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Gangrenous cholecystitis: a contemporary review

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ABSTRACT

Background: Despite the established superiority of laparoscopic cholecystectomy (LC) for acute cholecystitis, gangrenous cholecystitis (GC) is commonly treated with open cholecystectomy (OC). This study aimed to characterize outcomes of GC in the modern era and between LC or OC surgical approach.

Materials and methods: Patients with a diagnosis of GC were identified using the 2005–2011 National Surgical Quality Improvement Project Participant User File. Baseline patient and operative characteristics and 30-d outcomes were established for all patients. Patients were stratified by surgical approach (LC or OC), and groups were propensity matched with a nearest-neighbor matching algorithm. Primary outcomes were 30-d mortality and any 30-d complication. A nonparsimonious multiple logistic regression model was used in the matched subset to adjust for patient comorbidities, demographics, and laboratory values.

Results: A total of 141,970 cholecystectomies were identified with 7017 having a diagnosis of GC. Overall 30-d mortality for the entire cohort was 0.8% ($n = 239$) and overall 30-d complication rate was 8.0% ($n = 2485$). For GC patients, the 30-d mortality was 1.2% ($n = 84$) and overall complication rate was 10.8% ($n = 761$). The multivariate logistic regression model demonstrated a significant decrease in overall (odds ratio = 0.46; $P < 0.001$) complication rates for LC patients but did not reveal a significant difference in 30-d mortality (odds ratio = 0.59; $P = 0.12$).

Conclusions: GC is associated with increased morbidity and mortality compared with that of acute cholecystitis. A LC approach is a safe option for patients with GC and is associated with decreased 30-d morbidity. Although LC should be used when possible for GC to minimize postoperative complications, OC should not be avoided if necessary to ensure patient safety.

1. Introduction

Since the first report in 1894 by Hotchkiss, gangrenous cholecystitis (GC) has been described as a severe form of acute cholecystitis (AC) [1]. While GC is reported to comprise 2%–40% of all AC [2–5], patients presenting with this pathology tend to be sicker and the associated cholecystectomy is usually more challenging [6–9]. Given the increased difficulty of

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cholecystectomy with GC, an open (OC) or laparoscopic (LC) converted to OC, cholecystectomy has historically been more common when compared with patients with simple AC [7].

Because of the less frequent nature of GC, most literature is based on single-center experiences, limiting the number of cases examined and efforts to determine predictors of GC and the efficacy of LC in this setting [5,7]. Additionally, with increased utilization and comfort with laparoscopy as well as the advent of acute care surgery programs, it is unclear if previous data for GC remain applicable in the modern surgical era, particularly with regard to the use of OC procedures.

Thus, the purpose of the present study was to establish national trends in treatment in GC and help to establish differences between a LC and OC approach for GC.

2. Materials and methods

The 2005–2011 National Surgical Quality Improvement Project (NSQIP) Participant User File (PUF) was used as the data source for this study. The NSQIP PUF is a validated and audited clinical database of surgical procedures that captures preoperative, intraoperative, and postoperative patient and procedural characteristics from over 500 community and academic medical centers. All patients undergoing a cholecystectomy as the primary procedure, identified by the current procedural terminology code of 47562, 47563, 47600, and 47605, from 2005–2011 were identified ($N = 141,970$). All cases done for an indication other than cholecystitis were excluded, and 24,088 cases of AC and 7071 cases of GC were found. Cases of AC and GC were identified by International Classification of Diseases 9 codes. American College of Surgeons (ACS)-NSQIP coders designate a case as GC only if the surgeon dictates the case indication as GC or when the International Classification of Diseases 9 code of GC was used to classify the case and patient diagnosis.

Within the GC group, patients were then stratified based on operative approach (OC or LC), with patients converted from a LC to OC approach being included in the LC cohort, as the primary treatment intent was LC. Patients were classified as conversion to OC based on having a primary procedure designated as OC and secondary procedure designated as LC, or vice versa.

