Are They Too Old for Surgery? Safety of Cholecystectomy in Superelderly Patients (≥ Age 90)

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ABSTRACT

Context: Cholecystectomy is the most common general surgery procedure in patients older than age 65 years. By 2050, it is estimated that 2.0% of the population will be older than age 90 years.

Objective: To assess the mortality of cholecystectomy in superelderly patients (≥ age 90 years).

Design: Using the American College of Surgeons National Surgical Quality Improvement Program database, a retrospective analysis was performed of superelderly patients who underwent laparoscopic and open cholecystectomy between 2005 and 2012.

Main Outcome Measures: Thirty-day mortality.

Results: A total of 1007 cholecystectomies were performed in superelderly patients between 2005 and 2012. Of these surgical procedures, 807 (80%) were nonemergent and 200 (20%) were performed emergently. Two hundred sixteen procedures (21.4%) were open and 791 (78.6%) were laparoscopic. Mortality did not decrease significantly during the study period. The overall mortality was 5.5%, significantly less for the laparoscopic group (3.7% vs 12%, $p < 0.001$) and for the nonemergent group (4.5% vs 9.5%, $p < 0.005$). The median length of stay for open cholecystectomy was 9 days compared with 5 days for laparoscopic ($p < 0.001$); for nonemergent cholecystectomy it was 5 days compared with 7 days for emergent cholecystectomy ($p < 0.001$).

Conclusion: The mortality after cholecystectomy in superelderly patients did not change significantly during the study period. The mortality and morbidity for laparoscopic and elective procedures were significantly lower than for open procedures and for emergent procedures, respectively.

INTRODUCTION

Elderly individuals are the fastest growing segment of the US population.[1] It is projected that by 2050, individuals aged 90 years and older, designated "superelderly," will represent 2% of the population.

The incidence of gallstones rises with age because of increasing lithogenicity of bile and gallbladder dysfunction.[2] By age 90 years, greater than 24% of men and 35% of women have gallstones.[3] Complications secondary to gallstones such as cholecystitis, cholangitis, and pancreatitis also increase with age.[4] Although cholecystectomy is accepted as the standard treatment of gallstone complications, the likelihood of a patient undergoing a cholecystectomy after presenting with symptomatic gallstone disease reduces with age.[5] Elderly patients who do not undergo cholecystectomy after their initial presentation with symptomatic gallstones are at risk of presenting again in the emergent setting with gallstone complications. This leads to increased morbidity, mortality, and cost.[6] Those who undergo surgery have a higher likelihood of undergoing open procedures than do younger patients.[5]

Despite the reluctance of some surgeons to perform cholecystectomy in elderly patients,[5] cholecystectomy remains the most common general surgery procedure in the elderly.[7] Increasing age has been identified as an independent risk factor for mortality after surgery[8]; however, few studies have addressed the outcomes of superelderly patients after cholecystectomy. The purpose of our study was to assess the mortality and morbidity of superelderly (≥ age 90 years) patients after laparoscopic and open cholecystectomy.

METHODS

The American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) is a national, validated program for measuring risk-adjusted surgical outcomes. Surgical clinical reviewers collect data from before the operation through 30 days postoperatively. The data collected are entered securely into a Web-based platform and are used to create a Participant Use Data File. The data in the Participant Use Data File are available for researchers to perform studies to advance patient care.[9,10]

Using data from the ACS NSQIP database, we performed a retrospective analysis of all patients age 90 years and older who underwent cholecystectomy as the primary hospital procedure between 2005 and 2012. Current Procedural Terminology codes were as follows: 47562 (laparoscopic cholecystectomy), 47563 (laparoscopic cholecystectomy with intraoperative cholangiogram, 47600 (open cholecystectomy), and 47605 (open cholecystectomy with intraoperative cholangiogram). Data before 2005 were not included, because 2005 was the first year the NSQIP database documented whether a procedure was emergent. Cases with malignant neoplasm of the gallbladder and extrahepatic bile ducts (International Classification of Diseases, Ninth Revision Code 156) were excluded from analysis.

