

The Impact of Gastrointestinal Complications on Patients who Undergo Coronary Artery Bypass Grafting

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Abstract

Objective: The incidence of gastrointestinal (GI) complications in patients undergoing coronary artery bypass grafting (CABG) is increasing as the population ages. The reported incidence ranges from 0.3% to 3.7%. Coronary Artery Bypass Grafting (CABG) is one of the most common operations performed. The outcome of patients who undergo abdominal operations for GI complications after CABG is not known. The purpose of the study is to determine the impact of abdominal surgery on patients who undergo CABG.

Methods: A retrospective review of nationwide data of all patients undergoing CABG from 2006 to 2010. A total of 160,513 patients who underwent CABG were reviewed.

Results: A total of 236 patients out of the 160,513 patients who underwent CABG developed GI complications that required abdominal surgery. The abdominal procedures included small and large bowel resections as well as colostomy formation. The indications for abdominal surgery varied and included ischemic bowel, and bowel obstruction. The patients who underwent concomitant abdominal surgery were more likely to develop renal Confidence Interval (CI) (8.5 to 14.2) ($P < 0.0001$), respiratory CI (8.5 to 14.8) ($P < 0.0001$), and infectious CI (16.3 to 28.6) ($P < 0.0001$) complications. They were also more likely to have higher mortality CI (16.2 to 29.0), ($P < 0.0001$). Patients who underwent abdominal operations had longer length of stay (LOS) 37.23 ± 32.8 days versus 8.2 ± 6.1 days ($P < 0.0001$) and higher hospital charges, $\$389,586 \pm 260,546$ compared to $\$111,290 \pm 82,462.2$ ($P < 0.0001$).

Conclusion: Although rare, the impact of abdominal surgery resulting from GI complications is significant. The patients who had abdominal surgery and underwent CABG were more likely to develop multiple complications. As a result, these patients had a higher rate of mortality, longer LOS, and higher hospital costs. Taken together, these results indicate that patients with GI complications should be identified promptly and aggressively treating these patients is of paramount importance.

Keywords: CABG; Hypoperfusion; Complication

Introduction

Gastrointestinal (GI) complications have been reported to occur after cardiac surgery 0.29% - 5.5% and are associated with mortality rates of 11% - 72% [1-4]. The high mortality in these patients has been attributed to delayed diagnosis and treatment of GI complications. In addition, these patients frequently have serious associated medical problems and limited physiologic reserve. The major factor in precipitating GI complications after cardiac surgery is likely reduced cardiac flow with hypoperfusion of end organs [5]. Coronary Artery Bypass Grafting (CABG) is one of the most common operations performed. The outcome of patients who undergo abdominal operations for GI complications after CABG is not known. The purpose of the study is to determine the impact of abdominal surgery on patients who developed GI complications after CABG.

Methods

A retrospective review of nationwide data of all patients undergoing CABG from 2006 to 2010.

Data source

Nationwide Inpatient Sample (NIS) from the year 2002 to the year 2009 was used for this study. This is the largest all-payer database in the U.S. that is developed as part of the AHRQ (Agency for Healthcare Research and Quality) Healthcare Cost and Utilization Project (HCUP) and includes information about 20% of all hospitalizations in approximately 1,000 non-federal short-term hospitals. The most current NIS contains inpatient stay records from 45 states and comprises

over 96 percent of the United States population. The sampling strategy of this database provides opportunity for computing nationwide estimates. Detailed NIS documentation with the description of all data elements is available at <http://www.hcup-us.ahrq.gov/db/nation/nis/nisdbdocumentation.jsp>

Statistical analysis

Data analysis and all statistics were performed with SAS 9.2 software (SAS Institute, Cary, NC). Hospital mortality was defined as any-cause death during hospitalization and was calculated for each group as a number of patients who died divided by the total number of patients in this group and expressed as a percentage. To calculate hospital cost we used the HCUP Cost-to-Charge Ratio Files that allow conversion of hospital charges in the database to actual hospital reimbursement. Difference between two groups for categorical variables was tested with chi-square bivariate analysis. Controlling for the confounding effects was performed with the multivariable logistic regression analysis with

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adjustment by age, gender, race, comorbidities, and other possible confounders. Because numeric variables hospital length of stay (LOS) and cost were not normally distributed and highly skewed to the right, we calculated their medians in various groups and compared intergroup differences with the non-parametric Wilcoxon rank sum test. A value of $P < .05$ was considered as statistically significant. The study was approved by the Institutional Review Board of the University of Medicine and Dentistry of New Jersey – Robert Wood Johnson Medical School.

