Outcomes of Complex Gastrointestinal Procedures Performed in a Community Hospital

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ABSTRACT
Background: Complex gastrointestinal (GI) procedures have been defined as those that are associated with higher morbidity and mortality, require a high level of technical expertise, and occur in less than 6000 patients per year in the United States. Prior studies suggest a direct volume-outcome relationship.

Hypothesis: Complex GI procedures may be performed with good outcomes in a lower volume hospital with a commitment to surgical residency training.

Methods: Retrospective chart review of all patients undergoing non-emergent operations that are considered complex GI procedures (esophagectomy, total gastrectomy, major hepatic resection, pancreaticoduodenectomy, biliary tract Anastomosis, and total abdominal proctocolectomy) from July 1989-June 1997 in a rural referral medical center.

Results: One hundred six consecutive patients underwent complex GI procedures during a 7-year period ending June 1997. Patients ranged from 19–90 years (mean 62). Forty-eight patients (45.3%) had 1 or more major comorbidities. Seventy-three patients (68.9%) had operations for malignancies. Average length of stay (LOS) was 13.2 days (range 5-38). Major complications occurred in 15 patients (14%). Two patients died (mortality 1.9%), 1 after esophagectomy and 1 after a Whipple procedure. LOS, morbidity, and mortality were less than or equivalent to published reports from high-volume medical centers.

Conclusion: Excellent outcomes for complex GI procedures can be achieved at lower volume medical centers. Regionalization strategies to improve patient care should be based on outcome studies rather than volume alone.

INTRODUCTION
Numerous studies have described better patient outcomes at high-volume hospitals. The inverse relationship between patient volume and mortality seems especially evident for complex procedures. Demonstrated reductions in hospital length of stay (LOS), cost, morbidity, and mortality have motivated coalitions of public and private purchasers (e.g., the Leapfrog Group) to encourage patients to undergo specified complex procedures at high-volume hospitals. Medical centers and insurance companies have also created care pathways to identify preferred treatment regimens and more appropriate locations of care. Studies reporting correlations between patient outcome and hospital or surgeon volume have examined a wide range of surgical procedures and drawn different conclusions. Gordon et al evaluated statewide outcomes of 6 complex high-risk gastrointestinal (GI) surgical procedures based on the average number of cases performed each year in Maryland. They found that high-volume hospitals (>201 procedures/year) had better outcomes than medium- (21-50 procedures/year) or low-volume centers (<10-20 procedures/year). The study reported herein examines the outcomes of the same 6 complex, high-risk GI surgical procedures that were performed at a lower-volume community hospital.

METHODS
The study population was based on 6 procedures deemed to be complex, high-risk GI surgical proce-
dures by Gordon et al. These procedures are associated with higher morbidity and mortality rates, require a high level of technical expertise, and occur in less than 6000 patients per year in the United States. The 6 procedures and their International Classification of Disease (ICD-9 CM) codes were as follows: 42.40 to 42.42—excision of the esophagus; 43.91 to 43.99—gastrectomy; 45.8—total abdominal colectomy; 50.3—hepatic lobectomy; 51.31 to 51.39—biliary tract anastomosis; and 52.7—radical pancreaticoduodenectomy. Patients who underwent these 6 procedures emergently were excluded. Age, race, sex, and admission status were recorded. Each patient’s comorbidity score was assigned using the Dartmouth-Manitoba variation of the Charlson Co-morbidity index. Each comorbid condition was assigned 1 point and then added together. A disease counted as a comorbid condition if it was coded on the discharge summary as a secondary diagnosis of either the index admission or any prior discharge lists.

All operations were performed at Gundersen Lutheran Health System, La Crosse, Wisconsin, a 325-bed tertiary care hospital in rural western Wisconsin. Gundersen Lutheran is staffed by 386 physicians in La Crosse and outreach clinics that cover a referral area of 19 counties in 3 states, with 500,000 residents. The institution provides 2 fully accredited categorical general surgery positions in a 5-year residency program. All 6 complex procedures were performed with at least 1 resident and 1 staff physician. The surgical team that performed the complex operation monitored and was in charge of the patients’ postoperative care. Minimal cross-coverage by residents and staff who were unfamiliar with patients occurred. Night and weekend coverage was almost always provided by the attending surgeon and surgical resident who performed the procedure. The surgical team remained primary physicians for patients admitted to an open intensive care unit.

Primary outcomes recorded for each patient included length of stay, perioperative death, and complications. A perioperative death was defined as death within 30 days of the operation or the patient dying as a consequence of having surgery. A major complication was defined as any postoperative event or condition that was directly related to the operative procedure and required medical or surgical intervention.

RESULTS
The study population included 106 patients treated from July 1989 to June 1997 at Gundersen Lutheran Hospital (average 13.25 cases/year). Patients were all Caucasians, with a male majority (59.4%). Age ranged from 19 to 90 years (mean age 62 years). Eighty-eight (83%) patients had either 0 or 1 comorbid disease. Fifteen patients (14.2%) had 2, and 3 patients (2.8%) had >3 comorbidities. Seventy-three (68.9%) patients underwent operations for malignancy. Table 1 lists the number of each procedure performed.

