy were analyzed collectively and in subgroups by type of operation: Laparoscopic right colectomy, Open right colectomy, Laparoscopic left colectomy, Open left colectomy, Open total colectomy/proctectomy, Laparoscopic converted to open colectomy. Operating room cost was calculated as charges for equipment utilized and personnel cost.

Main Outcome Measures: Outcome was expressed as a weighted numerical score for each patient, ranging from 0 to 10. The score took into account hospital length of stay, complications, 30-day readmission and mortality.

Results: Colectomy cost ranged from \$387 to \$8262 (mean=\$2176 ± 1244). The mean outcome score was 8.01 ± 2.4 (p=0.091). Operating room cost did not correlate with outcome, collectively or per subgroup.

Conclusions: Higher operating room expenditures did not achieve a superior outcome for elective colectomy. This preliminary work may prompt further analyses of resource utilization versus outcome in surgical practice.

Keywords: Surgical quality metrics; Colectomy; Surgical outcomes

Introduction

In the practice environment resulting from healthcare reform, characterized by increased health costs coupled with decreased reimbursement, both hospitals and physicians are facing new challenges in health care delivery with increasing focus on quality indicators [1]. The goal of delivering cost effective care without compromising outcome necessitates monitoring of healthcare expenditures and their impact on clinical outcomes. The delineation of various cost-saving measures and their consequences on patients has yet to be clearly defined. Reimbursement incentives for achieving targets such as reduction in length of stay and readmission rates have been described, but have not provided conclusive results with regard to their impact on patient management among different physicians [2,3]. Studies on the variability of cost in common surgical procedures and its impact on outcome may potentially contribute to determining value in health care, as defined by achievement of high quality of care along with judicious resource utilization.

For example, short-term outcome measures for major abdominal surgical procedures may include rate of complications and readmissions and duration of hospitalization [4,5]. Systematic quantitative assessment of complications and their severity is still not standardized across health care systems [6]. The current absence of a clinical outcomes score weighted by surgical experts has been felt most prominently in light of expanding efforts by the Centers for Medicare and Medicaid Services to reduce hospital costs by targeting hospital performance measures, including readmission rates [7,8]. The integration of a collective grading system to evaluate and compare short-term outcomes of different procedures would likely facilitate a more equitable allocation of resources [9]. Economic evaluation of length of stay, post-operative complications and overall surgical outcome metrics may lead to an inventory of feasible cost containment measures [10].

The objective of this study was to evaluate intraoperative cost differences in a high-volume acute care hospital. As a common and fairly standardized surgical procedure, colectomy was chosen as the operative intervention to analyze. In particular, a major focus of this analysis was to determine whether or not higher operating room costs yielded superior outcome in the postoperative recovery phase.

Methods

Data source

This study was approved by the Institutional Review Board. It involved a retrospective analysis of prospectively collected data from the hospital Operating Room Charges database from March 2010 to July 2011. The database described patients who underwent an elective colectomy at the institution. Direct health services costs included operating room costs, by adding operating room time and supplies to charges by increments of time for anesthesia and other services. Professional fees of surgeons were not included in the cost analysis. Additional data was collected as information on patient demographics, disease characteristic, and overall postoperative course variables to be analyzed.

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Study population

All patients who underwent a colectomy from March 2010 to July 2011 were identified using the procedure label "colectomy". Patients who underwent emergency procedures or other major procedures at the time of colectomy were excluded, due to impact on total operating room time or utilization of additional resources. The study cohort was limited to patients with elective admissions for a colectomy. Patients who received additional minor procedures with no additional incisions (e.g. umbilical hernia repair) at the time of their colectomy were included in the study. A total of 114 consecutive patients were included in the study, 61 males (53.5%) and 53 females (46.5%), ranging in age between 22 and 88 years of age (mean=60.5 years).

Patient group assignment was made according to extent/site of colectomy as well as technique used: Right colectomy - laparoscopic, Right colectomy - open, Left colectomy - laparoscopic, Left colectomy - open, total colectomy/proctectomy - open. Patients who underwent a laparoscopic converted to open colectomy were also identified.

