Readmissions After Biliary Acute Pancreatitis: Analysis of the Nationwide Readmissions Database

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Abstract

Background: Acute pancreatitis is a common inflammatory condition that involves the pancreas. Gallstones and alcohol are the most common etiologies in the USA. Cholecystectomy is the cornerstone procedure in the management of biliary acute pancreatitis (BAP). In this study, we examined the causes and predictors of readmissions following BAP based on the procedure performed.

Methods: Using the Nationwide Readmissions Database (NRD) and the International Classification of Diseases, Tenth Revision, Clinical Modification/Procedure Coding System (ICD10-CM/PCS), we retrospectively studied BAP hospitalizations (2016 - 2018). The first hospitalization within the year was marked as index hospitalization. Index hospitalizations were categorized based on whether an endoscopic retrograde cholangiopancreatography (ERCP) and/or a cholecystectomy was performed into no procedure group, ERCP group, cholecystectomy group, and both procedures group. We subsequently identified readmissions within 30 days. Using this categorization, we studied reasons, rates, and predictors of readmissions.

Results: A total of 127,318 index hospitalizations were included. The cholecystectomy group constituted the largest share of this cohort (43.5%). Using the no procedure group as a reference, analysis of the outcomes showed that the cholecystectomy group had the lowest inpatient mortality (adjusted odds ratio (aOR): 0.18, P < 0.001), while both procedures group had the highest total hospital charges (adjusted mean difference (aMD): 42,249, P < 0.001). Acute pancreatitis without necrosis or infection was the most frequent principal diagnosis for readmission (18.7%). Analysis of readmission predictors showed that both procedures group had the lowest risk for readmission (adjusted hazard ratio (aHR): 0.40, P < 0.001). Females were less likely to be readmitted compared to males (aHR: 0.82, P < 0.001) and elderly were less likely to be readmitted compared to young adults (aHR: 0.82, P < 0.001). Patients discharged against medical advice were more likely to be readmitted (aHR: 1.76, P < 0.001).

Conclusion: Undergoing both ERCP and cholecystectomy for BAP resulted in significantly higher hospital charges with no additional mortality benefit. However, it decreased the readmission risk significantly. Acute pancreatitis without necrosis or infection was the most frequent reason for readmissions.

Keywords: Biliary acute pancreatitis; Readmission; Nationwide Readmissions Database; ERCP; Cholecystectomy

Introduction

Acute pancreatitis remains one of the most common gastrointestinal diagnoses requiring hospitalization [1, 2]. The estimated global incidence for acute pancreatitis is 33.7 cases per 100,000 person-years with 1.6 deaths per 100,000 person-years [3]. The incidence of acute pancreatitis has been increasing in North America and Europe [4, 5]. Gallstones and alcohol are the most common causes of acute pancreatitis. The proportion of cases attributed to gallstones and alcohol varied among studied countries [4, 6].

The incidence of recurrent biliary acute pancreatitis (BAP) varies widely, from 0% to 57%, depending on the population studied, the initial treatment, and the follow-up time [7]. Current guidelines recommend cholecystectomy during the initial admission in patients with BAP [8, 9]. Unfortunately, many studies showed nonadherence to the current guidelines in the management of these patients [10-13].

In this study, we aimed to provide an additional insight regarding the predictors and causes of readmissions after an initial episode of BAP based on the procedure performed. In addition, we highlight the demographics of patients and treating hospitals for initial hospitalizations and readmissions.

Materials and Methods

Design and data source

This was an observational retrospective study involving hos-
hospitalizations with BAP in the USA from 2016 to 2018. We extracted data from the Nationwide Readmissions Database (NRD) for the years 2016, 2017, and 2018. The NRD is the largest publicly available readmission database in the USA, drawn from the Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (HCUP), and State Inpatient Databases (SID) [14]. The NRD is an annual file constructed using one calendar year of discharge data. Discharge weights were calculated using post-stratification on hospital characteristics (census region, urban-rural location, teaching status, bed size, and hospital control) and patient characteristics (sex and five age groups (0, 1 - 17, 18 - 44, 45 - 64, and 65 and older)). The NRD 2018 contains discharge data from 28 geographically dispersed states accounting for 59.7% of the total USA population and 58.7% of all USA hospitalizations. It comprises both patient and hospital-level information. Up to 40 discharge diagnoses and 25 procedures are collected for each patient using the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD10-CM/PCS). Diagnoses are classified as a principal diagnosis, which is the reason for hospitalization, and secondary diagnosis which is any other discharge diagnosis. Hospitals are stratified according to ownership control, the number of beds, teaching status, urban/rural location, and geographic region. The NRD allows for weighted analysis to obtain 100% of the USA hospitalizations within a given year [15]. This manuscript conforms with the STROBE statement for reporting observational studies.

Study population and variables

The study involved hospitalizations with a principal diagnosis of BAP using the ICD-10 code “K85.1x”. Hospitalizations involving patients under the age of 18 were excluded. We excluded December hospitalizations for each year due to the lack of an adjoining 30-day period to assess 30-day readmissions. The first hospitalization within the year was marked as the index admission. Using the index admission and unique identifiers available in the NRD, we identified one subsequent hospitalization within 30 days, and this was marked as readmission. Elective and traumatic admissions were excluded.

Index hospitalizations were stratified into four procedural groups as follows. Group 1 included patients who did not have endoscopic retrograde cholangiopancreatoscopy (ERCP) or cholecystectomy (no procedure group), group 2 included patients who had only ERCP (ERCP group), group 3 had only cholecystectomy (cholecystectomy group), and group 4 had both ERCP and cholecystectomy (both procedures group). The procedural codes for ERCP and cholecystectomy were obtained from HCUP validated procedure classes that were refined for the ICD-10-PCS software [16].

The NRD contains variables on patient demographics, including age, sex, median household income (MHOI) by zip code (income quartiles referred to patients as 1 - low income, 2 - middle income, 3 - upper middle income, 4 - high income), and primary payer. It also contains hospital-specific variables including bed size, teaching status, and location. We assessed the comorbidity burden using Sundararajan’s adaptation of the modified Deyo’s Charlson Comorbidity Index (CCI). The CCI contains a list of comorbidities with a weighted score assigned based on the relative risk of 1-year mortality. Consequently, the sum of the index score is an indicator of disease burden and a good estimator of mortality. Deyo’s modification groups CCI into four groups in increasing risk for mortality. It has been adapted to population-based database research [17, 18]. A score of > 3 has about a 25% 10-year mortality, while a score of 2 or 1 has a 10% and 4% 10-year mortality, respectively. This cutoff point was chosen as a mean of assessment of increased risk of mortality [19]. The CCI also predicts healthcare cost utilization [20].