Results

A total of 160,513 patients who underwent CABG were reviewed (Table 1). A total of 236 patients out of the 160,513 patients (0.15%) who underwent CABG developed GI complications that required abdominal surgery. The abdominal procedures included small and large bowel resections as well as colostomy formation. The indications for abdominal surgery varied and included ischemic bowel, and bowel obstruction. The patients who underwent concomitant abdominal surgery were more likely to develop renal CI (8.5 to 14.2) ($P < 0.0001$), respiratory CI (8.5 to 14.8) ($P < 0.0001$), and infectious CI (16.3 to 28.6) ($P < 0.0001$) complications. They were also more likely to have higher mortality CI (16.2 to 29.0), ($P < 0.0001$). Patients who underwent abdominal operations had longer length of stay (LOS) 37.23 ± 32.8 days versus 8.2 ± 6.1 days ($P < 0.0001$) and higher hospital charges, $\$389,586 \pm 260,546$ compared to $\$111,290 \pm 82,462.2$ ($P < 0.0001$).

Discussion

The data from our study shows that patients who undergo abdominal surgery after GI complications have a higher rate of morbidity and mortality. These patients were noted to have more renal, respiratory, and infectious complications. The patients with GI complications who had abdominal surgery also had a higher mortality. The incidence of GI complications after cardiac surgery is low, but the mortality and morbidity, as well as the cost in terms of prolonged hospitalization, are all considerable. Delayed recognition of these complications leads to a high incidence of morbidity and mortality, therefore prompt diagnosis and treatment are essential.

The prevention, early diagnosis and treatment of GI complications

Characteristics	CABG		Total
	with AS	w/o AS	
Age, years (mean \pm SD)	70.3 \pm 9.1	65.2 \pm 10.3	65.2 \pm 10.3
Age groups:			
40-59	30 (12.7%)	48,770 (30.4%)	48,800 (30.4%)
60-69	75 (31.8%)	54,568 (34.1%)	54,643 (34.1%)
70-79	90 (38.1%)	43,466 (27.1%)	43,556 (27.1%)
80+	41 (17.4%)	13,473 (8.4%)	13,514 (8.4%)
Gender:			
males	182 (77.1%)	118,064 (73.7%)	118,246 (73.7%)
females	54 (22.9%)	42,205 (26.3%)	42,259 (26.3%)
missing	0	8	8
Race:			
whites	175 (74.1%)	110,469 (68.9%)	110,644 (68.9%)
blacks	12 (5.1%)	8,603 (5.4%)	8,615 (5.4%)
Hispanics	11 (4.7%)	9,404 (5.9%)	9,415 (5.9%)
other and missing	38 (16.1%)	31,801 (19.8%)	31,839 (19.8%)
Total	236 (0.15%)	160,277 (99.85%)	160,513

^CABG: Coronary Artery Bypass Graft; AS: Abdominal Surgery; SD: Standard Deviation

Table 1: Socio-demographic characteristics of the study population.

after cardiac surgery must gain significance in order to improve the outcome of these patients. There are a few studies that have addressed this issue such as Yoshida et al., and Rodriguez et al. [6,7]. These authors also support the notion that GI complications after CABG although rare can be lethal. The occurrence of life-threatening GI complications after cardiopulmonary bypass (CPB) was first reported in 1963 [8]. The pathophysiology of GI complications following cardiac surgery has not been well elucidated. Low cardiac output resulting in visceral hypoperfusion and mucosal ischemia and necrosis has been suggested on by multiple authors [1,9]. Multiple risk factors have been considered significant with GI complications including age greater than 70 years, long duration of cardiopulmonary bypass, blood transfusion, reoperation, ischemic heart disease, renal failure, and low cardiac index [10]. One of the pivotal studies in this area was conducted by Byhahn et al. [11]. This is a prospective study that sought to determine risk factors for subsequent GI complications after cardiosurgical procedures. The authors identified low cardiac output syndrome, loss of sinus rhythm and onset of atrial fibrillation, and vasopressor support as additional risk factors leading to GI complications.

One of the key potential risk factors in the development of GI complications is the use of the cardiopulmonary bypass (CPB) machine. Off pump CABG has been promoted by many cardiothoracic surgeons as better than on pump CABG in terms of reduced neurological complications, decreased morbidity and mortality, and renal dysfunction [12]. The impact of CPB on the development of GI complications has been studied with varied results [13,14]. Sanisoglu et al. showed that the incidence rates of GI complications were similar in the on- and off-pump coronary artery bypass groups, the type of GI complications, however, was different. CPB did not emerge as a risk factor for GI complications, but prolonged CPB (longer than 98 minutes) resulted in a high incidence of such complications [14]. Further research in this area will be required in order to clarify these results.

Although rare, the impact of abdominal surgery resulting from GI complications is significant. The patients who had abdominal surgery and underwent CABG were more likely to develop multiple complications. As a result, these patients had a higher rate of mortality, longer LOS, and higher hospital costs. Taken together, these results indicate that patients with GI complications should be identified promptly and aggressively treating these patients is of paramount importance.

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