Mean Outcome Measures

Data on type of surgery, 30-day postoperative morbidity and mortality, length of stay and rates of re-admission and re-operation were obtained. The outcome was expressed as the composite of a novel weighted numerical score for each patient, ranging from 0 (worst) to 10 (best), proposed by the lead author (V. E. Pricolo) (Table 1). A more favorable outcome was directly correlated with a higher score, 10 being the highest possible score. A maximum of 3 points was awarded for best length of stay data, while a maximum of 7 points for absence of any complications. The degree of severity among postoperative complications was stratified from a 0 to 7 point system, with zero indicating mortality (Table 1). If multiple complications occurred, for purposes of analysis, the more severe complication was chosen and the lower score was assigned.

Cost measurements of the elective operative management of each patient included a total operating room case cost, i.e. a composite score of supply cost as well as labor cost.

Statistical analysis

Univariate and multivariate comparisons were done using the 2-sample *t*-test, ANOVA and Spearman correlation between continuous variables of total operating room cost (in \$) versus outcome (0-10 score). For all tests, a *p* value < 0.05 was considered statistically significant. All statistical analyses were stratified by a two-tier group assignment, which included the laparoscopic and open colectomy groups as well as the further subdivisions of different extent and site of colectomy procedures.

Results

The distribution of operative procedures, their cost and outcome (expressed as a mean \pm standard deviation) and statistical data are reported in Table 2. Operative procedures included 29 laparoscopic right colectomies (25.4%), 21 open right colectomies (18.4%), 10 laparoscopic left colectomies (8.8%), 26 open left colectomies (22.8%), 22 open total colectomies and/or proctectomies (19.3%), and 6 laparoscopic converted to open colectomies (5.3%). For the entire group of patients, operating room costs ranged from \$387 to \$8262 (mean=2176 \pm 1244). The mean total outcome score was 8.01 \pm 2.4. Postoperative length of stay for the whole group ranged from 2 to 58 days, with a mean of 7.2 days. A total of 46 patients (40.4%) experienced a complication of any kind. The most common complications were found at a score of 6 and 4 (13/114=11.4%), followed by scores of 5 and 3 (5/114=4.4%). There were 2 deaths (composite score of 0),

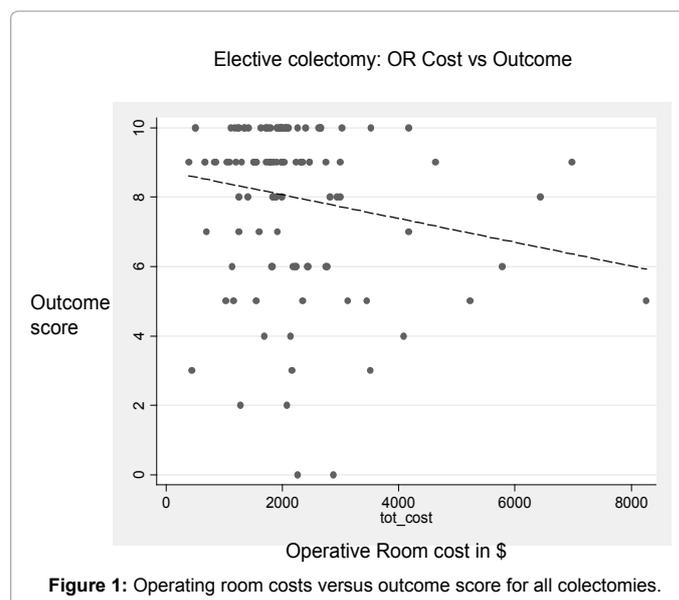
while a score of 10 was achieved in 37 patients (32.5%). There was a trend toward lower complication rate in comparable site procedures performed laparoscopically rather than open. The complication rate for right colectomies was 20.7% (lap) vs. 28.6% (open), for left colectomies 20% (lap) vs. 61.5% (open). However, the cost trend was higher in laparoscopic than in open procedures: \$2165 \pm 629 vs. \$1318 \pm 515 for right colectomies; \$2392 \pm 484 vs 1970 \pm 1060 for left colectomies. Due to limited sample size, no statistical significance was achieved in these correlations. The total readmission rate was 35.9% (41/114), most commonly for abdominal pain (11/114=9.6%), followed by partial small bowel obstruction (3/114=2.6%). The mean readmission length of stay was 4 days. Figure 1 is a scatter gram that provides a visual representation of the lack of positive correlation between higher operating room costs and a more favorable outcome.