Outcome measures

We compared the demographic data of hospitalizations and readmissions using the no procedure (group 1) as the reference group. Outcomes included the most frequent reasons for readmissions and the rates of readmissions stratified based on procedural group during the index hospitalization. Other outcomes included assessment of index hospitalizations mortality, mean length of hospital stay (LOS), total hospital charges (THC), and independent predictors of readmissions for each procedural group. We adjusted the THC for inflation using the Medical Expenditure Panel Survey index for hospital care, with 2018 as the reference point [21].

Statistical analysis

We analyzed the data using Stata® Version 16 software (StataCorp, Texas, USA). We conducted all the analysis using the weighted samples for national estimates in accordance with HCUP regulations for using the NRD [15]. Age was grouped as 18 - 44 years representing young adults, 45 - 64 years representing middle-aged adults, and above 65 years representing elderly. We calculated comorbidities as proportions of the cohorts and used the Chi-square test to compare characteristics among the procedural groups for both index hospitalizations and readmissions. We used univariable regression to compare readmission mortality, LOS, and THC. We employed a univariable pre-screening model to identify variables associated with readmissions to obtain the independent predictors of 30-day readmissions. We screened age categories, sex, hospital location, hospital teaching status, hospital bed size, MHOI, and the 17 CCI comorbidities. The use of CCI comorbidities is similar to the validated model employed by Moore et al for assessing comorbidity burden in administrative databases [22]. We included those variables having a P-value less than 0.2 in the final multivariable regression analysis. Subsequently, we ran a multivariable Cox regression analysis to identify independent predictors of readmissions with P-values < 0.05 set as the threshold for statistical significance. This model included the procedural group, sex, age categories, discharge against medical advice...
status, primary payer, MHOI, hospital teaching status, hospital volume in quintiles, and all the 17 CCI comorbidities excluding mild liver disease.

Ethical considerations

The NRD database lacks patient and hospital level identifiers. This study, therefore, did not require Cook County Health Institutional Review Board approval or informed consents.

Results

Analysis of demographics

We included a total of 127,318 index hospitalizations with BAP as the primary diagnosis for admission in our study (Table 1). The cholecystectomy group included 55,359 hospitalizations, constituting the largest share of the cohort (43.5%). In contrast, the ERCP group included 13,802 hospitalizations (10.8%). A total of 15,523 hospitalizations (12.2%) included both procedures, while 42,633 hospitalizations had no procedure done (33.5%). In the four groups, most hospitalizations were for females (P < 0.001). Analysis of groups’ mean age showed that patients in the ERCP group had a mean age of 63.9 (standard deviation (SD): 18.6), which was the highest across the studied groups (P < 0.001). In contrast, the cholecystectomy group had a mean age of 53.9 (SD: 19.5), which was the lowest compared to all groups (P < 0.001). Consistent across the studied cohort, the highest proportion of patients had a CCI score of 0 (P < 0.001). In all four groups, diabetes mellitus (DM) without complications was the most frequent comorbidity (P < 0.001). Medicare was the most frequent primary payer for the no procedure group (49.8%), ERCP group (55.4%), and both procedures group (41.6%). However, private insurance was the most frequent primary payer for the cholecystectomy group (40.1%). Analysis of the MHOI showed that most patients were in the lower- and middle-income quartiles (P < 0.001). The highest proportion of patients across the studied groups were treated in metropolitan teaching hospitals (P < 0.001) with large bed size (P < 0.001).

Analysis of outcomes

Among patients in the no procedure group, 1.6% died during the index hospitalization (Table 2). This was higher compared to cholecystectomy group, in which 0.2% died during hospitalization (adjusted odds ratio (aOR): 0.18, P < 0.001), both procedures group, in which 0.3% died (aOR: 0.23, P < 0.001), and the ERCP group (this finding did not reach statistical significance (P = 0.123)). The mean LOS for the no procedure group was 4.7 days (standard error (SE): 0.05), which was lower than all other groups (P < 0.001). On average, the ERCP group stayed longer than other groups with a mean LOS of 6.1 days (SE: 0.10, P < 0.001). Examination of hospital charges showed that compared to other groups, both procedures group had the highest mean THC at USD83,593 (SE: 1,231.6, P < 0.001).

30-day readmission analysis

We included a total of 12,568 readmissions in our study. As shown in Table 3, acute pancreatitis without necrosis or infection was the most frequent principal diagnosis accounting for 18.7% of all readmissions (10.7% were biliary and 8.0% were unspecified), followed by sepsis with unspecified organism (6.2%). As shown in Table 4, the no procedure and the ERCP groups had the highest readmission rates; 15.0% and 13.0% of the index hospitalizations in each group were readmitted, respectively. On the other hand, the cholecystectomy and both procedures groups had the lowest readmission rates (6.5% and 5.8%, respectively). The readmitted cohort in the no procedure group had a mean age of 61.5 (SD: 19.0), which was the highest across all groups (P < 0.001). In the ERCP and cholecystectomy groups, DM without complications was the most frequent comorbidity (18.6% and 18.5%, respectively, P = 0.049). Renal disease accounted for 20.5% of the studied comorbidities in the no procedure group (P < 0.001). Chronic pulmonary disease was the most frequent comorbidity in patients who underwent both procedures; however, this observation did not reach statistical significance (P = 0.186). In all four groups, Medicare was the most frequent primary payer (P < 0.001). Consistent with the index hospitalizations, readmissions took place most frequently in metropolitan teaching hospitals (P < 0.001), with large bed size (P = 0.002). These findings were observed in all groups.