Patient variables examined include sex, race, inpatient or outpatient status, year of the operation, level of resident supervision, diabetes, smoking, alcohol use (> 2 drinks a day 2 weeks before surgery), do-not-resuscitate status, functional health before surgery, history of severe chronic obstructive pulmonary disease, current pneumonia, hypertension requiring medication, congestive heart failure within 30 days of surgery, history of myocardial infarction 6 months before surgery, open wound or infection,

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emergency case, open or laparoscopic procedure, American Society of Anesthesiologists class, and mortality (Table 1).

Laparoscopic converted to open procedures were identified as cases that had open cholecystectomy as their primary procedure but laparoscopic cholecystectomy as their secondary procedure. Because the difference in outcomes between the open cholecystectomy group and the laparoscopic converted to open group was small, they were combined to form an "open cholecystectomy" group for our regression.

The primary outcome evaluated was 30-day mortality. Our secondary outcomes were: postoperative length of stay, superficial surgical site infection, deep incisional infection, organ space infections, pneumonia, pulmonary embolism, ventilator dependence longer than 48 hours, acute kidney injury, urinary tract infection, cardiac arrest requiring cardiopulmonary resuscitation, bleeding requiring blood transfusions, sepsis, and septic shock. Descriptions of these variables can be found in the ACS NSQIP participant user guide.[11]

Incidences of primary and secondary outcomes were determined, as were their association with patient variables. Patient variables that were associated with a statistically significant increase in mortality and postoperative complications were entered into a logistic regression to determine which were predictive.

Scale variables were reported as the median secondary to skewness.

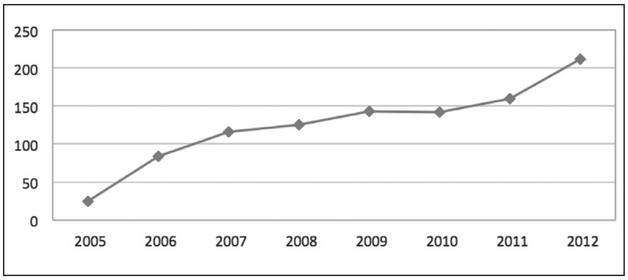

Figure 1. Number of cholecystectomies each year in patients aged 90 years and older.

RESULTS

We identified 1007 (64.6% women and 35.1% men) superelderly patients who underwent cholecystectomy as their primary hospital procedure between 2005 and 2012. Of the 1007 cholecystectomies, 791 (78.6%) were laparoscopic and 216 (21.4%) were open procedures. Of the open procedures, 41 started out as laparoscopic but subsequently converted to open procedures. Ten (24%) of these laparoscopic converted to open procedures were emergent. Eight hundred seven (80%) of

Table 1. Demographics of patients who underwent cholecystectomy (N = 1007)

Demographic factor	Number (%)	Demographic factor	Number (%)
Sex		**Functional health status before surgery**	
Women	651 (64.6)	Independent	717 (71.2)
Men	353 (35.1)	Partially dependent	241 (23.9)
Unknown	3 (0.3)	Totally dependent	49 (4.9)
Race		**Emergency case status**	
White	849 (84.3)	Nonemergent	807 (80.0)
Black	53 (5.3)	Emergent	200 (20.0)
Other	32 (3.2)	**Type of surgery**	
Hispanic	16 (1.6)	Open cholecystectomy	216 (21.4)
Unknown	57 (5.7)	Laparoscopic cholecystectomy	791 (78.6)
Inpatient/outpatient status		**ASA classification**	
Inpatient	842 (83.6)	1	4 (0.4)
Outpatient	165 (16.4)	2	198 (19.7)
Year of operation		≥ 3	805 (79.9)
2005	25 (2.5)	**Mortality**	
2006	84 (8.3)	Lived	952 (94.5)
2007	116 (11.5)	Died	55 (5.5)
2008	125 (12.4)	**Other factors**	
2009	143 (14.2)	Diabetes mellitus treated with oral agents or insulin	138 (13.7)
2010	142 (14.1)	Current smoker within 1 year	16 (1.6)
2011	160 (15.9)	Alcohol use (> 2 drinks/d in 2 wks before admission)	10 (1.3)
2012	212 (21.1)	Do-not-resuscitate status	74 (9.4)
Level of resident supervision		History of severe COPD	71 (7.1)
Attending and resident in OR	143 (14.2)	Current pneumonia	9 (1.1)
Attending alone	390 (38.7)	Hypertension requiring medication	743 (73.8)
Attending in OR or suite	274 (27.2)	CHF within 30 days before surgery	50 (5.0)
Unknown	200 (19.9)	History of myocardial infarction 6 months before surgery	7 (0.9)
		Open wound/wound infection	33 (3.3)

