A population-based analysis of the clinical course of 10,304 patients with acute cholecystitis, discharged without cholecystectomy

Charles de Mestral, MD, Ori D. Rotstein, MD, MSc, Andreas Laupacis, MD, MSc, Jeffrey S. Hoch, MA, PhD, Brandon Zagorski, MS, *and* **Avery B. Nathens, MD, PhD, MPH,** *Toronto, Canada*

AAST Continuing Medical Education Article

Accreditation Statement

This activity has been planned and implemented in accordance with the Essential Areas and Policies of the Accreditation Council for Continuing Medical Education through the joint sponsorship of the American College of Surgeons and the American Association for the Surgery of Trauma. The American College Surgeons is accredited by the ACCME to provide continuing medical education for physicians.

AMA PRA Category 1 Credits™

The American College of Surgeons designates this Journal-based CME activity for a maximum of *1 AMA PRA Category 1 Credit*™ for each article. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Credits can only be claimed online at this point.

AMERICAN COLLEGE OF SURGEONS
Inspiring Quality:
Highest Standards, Better Outcomes

Objectives

After reading the featured articles published in the *Journal of Trauma and Acute Care* Surgery, participants should be able to demonstrate increased understanding of the material specific to the article. Objectives for each article are featured at the beginning of each article and online. Test questions are at the end of the article, with a critique and specific location in the article referencing the question topic.

Claiming Credit

To claim credit, please visit the AAST website at http://www.aast.org/ and click on the "e-Learning/MOC" tab. You must read the article, successfully complete the post-test and evaluation. Your CME certificate will be available immediately upon receiving a passing score of 75% or higher on the post-test. Post-tests receiving a score of below 75% will require a retake of the test to receive credit.

Disclosure Information

In accordance with the ACCME Accreditation Criteria, the American College of Surgeons, as the accredited provider of this journal activity, must ensure that anyone in a position to control the content of *J Trauma Acute Care Surg* articles selected for CME credit has disclosed all relevant financial relationships with any commercial interest. Disclosure forms are completed by the editorial staff, associate editors, reviewers, and all authors. The ACCME defines a 'commercial interest' as "any entity producing, marketing, re-selling, or distributing health care goods or services consumed by, or used on, patients." "Relevant" financial relationships are those (in any amount) that may create a conflict of interest and occur within the 12 months preceding and during the time that the individual is engaged in writing the article. All reported conflicts are thoroughly managed in order to ensure any potential bias within the content is eliminated. However, if you perceive a bias within the article, please report the circumstances on the evaluation form.

Please note we have advised the authors that it is their responsibility to disclose within the article if they are describing the use of a device, product, or drug that is not FDA approved or the off-label use of an approved device, product, or drug or unapproved usage.

Disclosures of Significant Relationships with Relevant Commercial Companies/Organizations by the Editorial Staff:

Ernest E. Moore, Editor: PI, research grant, Haemonetics. Associate editors: David Hoyt, Ronald Maier, and Steven Shackford have nothing to disclose. Editorial staff: Jennifer Crebs, Jo Fields, and Angela Sauaia have nothing to disclose.

Author Disclosures: All authors have nothing to disclose.

Reviewer Disclosure: The reviewers have nothing to disclose.

Cost

For AAST members and *Journal of Trauma and Acute Care Surgery* subscribers there is no charge to participate in this activity. For those who are not a member or subscriber, the cost for each credit is $50.

System Requirements

The system requirements are as follows: Adobe® Reader 7.0 or above installed; Internet Explorer® 7 and above; Firefox® 3.0 and above, Chrome® 8.0 and above, or Safari™ 4.0 and above.

Questions

If you have any questions, please contact AAST at 800-789-4006. Paper test and evaluations will not be accepted.