We performed multivariate analysis for predictors of readmission (Table 5). Using the no procedure group as a reference, aHR for readmission in the ERCP group was 0.86 (P < 0.001), while the cholecystectomy and both procedures groups had aHR of 0.47 and 0.40, respectively (P < 0.001). Females had an aHR of 0.82 for readmission when compared to males (P < 0.001). Elderly patients were less likely to be readmitted compared to young adults (aHR: 0.82, P < 0.001). Patients who were discharged against medical advised were more likely to be readmitted (aHR: 1.76, P < 0.001). Private insurance patients were less likely to be readmitted compared to Medicaid patients (aHR: 0.71, P < 0.001). The highest income patients were less likely to be readmitted compared to the lowest income (aHR: 0.89, P = 0.006). Comorbidities that were associated with increased risk for readmission were congestive heart failure (aHR: 1.26, P < 0.001), cerebrovascular disease (aHR: 1.27, P = 0.003), chronic pulmonary disease (aHR: 1.22, P < 0.001), rheumatologic disease (aHR: 1.33, P < 0.001), peptic ulcer disease (aHR: 1.51, P < 0.001), diabetes without complications (aHR: 1.15, P < 0.001), diabetes with complications (aHR: 1.10, P < 0.001), renal disease (aHR: 1.18, P < 0.001), any malignancy (aHR: 1.22, P < 0.001), moderate or severe liver disease (aHR: 1.11, P < 0.001), metastatic solid tumor (aHR: 1.12, P < 0.001), and human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) (aHR: 1.09, P = 0.006).
| Variable | No procedure | Only ERCP | Only cholecystectomy | ERCP and cholecystectomy | P-value |
|----------|--------------|-----------|----------------------|--------------------------|---------|
| Number of hospitalizations | 42,633 (33.5%) | 13,802 (10.8%) | 55,359 (43.5%) | 15,523 (12.2%) | < 0.001 |
| Mean age (years ± SD) | 60.9 ± 19.9 | 63.9 ± 18.6 | 53.9 ± 19.5 | 56.5 ± 19.7 | < 0.001 |
| Age categories (%) | < 0.001 |
| Young adults | 21.1 | 15.9 | 32.2 | 28.2 |
| Middle-aged | 32.7 | 30.7 | 35.6 | 32.4 |
| Elderly | 46.2 | 53.5 | 32.2 | 39.4 |
| Female (%) | < 0.001 |
| 0 | 39.8 | 39.1 | 53.1 | 51.6 |
| 1 | 25.0 | 25.7 | 25.1 | 24.4 |
| 2 | 13.8 | 13.2 | 10.7 | 11.3 |
| ≥ 3 | 21.5 | 22.0 | 11.1 | 12.7 |
| Mean CCI | 1.5 | 1.5 | 0.9 | 1.0 |
| Primary payer (%) | < 0.001 |
| Medicare | 49.8 | 55.4 | 35.4 | 41.6 |
| Medicaid | 15.8 | 11.8 | 18.6 | 17.1 |
| Private insurance | 30.0 | 29.1 | 40.1 | 35.9 |
| Self-pay | 4.4 | 3.6 | 6.0 | 5.5 |
| MHOI quartile (%) | < 0.001 |
| 1 | 26.5 | 24.4 | 28.4 | 27.4 |
| 2 | 27.8 | 29.7 | 27.8 | 27.4 |
| 3 | 25.0 | 25.7 | 25.4 | 25.7 |
| 4 | 20.6 | 20.2 | 18.4 | 19.5 |
| Comorbidities (%) | < 0.001 |
| Myocardial infarction | 6.6 | 6.7 | 3.6 | 3.8 |
| Congestive heart failure | 12.2 | 12.8 | 6.0 | 7.0 |
| Peripheral vascular disease | 6.5 | 6.8 | 3.5 | 3.9 |
| Cerebrovascular disease | 2.5 | 2.3 | 1.4 | 1.7 |
| Dementia | 5.3 | 4.9 | 1.9 | 2.0 |
| Chronic pulmonary disease | 15.9 | 16.8 | 13.5 | 13.0 |
| Rheumatologic disease | 2.2 | 2.1 | 1.6 | 2.0 |
| Peptic ulcer disease | 1.5 | 3.6 | 0.9 | 2.9 |
| Mild liver disease | 11.9 | 9.9 | 11.7 | 11.2 |
| Diabetes without complications | 18.4 | 17.2 | 15.6 | 14.6 |
| Diabetes with complications | 7.8 | 8.1 | 5.1 | 5.4 |
| Hemiplegia/paraplegia | 0.3 | 0.4 | 0.3 | 0.4 |
| Renal disease | 14.0 | 14.4 | 7.7 | 8.9 |
| Any malignancy | 2.7 | 2.7 | 1.4 | 1.8 |
| Moderate or severe liver disease | 2.0 | 2.1 | 0.3 | 0.6 |
| Metastatic solid tumor | 1.0 | 1.4 | 0.4 | 0.4 |
| HIV/AIDS | 0.3 | 0.1 | 0.2 | 0.1 |

Hospital characteristics
Table 1. Demographics and Hospital Characteristics of Index Hospitalizations - (continued)

| Variable                          | No procedure | Only ERCP | Only cholecystectomy | ERCP and cholecystectomy | P-value |
|-----------------------------------|--------------|-----------|----------------------|--------------------------|---------|
| Hospital bed size (%)             |              |           |                      |                          | < 0.001|
| Small                             | 21.2         | 13.7      | 18.6                 | 13.9                     |         |
| Medium                            | 29.5         | 29.3      | 29.0                 | 28.3                     |         |
| Large                             | 49.4         | 57.0      | 52.4                 | 57.8                     |         |
| Hospital teaching status and location (%) |              |           |                      |                          | < 0.001|
| Metropolitan non-teaching         | 26.0         | 22.7      | 27.2                 | 25.8                     |         |
| Metropolitan teaching             | 63.2         | 73.8      | 64.2                 | 70.8                     |         |
| Non-metropolitan                  | 10.9         | 3.5       | 8.6                  | 3.4                      |         |

CCI: Charlson comorbidity index; ERCP: endoscopic retrograde cholangiopancreatography; MHOI: median household income for ZIP code; SD: standard deviation from the mean.

Table 2. Outcomes of Index Hospitalizations

| Variable                          | No procedure | Only ERCP | Only cholecystectomy | ERCP and cholecystectomy | P-value |
|-----------------------------------|--------------|-----------|----------------------|--------------------------|---------|
| Mortality                         |              |           |                      |                          |         |
| Mortality rate (%)                | 1.6          | 1.4       | 0.2                  | 0.3                      |         |
| aOR (95% CI)                      | -            | 0.82 (0.63 - 1.06) | 0.18 (0.13 - 0.24) | 0.23 (0.15 - 0.36) |         |
| P-value                           | -            | 0.123     | < 0.001              | < 0.001                  |         |
| LOS                               |              |           |                      |                          |         |
| Mean LOS in days (SE)             | 4.7 (0.05)   | 6.1 (0.10) | 5.0 (0.03)           | 5.9 (0.06)               |         |
| aMD (95% CI)                      | -            | 1.31 (1.10 - 1.52) | 0.45 (0.34 - 0.56) | 1.31 (1.16 - 1.47)      |         |
| P-value                           | -            | < 0.001   | < 0.001              | < 0.001                  |         |
| Hospital charges                  |              |           |                      |                          |         |
| Mean THC in USD (SE)              | 42,438 (719.2) | 69,194 (1,516.4) | 61,845 (639.7) | 83,593 (1,231.6)         |         |
| aMD (95% CI)                      | -            | 25,999 (23,036 - 28,962) | 21,512 (19,981 - 23,043) | 42,249 (39,744 - 44,753) |         |
| P-value                           | -            | < 0.001   | < 0.001              | < 0.001                  |         |

aMD: adjusted mean difference for age categories and sex relative to no procedure group; aOR: adjusted odds ratio for age categories and sex relative to no procedure group; CI: confidence interval; ERCP: endoscopic retrograde cholangiopancreatography; LOS: length of hospital stay; SE: standard error; THC: total hospital charge; USD: United States dollar.