ASA = American Society of Anesthesiologists; CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease; OR = operating room.

the cholecystectomies were nonemergent and 200 (20%) were performed emergently. The rate of cholecystectomies captured over the study period rose by 2.26 per 10,000: from 1.64 per 10,000 in 2005 to 3.9 per 10,000 in 2012. Using rate calculations takes into consideration increases in patient volume and hospital participation over the study period. Figure 1 shows the number of cholecystectomies captured per year by the NSQIP database.

Table 2. Factors associated with statistically significant increases in mortality			
Factor	**Lived (%)**	**Died (%)**	**p value**
Inpatient/outpatient status			
Inpatient	93.82	6.18	0.023
Outpatient	98.18	1.82	
Functional health status before current illness			
Independent	95.25	4.75	< 0.001
Partially dependent	93.68	6.32	
Totally dependent	57.14	42.86	
Functional health status before surgery			
Independent	96.51	3.49	< 0.001
Partially dependent	92.95	7.05	
Totally dependent	73.47	26.53	
Systemic sepsis status (preoperative)			
Sepsis	84.93	15.07	< 0.001
Septic shock	76.92	23.08	
SIRS	89.19	10.81	
Type of surgery			
Open cholecystectomy	87.96	12.04	< 0.001
Laparoscopic cholecystectomy	96.33	3.67	
Other factors			
Do-not-resuscitate order	81.08	18.92	< 0.001
Ventilator dependent	66.67	33.33	0.038
CHF in 30 days before surgery	86.00	14.00	0.016
Previous PCI	85.71	14.29	0.015
Acute renal failure (postoperative)	75.00	25.00	0.024
Impaired sensorium	75.00	25.00	0.001
Emergency case	90.50	9.50	0.008
Superficial incisional SSI	61.50	38.50	0.019
Acute renal failure	33.30	66.66	< 0.001
Cardiac arrest requiring CPR	0.00	100.00	< 0.001
DVT requiring therapy	78.50	21.50	0.007
Myocardial infarction	66.67	33.33	0.01
Pneumonia	75.00	25.00	< 0.001
Pulmonary embolism	66.67	33.33	0.038
Sepsis (complications)	76.00	24.00	0.002
Septic shock (complications)	40.00	60.00	< 0.001
Unplanned intubation	53.85	46.15	< 0.001
On ventilator > 48 hours	62.96	37.04	< 0.001
Bleeding/transfusions	83.33	16.67	0.001

CHF = congestive heart failure; CPR = cardiopulmonary resuscitation; DVT = deep venous thrombosis; PCI = percutaneous coronary intervention; SIRS = systemic inflammatory response syndrome; SSI = surgical site infection.

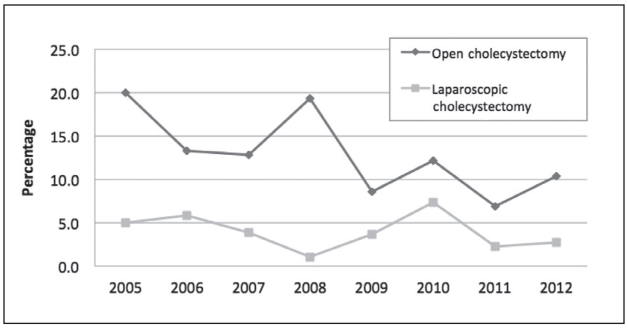

Figure 2. Mortality by year.