Submitted: August 1, 2012, Revised: August 22, 2012, Accepted: August 23, 2012.
From the Li Ka Shing Knowledge Institute (C.D.M., O.D.R., A.L., J.S.H., A.B.N.), St Michael's Hospital; and Institute for Clinical Evaluative Science (C.D.M., A.L., J.S.H., B.Z., A.B.N.), Toronto, Ontario, Canada.
The study was presented at the 71st annual meeting of the American Association for the Surgery of Trauma, September 12–15, 2012, in Kauai, Hawaii.
Address for reprints: Dr. Charles de Mestral, 30 Bond St, Queen Wing 3-076, Toronto, ON, Canada, M5B 1W8; email: charles.demestral@mail.utoronto.ca.

DOI: 10.1097/TA.0b013e3182788e4d

BACKGROUND: Randomized trials and expert opinion support early laparoscopic cholecystectomy for most patients with acute cholecystitis (AC); however, practice patterns remain variable worldwide, and delayed cholecystectomy remains a common practice. We therefore present a population-based analysis of the clinical course of patients with AC discharged without cholecystectomy.

METHODS: Using administrative databases capturing all emergency department (ED) visits and hospital admissions within a geographic region encompassing 13 million persons, we identified adults with a first emergency admission for uncomplicated AC during the period of 2004 to 2011. In those discharged without cholecystectomy, the probability of a subsequent gallstone-related event (gallstone-related ED visit or hospital admission) was evaluated using Kaplan-Meier methods. The association of patient characteristics with time to first gallstone-related event after discharge was explored through multivariable time to event analysis.

RESULTS: Of 25,397 patients with AC, 10,304 (41%) did not undergo cholecystectomy on first admission. The probability of a gallstone-related event by 6 weeks, 12 weeks, and 1 year after discharge was 14%, 19%, and 29% respectively. Of these events, 30% were for biliary tract obstruction or pancreatitis. When controlling for sex, income, and comorbidity level, the risk of a gallstone-related event was highest for patients 18 years to 34 years old.

CONCLUSION: For patients who do not undergo cholecystectomy on first admission for AC, the probability of a gallstone-related ED visit or hospital admission within 12 weeks of discharge is 19%. The increased risk in younger patients reinforces the value of early cholecystectomy in the nonelderly. (*J Trauma Acute Care Surg*. 2013;74: 26–31. Copyright © 2013 by Lippincott Williams & Wilkins)

LEVEL OF EVIDENCE: Prognostic study, level III; therapeutic study, level IV.

KEY WORDS: Acute cholecystitis; recurrent gallstone symptoms; delayed cholecystectomy.

Randomized trials and expert opinion support early laparoscopic cholecystectomy within up to 7 days of symptom onset for most patients with acute cholecystitis (AC).[1–9] Nevertheless, early cholecystectomy rates reported worldwide vary from 33% to 88%, suggesting that delayed cholecystectomy remains a common practice at many institutions.[10–14] One of the strongest arguments against delayed cholecystectomy is that, in the interval between discharge and delayed elective cholecystectomy, patients are at risk of recurrent gallstone-related symptoms. Existing data suggest that the frequency of recurrent symptoms after discharge is in the range of 0% to 38%.[5–9,13] Small study samples, single-center analyses, and data sources limited to specific patient subgroups are limitations of these studies.[5–9,13] Accurate estimates that can be generalized to a broad population of adults are needed to inform clinical and resource allocation decisions about the management of AC. Therefore, the objectives of this study were to determine the frequency of recurrent gallstone-related symptoms using population-based data and to identify patient subgroups at highest risk of recurrent symptoms.

METHODS

Study Design and Setting

This is a population-based retrospective cohort study of the clinical course of adults admitted with a first episode of AC and discharged without undergoing cholecystectomy. We used data from Ontario, Canada's most populous province with more than 13 million residents. Funding for all hospital and physician services accessed by Ontario residents is solely provided by the provincial Ministry of Health. This study was approved by the research ethics board of Sunnybrook Health Sciences Center.