Unadjusted descriptive comparisons of preoperative, intraoperative, and postoperative variables were done between the AC and GC cohorts using the Pearson chi-square test or Student *t*-test for categorical and continuous variables, respectively. Additionally, within the GC cohort, an unadjusted comparison of preoperative and intraoperative variables of the OC and LC patients was performed. To identify potential predictors of GC, a multivariate logistic regression model was created to identify preoperative predictors of GC.

To adjust for treatment-level bias between the use of OC and LC in GC patients, a propensity analysis was conducted to account for nonrandom, fundamental differences between the groups. Variables used for adjustment included age, sex, smoking status, body mass index, alcohol abuse, functional status, history of chronic obstructive pulmonary disease, history of steroid use, preoperative white blood cell count, history of bleeding disorder, American Society of Anesthesiologists class, coronary artery disease, resident involvement, preoperative sepsis, perioperative transfusion, and do-not-resuscitate status. A multivariate logistic regression model using similar variables as in the propensity match was created to ascertain patient characteristics that were independently associated with OC among patients with GC. Patients were matched according to propensity to undergo an OC, using a 1:1 nearest-neighbor match algorithm to find the most appropriate matched pairs. For purposes of calculating propensity scores, missing data were imputed using previously described methods for propensity models, with indicator variables created for missing values inputted into the regression model [10]. The balance of each covariate was then measured to ensure adequate matching performance. All covariates for the propensity match and multivariate model were chosen *a priori*.

A nonparsimonious multivariate logistic regression model was created to examine the effect of surgical approach on various postoperative outcomes, using the propensity-matched cohort. The primary outcomes of the study were 30-d mortality (any cause) and any major complication within 30 d. Secondary outcomes included specific postoperative complications (early return to the operating room, renal failure, sepsis or septic shock, and respiratory complications, consisting of pneumonia, reintubation, or >48 h of ventilator required).

For all analyses, an affirmative decision was made to set statistical significance at alpha = 0.05. All statistical analyses were conducted using R version 3.0.1, Vienna, Austria.

3. Results

A total of 141,970 cholecystectomies were identified from the 2005–2011 NSQIP PUF with 24,088 cases of AC and 7071 cases of GC. In the GC cohort, there were 1295 OCs (18.3%) and 5776 (81.7%) LCs, of which 226 (3.9%) were LC converted to OC (Fig. 1). The proportion of cholecystectomies approached in an OC fashion for GC remained relatively constant during the study period, ranging from 15%–22% (Fig. 2).

Unadjusted analysis revealed that patients with GC were older, had increased levels of leukocytosis, and more commonly were male, had preoperative systemic inflammatory response syndrome or sepsis, had diabetes mellitus (DM), use of chronic steroids, or had a nonindependent functional status ($P < 0.001$ in all cases; Table 1) when compared with the AC cohort. After adjustment with a multivariate model, male sex (odds ratio [OR] = 1.29; 95% confidence interval [CI] = 1.21–1.38), previous alcohol abuse (OR = 1.23; 95% CI 1.01–1.48), preoperative dyspnea (OR = 1.14; 95% CI = 1.02–1.28), diabetes (OR = 1.17, 95% CI = 1.07–1.27), nonindependent functional status (OR = 1.4, 95% CI = 1.24–1.59), and abnormal hematocrit (OR = 1.32; 95% CI = 1.22–1.43) were found to be independent predictors of GC. Notably, a body mass index >30 (OR = 0.85; 95% CI 0.80–0.90) and abnormal serum albumin (OR = 0.93; 95% CI = 0.86–0.99) were more predictive of AC (Fig. 3).

Overall 30-d mortality was 0.8% ($n = 239$) for all patients and overall 30-d complication rate was 8.0% ($n = 2485$). GC patients had a 30-d mortality of 1.2% ($n = 84$) and overall