Patients with acute cholecystitis should be admitted to a surgical service

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BACKGROUND: In bowel obstruction and biliary pancreatitis, patients receive more expedient surgical care when admitted to surgical compared with medical services. This has not been studied in acute cholecystitis.

METHODS: Retrospective analysis of clinical and cost data from July 2013 to September 2015 for patients with cholecystitis who underwent laparoscopic cholecystectomy in a tertiary care inpatient hospital. One hundred ninety lower-risk (Charlson-Deyo) patients were included. We assessed admitting service, length of stay (LOS), time from admission to surgery, time from surgery to discharge, number of imaging studies, and total cost.

RESULTS: Patients admitted to surgical (n = 106) versus medical (n = 84) service had shorter mean LOS (1.4 days vs. 2.6 days), shorter time from admission to surgery (0.4 days vs. 0.8 days), and shorter time from surgery to discharge (0.8 days vs. 1.1 days). Surgical service patients had fewer CT (38% vs. 56%) and magnetic resonance imaging (MRI) (5% vs. 16%) studies. Cholangiography (30% vs. 25%) and endoscopic retrograde cholangiopancreatography (ERCP) (3 vs. 8%) rates were similar. Surgical service patients had 39% lower median total costs (US $7787 vs. US $12572).

CONCLUSION: Nonsurgical admissions of patients with cholecystitis are common, even among lower-risk patients. Routine admission to the surgical service should decrease LOS, resource utilization and costs. (*J Trauma Acute Care Surg.* 2019;87: 870–875. Copyright © 2019 Wolters Kluwer Health, Inc. All rights reserved.)

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KEY WORDS: Cholecystitis; length of stay; surgical admission.

Gallstone-related disease is the second-most common emergency general surgical problem in the United States.[1] In the spectrum of gallstone-related disease, acute cholecystitis is the problem most commonly encountered by general and acute care surgeons. Laparoscopic cholecystectomy (CCY) is well accepted as the procedure of choice for acute cholecystitis, but the optimal timing of CCY has been debated. While the benefits of early CCY (i.e., within 7 days) are recognized by most surgeons,[2–7] there is lack of consensus on how early we should strive to complete the surgery. Recent analyses of National Surgical Quality Improvement Program[8] and Nationwide Inpatient Sample (NIS) databases[9,10] have indicated that delays to CCY past the second hospital day add considerable cost to care. Moreover, patients having surgery later than the second hospital day experience longer operative time; increased likelihood of conversion to open; longer length of stay (LOS); increased morbidity; and higher mortality.[9]

There are many potential barriers to early cholecystectomy, such as availability of the surgeon and an operating room (OR). Another factor that may contribute to delayed surgery is the admitting service. In disease processes such as small bowel obstruction and biliary pancreatitis, patients receive more expedient surgical care when admitted to surgical services. In these patient populations, LOS and time to surgery are decreased when patients are admitted to surgical services.[11–13] This has not been well studied in acute cholecystitis.

The purpose of this quality improvement project was to examine patterns and timing of care, LOS, and costs of patients presenting to our hospital emergency department (ED) and diagnosed with acute cholecystitis. We hypothesized that significant differences were related to the admitting service, with lower costs and LOS associated with admission to the surgical service.

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METHODS

We conducted an analysis approved by the hospital quality improvement group utilizing a retrospective cohort study of patients with the International Classification of Diseases—9th Rev.—Clinical Modification (ICD-9-CM) diagnosis of cholecystitis (ICD-9 diagnosis codes 575.0, 575.1, 574.0, 574.1, 574.3) who arrived via the ED and underwent laparoscopic CCY at our urban teaching hospital from 7/2013–9/2015. All staff in our hospital are full-time employees, including acute care surgeons, medical hospitalists, and radiologists. The surgery services have ACGME-accredited residents involved in all aspects of patient care. The medicine and radiology services do not include residents. Patients were grouped based on their admitting service (medical hospitalist vs. surgery). Total LOS, time from admission to surgery, time from surgery to discharge, sequence and number of imaging studies, and total cost were measured.

Patient demographics and outcomes information were gathered electronically. Patient risk level was assigned with the Charlson-Deyo comorbidity index, which assigns tiered points for various ICD-9-CM coded comorbidities in the patient's record associated with 1-year all-cause mortality and controlled for patient age.[14] Patients older than 18 years and a Charlson-Deyo comorbidity index of 3 or less have a predicted 10 year survival rate ≥77.5%[15] and were considered "low-risk" for inclusion in this study. Cost data for each encounter was obtained from the medical center finance department. Continuous data were compared with Mann-Whitney *U* test and categorical data with χ^2 test or Fisher's exact test where appropriate. A two-sided *p* value less than 0.05 was considered statistically significant. Statistical analyses were conducted in SAS version 9.4.