Thirty-Day Mortality

The overall mortality was 5.5%. The mortality for open cholecystectomy was 12% compared with 3.7% for laparoscopic cholecystectomy ($p < 0.001$). For laparoscopic converted to open procedures, the mortality was 12.2% ($p < 0.001$). During the study period, the mortality for open cholecystectomy decreased from 20% to 10.3% ($p = 0.874$). The mortality for laparoscopic cholecystectomy decreased from 5% to 2.7% during the study period ($p = 0.322$, Figure 2). The mortality for nonemergent cholecystectomy was 4.5% and for emergent cholecystectomy was 9.5% ($p = 0.005$). There was no statistically significant difference in the overall mortality of women and men (6.1% and 4.2%, respectively).

Predictors of Mortality

Table 2 shows patient variables associated with a statistically significant increase in mortality. When all of these variables were entered into a logistic regression model, totally dependent functional status before surgery (odds ratio [OR] = 19.3, $p < 0.001$), impaired sensorium (OR = 6.1, $p = 0.013$), postoperative myocardial infarction (OR = 31.3, $p = 0.008$), septic shock (OR = 8.9, $p = 0.009$), and open cholecystectomy (OR = 5.4, $p < 0.001$) were predictive of mortality (Table 3).

Table 3. Predictors of mortality using logistic regression		
Predictor	**p value**	**Odds ratio (95% CI)**
Functional health status before surgery		
Independent		Reference
Totally dependent	< 0.001	19.3 (5.01-74.62)
Impaired sensorium		
No		Reference
Yes	0.013	6.1 (1.46-25.55)
Postoperative myocardial infarction		
No		Reference
Yes	0.008	31.3 (2.45-398.97)
Septic shock		
No		Reference
Yes	0.009	8.9 (1.73-45.93)
Type of surgery		
Laparoscopic cholecystectomy		Reference
Open cholecystectomy	< 0.001	5.4 (2.09-13.91)

CI = confidence interval.

Complications

Overall, 17.1% of patients had at least 1 postoperative complication. Of those who underwent open cholecystectomy as their primary procedure, 32% had at least 1 complication compared with 13.1% in those who underwent laparoscopic cholecystectomy ($p < 0.001$). In the laparoscopic converted to open cholecystectomy group, 26.8% of patients had at least 1 complication ($p < 0.001$). Bleeding requiring blood transfusion was the most common postoperative complication, with an incidence of 3.6%. There was no statistically significant difference in international normalized ratio between those who had a bleeding complication necessitating blood transfusion and those who did not. Pneumonia (3.3%), urinary tract infection (2.7%), ventilator dependence longer than 48 hours (2.7%), and unplanned reintubation (2.6%) were the next most common complications.

Predictors of Complications

Table 4 shows patient variables associated with a statistically significant increase in postoperative complications. When these variables were entered into a logistic regression, Hispanic race (OR = 4.89, $p = 0.007$), smoking (OR = 4.87, $p = 0.019$), totally dependent functional status (OR = 3.49, $p = 0.001$), preoperative acute renal failure (OR = 7.64, $p = 0.018$), corticosteroid use for chronic condition (OR = 4.05, $p = 0.001$), sepsis (OR = 2.54, $p < 0.001$), systemic inflammatory response syndrome (OR = 2.32, $p = 0.001$), and open cholecystectomy (OR = 2.19, $p = 0.001$) were predictive of postoperative complications (Table 5).

Length of Stay and Duration of Procedure

The median length of stay for open cholecystectomy was 9 days compared with 5 days for laparoscopic ($p < 0.001$). For nonemergent cholecystectomy it was 5 days compared with 7 days for emergent procedures ($p < 0.001$). The median length of stay for cases with 1 or more complications was 10 days compared with 5 days for cases with no complications ($p < 0.001$). The median operative time for laparoscopic cholecystectomy was 64 minutes compared with 85 minutes for open cholecystectomy ($p < 0.001$). Operative time for emergent procedures was 76 minutes vs 66 minutes for nonemergent cholecystectomy, respectively ($p = 0.004$).