Table 3. Most Common Principal Diagnoses for Readmissions

| Principal readmission diagnosis                                           | Proportion (%) |
|-------------------------------------------------------------------------|----------------|
| Biliary acute pancreatitis without necrosis or infection                | 10.7           |
| Acute pancreatitis without necrosis or infection, unspecified           | 8.0            |
| Sepsis, unspecified organism                                            | 6.2            |
| Pseudocyst of pancreas                                                 | 2.8            |
| Calculus of gallbladder with acute cholecystitis without obstruction     | 2.0            |
| Other postprocedural complications and disorders of the digestive system| 1.7            |
| Acute kidney failure, unspecified                                       | 1.5            |
| Acute pancreatitis with uninfected necrosis, unspecified                | 1.5            |
| Biliary acute pancreatitis with uninfected necrosis                     | 1.4            |
| Hypertensive heart and chronic kidney disease with heart failure and stage 1 through stage 4 chronic kidney disease, or unspecified chronic kidney disease | 1.0            |
| Variable                        | No procedure | Only ERCP | Only cholecystectomy | ERCP and cholecystectomy | P-value |
|--------------------------------|--------------|-----------|----------------------|--------------------------|---------|
| Readmission\(^a\) (%)         | 15.0         | 13.0      | 6.5                  | 5.8                      | < 0.001 |
| Mean age (years ± SD)         | 61.5 ± 19.0  | 57.7 ± 19.7 | 57.8 ± 19.5          | 57.2 ± 19.7              | < 0.001 |
| Age categories (%)            |              |           |                      |                           | < 0.001 |
| Young adults                  | 19.0         | 25.9      | 25.0                 | 27.2                     |         |
| Middle-aged                   | 33.4         | 34.1      | 34.7                 | 31.4                     |         |
| Elderly                       | 47.6         | 40.2      | 40.3                 | 41.4                     |         |
| Female (%)                    | 51.7         | 55.5      | 51.9                 | 52.3                     | 0.355   |
| CCI score (%)                 |              |           |                      |                           | < 0.001 |
| 0                             | 31.2         | 41.7      | 42.3                 | 46.8                     |         |
| 1                             | 22.1         | 23.1      | 24.3                 | 21.9                     |         |
| 2                             | 14.2         | 12.5      | 13.5                 | 15.2                     |         |
| ≥ 3                           | 32.5         | 22.7      | 20.0                 | 16.1                     |         |
| Mean CCI                      | 2.0          | 1.5       | 1.4                  | 1.2                      | < 0.001 |
| Primary payer (%)             |              |           |                      |                           | < 0.001 |
| Medicare                      | 54.3         | 45.2      | 46.5                 | 48.6                     |         |
| Medicaid                      | 16.2         | 19.8      | 17.5                 | 17.2                     |         |
| Private insurance             | 25.4         | 31.6      | 31.1                 | 30.5                     |         |
| Self-pay                      | 4.1          | 3.4       | 4.8                  | 3.8                      |         |
| MHOI quartile (%)             |              |           |                      |                           | 0.074   |
| 1                             | 29.5         | 27.2      | 24.0                 | 28.4                     |         |
| 2                             | 28.8         | 28.0      | 29.8                 | 30.8                     |         |
| 3                             | 24.4         | 25.0      | 25.7                 | 25.1                     |         |
| 4                             | 17.3         | 19.9      | 20.5                 | 15.7                     |         |
| Comorbidities (%)             |              |           |                      |                           |         |
| Myocardial infarction         | 8.5          | 4.9       | 5.3                  | 6.1                      | < 0.001 |
| Congestive heart failure      | 19.4         | 12.0      | 11.0                 | 10.1                     | < 0.001 |
| Peripheral vascular disease   | 7.0          | 4.5       | 5.5                  | 3.5                      | 0.022   |
| Cerebrovascular disease       | 4.4          | 1.8       | 2.4                  | 1.3                      | < 0.001 |
| Dementia                      | 5.1          | 3.6       | 2.5                  | 3.1                      | 0.003   |
| Chronic pulmonary disease     | 18.8         | 16.3      | 17.1                 | 15.2                     | 0.186   |
| Rheumatologic disease         | 2.5          | 2.3       | 2.2                  | 2.8                      | 0.946   |
| Peptic ulcer disease          | 3.7          | 4.2       | 1.5                  | 3.3                      | 0.004   |
| Mild liver disease            | 7.8          | 7.5       | 9.9                  | 10.9                     | 0.109   |
| Diabetes without complications| 20.0         | 18.6      | 18.5                 | 12.5                     | 0.049   |
| Diabetes with complications   | 12.2         | 6.8       | 7.2                  | 5.2                      | < 0.001 |
| Hemiplegia/paraplegia         | 1.0          | 0.1       | 0.4                  | 0.8                      | 0.029   |
| Renal disease                 | 20.5         | 12.4      | 13.6                 | 11.8                     | < 0.001 |
| Any malignancy                | 4.6          | 6.9       | 3.7                  | 1.9                      | 0.008   |
| Moderate or severe liver disease| 3.1        | 3.8       | 1.4                  | 2.2                      | 0.019   |
| Metastatic solid tumor        | 2.6          | 1.1       | 1.3                  | 0.8                      | 0.004   |
| HIV/AIDS                      | 0.5          | 0.4       | 0.0                  | 0.3                      | 0.236   |
### Table 4. Demographics and Hospital Characteristics of Readmissions - (continued)

| Variable                              | No procedure | Only ERCP | Only cholecystectomy | ERCP and cholecystectomy | P-value |
|---------------------------------------|--------------|-----------|----------------------|--------------------------|---------|
| Hospital characteristics              |              |           |                      |                          |         |
| Hospital bed size (%)                 |              |           |                      |                          |         |
| Small                                 | 16.5         | 10.3      | 17.7                 | 15.6                     | 0.002   |
| Medium                                | 26.8         | 27.1      | 28.1                 | 28.7                     |         |
| Large                                 | 56.7         | 62.7      | 54.2                 | 55.7                     |         |
| Hospital teaching status and location (%) |              |           |                      |                          | < 0.001|
| Metropolitan non-teaching             | 22.8         | 20.4      | 24.3                 | 21.2                     |         |
| Metropolitan teaching                 | 69.3         | 76.1      | 68.2                 | 75.1                     |         |
| Non-metropolitan                      | 7.9          | 3.5       | 7.5                  | 3.7                      |         |

aPercentage of readmissions for each procedural group after index hospitalization. CCI: Charlson Comorbidity Index; ERCP: endoscopic retrograde cholangiopancreatography; MHOI: median household income for ZIP code; SD: standard deviation from the mean; HIV: human immunodeficiency virus; AIDS: acquired immune deficiency syndrome.