Data Sources

The cohort was identified from administrative data sets housed and consolidated at the Institute for Clinical Evaluative Sciences, Toronto, Canada. Diagnostic and procedural information was obtained from the Discharge Abstract Database that contains data about all hospital admissions in Ontario and the National Ambulatory Care Reporting System that includes data about all emergency department (ED) visits and same-day surgeries. Demographic data and date of death were obtained from the Registered Person Database. An encrypted unique patient identifier allows these data sets to be deterministically linked, thereby providing an accurate record of patients' clinical trajectories.

Cohort

All Ontario residents, admitted via the ED from April 2004 to March 2011 with a most responsible diagnosis of AC (International Classification of Disease codes- 10th Revision,Canada- K80.00, K80.01, K80.10, K80.11, K81.0, K81.8, and K81.9), were considered for inclusion in the cohort. We identified patients with a first episode of AC by excluding those with an ED visit or hospital admission for gallstone disease in the 2 years preceding the index admission. We also excluded patients with complicated cholecystitis, namely, those with a concurrent diagnosis of pancreatitis or common bile duct obstruction, those with severe cholecystitis as evidenced by direct admission to an intensive care unit, and those who underwent cholecystostomy tube placement. The remaining patients who survived to hospital discharge and did not undergo cholecystectomy on their index admission constituted the final cohort.

TABLE 1. Probability of a Gallstone-Related Event by Time From Discharge

Time From Discharge	Probability of Gallstone-Related Event by Time From Discharge (99% CI), %*	No. Patients Remaining at Risk of Gallstone-Related Event
6 wk	14.0 (13.1–14.9)	7,126
12 wk	18.9 (17.7–19.9)	4,877
6 mo	24.2 (22.9–25.5)	3,340
1 y	28.8 (27.4–30.3)	2,552
2 y	33.9 (32.2–35.6)	1,745
3 y	37.6 (35.7–39.5)	1,191
4 y	39.8 (37.8–41.9)	789
5 y	40.8 (38.7–43.1)	471

*Probability is conditional on surviving and not undergoing elective cholecystectomy before time from discharge.

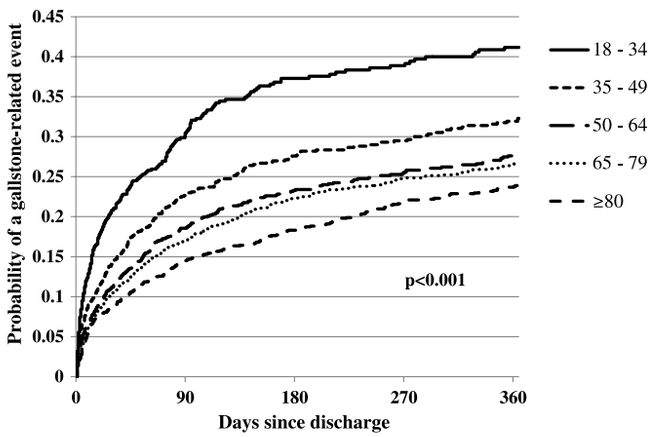

Figure 1. Unadjusted probability of a gallstone-related event across age groups in the first year following discharge.

Outcome

The outcome of interest was time to first gallstone-related event. A gallstone-related event was defined as any ED visit or hospital admission for biliary colic, recurrent AC, choledocholithiasis, cholangitis, biliary pancreatitis, or gallstone ileus. All ED visits and hospital admissions between the date of hospital discharge and date of maximum follow-up were searched. Identification of gallstone-related events was limited to the main diagnosis field for ED visits and to the most responsible and postadmission comorbidity fields for hospital admissions. If a hospital admission included two or more gallstone diagnoses (e.g., cholecystitis and pancreatitis), the gallstone-related event was classified based on the diagnosis with greatest potential morbidity (i.e., pancreatitis).