Transfer Status and Discharge Destination

Eighty-five percent of the patients were transferred from home, 9.3% from a skilled nursing facility, 4.5% from other hospitals, and 1.2% had unknown transfer status. Most of the discharge destinations were unknown (63.1%); 22.4% were discharged to home, 9.4% discharged to a skilled care facility which was not their home, 2.0% were discharged to a facility which was their home, 1.5% were discharged to rehab, 0.4% were discharged to an acute care facility and 0.1% were discharged to an unskilled facility. The discharge destination of 0.8% of patients was documented as "Died."

DISCUSSION

Elderly individuals are the fastest growing segment of the population and are projected to constitute 2% of the US population by 2050.[1] Cholecystectomy is the most common general

Table 4. Factors associated with statistically significant increase in complications

Factor	No complication (%)	One or more complications (%)	p value
Race			
White	83.3	16.7	0.004
Black	73.6	26.4	
Other	84.4	15.6	
Hispanic	56.3	43.8	
Unknown	93.0	7.0	
Inpatient/outpatient status			
Inpatient	80.9	19.1	< 0.001
Outpatient	93.3	6.7	
Dyspnea			
At rest	64.0	36.0	0.029
Moderate exertion	80.9	19.1	
No	83.7	16.3	
Functional health status (before current illness)			
Independent	85.0	15.0	< 0.001
Partially dependent	80.0	20.0	
Totally dependent	42.9	57.1	
Functional health status (before surgery)			
Independent	86.9	13.1	< 0.001
Partially dependent	76.8	23.2	
Totally dependent	55.1	44.9	
Systemic sepsis status			
None	88.7	11.3	< 0.001
Sepsis	60.3	39.7	
Septic shock	46.2	53.8	
SIRS	66.9	33.1	
Emergency case status			
Nonemergent	85.5	14.5	< 0.001
Emergent	72.5	27.5	
Type of surgery			
Open cholecystectomy	68.5	31.5	< 0.001
Laparoscopic cholecystectomy	86.9	13.1	
ASA classification			
1	100.0	0.0	0.001
2	91.4	8.6	
≥ 3	80.7	19.3	
Other factors			
Do-not-resuscitate order	70.3	29.7	0.003
Ventilator dependent	16.7	83.3	0.001
History of severe COPD	71.8	28.2	0.01
Ascites	57.1	42.9	0.021
CHF in 30 days before surgery	68.0	32.0	0.007
Acute renal failure (postop)	41.7	58.3	0.001
Corticosteroid use for chronic condition	67.6	32.4	0.033
Open wound/wound infection	66.7	33.3	0.018
Current smoker within 1 year	62.5	37.5	0.041

ASA = American Society of Anesthesiologists; CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease; postop = postoperatively; SIRS = systemic inflammatory response syndrome.

surgery procedure performed in elderly patients because the incidence of gallstones and gallstone complications increases with age.[2,4] Unfortunately, elderly patients with gallstone complications are less likely to undergo cholecystectomy than are younger patients.[5] Riall et al[12] showed less than 25% of elderly patients who met criteria for elective cholecystectomy underwent cholecystectomy. In their study, failure by primary care physicians and Emergency Department physicians to refer patients to surgeons played a role in the low rates of surgical therapy.[12] Bergman et al[5] also found increasing age to be a negative predictor of undergoing cholecystectomy after an admission for gallstone complications.

Our analysis showed that the mortality for superelderly patients after laparoscopic and open cholecystectomy was 3.7% and 12% respectively, significantly higher than the mortality rate of 0.3% and 3.8% for laparoscopic and open cholecystectomy, respectively, in the general population.[13] The mortality of laparoscopic converted to open cholecystectomy was similar to that of open procedures, at 12.2%. The increased mortality in superelderly individuals is expected because age has been shown to be an independent predictor of mortality.[8,14] Our overall mortality of 5.5% was similar to that observed by Dubecz et al[15] but remarkably lower than the mortality rate of 10.5% observed by Lee[16] in a study of patients age 80 years and older.