### Table 5. Predictors of Readmissions

| Variable                              | aHR   | 95% confidence interval | P-value |
|---------------------------------------|-------|-------------------------|---------|
| ERCP only**a                          | 0.86  | 0.80 - 0.93             | < 0.001 |
| Cholecystectomy onlya                 | 0.47  | 0.44 - 0.50             | < 0.001 |
| ERCP + cholecystectomya               | 0.40  | 0.36 - 0.44             | < 0.001 |
| Femaleb                               | 0.82  | 0.78 - 0.87             | < 0.001 |
| Middle-agedc                          | 1.04  | 0.96 - 1.12             | 0.331   |
| Elderlyc                              | 0.82  | 0.74 - 0.91             | < 0.001 |
| Highest income quartiled             | 0.89  | 0.82 - 0.97             | 0.006   |
| Private insurancec                   | 0.71  | 0.65 - 0.78             | < 0.001 |
| Myocardial infarction                 | 0.98  | 0.88 - 1.09             | 0.683   |
| Congestive heart failure              | 1.26  | 1.17 - 1.37             | < 0.001 |
| Peripheral vascular disease           | 1.03  | 0.92 - 1.14             | 0.661   |
| Cerebrovascular disease               | 1.27  | 1.08 - 1.48             | 0.003   |
| Dementia                              | 0.92  | 0.81 - 1.05             | 0.242   |
| Chronic pulmonary disease             | 1.22  | 1.14 - 1.31             | < 0.001 |
| Rheumatologic disease                 | 1.33  | 1.13 - 1.55             | < 0.001 |
| Peptic ulcer disease                  | 1.51  | 1.28 - 1.78             | < 0.001 |
| Diabetes without complications        | 1.15  | 1.07 - 1.23             | < 0.001 |
| Diabetes with complications           | 1.10  | 1.05 - 1.15             | < 0.001 |
| Hemiplegia/paraplegia                | 1.15  | 0.94 - 1.41             | 0.173   |
| Renal disease                         | 1.18  | 1.13 - 1.23             | < 0.001 |
| Any malignancy                       | 1.22  | 1.14 - 1.32             | < 0.001 |
| Moderate or severe liver disease      | 1.11  | 1.05 - 1.18             | < 0.001 |
| Metastatic solid tumor                | 1.12  | 1.08 - 1.17             | < 0.001 |
| HIV/AIDS                              | 1.09  | 1.03 - 1.64             | 0.006   |
| Discharge against medical advice      | 1.76  | 1.51 - 2.06             | < 0.001 |

aRelative to no procedure. bRelative to male. cRelative to young adults. dRelative to lowest income. eRelative to Medicare. aHR: adjusted hazard ratio; ERCP: endoscopic retrograde cholangiopancreategory; HIV: human immunodeficiency virus; AIDS: acquired immune deficiency syndrome.
Discussion

In our analysis, the largest share of index hospitalizations underwent cholecystectomy, accounting for 43.5% of the cohort. On the other hand, only a minority of them underwent both procedures (12.2%). The American Gastroenterological Association (AGA) and American College of Gastroenterology (ACG) guidelines strongly recommend cholecystectomy during the initial admission in patients with BAP. In addition, both guidelines recommend against the use of ERCP in the absence of cholangitis and biliary obstruction; however, these recommendations are based on low quality of evidence [8, 9]. The International Association of Pancreatology/American Pancreatic Association (IAP/APA) guidelines also recommend against ERCP in patients without cholangitis and biliary obstruction [23]. In a systematic review of eight randomized controlled trials, Vege et al. found that mortality, multiorgan failure, single organ failure (respiratory, renal, circulatory), infected (peri) pancreatic necrosis, and total necrotizing pancreatitis were not different between patients randomized to the urgent ERCP or the conservative management groups [24]. Despite the fact that included trials attempted to exclude patients with cholangitis, marked clinical heterogeneity in adopted selection criteria/ definitions limited the interpretation of these findings. Similarly, Tse et al. found no evidence that early routine ERCP significantly affects mortality or local or systemic complications of pancreatitis, regardless of predicted severity [25]. Another metaanalysis that involved 11 randomized controlled trials showed that the overall complications were significantly reduced in the ERCP group in severe pancreatitis patients; however, there was no statistically significant difference in mild pancreatitis group [26]. Unfortunately, many studies showed poor adherence to recommended guidelines resulting in higher mortality and costs [10-13]. In addition, there was a trend of decreasing procedures for BAP between 2010 and 2014 [27].

Gallstones are more common in females [28-31], which likely reflects the lithogenic effect of estrogen as it promotes cholesterol crystallization [32, 33]. As expected, most hospitalizations in the four studied groups were for females. Patients in the cholecystectomy and both procedures group were younger compared to the other groups. Elderly patients are at higher risk of morbidity and mortality from cholecystectomy than compared to younger patients, and they also have longer hospital stays and higher costs [34-37]. As a result, they have lower rates of laparoscopic cholecystectomy when compared to nonelderly patients [37-39].

Many studies have shown increased risk of gallstones in diabetic patients [40-44]. Possible explanations include the secretion of supersaturated bile [45] and poor gallbladder contractility [46, 47]. Interestingly, Maringhini et al. found that gallbladder motility is needed to promote the expulsion of biliary sludge and stones to trigger and develop acute pancreatitis [48-50]. In our study, DM was the most frequent comorbidity in all four groups. Management of hospitalized patients can be affected by insurance and socioeconomic status, and this applies to BAP as well [51]. We found that Medicare was the primary payer for the largest proportion of hospitalizations except for the cholecystectomy group. According to the HCUP, Medicare care had the largest share of total readmissions in the USA (55.9%) [52]. Private insurance was the most frequent primary payer for the cholecystectomy group. Janeway et al. found that privately insured patients had higher rates of cholecystectomy compared to all other insurance types [53]. Similarly, Shmelev et al. found that same-admission cholecystectomy in biliary pancreatitis was higher in privately insured patients [11].

Analysis of index hospitalizations’ outcomes showed that the cholecystectomy group had the lowest mortality rates among the four groups. Previous studies showed that cholecystectomy was associated with decreased mortality in patients with BAP [10, 54]. Both procedures group had also a comparable low mortality rate, and this was consistent with the available evidence of no additional mortality benefit when ERCP was performed along with cholecystectomy as discussed above. Given the high costs of such procedures, both procedures group had the highest hospital charges, and the no procedure group had the lowest charges during index hospitalizations.

Our study showed that acute pancreatitis without necrosis or infection was the most common reason for readmission. Krishna et al. found that 50% of readmissions in BAP patients were related to recurrences or acute pancreatitis-related complications [55]. Similarly, Garg et al. found that recurrent acute pancreatitis was the most common reason for readmission (41.5%) in patients with acute pancreatitis [56]. These readmissions are thought to be related to exacerbation of smoldering symptoms, progression of local complications, or recurrent attacks likely related to persistence of risk factors for the index admissions [57].