Patient Characteristics

Risk of recurrent gallstone-related symptoms across patient subgroups was examined based on the following patient characteristics: age, sex, comorbidity level, and income quintile. Used as a crude proxy for socioeconomic status, income quintile reflects the median household income in a patient's postal code of residence based on 2001 or 2006 Canada census data.[15,16] The John Hopkins Aggregate Diagnosis Groups (ADG) system was used to quantify the level of comorbidity based on inpatient and outpatient records in the 2 years preceding the index cholecystitis admission.[17] From this grouping system, an ADG-based comorbidity index was calculated according to an algorithm validated for the prediction of 1-year mortality in a large cohort of adult Ontarians.[18,19]

Statistical Analysis

First, the probability of a gallstone-related event by clinically meaningful time points following discharge was calculated using the Kaplan-Meier method (1 minus the product limit value). Patients who underwent elective cholecystectomy, who died, or who reached the maximal follow-up date before any gallstone-related event were censored. Cholecystectomy was considered elective if performed as same-day surgery or on an inpatient admission without an associated ED visit. Any admission for gallstone disease involving a cholecystectomy but with an associated ED visit was considered an admission for a recurrent gallstone-related event.

Second, to understand which patient subgroups might be at greater risk of recurrent gallstone symptoms, we performed univariable comparisons with the log-rank test as well as developed a Cox proportional hazard model. This multivariable time to event analysis was used to describe the association of all the previously listed patient characteristics with time to first gallstone-related event. The proportional hazards assumption was evaluated graphically by plotting logarithm-minus-logarithm survival curves.[20] Given the large sample size, α was set at 0.01.

RESULTS

Study Cohort

Of 25,397 patients admitted with a first episode of uncomplicated AC meeting inclusion criteria, 10,304 (41%) were discharged without undergoing cholecystectomy. The majority (54%, n = 5,550) were female, and the median age was 62 years (interquartile range [IQR], 47–76 years). The cohort was evenly distributed across study years.

Median follow-up was 3.4 years (IQR, 1.7–5.1). During the interval of follow-up, 2,479 patients (24%) had an observed gallstone-related ED visit or admission. Median time to first event was 78 days, with 88% (n = 2,177) of events occurring within 1 year of discharge. A total of 4,617(45%) underwent elective cholecystectomy, and an additional 733 (7%) patients died before any gallstone-related event. Median times to elective cholecystectomy and death were 8 weeks (IQR, 5–13 weeks) and 14 months (IQR, 4–30 months), respectively.

TABLE 2. Multivariable Time to Event Analysis Showing Adjusted Risk of Gallstone-Related Event Across Patient Characteristics

Patient Characteristic	Hazard Ratio (99% CI)
Age, y	
18–35 (n = 1,133)	2.23 (1.82–2.74)
36–50 (n = 1,958)	1.57 (1.29–1.90)
51–65 (n = 2,473)	1.26 (1.05–1.51)
66–80 (n = 2,988)	1.16 (0.98–1.39)
>80 (n = 1,752)	Reference
Sex	
Female (n = 5,564)	0.97 (0.87–1.09)
Male (n = 4,740)	Reference
Income quintile	
1 (n = 1,855)*	1.11 (0.93–1.33)
2 (n = 1,958)	1.12 (0.94–1.34)
3 (n = 2,061)	1.03 (0.86–1.24)
4 (n = 2,164)	1.00 (0.83–1.21)
5 (n = 2,262)	Reference
ADG comorbidity index quartile	
1 (n = 2,483)*	0.94 (0.80–1.11)
2 (n = 2,669)	0.88 (0.75–1.03)
3 (n = 2,545)	0.89 (0.76–1.04)
4 (n = 2,607)	Reference

*1 reflects lowest income and comorbidity level.

