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Asian Race/Ethnicity as a Risk Factor for Bile Duct Injury During Cholecystectomy

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Abstract

Iatrogenic bile duct injury (BDI) is an uncommon but serious complication of cholecystectomy, with identified risk factors of acute cholecystitis, male sex, older age, and aberrant biliary anatomy. The Nationwide Inpatient Sample (1998-2006) was queried for cholecystectomy performed on hospital day 0 or 1. Bile duct injury repair procedure codes were used as a surrogate for BDI. We identified 377 424 patients who underwent cholecystectomy, with 1124 BDIs (0.3%). On multivariate logistic regression analysis, Asian race/ethnicity was a significant risk factor for BDI (odds ratio [OR], 2.26; 95% confidence interval [CI], 1.59-3.23; *P*<.001). This persisted for laparoscopic (OR, 2.62; 95% CI, 1.28-5.39; *P*=.009) and open (2.21; 1.59-3.07; *P*<.001) cholecystectomies. No other race/ethnicity was identified as a risk factor for BDI. We report a new finding that Asian race/ethnicity is a significant risk factor for BDI in laparoscopic and open cholecystectomies.

Bile duct injury (BDI) is a feared but rare (0.5%) iatrogenic complication of cholecystectomy that can cause significant morbidity for the patient.[1] Previous studies[2-6] showed that male patients, older patients, and patients diagnosed as having acute cholecystitis are more likely to experience a BDI during their cholecystectomy, perhaps because of increased adhesions and inflammatory response of tissue. Furthermore, studies[7-11] early in the adoption of laparoscopic techniques for cholecystectomy demonstrated that patients who underwent a laparoscopic cholecystectomy are more likely to experience a BDI than patients who underwent an open cholecystectomy.

Beyond all these risk factors, difficulty for the surgeon to identify structures in the triangle of Calot, likely due to aberrant biliary anatomy, is the most often cited reason for BDI.[8,9]

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Although evidence suggests that some Chinese patients may be more likely to have aberrant arterial anatomy relative to the gallbladder,[12] no data show that race/ethnicity has any effect on the likelihood of BDI. We examined a large population-based data set to determine the effect, if any, of race/ethnicity on the likelihood of BDI.

Methods

A 9-year retrospective analysis of raw data from the Nationwide Inpatient Sample (NIS) from 1998 through 2006 was performed. The NIS is a database of charge information on all in-patients from 1045 hospitals in 38 states, comprising almost 8 million stays per year.

Inclusion criteria were cholecystectomy as primary procedure code (*International Classification of Diseases, Ninth Revision* [*ICD-9*] 51.22 [laparoscopic cholecystectomy]) or code 51.23 [open cholecystectomy]) performed on hospital admission day 0 or 1 without an additional procedure performed on that day. Cholecystectomies performed after hospital day 1 were omitted from analysis to eliminate severely ill patients as confounders. Procedure codes for bile duct repair (*ICD-9* codes 51.36, 51.37, 51.39, 51.71, 51.72, and 51.79) were used as a surrogate for BDI. Because of a limitation of the NIS whereby the treatment of patients who were discharged to another medical institution is not linked to the initial treating hospital records, such patients were also excluded from analysis.

Commercially available software (STATA/multiprocessor version 10; StataCorp LP, College Station, Texas) was used for all statistical analyses. χ^2 Test was used to evaluate categorical variables, and 2-tailed *t* test was used to evaluate continuous variables such as age. Likelihood of BDI was examined using multivariate logistic regression analysis, first controlled for, then stratified by cholecystectomy approach (laparoscopic vs open). Multivariate analyses controlled for patient- and hospital-level factors potentially associated with BDI, including age, sex, morbid obesity (*ICD-9* code 278.01), diagnosis of acute cholecystitis (*ICD-9* code 87.50), performance of intraoperative cholangiography (*ICD-9* code 87.53), insurance status, academic hospital status, year of surgery, and hospital annual volume of cholecystectomies. Race/ethnicity was defined using the NIS categories of white, African American, Hispanic, Asian, and other.

Results

We identified 377 424 patients who underwent cholecystectomy, 312 522 (82.8%) of whom underwent laparoscopic cholecystectomy and 64 902 (17.2%) of whom underwent open cholecystectomy. The median age at presentation was 51 years, and 262 711 patients (69.9%) were female (among 375 936 patients for whom sex was known). Morbid obesity was a comorbid diagnosis for 2.3% of all patients who underwent cholecystectomy, while a slightly larger fraction (3.9%) were diagnosed as having acute cholecystitis. White patients represented 70.8% of the population (among 318 673 patients for whom race/ethnicity was known), with 8.1% African American, 15.7% Hispanic, 2.2% Asian, and 3.3% other. Almost one-quarter (23.5%) of the entire cohort who underwent cholecystectomy received an intraoperative cholangiogram on the day of cholecystectomy. Less than 1% of patients

(0.3%) experienced a BDI during their hospitalization for cholecystectomy. Table 1 summarizes the bivariate analysis of these patients by their BDI status.