Analysis of predictors of readmissions showed that undergoing both procedures carried the lowest risk for readmission compared to the other groups, a finding that is consistent with the available data [7, 58]. This observation might be related to residual stones in the biliary tree in patients who undergo cholecystectomy alone. Van Geenen et al. found that intraoperative cholecloolithiasis was present in 13-24% of those undergoing cholecystectomy [7]. Stone migration from the gallbladder into the common bile duct (CBD) after initial stone clearance increases the risk of recurrent pancreatitis in those who did not undergo cholecystectomy. Moreau et al. found that regardless of whether patients with gallstones have had a prior attack of pancreatitis, cholecystectomy reduces the risk of acute pancreatitis to almost the same level of the general population [59].

Surprisingly, older age was associated with lower rates of readmission in our analysis, which comes consistent with the available data [56, 57, 60]. Higher mortality in elderly might have removed them from the readmission cohort. In addition, interventions in elderly might result in different outcomes when compared to the general population [61, 62]. Welbourn et al. found that endoscopic sphincterotomy alone was an acceptable alternative to cholecystectomy in the prevention of further attacks of BAP in the elderly [62]. Females were less likely to be readmitted compared to males in our analysis, consistent with the available evidence [56, 57]. Studies have found that women were more likely to undergo cholecystectomy for BAP and were subsequently less likely to be readmitted for any cause [27, 63]. Yol et al. found that in the context of symp-
tomatic gallbladder stones, inflammation and fibrosis are more extensive in men than in women. In addition, conversion to open surgery was higher in men than in women [64]. Private insurance and higher income were associated with lower re-admission rates in our analysis. As discussed above, privately insured patients were more likely to undergo cholecystectomy. Nguyen et al found that lower income was associated with disproportionately admitted to hospitals with lower cholecystectomy volumes [13]. Discharge against medical advice is associated with over twice the odds of all-cause unplanned 30-day readmission compared with routine discharge [65]. Our analysis showed higher rates of readmission in patients left against medical advice. These patients likely were discharged before completion of guideline-directed therapy for BAP which makes them more likely to be readmitted for recurrent BAP or complications associated with BAP. Analysis of comorbidities showed that the presence of any of them was associated with higher risk of readmission (except for dementia and myocardial infarction which were associated with decreased risk; however, these were statistically insignificant). Previous studies showed that patients with fewer comorbidities were more likely to undergo early cholecystectomy [11, 66]. Tabak et al found that higher comorbidity index was associated with more adverse events during ERCP [67].

More than 12% of the patients did not have any procedure performed in our study. Studies showed variable rates for cholecystectomy and ERCP in patients with BAP. This variation is likely multifactorial; as race, severity of disease, presence of comorbidities, hospital location, availability of specialists, and income play a role in the decision to perform procedures. Nguyen et al found that cholecystectomy and ERCP rates were lower among African Americans and Asians compared to Whites [12]. Toh et al found that in mild cases of BAP, only one-third of patients had definitive treatment within 4 weeks [68]. Kamal et al found that patients who underwent cholecystectomy for BAP had fewer comorbidities [66]. In addition, patients from rural areas and with lower income were disproportionately admitted to hospitals with lower cholecystectomy volumes [13]. Aly et al found that implementation of national guidelines for the management of acute pancreatitis was greater in the practice of hepatobiliary and pancreatic specialists than non-specialists [69].

We found that undergoing both procedures (ERCP and cholecystectomy) decreased the risk of readmission; however, it did not improve mortality and was associated with significantly higher hospital charges. Acute pancreatitis without infection or necrosis was the most common reason for readmission. Females, elderly, and privately insured were less likely to be readmitted. Our study has some important limitation. The NRD reports information on hospitalizations rather than individual patients, as a result, one patient can be included more than one time in the analysis. The study used ICD codes; therefore, it may contain errors related to miscoding. The severity of pancreatitis, medications given, radiologic and laboratory investigations cannot be determined from the data provided in NRD. This study did not assess other surgical or procedural interventions that can be performed in these patients including percutaneous drainage. Lastly, patients were not stratified based on the presence of ascending cholangitis in our analysis, a complication that might impact the outcomes and procedures performed.

Acknowledgments

We would like to thank the Gastroenterology and Hepatology Department at John H. Stroger Jr. Hospital of Cook County for the tremendous support and help in completing this project.

Financial Disclosure

None to declare.

Conflict of Interest

None to declare.

Informed Consent

Not applicable.

Author Contributions

Dr. Attar supervised the entire study including the design and the analysis. Dr. Laswi and Dr. Shaka designed the study, performed data analysis, and reviewed the final manuscript. Dr. Kwei, Dr. Ishaya, Dr. Ojemolon, Dr. Natour, and Dr. Darweesh wrote the manuscript in consultation with Dr. Laswi.

Data Availability

The Nationwide Readmissions Database is publicly available as stated in the methods. Any inquiries regarding supporting data of this study should be directed to the corresponding author.

Abbreviations

ACG: American College of Gastroenterology; AGA: American Gastroenterological Association; AHRQ: Agency for Healthcare Research and Quality; aMD: adjusted mean difference; aOR: adjusted odds ratio; APA: American Pancreatic Association; BAP: biliary acute pancreatitis; CBD: common bile duct; CCI: Charlson Comorbidity Index; CI: confidence interval; ERCP: endoscopic retrograde cholangiopancreatography; IAP: International Association of Pancreatology; ICD10-CM/PCS: International Classification of DiseasesTenth Revision, Clinical Modification/Procedure Coding System; LOS: length of hospital stay; MHOI: median household income; NRD: Nationwide Readmissions Database; SD: standard deviation; SE:
standard error; SID: State Inpatient Databases; THC: total hospital charges; USD: United States dollar

References

1. Myer PA, Mannalithara A, Singh G, Singh G, Pasricha PJ, Ladabaum U. Clinical and economic burden of emergency department visits due to gastrointestinal diseases in the United States. Am J Gastroenterol. 2013;108(9):1496-1507.

2. Peery AF, Crockett SD, Murphy CC, Lund JL, Dellow ES, Williams JL, Jensen ET, et al. Burden and cost of gastrointestinal, liver, and pancreatic diseases in the United States: update 2018. Gastroenterology. 2019;156(1):254-272.e211.

3. Xiao AY, Tan ML, Wu LM, Asrani VM, Windsor JA, Yadav D, Petrov MS. Global incidence and mortality of pancreatic diseases: a systematic review, meta-analysis, and meta-regression of population-based cohort studies. Lancet Gastroenterol Hepatol. 2016;1(1):45-55.

