Failure to rescue in postoperative patients with colon cancer: time to rethink where you get surgery

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ABSTRACT

Background: Failure to rescue (FTR) is an important measure of quality of care. The aim of this study was to assess FTR in patients with colon cancer (CC) who underwent surgical resection. We hypothesized that patient managed in urban centers had lower FTR.

Methods: We performed a 1-y (2011) retrospective analysis of the National Inpatient Sample database and identified all patients with CC who underwent surgical management. Patients were stratified based on the location of treatment: urban *versus* rural. Outcome measure was FTR, which was defined as death after major complications. Regression analysis was performed to evaluate the independent predictors of FTR.

Results: A total of 49,789 patients with CC who underwent surgery were analyzed. The mean age was 71 ± 20.2 y and 59% were males. About 21.5% patients developed in-hospital complications. The overall rates of complications, mortality, and FTR were 21.5%, 3.0%, and 33.8% respectively. Patient managed in rural centers had higher FTR compared with urban centers (39.5% *versus* 30.1%, $P = 0.01$). On regression analysis after controlling for age, gender, type of procedure, Charlson Comorbidity Index, and insurance status, management in rural center was independently associated with FTR (odds ratio: 1.9 [1.4-3.7]). On subanalysis of urban centers, management in teaching urban hospital was independently associated with higher FTR (odds ratio: 1.4 [1.2-3.8]).

Conclusions: Disparities exist among centers managing patients with CC undergoing surgical intervention. Rural centers have higher FTR compared with similar cohort of patients managed in urban centers. Teaching urban hospital performed worse than nonteaching urban centers. Understanding the reason for these differences may help standardize care across centers and help improve patient outcomes.

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Introduction

Colorectal cancer (CRC) is the third most commonly diagnosed cancer among both males and females and the second leading cause of cancer-related deaths in the United States.[1] Although commonly grouped together as CRC, there are significant differences between colon cancer (CC) and rectal cancer at the genomic level, vasculature and histology between these two cancers, and they should therefore be queried individually.[2,3] CC resection is a high-risk operative intervention and it is associated with high risk of developing complications. Patients who develop a complication are subsequently more likely to die. Over the past decade, there has been a major focus on quality of care provided by the hospitals. FTR is one of the important measures to evaluate the quality of care provided to patients.

FTR is defined as death after developing a major complication and can be used as a gauge to show how well hospitals perform once these complications occur.[4] FTR has been widely adopted as a safety indicator by the Agency for Healthcare Research and Quality and is an important measure of quality of care.[5,6] FTR patients account for a considerable amount of postoperative mortality.[6] While our previous studies have demonstrated that disparities exist in FTR and there is literature discussing other factors affecting FTR for certain surgical operations, there is little data in regard to whether urban centers or rural centers have better or worse FTR, especially when associated with CC patients.[6,7] The aim of our study was to assess FTR in patients with CC who underwent elective surgical resection at urban center *versus* rural center. We hypothesize that urban centers have lower FTR compared with rural centers.

Methods

Data source

This is a 1-y (2011) retrospective analysis of the National Inpatient Sample (NIS) database, which is maintained by the Agency for Healthcare Research and Quality as part of the Healthcare Cost and Utilization Project. The NIS databank is the largest all-payer inpatient care database publically available in the United States. The data in the NIS are derived from a stratified sample of 20% of the discharges from all hospitals (short-term, nonfederal, general, specialty, and non-rehabilitation hospitals) in the United States. The data are weighted back to help make population estimates of the various parameters. For our study, the use of NIS database was conformed to the data-use agreement from the Healthcare Cost and Utilization Project. Every year, the NIS contains information for nearly 8 million weighted discharges from over 1100 hospitals across 44 states in the United States. The institutional review board approval is not required because NIS database contains only deidentified patient's variables.

Patient population

Patients with age >18 y with CC undergoing elective surgery were identified from the NIS database using the Ninth Revision of the International Classification of Diseases codes (ICD-9). We included all patients with CC (ICD-9 CM diagnosis code 153.0-153.9) who underwent surgical management including right hemicolectomy (ICD-9 CM procedure code 945.73), left hemicolectomy (ICD-9 CM procedure code 45.75), sigmoid colectomy (ICD-9 CM procedure code 45.76), transverse colectomy (ICD-9 CM procedure code 45.74), and total abdominal colectomy (ICD-9 CM procedure code 45.8). We excluded patients who underwent emergent surgery or had rectal cancer (ICD-9 CM procedure code 48). We excluded emergent surgeries to select a uniform cohort and limit variability among patients (hemodynamic status, time to presentation, presence of sepsis) in our study.

Variables and definitions

We extracted data on patients' demographics (age, gender, and race), insurance status (private, public, and uninsured), teaching status of the hospital (teaching and nonteaching), location of the hospital (urban *versus* rural), hospital region (Northeast, Midwest, South, and West), procedure (right colectomy, left colectomy, sigmoid colectomy, transverse colectomy), operative approach (open, laparoscopic, and robotic), severity of illness using the Charlson Comorbidity Index, preoperative variables (diabetes, congestive heart failure, chronic lung disease, peripheral vascular disease, depression, mental illness history, weight loss, hypothyroidism, and blood loss anemia), in-hospital complications (wound, respiratory, cardiovascular, infectious, hematologic, renal and other), hospital length of stay, mortality, and FTR rate. FTR was defined as death after developing a major complication. We defined the complications according to NSQIP definitions as respiratory complications, infectious cardiovascular, and hepatorenal. Major complications were defined as respiratory complications (acute respiratory distress syndrome), infectious (sepsis), cardiovascular (myocardial infarction, cardiac failure), and renal failure.

Outcomes

The patient population was divided into two groups, those who underwent operative intervention at an urban center *versus* those who had their operation at a rural center. Our primary outcome was to compare the FTR rate between urban center and rural center. Secondary outcome measures were to compare the complications, hospital length of stay, and mortality between the two groups. We also performed a subanalysis of the FTR based on the teaching status of the hospital.

Missing data analysis

Missing data for all the variables were treated as missing at random. Multiple imputations were performed using a missing value analysis technique to account for the missing values. This technique is used to reduce bias and increase the number of cases available. To impute the data sets, the original data set was analyzed for random missing data points using Little's missing completely at random test. The procedure utilized for multiple imputations was the Markov Chain Monte Carlo method. This method refers to a collection