A total of 33 complications occurred in 22 patients, including 15 major (45.5%) and 18 minor (54.5%) complications. Two perioperative deaths occurred, for an overall mortality rate of 1.9%. One patient died after esophagectomy and another after radical pancreaticoduodenectomy. Each of the two patients had 2 comorbid conditions. Table 2 lists each major complication.

DISCUSSION
Luft et al suggested a possible benefit of regionalization of medical resources in 1979 based on surgical volume. Subsequently, numerous studies have been conducted to study the hypothesis that increased volume is associated with better results. In evaluating outcome after esophagectomy, at least 3 reports revealed better outcomes in higher-volume centers. Dimick et al and Kuo et al found reductions in mortality rates for esophagectomies in statewide studies in Maryland and Massachusetts. Dimick et al also reported a shorter...
hospital stay and a lower cost for esophagectomies performed at high-volume hospitals in Maryland.\textsuperscript{21} Swisher et al compared outcomes from 13 national cancer institutions and 88 community hospitals.\textsuperscript{22} Mortality was reduced from 12.2\% to 3.0\% (P=0.05) in hospitals performing more than 5 esophagectomies per year.

Choti et al studied outcomes after hepatic resections in relation to hospital volume.\textsuperscript{13} Mortality in high-volume groups was 1.5\%, compared to 7.9\% in low-volume hospitals \textit{(P}<0.01, RR=5.2). They concluded that both major and minor hepatic surgery and resections for metastatic disease could be performed more safely at higher-volume referral centers. Dimick et al detailed the postoperative complication and mortality rate of all patients undergoing hepatic resection in Maryland from 1994 to 1998. High-volume hospitals (>60 cases over 5 years) had better outcomes.\textsuperscript{4}

Many high-volume centers have reported their 30-day mortality rates and postoperative mortality rates after pancreaticoduodenectomy.\textsuperscript{9,10} Begg et al and Birkmeyer et al reported mortality rates of 3.0\% and 5.8\%, respectively.\textsuperscript{9,10} They concluded that their “high-volume” centers had lower mortality rates than lower-volume hospitals. Glasgow et al discovered similar findings in their statewide evaluation of patient outcomes after pancreatic resection in California.\textsuperscript{14} They found better outcomes and lower hospital charges in high-volume centers and concluded that regionalizing such high-risk procedures would better serve patients with pancreatic cancer.\textsuperscript{14}

However, not all studies report better outcomes in higher-volume centers. The Veterans Health Administration (VHA), in an effort to consolidate cost without compromising care, created the VHA National Surgical Quality Improvement Program. Data were collected on 68,631 operations. Khuri and Daley found no statistically significant association between procedure or specialty volume and 30-day mortality rate or 30-day stroke rate for carotid endarterectomies.\textsuperscript{7} The authors concluded that the assumptions that better surgical outcomes are achieved in high-volume hospitals cannot be proven and the “volume of surgery should not be used as a surrogate for quality of surgical care.”\textsuperscript{7}

Schwarz et al examined the outcome of a complex surgical procedure performed in a lower-volume practice.\textsuperscript{8} They documented outcomes for 54 patients undergoing pancreaticoduodenectomy for periampullary cancer from 1987-1998 (4.9 cases/year). The authors had no 30-day perioperative deaths and their LOS improved from 16.5 days to 12 days after 1995. They believed that their excellent outcomes were related to an exclusive oncology practice with surgeons who were trained at “high-volume” fellowship programs.\textsuperscript{8} Schwarz et al concluded that “quality can be independent of quantity.”\textsuperscript{8}

In a report of esophagectomy performed at 2 low-volume tertiary care centers (43 total patients during 5 years), the 30-day mortality rate was 4.7\% and the anastomotic leak rate was 11.6\%.\textsuperscript{15} Padmanabhan et al concluded that elective esophagectomy could be safely performed at low-volume centers and urged that regionalization/referral patterns for high-risk procedures should be guided by local outcomes and not by the total number of procedures performed at a specific center.\textsuperscript{15} In their published report of surgical outcomes for 6 complex high-risk GI surgical procedures, Gordon et al found that hospitals with higher procedure volumes in Maryland had a shorter LOS and a lower in-hospital mortality rate.\textsuperscript{5} In their publicly available statewide database, they compared low- and medium-volume hospitals to their own high-volume institution. Our study evaluated the same 6 high-risk procedures performed at our institution during the same 8-year period ending in 1997. The 6 procedures were performed an average of 13.25 times per year. This would categorize our hospital as a low-volume group as defined by Gordon et al.\textsuperscript{5} Gordon et al concluded that higher-volume centers were more experienced with complex procedures and better able to decrease morbidity, leading to shorter duration of hospital stay.\textsuperscript{5} Our study population had an average hospital stay of 13.2 days. This is lower than the 16.4 and 19.4 day average LOS for the high- and middle-volume providers reported in Maryland. Our 30-day perioperative mortality rate was 1.9\%, which is lower than the mortality rates reported in the statewide surgical registry of Maryland. In Maryland, Gordon et al found an 8.4\% mortality rate for medium-volume hospitals and a 2.9\% rate for higher-volume providers (Table 3). Mortality was recorded in our series not just for patients who died during the 30 days of the perioperative period, but also included those patients who were discharged home but expired thereafter from a surgical complication. Evaluating only hospital mortality rates, as reported in the Maryland registry, would exclude those patients who did well initially only to expire from complications after being discharged from the hospital. The mean age, gender, elective admission status, and percentage of patients with malignancy were all similar when comparing our study population to the Maryland registry.