4. Yadav D, Lowenfels AB. Trends in the epidemiology of the first attack of acute pancreatitis: a systematic review. Pancreas. 2006;33(4):323-330.

5. Iannuzzi JP, King JA, Leong JH, Quan J, Windsor JW, Yadav D, Petrov MS. Global Incidence of Acute Pancreatitis Is Increasing Over Time: A Systematic Review and Meta-Analysis. Gastroenterology. 2022;162(1):122-134.

6. Roberts SE, Morrison-Rees S, John A, Williams JG, Brown TH, Samuel DG. The incidence and aetiology of acute pancreatitis across Europe. Pancreatology. 2017;17(2):155-165.

7. van Geenen EJ, van der Peet DL, Mulder CJ, Cuesta MA, Bruno MJ, Palazzo F. National recurrence of pancreatitis and relapses of cholecystectomy from the National Readmission Databases. JAMA Surg. 2015;150(6):569-577.

8. van Geenen EJ, van der Peet DL, Mulder CJ, Cuesta MA, Bruno MJ, Palazzo F. National recurrence of pancreatitis and relapses of cholecystectomy from the National Readmission Databases. JAMA Surg. 2015;150(6):569-577.

9. ACG clinical guideline: management of acute pancreatitis. (unpublished).

10. Shmelev A, Axentiev A, Hossain MB, Cunningham AN. Initial Medical Treatment of Acute Pancreatitis: American Gastroenterological Association Institute Technical Review. Gastroenterology. 2018;154(4):1103-1139.

11. Sundararajan V, Quan H, Halfon P, Fushimi K, Luthi JC, Burnand B, Ghali WA, et al. Cross-national comparative performance of three versions of the ICD-10 Charlson index. Med Care. 2007;45(12):1210-1215.

12. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chronic Dis. 1987;40(5):373-383.

13. Charlson ME, Charlson RE, Peterson JC, Marinopoulos SS, Briggs WM, Hollenberg JP. The Charlson comorbidity index is adapted to predict costs of chronic disease in primary care patients. J Clin Epidemiol. 2008;61(12):1234-1240.

14. Dunn A, Grose SD, Zuvekas SH. Adjusting health expenditures for inflation: a review of measures for health services research in the United States. Health Serv Res. 2018;53(1):175-196.

15. Moore BJ, White S, Washington R, Coenen N, Elixhauser A. Identifying increased risk of readmission and in-hospital mortality using hospital administrative data: the AHRQ elixhauser comorbidity index. Med Care. 2017;55(7):698-705.

16. IAP/APA evidence-based guidelines for the management of acute pancreatitis. (unpublished).

17. Vege SS, DiMagno MJ, Forsmark CE, Martel M, Barkun AN. Initial Medical Treatment of Acute Pancreatitis: American Gastroenterological Association Institute Technical Review. Gastroenterology. 2018;154(4):1103-1139.

18. Tse F, Yuan Y. Early routine endoscopic retrograde cholangiopancreatography strategy versus early conservative management strategy in acute gallstone pancreatitis. Cochrane Database Syst Rev. 2012;5:CD009779.

19. Burston MJ, Yunus RM, Hossain MB, Khan S, Memon B, Memon MA. Meta-analysis of early endoscopic retrograde cholangiopancreatography (ERCP) +/- endoscopic sphincterotomy (ES) versus conservative management for gallstone pancreatitis (GSP). Surg Laparosc Endosc Percutan Tech. 2015;25(3):185-203.

20. Galg SK, Bazerbacha F, Sarvepalli S, Majumder S, Vege SS. Why are we performing fewer cholecystectomies for mild acute biliary pancreatitis? Trends and predictors of cholecystectomy from the National Readmissions Database (2010-2014). Gastroenterol Rep (Oxf).
Biliary Acute Pancreatitis Readmissions

Gastroenterol Res. 2022;15(4):188-199

28. Maurer KR, Everhart JE, Ezzati TM, Johannes RS, Knowler WC, Larson DL, Sanders R, et al. Prevalence of gallstone disease in Hispanic populations in the United States. Gastroenterology. 1989;96(2 Pt 1):487-492.

29. Jensen KH, Jorgensen T. Incidence of gallstones in a Danish population. Gastroenterology. 1991;100(3):790-794.

30. Barbara L, Sama C, Morselli Labate AM, Taroni F, Rusticali AG, Festi D, Sapiro C, et al. A population study on the prevalence of gallstone disease: the Sirmione Study. Hepatology. 1987;7(5):913-917.

31. Shabanzadeh DM, Sorensen LT, Jorgensen T. Determinants for gallstone formation - a new data cohort study and a systematic review with meta-analysis. Scand J Gastroenterol. 2016;51(10):1239-1248.

32. de Bari O, Wang TY, Liu M, Portincasa P, Wang DQ. Estrogen induces two distinct cholesterol crystallization pathways by activating ERalpha and GPR30 in female mice. J Lipid Res. 2015;56(9):1691-1700.

33. Wang HH, de Bari O, Arnatt CK, Liu M, Portincasa P, Wang DQ. Activation of estrogen receptor G protein-coupled receptor 30 enhances cholesterol cholelithogenesis in female mice. Hepatology. 2020;72(6):2077-2089.

34. Loozen CS, van Ramshorst B, van Santvoort HC, Boerma D. Early cholecystectomy for acute cholecystitis in the elderly population: a systematic review and meta-analysis. Dig Surg. 2017;34(5):371-379.

35. Lord AC, Hicks G, Pearce B, Tanno L, Pucher PH. Safety and outcomes of laparoscopic cholecystectomy in the extremely elderly: a systematic review and meta-analysis. Acta Chir Belg. 2019;119(6):349-356.

36. Kuy S, Sosa JA, Roman SA, Desai R, Rosenthal RA. Age matters: a study of clinical and economic outcomes following cholecystectomy in elderly Americans. Am J Surg. 2011;201(6):789-796.

37. Tucker JF, Yanagawa F, Grim R, Bell T, Ahuja V. Laparoscopic cholecystectomy is safe but underused in the elderly. Am Surg. 2011;77(8):1014-1020.

38. Bergman S, Sourial N, Vedel I, Hanna WC, Fraser SA, Newman D, Bilek AJ, et al. Gallstone disease in the elderly: are older patients managed differently? Surg Endosc. 2011;25(1):55-61.

39. Fukami Y, Kurumiya Y, Mizuno K, Sekoguchi E, Kobayashi S. Cholecystectomy in octogenarians: be careful. Updates Surg. 2014;66(4):265-268.

40. Attili AF, Capocaccia R, Carulli N, Festi D, Roda E, Barbara L, Capocaccia L, et al. Factors associated with gallstone disease in the MICOL experience. Multicenter Italian Study on Epidemiology of Cholelithiasis. Hepatology. 1997;26(4):809-818.