RESULTS

A total of 190 consecutive patients with acute cholecystitis were identified and analyzed. There were no differences in baseline demographics between patients admitted to surgical (SURG; n = 106) versus medical (MED; n = 84) services (Table 1) except for the presence of renal disease and total bilirubin greater than 1.9 mg/dL; however, these numbers were small.

TABLE 1. Patient Demographics for all patients and those admitted to SURG versus MED services

	Total (n = 190) Mean ± SD or n (%)	SURG (n = 106, 56%) Mean ± SD or n (%)	MED (n = 84, 44%) Mean ± SD or n (%)	*p* value
Age	43 ± 13	44 ± 13	43 ± 13	0.87
Female	117 (62)	65 (61)	52 (62)	0.93
BMI	33 ± 8	32 ± 7	33 ± 9	0.6
Race/ethnicity				0.15
Asian	82 (43)	37 (35)	45 (54)	
White	52 (27)	31 (29)	21 (25)	
Native Hawaiian or Other Pacific Islander	50 (26)	34 (32)	16 (19)	
Black or African American	3 (2)	2 (2)	1 (1)	
Not reported	2 (1)	1 (1)	1 (1)	
American Indian or Alaska Native	1 (0.5)	1 (1)	0 (0)	
Charlson-Deyo Comorbidity Risk Level 2	49 (26)	25 (24)	24 (29)	0.44
ASA rating 3 or above	67 (35)	38 (36)	29 (35)	0.85
Comorbidities				
Chronic pulmonary disease	27 (14)	17 (16)	10 (12)	0.53
Congestive heart failure	2 (1)	2 (2)	0 (0)	0.5
Diabetes	17 (9)	7 (7)	10 (12)	0.21
Liver disease	12 (6)	6 (6)	6 (7)	0.77
Myocardial infarction	1 (0.5)	0 (0)	1 (1)	0.44
Peripheral vascular disease	3 (2)	1 (1)	2 (2)	0.58
Renal disease	4 (2)	0 (0)	4 (5)	0.037
Bilirubin >1.9	15 (8)	4 (4)	11 (13)	0.028

SURG, surgical; MED, medical; BMI, body mass index; ASA, American Society of Anesthesiologists.

Outcomes are listed in Table 2. Median LOS was shorter among SURG compared with MED patients (1.4 days vs. 2.6 days, $p < 0.0001$). Both time from admission to surgery (0.4 days vs. 0.8 days, $p < 0.0001$) and from surgery to discharge (0.8 days vs. 1.1 days, $p < 0.0001$) were shorter in the SURG patients. Diagnostic imaging was common (Table 3), but SURG patients had fewer CT (38% vs. 56%, $p = 0.012$) and MRI (5% vs. 16%, $p = 0.022$) studies. Ultrasound was only used for 73% of all patients. The SURG patients had 39% lower median total costs ($7,787 vs. $12,572, $p < 0.0001$).

Although there was no significant difference in admission to a SURG or MED service on weekdays versus weekends, more patients were admitted to a MED service at night (7 pm – 7 am) (Table 4). There were a total of 22 surgeons whose patients were included in this review. Nine (41%) of the 22 surgeons each performed more than 10 CCYs during the 2 years; they accounted for 79% of the cases (150) (Table 5). Of note, five surgeons appeared to admit patients preferentially to SURG, with 69% or greater SURG admissions. In contrast, three surgeons appeared to routinely prefer NONSURG admission, with 25% or fewer SRG admissions. Those who tended to admit to SURG had significantly shorter LOS among their SURG compared with MED patients. However, those who tended to admit to MED had patients whose LOS did not differ based on admitting service.

DISCUSSION

In this audit, we found that low-risk patients with acute cholecystitis are commonly—44% in this series—admitted to medical services. Further, we found that patients admitted to medical services had longer LOS, higher costs, and more imaging. The first question asked was whether the SURG and MED groups were the same. To remove confounding factors such as comorbid medical diseases the patient population was limited to those with a low-risk Charlson-Deyo comorbidity risk adjustment score. In addition, we excluded patients who had more "complicated" gallstone-related diseases such as biliary pancreatitis, choledocholithiasis, and cholangitis, as those conditions would often require additional testing and interventions, leading

TABLE 2. Outcomes for all patients and those admitted to SURG versus MED services

