International Journal of Surgery 39 (2017) 119–126

Contents lists available at ScienceDirect

International Journal of Surgery

journal homepage: www.journal-surgery.net

Age-related differences pre-, intra-, and postcholecystectomy: A retrospective cohort study of 6,868 patients☆

Hadia Maqsood [a, 1], Kalpesh Patel [a, 1], Hamid Ferdosi [a, b, 1], Anne M. Sill [a], Bin Wu [a], Thomas Buddensick [a], Amanda Sautter [a], Haroon Shaukat [a], Gisela Sulkowski [a], Dusty Marie Narducci [a], Mustafa Siddique [a], Farin Kamangar [c], Gopal C. Kowdley [a], Steven C. Cunningham [a, *]

[a] Department of Surgery, Saint Agnes Hospital, Baltimore, MD, USA
[b] Department of Epidemiology & Biostatistics, George Washington Univ., Washington, DC, USA
[c] Department of Public Health Analysis, Morgan State Univ., Baltimore, MD, USA

HIGHLIGHTS

- Older patients undergoing cholecystectomy (CCY) have distinct perioperative characteristics compared with younger patients.
- Among older patients, preoperative testing, blood loss, operative times and complications are greater.
- The risk for developing complications increased by 2% per year of life.

ARTICLE INFO

Article history:
Received 23 November 2016
Received in revised form
7 January 2017
Accepted 12 January 2017
Available online 16 January 2017

Keywords:
Cholecystectomy
Elderly
Young
Complications
Age
Adenomyosis
Cholesterolosis

ABSTRACT

Background: Cholecystectomy (CCY) is increasingly performed in older individuals. We sought to examine age-related differences in pre-, intra-, and postoperative factors at a community hospital, using a very large, single-institution cholecystectomy database.

Materials and methods: A retrospective review of 6868 patients who underwent CCY from 2001 to 2013 was performed. ROC analysis identified the optimal age cutoff when complications reached a significant inflection point (<55 and ≥55 years). Multiple clinical features and outcomes were measured and compared by age. Logistic regression was used to examine how well a set of covariates predicted postoperative complications.

Results: Older patients had significantly higher rates of comorbidities and underwent more extensive preoperative imaging. Intraoperatively, older patients had more blood loss, longer operative times, and more open operations. Postoperatively, older patients experienced more complications and had significantly different pathological findings. While holding age and gender constant, regression analyses showed that preoperative creatinine level, blood loss and history of previous operation were the strongest predictors of complications. The risk for developing complications increased by 2% per year of life.

Conclusion: Older patients have distinct pre-, intra-, and postoperative characteristics. Their care is more imaging- and cost-intensive. CCY in this population is associated with higher risks, likely due to a combination of comorbidities and age-related worsened physiological status. Pathologic findings are significantly different relative to younger patients. While removing the effect of age, preoperative creatinine levels, blood loss, and history of previous operation predict postoperative complications. Quantifying these differences may help to inform management decisions for older patients.

☆ Submitted to *International Journal of Surgery* (an earlier version of this work was presented at the Americas Hepato-Pancreatico-Biliary Association in Miami, FL, USA 2013).

* Corresponding author. Saint Agnes Hospital and Cancer Institute, 900 Caton Avenue, MB 207 Baltimore, MD, 21229, USA.
E-mail address: Steven.Cunningham@stagnes.org (S.C. Cunningham).

[1] Maqsood, Patel, and Ferdosi contributed equally to this work.

http://dx.doi.org/10.1016/j.ijsu.2017.01.046
1743-9191/

1. Introduction

Gallbladder disease is one of the most common indications for abdominal surgery. The prevalence of gallbladder disease requiring cholecystectomy (CCY) is highest in older patients, with 8.1% of men, and 16.6% of women aged 60–74 years undergoing CCY [1]. Compounding this problem is the fact that the average age of many global populations is increasing. For example, the United States Census predictions estimate that the percentage of the population 65 years of age and over will increase from 14.8% in 2015 to 20.2% (or an additional 30 million individuals) by the year 2035 [2].

The aim of our study is to critically examine our experience in the treatment of gallbladder disease in younger versus older patients. A sub-aim was to identify risk factors for postoperative complications. We examined differences in pre-, intra-, and postoperative characteristics of older versus younger patients in order to identify areas where improvements may be made to optimize care for older patients undergoing CCY.