41. De Santis A, Attili AF, Ginianni Corradini S, Scafato E, Cantagalli A, De Luca C, Pinto G, et al. Gallstones and diabetes: a case-control study in a free-living population sample. Hepatology. 1997;25(4):787-790.

42. Diehl AK, Stern MP, Ostrower VS, Friedman PC. Prevalence of clinical gallbladder disease in Mexican-American, Anglo, and black women. South Med J. 1980;73(4):438-441, 443.

43. Diehl AK, Haffner SM, Hazuda HP, Stern MP. Coronary risk factors and clinical gallbladder disease: an approach to the prevention of gallstones? Am J Public Health. 1987;77(7):841-845.

44. Hanis CL, Hewett-Emmett D, Kubrusly LF, Maklad MN, Douglas TC, Mueller WH, Barton SA, et al. An ultrasound survey of gallbladder disease among Mexican Americans in Starr County, Texas: frequencies and risk factors. Ethn Dis. 1993;3(1):32-43.

45. de Leon MP, Ferenderes R, Curalli N. Bile lipid composition and bile acid pool size in diabetes. Am J Dig Dis. 1978;23(8):710-716.

46. Tran KQ, Goldblatt Mi, Swartz-Basile DA, Svatck E, Nakneeb A, Pitt HA. Diabetes and hyperlipidemia correlate with gallbladder contractility in leptin-related murine obesity. J Gastrointest Surg. 2003;7(7):857-862; discussion 863.

47. de Boer SY, Mascele AA, Lam WF, Lemkes HH, Schipper J, Frohlich M, Jansen JB, et al. Effect of hyperglycaemia on gallbladder motility in type 1 (insulin-dependent) diabetes mellitus. Diabetologia. 1994;37(1):75-81.

48. Maringhini A, Dardanoni G, Fantaci G, Patti R, Maringhini M. Acute pancreatitis during and after pregnancy: incidence, risk factors, and prognosis. Dig Dis Sci. 2021;66(9):3164-3170.

49. Maringhini A, Maringhini M, Dardanoni G, Rossi M, Patti R, Amata M, Arnone S, et al. Breastfeeding in prevention of postpartum acute pancreatitis. Dig Dis Sci. 2021.

50. Maringhini A, Ciambra M, Baccelliere P, Raimondo M, Orlando A, Tine F, Grasso R, et al. Biliary sludge and gallstones in pregnancy: incidence, risk factors, and natural history. Ann Intern Med. 1993;119(2):116-120.

51. Chouairi F, McCarty TR, Hathorn KE, Sharma P, Aslanian HR, Jamidar PA, Thompson CC, et al. Evaluation of socioeconomic and healthcare disparities on same admission cholecystectomy after endoscopic retrograde cholangiopancreatography among patients with acute gallstone pancreatitis. Surg Endosc. 2022;36(1):274-281.

52. https://www.hcup-us.ahrq.gov/Reports/Statbriefs/Sb172-Conditions-Readmissions-Payer.Pdf. (unpublished).

53. Janeway MG, Sanchez SE, Rosen AK, Patts G, Allee LC, Lasser KE, Dechert TA. Disparities in utilization of ambulatory cholecystectomy: results from three states. J Surg Res. 2021;266:373-382.

54. Gangu K, Bobba A, Chela HK, Basar O, Min RW, Tahan V, Dagliar E. Cutting out cholecystectomy on index hospitalization leads to increased readmission rates, morbidity, mortality and cost. Diseases. 2021;9(4):89.

55. Krishna SG, Kruger AJ, Patel N, Hinton A, Yadav D, Conwell DL. Cholecystectomy during index admission for acute biliary pancreatitis lowers 30-day readmission rates. Pancreas. 2018;47(8):996-1002.

56. Garg SK, Campbell JP, Anugwom C, Wadhwa V, Singh R, Gupta N, Sanaka MR. Incidence and predictors of readmissions in acute pancreatitis: a nationwide analysis. Pancreas. 2021;50(7);661-666.

57. Vipperla K, Papachristou GI, Esler J, Muddana V, Slivka A, Whitcomb DC, Yadav D. Risk of and factors associated with readmission after a sentinel attack of acute pan-
creatitis. Clin Gastroenterol Hepatol. 2014;12(11):1911-1919.
58. Nguyen GC, Rosenberg M, Chong RY, Chong CA. Early cholecystectomy and ERCP are associated with reduced readmissions for acute biliary pancreatitis: a nationwide, population-based study. Gastrointest Endosc. 2012;75(1):47-55.
59. Moreau JA, Zinsmeister AR, Melton LJ, 3rd, DiMagno EP. Gallstone pancreatitis and the effect of cholecystectomy: a population-based cohort study. Mayo Clin Proc. 1988;63(5):466-473.
60. Yadav D, Lee E, Papachristou GI, O'Connell M. A population-based evaluation of readmissions after first hospitalization for acute pancreatitis. Pancreas. 2014;43(4):630-637.
61. Uomo G, Manes G, Laccetti M, Cavallera A, Rabitti PG. Endoscopic sphincterotomy and recurrence of acute pancreatitis in gallstone patients considered unfit for surgery. Pancreas. 1997;14(1):28-31.
62. Welbourn CR, Beckly DE, Eyre-Brook IA. Endoscopic sphincterotomy without cholecystectomy for gall stone pancreatitis. Gut. 1995;37(1):119-120.
63. Shen HN, Wang WC, Lu CL, Li CY. Effects of gender on severity, management and outcome in acute biliary pancreatitis. PLoS One. 2013;8(2):e57504.
64. Yol S, Kartal A, Vatansev C, Aksoy F, Toy H. Sex as a factor in conversion from laparoscopic cholecystectomy to open surgery. JSL. 2006;10(3):359-363.
65. Kumar N. Burden of 30-day readmissions associated with discharge against medical advice among inpatients in the United States. Am J Med. 2019;132(6):708-717.e704.
66. Kamal A, Akhuemonkhan E, Akshintala VS, Singh VK, Kalloo AN, Hutfless SM. Effectiveness of guideline-recommended cholecystectomy to prevent recurrent pancreatitis. Am J Gastroenterol. 2017;112(3):503-510.
67. Tabak F, Wang HS, Li QP, Ge XX, Wang F, Ji GZ, Miao L. Endoscopic retrograde cholangiopancreatography in elderly patients: Difficult cannulation and adverse events. World J Clin Cases. 2020;8(14):2988-2999.
68. Toh SK, Phillips S, Johnson CD. A prospective audit against national standards of the presentation and management of acute pancreatitis in the South of England. Gut. 2000;46(2):239-243.
69. Aly EA, Milne R, Johnson CD. Non-compliance with national guidelines in the management of acute pancreatitis in the United kingdom. Dig Surg. 2002;19(3):192-198.