	Total (n = 190) Median [Q1, Q3] or n (%)	SURG (n = 106) Median [Q1, Q3] or n (%)	MED (n = 84) Median [Q1, Q3] or n (%)	*p* value
Total LOS, d	1.8 [1.1, 2.9]	1.4 [0.9, 2.2]	2.6 [1.7, 3.4]	<0.0001
Admission to surgery time, d	0.6 [0.3, 1.1]	0.4 [0.3, 0.8]	0.8 [0.5, 1.8]	<0.0001
Surgery to discharge time, d	1.0 [0.6, 1.7]	0.8 [0.3, 1,6]	1.1 [0.9, 2.0]	<0.0001
Total cost, US $	9,652 [7,264, 13,058]	7,787 [6,633, 9,942]	12,572 [10,262, 15,434]	<0.0001
30-d Readmissions	4 (2.1)	1 (0.9)	3 (3.6)	0.21

TABLE 3. Diagnostic Imaging for all patients and those admitted to SURG versus MED services

	Total (n = 190) n (%)	SURG (n = 106) n (%)	MED (n = 84) n (%)	*p* value
Ultrasound	139 (73)	73 (69)	66 (79)	0.14
CT	87 (46)	40 (38)	47 (56)	0.012
MRI	18 (10)	5 (5)	13 (16)	0.022
ERCP	10 (5)	3 (2.8)	7 (8)	0.092
Intraoperative cholangiogram	53 (28)	32 (30)	21 (25)	0.43

to longer LOS and higher costs. As seen in Table 1, the groups were not different in terms of medical condition.

In the course of the review, we noted that a substantial number of patients were discharged home without CCY. While that may have been due to severe disease leading to tube cholecystostomy or planned nonoperative management, it may be that the admitting medical doctors were not familiar with current practice in this area. There is a sizable body of literature that has addressed the optimal timing of laparoscopic CCY for acute cholecystitis, and specifically the issue of whether patients should undergo CCY during the index hospitalization or to treat with antibiotics and perform a delayed (6–12 weeks) cholecystectomy after resolution of inflammation (i.e., "cooling down"). A meta-analysis of 15 RCTs including 1,625 patients compared early (within 7 days of symptoms, and specifically the onset of pain) with delayed (>1 week after symptoms resolved) laparoscopic CCY.[2] Early CCY was associated with a longer duration of operation, but benefitted the patient in terms of lower hospital costs, fewer work days lost, higher patient satisfaction and quality of life, lower risk of wound infection, shorter hospital LOS, and similar mortality and morbidity (bile duct injury, bile leakage, conversion to open procedure).[2] A 2013 Cochrane review defined delayed CCY as greater than 6 weeks, and had similar conclusions.[3] A national Medicare sample with 29,818 patients older than 65 years with acute cholecystitis included 25% who did not receive CCY at initial admission. Among these patients, 38% had gallstone-related admissions over the next 2 years.[4] Similarly, a Canadian study of 25,397 adults with acute cholecystitis included 41% who did not receive CCY at initial admission.[5] The incidence of gallstone-related events was 29% at 1 year, with biliary pancreatitis comprising 30% of these events. In addition, a model-based cost-utility analysis from Canada compared early CCY (within 1 week of presentation), delayed CCY (8–12 weeks after presentation), and watchful waiting. This study demonstrated early CCY was the most cost-effective strategy.[7] Thus, laparoscopic CCY should be performed during the index hospitalization.

In the current study, the median overall LOS for those who underwent CCY was 1.8 days. However, those who were admitted to the medical service had a median LOS of 2.6 days, compared with 1.4 days among the SURG admissions. In the interest of quality improvement, this makes a difference. In a National Surgical Quality Improvement Program database study of 5,268 patients undergoing emergency CCY for acute cholecystitis, CCY was performed on Day 0 or 1 in 83% of patients. Those undergoing CCY Days 2 to 7 had nearly twice the conversion rate to an open procedure, increased operative time, and increased LOS.[8] A retrospective review of 95,523 patients from the NIS who underwent laparoscopic CCY within 10 days of presentation for acute cholecystitis also demonstrated increasing mortality, postoperative infection, and hospital costs for those who underwent surgery on Days 2 to 10, compared with those who underwent surgery days 0 to 1.[9] A Swiss study found that with CCY performed on Day 0 to Day 6, conversion to open surgery increased from 12% to 28%, postoperative complications increased from 6% to 13%, and need for re-operation increased from 1% to 3%, respectively.[16] Finally, Schwartz and colleagues[10] queried the NIS for patients undergoing laparoscopic CCY for acute cholecystitis between 2003 and 2011, and found over 190,000 records. After controlling for patient- and hospital-related factors, they found that for laparoscopic CCY performed on each day after the first day, the costs of care increased by approximately US $2000 per day. This held for those discharged within 24 hours of surgery, suggesting they were simply waiting to have the surgery. Given all of these data, laparoscopic CCY should be performed within 24 hours of patient presentation.