Table I: Length of stay and Complications.

Total Score (a+b)		
a. Length of Stay	≤ 4 d	3
	5-10 d	2
	11-60 d	1
b. Complications	None	7
	Ileus; Atelectasis; Arrhythmia	6
	Minor bleed; UTI	5
	Wound infection; C difficile; Internal bleed requiring transfusion	4
	Major cardiac or pulmonary complication	3
	Wound dehiscence; Deep abscess	2
	Leak; Sepsis	1
	Death	0

Table II: Operative procedures, their cost and outcome

Procedure	N	\$ Cost \pm SD	outcome \pm SD	<i>p</i> value
R - lap	29	2165 \pm 629	9.03 \pm 1.95	0.6855
R - open	21	1318 \pm 515	8.24 \pm 2.51	0.4194
L - lap	10	2392 \pm 484	8.70 \pm 2.67	0.4404
L - open	26	1970 \pm 1060	7.38 \pm 1.83	0.0681
Tot col/proct	22	3043 \pm 2097	6.77 \pm 2.65	0.4486
Lap to open	6	2585 \pm 516	8.33 \pm 1.75	0.5979



Discussion

This study raises several issues. It is intended to direct the attention of the surgical community to the relevance of operating room expenditures that surgeons are largely responsible for, yet not usually even aware of. This study shows that such costs have a very wide range of variability, from as little as \$387 to as much as \$8,262 for a colectomy. Our data showed a trend toward higher operating room cost in laparoscopic procedures, when compared to same procedures performed by open technique. However, procedures performed laparoscopically had a generally lower complication rate. Nonetheless, both overall and by subgroup, higher operating room expenditures could not be correlated with a superior outcome for an elective colectomy.

The current study has several limitations. The results were obtained from single institutional data, which might not accurately represent other population groups. Consequently, the study sample size is relatively small, which allowed limited statistical analysis by subgroup. Also, the study was not case-matched according to underlying patient co-morbidities [11]. The retrospective design of the study may not be a limitation, in that it prevented any awareness on the part of surgeons that may have led to changes, possibly reduction, in their operating room expenditures (Hawthorne effect).

The main value of this study lies in its timeliness and originality. It proposes a new, simple and reproducible scoring system that may allow outcome comparisons across institutions. It provides a way of tracking performance by institution, by procedure, by division and by surgeon, thereby facilitating data collection, feedback and quality improvement initiatives. It emphasizes the need for monitoring of expenses and its correlation with outcome, by allowing gathering of "value" data specific for each of the above mentioned categories. Such initiatives are likely to provide information that may be very useful to health care systems involved in negotiations for risk contracts with third party payors. This pilot study warrants further research on aggregated outcome scores as well as hospital performance measures, such as financial implications based on type of surgical case mix, especially in view of the implementation of healthcare reform.

Reduction of post-operative complications and length of hospital stay is fast becoming not only a moral imperative, but also an economic mandate, as health care reimbursements are further reduced [12]. The gathering of information that is procedurally-based and accounts for different factors that may affect clinical outcomes can aid cost analyses in surgery and other procedure oriented specialties [13]. Cost-effective surgical procedures may not necessarily equate suboptimal patient outcome, if key areas of safety and efficacy are preserved and possibly even further improved upon.

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Conflict of interest

Authors have no conflict of interests to declare

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