Frequency of Gallstone-Related ED Visit or Admission

The probability of a gallstone-related event by 6 and 12 weeks following discharge was 14% and 19%, respectively (Table 1). Of the patients with a gallstone-related event within 12 weeks of discharge, more than two thirds presented with recurrent cholecystitis or biliary colic (70%), with the remaining patients presenting with biliary tract obstruction (24%) or pancreatitis (6%). A similar distribution of event type was found by 1 year, with an additional small proportion of first gallstone-related ED visits or admissions (<1%) caused by gallstone ileus. For those patients readmitted for AC or biliary colic and for those with pancreatitis, biliary obstruction, or gallstone ileus, in-hospital mortality was 1.6% and 1.4%, respectively ($p = 0.77$).

Risk of Gallstone-Related ED Visit or Admission

Differences in the risk of a gallstone-related event were found across age groups (Fig. 1). For example, the probability of a first gallstone-related event by 12 weeks following discharge was 30% for patients between the ages of 18 years and 35 years, compared with only 14% in those 80 years of age or older ($p < 0.001$). No difference in the type of gallstone-related event was seen across age groups. On multivariable analysis, when controlling for sex, comorbidity level, and income, younger patients remained at greatest risk throughout the first year following discharge from hospital (Table 2). No difference in the probability of recurrent gallstone symptoms was seen between sexes or across comorbidity and income levels.

DISCUSSION

This study of the clinical course of patients with AC discharged without cholecystectomy demonstrates three main findings. First, by 12 weeks from discharge, the time interval conventionally used for delayed elective cholecystectomy after an episode of AC, the risk of a gallstone-related ED visit, or hospital admission was 19%. Second, in those who had recurrent symptoms, nearly 30% presented with biliary tract obstruction or pancreatitis, diseases with greater morbidity potential than the initial cholecystitis episode. Third, the risk of recurrent gallstone-related ED visit or hospital admission decreased with age.

In randomized trials comparing early with delayed intervention, 0% to 37% of patients randomized to delayed treatment had unresolving or recurrent gallstone symptoms.[5–9] In a large cohort study of patients with AC 65 years or older, Riall et al.[13] reported a 38% probability of gallstone-related readmission by 2 years after discharge. The same study also demonstrated a higher risk of recurrent symptoms in the youngest patients of the cohort.

Our results are consistent with the existing literature but provide estimates of the risk of recurrent symptoms that were derived from a broad population of adults with AC. Furthermore, to our knowledge, this analysis is the first to identify the relatively large proportion of patients returning with biliary tract obstruction or pancreatitis, which carry significant potential for morbidity. These data are critical for informed decision making with patients, concerning delayed cholecystectomy as a management strategy. That an age-related gradient in risk of recurrent symptoms was also found by Riall et al. reinforces the validity of our similar finding, but our data cannot explain the underlying reasons for such differences in risk across ages. It may be that diet, genetics, and anatomy contribute to the development of AC early in life in these younger patients, who then remain at increased risk of recurrent symptoms. The higher risk of symptomatic disease in younger patients and the lower risk in those older than 80 years can inform decision making about the benefits and risks of early cholecystectomy in these patients. Most clearly, these results reinforce the value of early cholecystectomy in the nonelderly.

Strengths of this study are its population-based scope, large sample size, and the capture of ED visits in addition to admissions. However, its limitations must be recognized. First, the increased risk of recurrent gallstone disease in younger patients may be partially attributable to unmeasured characteristics such as dietary intake, body mass index, genetic factors, biliary anatomy, or differences in cholecystitis severity. Second, our results may slightly overestimate the probability of recurrent gallstone disease if preadmission cholecystitis was erroneously coded as a postadmission comorbidity. However, when we restricted the outcome definition to only the most responsible diagnosis field for subsequent ED visits and admissions, the estimates of recurrent symptoms were not meaningfully lower from those in Table 1, and adjusted risks across patient characteristics were similar to those presented in Table 2. Finally, while we were able to capture all ED visits and hospitals admissions in Ontario, we did not capture outpatient clinic visits to a family physician for gallstone-related symptoms and therefore may be underestimating the probability of recurrent symptoms. Nonetheless, such visits are likely relatively few since most patients are instructed to return to an ED if symptoms recur.