Another opportunity for cost containment in our hospital appears to be the use of imaging. In the current study, CT was obtained in 44% of the patients. It is unclear why the use of CT was so prevalent, as transabdominal ultrasonography is well accepted and recommended as the imaging test of choice for gallstone-related disease.[17] It is noninvasive, portable, and able to confirm gallbladder pathology with 96% accuracy.[18,19] Moreover, many emergency physicians routinely perform bedside ultrasonography and can detect gallstones. While CT can be helpful in diagnosing gallstone-related complications, it has lower accuracy with respect to diagnosis of cholelithiasis.[17,18] Moving forward, we are emphasizing initial ultrasonography (US) and surgical consultation prior to use of CT or MRI. In patients with atypical presentations, CT may be helpful in diagnosing other etiologies of abdominal pain. Among elderly patients, who may not be able to articulate pain location and character, CT may be especially useful. Millet et al.[20] have recently demonstrated that among elderly patients 75 years and older, routine systematic unenhanced CT scan improved diagnostic accuracy compared with standard practice and CT per guidelines. Diagnostic accuracy improved from 76% to 85%, and "management accuracy" (i.e., the decision to admit or discharge) from 89% to 96%. In 30% of patients, the final diagnosis had not been suspected

TABLE 4. Time of admission characteristics for all patients and those admitted to SURG versus MED services

Time of Admission	Total, n (%)	SURG, n (%)	MED, n (%)	*p* value
Night (7:00 PM–7:00 AM)	87 (46)	39 (37)	48 (57)	0.0056
Weekend	60 (32)	31 (29)	29 (34)	0.53

TABLE 5. Admitting preference for higher-volume surgeons

	Cases, n	% SURG Admit	SURG Admit, n	SURG LOS	%MED Admit, n	MED LOS	*p* value
Surgeon							
A	12	92%	11	2.0	8%	4.8	—
B	21	86%	18	1.0	14%	5.3	
C	19	79%	15	1.7	21%	3.5	
D	15	73%	11	1.8	27%	3.6	
E	13	69%	9	1.3	31%	4.0	
Total "SURG-preferential"	80	80% (64)	64	1.52	20% (16)	4.07	<0.0001
F	12	25%	3	2.7	75%	1.9	
G	25	16%	4	1.7	84%	3.0	
H	16	13%	2	1.0	88%	2.5	
Total "MED-preferential"	53	17% (9)	9	1.88	83% (44)	2.62	0.33