2. Methods

2.1. Study population and data collection

A recently updated database of patients undergoing CCY at Saint Agnes Hospital from 2000 to 2013 was analyzed. This study was approved by the Institutional Review Board. Patients who underwent CCY as part of another major operation such as a Whipple, liver resection, bariatric operation, or cytoreduction with hyperthermic intraperitoneal chemotherapy, were excluded from the study. Those with a preoperative diagnosis of gallbladder cancer were also excluded. CCY was performed according to individual surgeon preferences, after an evaluation period that was similarly surgeon-dependent, making use of standard laboratory testing and imaging modalities, as dictated by the clinical scenario.

Data were obtained from hospital charts, including operative notes, pathology reports, imaging study reports, and lab reports. Standard patient demographic and clinicopathological data were collected, including age, gender, race, ASA score, comorbidities, operative and pathologic details, and postoperative morbidity. Perioperative morbidity was severity-graded based on the Clavien-Dindo classification system [3].

Data were entered into Excel™ (Redmond, WA) and imported into SPSS™ version 21.0 (Chicago, IL) for statistical analysis.

2.2. Statistical considerations

2.2.1. Sample size

This study sample represents a convenience sample of previously collected cases undergoing CCY. Although not formally "powered" to show differences in preselected measures, this exploratory study of 2883 younger and 2166 older patients likely provides adequate sample size to confidently demonstrate true population differences.

2.2.2. Analysis

A receiver operator characteristic (ROC) curve identified the point along the age continuum (age 55 years) at which the number of postoperative complications increased significantly. Therefore, patients were stratified by using this age cutoff (<55 and ≥ 55 years of age) and these groups served as the main comparison groups throughout the study.

Demographic, clinical, diagnostic, pathologic, and perioperative characteristics were compared using appropriate, univariate and bivariate parametric tests (frequencies, student t-test, chi-square test) and by nonparametric methods for ordinal and nominal variables. Patients with missing data were excluded. Understanding the logical confounders in the relationships between age and number of complications and morbidities, type of operation (eg, open or laparoscopic) and level of urgency (ie, emergent or elective), a binary logistic regression model was built to identify the most prominent predictors of developing 30-day postoperative complications. We controlled for age to determine the ability of the predictors to explain the variance in the outcome, i.e., presence or absence of postoperative complications. Given that 72% of the population was female, we also controlled for gender so as to avoid the overrepresentation of females in the regression analyses. The odds of developing complications and their 95% confidence intervals were also computed.

To examine independent predictors of postoperative complications, bivariate analyses of preoperative measures of laboratory markers, preexisting comorbidities and postsurgical pathologic findings were compared for those with and without complications within 30 days of operation. Variables found to be significantly different between those with and without complications ($P < 0.05$) became candidates for binomial logistic regression. A missing-values analysis was then conducted to select predictors with the least number of missing values to provide ample sample size for a regression analysis.

In an effort to revert the syllogism of the cause and effect of age and complications, we controlled for age in the binomial regression models; gender was also held constant to remove the overrepresentation of females in our population. Covariates were removed in a backward elimination fashion to identify the predictor(s) that gave the most weight in their ability to explain the variance in the outcome (postoperative complications).

3. Results

3.1. Selection

Of 6868 patients with varying indications undergoing CCY, 5049 patients were analyzed in this study after excluding cases that had incomplete data, or had the CCY performed secondary to another major operation, as described above.

3.2. Patient characteristics

Fifty-seven percent of patients were ≤ 55 years old (this cutoff chosen based on the ROC curve, as described above; Table 1). Both age groups contained significantly more females than males. Racial/ethnic distribution across age groups also varied significantly and appears to be partially explained by a greater number of younger Hispanic patients. The majority (79%) of the younger group had ASA scores of 1–2 while the majority (54%) of older patients had scores of 3–4. The older patients had a significantly higher percentage of comorbidities such as cardiovascular diseases, hypertension, cerebrovascular accident, coronary artery disease, chronic obstructive pulmonary disease, diabetes mellitus, renal failure (all $P < 0.001$), alcohol abuse, and hepatic cirrhosis ($P = 0.05$). The only exception was hepatitis infection, which, although higher in younger adults, did not reach statistical significance.

3.3. Imaging studies

A significantly higher percentage of patients >55 years old had preoperative investigations such as computed tomography (CT), magnetic resonance imaging (MRI), hepatobiliary iminodiacetic acid (HIDA) scans and endoscopic retrograde cholangiopancreatography (ERCP) performed (Table 2). Only the ultrasound (US) showed significantly larger gallbladder wall thickness