The science of how to assess and improve patient outcomes in a region or nation is complex and fraught with many confounding variables.\textsuperscript{2,24,25} Investigators have
attempted to correlate patient outcome with hospital volume, surgeon volume, American Board of Surgery certification, surgical subspecialty certification, site of residency training (university versus non-university), years of surgical experience, presence of a surgical residency program, presence of dedicated “intensivist” availability 24 hours per day, closed versus open intensive care units, quality of nursing and anesthesia care, and quantity of ICU nurses.4,16-18,26-28 Many investigations focus on only 1 of the aforementioned variables, but all may be important. Factors that may confound these studies and render conclusions difficult to interpret are detailed in Table 4. Publication bias may also occur. Institutions are more likely to submit and have their results accepted for publication if they are generally positive. There is an obvious disincentive to publish poor outcomes.

The relationship of a hospital’s teaching status to patient outcome has also been studied. Flood et al stated that a hospital’s teaching status had no effect on patient outcomes.11 This study classified a hospital as a teaching hospital if both the American Medical Association (AMA) and the American Hospital Association reported them to be conducting 1 or more residency training programs and if the AMA source reported there to be at least 2 resident physicians actually present in the hospital.11 These criteria do not address the type of residencies or the type of residents present in the hospital. In a surgical outcomes assessment, the presence of a surgical residency may be more influential in determining outcome than other types of training programs. Continuity of care and involvement of a surgical resident in-house may have contributed to the good outcomes demonstrated in this study.

CONCLUSION
Regionalization of surgical procedures is controversial. The outcomes study reported herein demonstrates good results in performing complex, high-risk GI procedures in a low-volume center with a commitment to surgical education. Postoperative outcomes are dependent on multiple factors, and hospital volume by itself is not an adequate measure of quality of care. Therefore, regionalization of surgical procedures should not be based on volume alone.

We do not dispute the statistical association of the usual reported direct positive relationship between hospital volume and outcome. However, the ultimate goal of best patient care is not simply achieved by regionalization of patients to a few medical centers but, rather, by directing patients to centers that demonstrate good outcomes regardless of volume.

Table 3. Mortality of High-Risk Procedures Based on Volume

<table>
<thead>
<tr>
<th>Volume Group*</th>
<th>Avg. # Cases/Year</th>
<th>Morbidity</th>
<th>Mortality</th>
<th>P value†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimal</td>
<td>4.3</td>
<td>NR</td>
<td>14.2%</td>
<td>.0003</td>
</tr>
<tr>
<td>Low</td>
<td>13.4</td>
<td>NR</td>
<td>12.7%</td>
<td>.0008</td>
</tr>
<tr>
<td>Medium</td>
<td>23.8</td>
<td>NR</td>
<td>8.4%</td>
<td>.0156</td>
</tr>
<tr>
<td>High</td>
<td>213.9</td>
<td>NR</td>
<td>2.9%</td>
<td>.5342</td>
</tr>
<tr>
<td>Gundersen Lutheran</td>
<td>13.5</td>
<td>15/106</td>
<td>2/106</td>
<td>(14.2%) (1.9%)†</td>
</tr>
</tbody>
</table>

* Defined by Gordon et al.5
† Comparison of volume group in Maryland statewide registry5 to Gundersen Lutheran using Pearson’s Chi square

Table 4. Confounding Variables in Outcome Assessment

- Retrospective, inadequate and incorrect coding during data retrieval
- Data collection from administrative and billing codes rather than medical databases
- Differing definitions of procedures, complications, and postoperative death
- Case mix difference between hospitals and patients
- Comorbidities
- Stage of disease
- Cultural variations (e.g., length of stay practice, incidence of obesity, malnutrition, other)
- Publication bias
  - Only best outcomes submitted and accepted
  - Disincentive to publish poor outcomes
- Difference in postoperative care, hospital support, anesthesia, quantity of ICU nurses, quality of nursing support, ICU support, 24-hour intensivist
- Teaching versus non-teaching hospital with 24-hour resident coverage
- Hawthorne effect (better outcomes occur when investigators realize they are under observation)

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REFERENCES