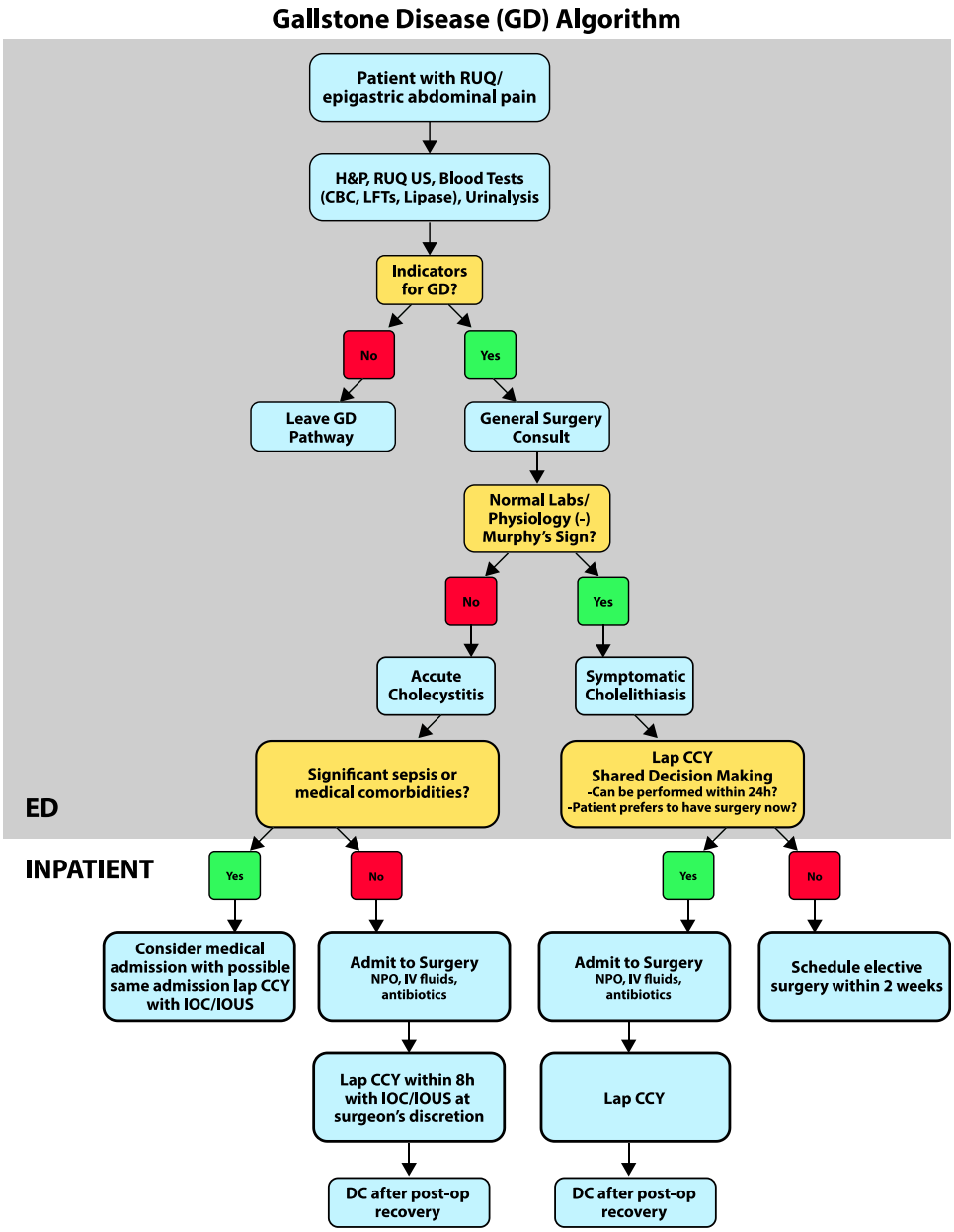

Figure 1. Algorithm for the approach to a patient with gallstone disease.

after initial clinical evaluation. In 3.4% the CT led to a surgical procedure that was not expected. Thus, CT should be considered in elderly patients with abdominal complaints.

Surgeons at our institution admitted more commonly to MED at night. However, there was no significant difference on weekends. The more disparate LOS for SURG versus MED for surgeons who admit primarily to SURG might suggest a more discerning approach, reserving the MED admission for the patient in whom medical issues truly impact the clinical course. On the other hand, surgeons who more often admit patients to MED may be distinguishing patients less on the patients' characteristics, but making decision based on the time of admission.

This retrospective study is limited in that it is a single-institution study where diagnoses are based on coding. We are not able to determine the reason(s) for admission to either the SURG or MED service. We are also not able to delineate the reasons for delay between admission and surgery, and also surgery to discharge for those admitted to a nonsurgical service. However, we can deduce that the delay to surgery may be due to waiting for results of additional imaging. In addition, delay in obtaining the surgical consult further delays the surgical start time as earlier notification of the surgical team could likely produce more favorable operating room availability. Finally, when the discharging service does not have the additional obstacle of obtaining discharge approval by a consulting team, discharge can occur more expeditiously. There is no reason to delay surgery except in those cases where biliary disease is complicated by choledocholithiasis, cholangitis, or pancreatitis, which are pathologies excluded from this study.

Since the period of this audit, we have been formalizing an acute care surgery service model in our hospital. This model has been shown to reduce time to surgery in cholecystitis.[21] In addition, the number of surgeons taking ED call has decreased, which should further limit variations in care. These data have been part of the impetus for the creation of a gallstone-disease management algorithm (Fig. 1).

This study supports routine admission to the surgical service for low-risk patients with acute cholecystitis. Such a policy should reduce costs, LOS, and potentially complications—and may improve patient satisfaction. Given the static Medicare reimbursement for surgical treatment of acute cholecystitis, resource optimization is necessary for high quality care of acute cholecystitis.

AUTHORSHIP

W.L.B. conducted the literature search. A.L. and W.L.B. completed the study design. Data collection and data analyses were performed by J.P. and G.Z. Data interpretation was performed by A.L., N.L. and W.L.B. Writing was performed by N.L. and W.L.B. Critical revision was performed by N.L., L.L.W., and W.L.B.

DISCLOSURE

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