Hispanic race was predictive of postoperative complications. In their study based on the Veterans Affairs NSQIP database, Ibrahim et al[17] also found that Hispanic race was predictive of postoperative complications after knee arthroplasty. Minority patients are more likely than white patients to be underinsured, and this may result in delayed presentation and poorer outcomes.[18] Unfortunately, the exact reason for the racial disparity remains unexplained and needs further investigation.

The cholecystectomy rate captured during the study period increased by 2.26 per 10,000, reflecting an increase in the number of superelderly patients in the population as well as an increase in NSQIP participation.[19,20] The number of superelderly patients tripled between 1980 and 2010.[21] In 2004, there were 18 participating hospitals in NSQIP, but by 2016 the number of participating hospitals had grown to 743.[22,23]

Emergent procedures carried a higher risk of death than did nonemergent procedures (9.5% vs 4.5%, $p < 0.001$). In addition, postoperative length of stay was longer after emergent cholecystectomy. This finding is consistent with prior studies[24-27] and is likely secondary to an inability to perform medical optimization preoperatively. Early identification of symptomatic cholelithiasis and subsequent nonemergent cholecystectomy may reduce the number of emergent procedures required.

Laparoscopic cholecystectomies were associated with a lower mortality, morbidity, and length of stay than were open cholecystectomies. Consistent with results of other studies,[5,28-30] open cholecystectomy was also predictive of mortality and postoperative complications. Given the data supporting the advantages of laparoscopic cholecystectomy, it is interesting that 216 (21.4%) of the patients in our study underwent open cholecystectomy; however, this finding is consistent with existing data that show rates of open cholecystectomy are higher in elderly patients.[5,16] This is presumed to be secondary to increased severity of gallbladder disease in this patient population as well as a lower threshold for conversion to open surgery by surgeons.[5] Given the high mortality and morbidity associated with open cholecystectomy in this age group, we recommend a laparoscopic approach when possible and a high threshold for conversion to open cholecystectomy. Subtotal laparoscopic cholecystectomy should also be considered as an alternative to open cholecystectomy in especially difficult cases because the mortality associated with laparoscopic subtotal cholecystectomy is lower than that of open cholecystectomy.[31,32] Bile leaks are the most frequent complication after subtotal laparoscopic cholecystectomy, but these usually resolve spontaneously or can easily be managed with postoperative endoscopic retrograde cholangiopancreatography.[31-33]

Poor preoperative functional status was predictive of postoperative mortality and complications in the present study. Multiple studies have shown that poor functional status is predictive of postoperative morbidity and mortality; however, the exact etiology remains unclear.[34,35] Attempts should be made to improve these patients' functional status before considering surgery. In those who present with acute cholecystitis whose functional status cannot be improved on, nonoperative intervention with a percutaneous cholecystostomy tube should be considered. Cholecystostomy tubes have been shown to be effective in the treatment of cholecystitis in high-risk patients, with overall lower mortality than for emergent cholecystectomy.[36,37] Howard et al[38] demonstrated the use of cholecystostomy tubes in 3 high-risk patients older than age 85 years. Wang et al,[39] in a retrospective study that included 184 patients, showed only a 9.2% recurrence rate of cholecystitis

Table 5. Predictors of complications using logistic regression

Predictor	p value	Odds ratio (95% CI)
Race		
White	Reference	
Hispanic	0.007	4.9 (1.53-15.60)
Current smoker within 1 year		
No	Reference	
Yes	0.019	4.9 (1.30-18.26)
Functional health status before surgery		
Independent	Reference	
Totally dependent	0.001	3.5 (1.68-7.26)
Acute renal failure (preoperative)		
No	Reference	
Yes	0.018	7.6 (1.41-41.37)
Corticosteroid use for chronic condition		
No	Reference	
Yes	0.001	4.1 (1.73-9.52)
Systemic sepsis status		
None	Reference	
Sepsis	0.006	2.5 (1.30-4.94)
SIRS	0.001	2.3 (1.40-3.85)
Type of surgery		
Laparoscopic cholecystectomy	Reference	
Open cholecystectomy	0.001	2.2 (1.40-3.42)