Multivariate logistic regression analysis, controlling for patient- and hospital-level characteristics, showed Asian patients to be at increased risk for BDI (odds ratio [OR], 2.26; 95% confidence interval [CI], 1.59-3.23; *P*<.001) in all patients undergoing cholecystectomy. African Americans had a trend toward decreased risk of BDI on multivariate logistic regression analysis (OR, 0.78; 95% CI, 0.60-1.01; *P*=.06). When stratified by type of cholecystectomy, Asian patients continued to be more likely to experience a BDI for laparoscopic (OR, 2.62; 95% CI, 1.28-5.39; *P*=.009) and open (2.21; 1.59-3.07; *P*< .001) approaches. As summarized in Table 2, no other race/ethnicity was a significant risk factor for BDI in these multivariate logistic regression analyses, although African Americans continued to show a trend toward decreased risk, especially for the laparoscopic approach.

Comment

Asian patients were found to be more likely than patients of other races/ethnicities to experience an iatrogenic BDI during cholecystectomy. To our knowledge, race/ethnicity has not previously been implicated as a risk factor for iatrogenic BDI. In this retrospective study, we cannot infer from our data why Asian patients may be more likely to have a BDI after inpatient cholecystectomy. Furthermore, our study underestimates the rates of BDI because we were unable to account for “missed” BDIs that were not repaired before discharge home or were identified but managed nonoperatively. In addition, because the NIS captures only inpatient procedures, we likely underestimated the number of procedures performed as laparoscopic cholecystectomies given that many, if not most, laparoscopic cholecystectomies are performed on an outpatient basis. However, there is no reason to expect that these factors should disproportionately affect Asians compared with other races/ethnicities. Moreover, the most commonly cited reason for BDI requiring reconstruction in a study by Kholdebarin et al[13] was failure to identify the cystic duct during the procedure. Correct identification of structures in the triangle of Calot may be more challenging among patients of Asian race/ethnicity because of increased aberrant biliary anatomy. For instance, Chen et al,[12] in a study of Chinese adults at autopsy, show that cystic arteries did not course through the triangle of Calot in more than 13% of patients. Furthermore, almost 30% of these patients had a cystic artery that coursed anterior to the common hepatic duct. Further research among Asian patients, especially regarding variants in cystic duct anatomy, may be needed to satisfactorily answer why they are more likely to experience a BDI.

In conclusion, we demonstrate an increased risk of BDI among Asian patients. This knowledge should motivate surgeons to exercise particular caution in clearly identifying structures during cholecystectomy for these higher-risk individuals.

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Table 1

Bivariate Analysis by Occurrence of Bile Duct Injury (BDI) for Patients in the Nationwide Inpatient Sample Who Underwent Cholecystectomy[a]

Variable	BDI (n=1124)	No BDI (n=376 300)	*P* Value
Age at presentation, mean, y	59.3	51.4	<.001
Length of stay, mean, d	8.1	2.9	<.001
Sex, No. (%)		(n=374 812)	<.001
Male	699 (0.38)	112 526 (99.62)	
Female	425 (0.27)	262 286 (99.73)	
Race/ethnicity, No. (%)	(n=948)	(n=317 725)	<.001
White	694 (0.31)	224 817 (99.69)	
African American	67 (0.26)	25 896 (99.74)	
Hispanic	110 (0.22)	49 777 (99.78)	
Asian	52 (0.75)	6857 (99.25)	
Other	25 (0.24)	10 378 (99.76)	
Morbid obesity, No. (%)	17 (0.19)	8754 (99.81)	.07
Acute cholecystitis, No. (%)	31 (0.21)	14 619 (99.79)	.05
Cholesystectomy approach, No. (%)			<.001
Laparoscopic	177 (0.06)	312 345 (99.94)	
Open	947 (1.46)	63 955 (98.54)	
Year of surgery, No. (%)	(n=1064)	(n=375 236)	.02
1998-2000	423 (0.33)	126 821 (99.67)	
2001-2003	375 (0.29)	129 408 (99.71)	
2004-2006	266 (0.27)	119 007 (99.73)	

[a]The number of patients varies because of missing data.

Table 2

Multivariate Logistic Regression Analysis for Risk of Bile Duct Injury[a]

Race/Ethnicity	Odds Ratio (95% Confidence Interval)	*P* Value
Entire cohort		
White	1.00 [Reference]	…
African American	0.78 (0.60-1.01)	.06
Hispanic	0.93 (0.73-1.18)	.53
Asian	2.26 (1.59-3.23)	<.001
Other	0.88 (0.53-1.45)	.61
Laparoscopic cholecystectomy		
White	1.00 [Reference]	…
African American	0.90 (0.45-1.80)	.77
Hispanic	0.80 (0.46-1.40)	.44
Asian	2.62 (1.28-5.39)	.009
Other	1.41 (0.57-3.48)	.46
Open cholecystectomy		
White	1.00 [Reference]	…
African American	0.76 (0.57-1.01)	.06
Hispanic	0.96 (0.76-1.21)	.72
Asian	2.21 (1.59-3.07)	<.001
Other	0.76 (0.43-1.35)	.35

Abbreviation: Ellipsis, not applicable.

[a]Adjusted for age, sex, morbid obesity, acute cholecystitis, performance of intraoperative cholangiography, insurance status, academic hospital status, year of surgery, and hospital annual volume of cholecystectomies.