CONCLUSION

This population-based analysis characterizes the risk of recurrent gallstone symptoms in a large cohort of patients who presented with a first episode of AC and were discharged without cholecystectomy. The probability of a gallstone-related ED visit or hospital admission within 12 weeks of discharge was 19%. The increased risk in younger patients reinforces the value of early cholecystectomy in the nonelderly.

AUTHORSHIP

C.D.M., O.D.R., A.L., J.S.H., and A.B.N. designed the study. C.D.M. and B.Z. created the cohort. C.D.M. and A.B.N. are responsible for the analysis. C.D.M., O.D.R., A.L., J.S.H., B.Z., and A.B.N. interpreted the results. C.D.M. drafted the article. C.D.M., O.D.R., A.L., J.S.H., B.Z., and A.B.N. contributed to the critical revisions and final approval of the article.

DISCLOSURE

This study was funded by operating grants from the Canadian Surgical Research Fund and Physician Services Inc. Foundation. In addition, this study was supported by the Institute for Clinical Evaluative Sciences (ICES), which is funded by an annual grant from the Ontario Ministry of Health and Long-Term Care (MOHLTC). The opinions, results and conclusions reported in this paper are those of the authors and are independent from the funding sources. No endorsement by ICES or

the Ontario MOHLTC is intended or should be inferred. No authors have conflicts of interest to declare. A.L. is supported by Canada Research Chair in Health Policy and Citizen Engagement. J.S.H. is supported by a grant to develop and direct the Pharmacoeconomics Research unit at Cancer Care Ontario and receives support from the Canadian Cancer Society as codirector of the Canadian Center for Applied Research in Cancer Control. A.B.N. is supported by a Canada Research Chair in Systems of Trauma Care.