CI = confidence interval; SIRS = systemic inflammatory response syndrome.

after initial treatment with cholecystostomy tubes. Their study, as well as others, demonstrate the use of cholecystostomy tubes as a definitive treatment of cholecystitis and as a bridge to elective cholecystectomy.[36-39]

Consistent with results of prior studies, postoperative myocardial infarction increased the risk of death after surgery.[40-42] Sepsis, systemic inflammatory response syndrome, smoking, and corticosteroid use were predictive of postoperative complications, congruent with the existing literature.[43-46] Smoking cessation at least 4 weeks before elective procedures will reduce postoperative pulmonary and wound complications.[45]

Preoperative acute delirium and septic shock were predictive of mortality. Delirium in this population was likely a sign of organ failure secondary to sepsis. Interestingly, preoperative comorbidities were not predictive of morbidity or mortality. This was an unexpected finding but is consistent with results of previous studies.[8,47,48]

The most common complication was bleeding requiring a blood transfusion, followed closely in frequency by pneumonia. Similarly, Donkervoort et al[49] found bleeding and pneumonia to be the leading complications of laparoscopic cholecystectomy in elderly patients (age > 65 years). Increasing age is an independent risk factor for postoperative pulmonary complications secondary to age-related reduction in pulmonary compliance, reduced responsiveness to hypoxia and hypercapnia, and diminished oropharyngeal protective reflexes.[50-53] The reason for the high rate of bleeding necessitating blood transfusion may be lower hemoglobin concentration at admission in this age group because anemia is more prevalent in elderly patients.[54] Advanced age is not associated with major alterations in the coagulation cascade, and consequently age alone does not increase the risk of bleeding.[55] There was no statistically significant difference in the international normalized ratio of those with postoperative bleeding necessitating blood transfusion compared with those without this complication.

In patients with good preoperative functional status, the risk of cholecystectomy must be balanced against the risk of recurrent gallstone complications, which is estimated to be between 25% and 47.7%.[4,56,57] The preoperative gallstone nomogram developed by Parmar et al[57] is a useful tool for predicting risk of recurrent gallstone complications and can help surgeons weigh the risk of nonoperative intervention against the risk of recurrence.

Our study has a number of limitations. The incidence of bile duct injury, an important complication after cholecystectomy, is not captured in the ACS NSQIP database. Also, ACS NSQIP collects data exclusively from participating hospitals; consequently, our results may not be applicable to nonparticipating hospitals. Additionally, the ACS NSQIP database collects data only up to 30 days postoperatively; subsequently, our outcomes were limited to this period, and the results of our study may have been different if patients were followed for a longer time. The confidence intervals for the predictors of mortality and complications were wide because of low contribution of the predictor owing to very low numbers. This was particularly evident for corticosteroid use and myocardial infarction; however, all results were statistically significant. Given the low number of superelderly patients in the population, low "N" values were unavoidable. A larger study is needed to obtain narrower intervals but may be difficult given the small proportion of superelderly patients compared with the rest of the population. We were unable show the impact of surgery on the loss of dependence as indicated by discharge to a skilled nursing facility because the discharge destination of most of the patients was unknown. Last, given the retrospective nature of our study the potential for bias exists.

CONCLUSION

An increasing number of superelderly patients (age 90 years or older) present with symptomatic gallstones, and surgeons are frequently faced with the question, "Are they too old for surgery?" Our results show that cholecystectomy in superelderly patients has a mortality rate of 5.5% and a complication rate of 17.2%. The mortality and morbidity rates for laparoscopic and elective procedures were significantly lower than those for open and emergent procedures. Superelderly patients with poor functional status are at increased risk of death and complications after cholecystectomy, and nonoperative management with cholecystectomy tubes should be considered for these patients. ❖

Disclosure Statement

The author(s) have no conflicts of interest to disclose.

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