REFERENCES

1. Gurusamy K, Samraj K, Gluud C, Wilson E, Davidson BR. Meta-analysis of randomized controlled trials on the safety and effectiveness of early versus delayed laparoscopic cholecystectomy for acute cholecystitis. *Br J Surg*. 2010;97:141–150.
2. Yamashita Y, Takada T, Kawarada Y, Nimura Y, Hirota M, Miura F, Mayumi T, Yoshida M, Strasberg S, Pitt HA, et al. Surgical treatment of patients with acute cholecystitis: Tokyo Guidelines. *J Hepatobiliary Pancreat*. 2007;14:91–97.
3. Strasberg S. Clinical practice. Acute calculous cholecystitis. *N Engl J Med*. 2008;358:2804–2811.
4. Germanos S, Gourgiotis S, Kocher HM. Clinical update: early surgery for acute cholecystitis. *Lancet*. 2007;369:1774–1776.
5. Lai PB, Kwong KH, Leung KL, Kowk SP, Chan AC, Chung SC, Lau WY. Randomized trial of early versus delayed laparoscopic cholecystectomy for acute cholecystitis. *Br J Surg*. 1998;85:764–767.
6. Lo CM, Liu CL, Fan ST, Lai CS, Wong J. Prospective randomized study of early versus delayed laparoscopic cholecystectomy for acute cholecystitis. *Ann Surg*. 1998;227:461–467.
7. Kolla SB, Aggarwal S, Kumar A, Kumar R, Chumber S, Parchad R, Seenu V. Early versus delayed laparoscopic cholecystectomy for acute cholecystitis: a prospective randomized trial. *Surg Endosc*. 2004;18:1323–1327.
8. Johansson M, Thune A, Nelvin L, Stiernstam M, Westman B, Lundell L. Randomized clinical trial of open versus laparoscopic cholecystectomy in the treatment of acute cholecystitis. *Br J Surg*. 2005;92:44–49.
9. Davila D, Manzanares C, Picho ML, Albors P, Cardenas F, Fuster E. Experience in the treatment (early vs. delayed) of acute cholecystitis via laparoscopy. *Cirugıa Espanola*. 1999;66. (Suppl 1):233.
10. Stephens MR, Beaton C, Steger AC. Early cholecystectomy after acute admission with cholecystitis: how much work? *World J Surg*. 2010;34: 2041–2044.
11. Lee SW, Yang SS, Chang CS, Yeh HJ. Impact of the Tokyo guidelines on the management of patients with acute calculous cholecystitis. *J Gastroenterol Hepatol*. 2009;24:1857–1861.
12. Casillas RA, Yegiyants S, Collins JC. Early laparoscopic cholecystectomy is the preferred management of acute cholecystitis. *Arch Surg*. 2008;143: 533–537.
13. Riall TS, Zhang D, Townsend CM Jr, Kuo YF, Goodwin JS. Failure to perform cholecystectomy for acute cholecystitis in elderly patients is associated with increased morbidity, mortality, and cost. *J Am Coll Surg*. 2010;210:668–677, 677–679.
14. Greenstein AJ, Moskowitz A, Gelijns AC, Egorova NN. Payer status and treatment paradigm for acute cholecystitis. *Arch Surg*. 2012;147:453–458.
15. Wilkins R. Use of postal codes and addresses in the analysis of health data. *Health Rep*. 1993;5:157–177.
16. Glazier RH, Creatore MI, Agha MM, Steele LS. , Inner City Toronto Time Trends Working Group. Socioeconomic misclassification in Ontario's Health Care Registry. *Can J Public Health*. 2003;94:140–143.
17. Johns Hopkins University. Johns Hopkins ACG Case-Mix Adjustment System. Available at: http://www.acg.jhsph.edu. Accessed July 1, 2011.
18. Austin PC, van Walraven C, Wodchis WP, Newman A, Anderson GM. Using the Johns Hopkins Aggregated Diagnosis Groups (ADGs) to predict mortality in a general adult population cohort in Ontario, Canada. *Med Care*. 2011;49:932–939.
19. Austin PC, Walraven C. The mortality risk score and the ADG score: two points-based scoring systems for the Johns Hopkins aggregated diagnosis groups to predict mortality in a general adult population cohort in Ontario, Canada. *Med Care*. 2011;49:940–947.
20. Kleinbaum DG, Klein M. *Survival Analysis*. 2nd ed. New York, NY: Springer; 2005:83–172.

DISCUSSION

Dr. Gregory J. Jurkovich (Seattle, Washington): Dr. de Mestral and his colleagues have presented a wonderfully compelling and, I believe, quite timely analysis of the clinical pathway of 10,000 patients with acute cholecystitis.

These were patients who were initially seen in an emergency department or during a hospital admission who were diagnosed with acute cholecystitis yet were sent home without a cholecystectomy.

The limitations of an administrative database prohibits a useful analysis of the flawed thinking behind this decision, reflecting one of the major limitations of the study.

Nonetheless, these data should influence a practice pattern of care for all of us and, more importantly, the practice patterns for internists, hospitalists, and emergency physicians who initially see these patients and evaluate them for their acute biliary tract disease.

The important conclusions are best illustrated by the graphics of the nicely presented article, displaying the probability of a recurrent attack of a cholecystitis over time.

Within 3 months, 20% of the patients regardless of age will have another preventable event, 25% at 6 months. The younger the patient, the more likely is the recurrence; conversely, the older the patient, the less likely is the occurrence of another biliary disease acute event.

Significantly, one quarter of the recurrences were for biliary obstruction, 6% for biliary pancreatitis, and 60% for recurrent cholecystitis. This brings me to my four questions.

First, although you commented on it briefly, what other explanations do you have for the observation that recurrent attacks are less common in the elderly?

Second, how reliable and accurate is this administrative database in capturing all recurrent attacks of biliary disease?

In developing the Kaplan-Meier graphics for the likelihood of recurrent disease, you adjusted for age, sex, socioeconomic status, and medical comorbidities, but perhaps, in doing so, you have denied us the opportunity to try to predict who is most likely to have a recurrent attack.

As such, my third question is the following: were the patients who had an immediate cholecystectomy different from those who were discharged without cholecystectomy? Likewise, were they also different from those who had a recurrent and subsequent delayed cholecystectomy?

Finally, did the training or specialty of the physicians who initially evaluated the patient at the first encounter also influence the decision to discharge without cholecystectomy?

This article is a very nice example of the importance of physician decision making in medical care and how it can remarkably influence medical expenses and morbidity. It is also an example of the importance of the acute care surgeon concept so that the resources are in place to provide care for these patients during their first encounter. Thank you.

Dr. Charles E. Wiles III (Buffalo, New York): Just to emphasize the previous discussion, can you tell from your database how many of the patients were initially seen by a surgeon physically on their initial presentation?

Dr. David P. Blake (Norfolk, Virginia): This was a very interesting prospective study on an intra-abdominal infection type of disease that should be managed by a surgeon.

A couple of years ago at the Surgical Infection Society, there was an update presentation on intra-abdominal infection, and they looked at diseases such as diverticulitis and noted that the recurrence of disease later on without operative management up front was typically, in most patients, no worse than what their initial presentation was. Yet, you alluded to a comment that many of these patients would come in with a fairly marked or worsening condition.

So, I am wondering if your database has any correlation between what their initial presentation was, and then for those patients that got delayed intervention, what was their return presentation?

Was it the same? Was it truly worse? You did mention that most patients were readmitted or reevaluated in the emergency department for cholecystitis. Thank you.

Dr. Charles de Mestral (Toronto, Ontario, Canada): Thank you Dr. Jurkovich, Dr. Wiles, and Dr. Blake for the insightful questions. First, given the data elements we have, we can only speculate on the underlying reasons for a lower risk of recurrent events in the elderly. It may be that anatomy, genetics, or diet lead certain patients to develop cholecystitis at a younger age and then remain at higher risk of recurrent symptoms when managed nonoperatively. Moreover, while we excluded patients with severe cholecystitis, older patients may have had slightly less serious cholecystitis when they came in, leading to a lower risk of recurrent symptoms. Another possible explanation is that younger patients were more prone to seek medical attention.

With respect to the second question about the reliability of the data, a recent large validation study showed almost perfect agreement on the main diagnosis field on admission between the administrative records and reabstracted data for gallstone disease. That being said, the estimates we presented only capture emergency department visits and hospital admissions. We did not capture outpatient visits to a family physician or surgeon, which means that these numbers may slightly underestimate the true rate of recurrent symptoms. However, we would expect that most patients with recurrent symptoms would come back to a hospital.

In the difference between patients who were operated on first admission and those who were discharged without cholecystectomy, patients discharged without cholecystectomy, as you might expect, were older and had greater comorbidity levels. This led us to want to examine the differences in the risk of a gallstone-related event across age groups and comorbidity levels.

There were a couple of questions about the specialty of the first assessing and admitting physician. In Ontario, most patients are admitted under general surgeons. When we looked for evidence in our data that there was at least a consultation by a general surgeon, we found that more than 85% of patients had a coded consultation by a general surgeon or were admitted under a general surgeon. How accurately consultations are captured is unknown, but we feel that it is likely an even larger proportion, if not nearly all of these patients, which were managed with some input from a general surgeon.

Finally, there was a question about whether the recurrent events were in fact worse than the initial index admission. Beyond excluding patients with severe cholecystitis, there was no information on any potential gradient in cholecystitis severity. Thus, in those patients who came back with recurrent acute cholecystitis, we cannot say whether it was worse than the initial event. We did find that 30% of patients came back with choledocholithiasis, cholangitis, or pancreatitis. While the morbidity associated with these events was likely greater than biliary colic or recurrent cholecystitis, in-hospital mortality was no different between patients returning with biliary colic or cholecystitis and those with more serious gallstone disease.

Thank you for the privilege of the podium.