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Trends in same-admission cholecystectomy and endoscopic retrograde cholangiopancreatography for acute gallstone pancreatitis: A nationwide analysis across a decade

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ABSTRACT

Background/objectives: Gallstones are the leading cause of acute pancreatitis in developed countries. National and international guidelines recommend that a cholecystectomy should be performed during the index hospitalization for acute gallstone pancreatitis. We aimed to delineate the national trends for same-admission cholecystectomy and ERCP for acute gallstone pancreatitis over the last ten years.
Methods: We used the 2004, 2009 and 2014 National Inpatient Sample database including patients with a principal diagnosis of acute pancreatitis and a secondary diagnosis of choledocholithiasis or cholelithiasis. Exclusion criteria were age <18 years and elective admission. Primary outcome was the trend in incidence rate of same admission cholecystectomy from 2004 to 2014. The secondary outcomes were: 10-year trend in 1) Incidence of gallstone pancreatitis, 2) proportion of gallstone pancreatitis compared to all other etiologies of acute pancreatitis, 3) incidence rate of same-admission ERCP, 4) length of hospital stay, and 5) total hospitalization costs and charges.
Results: The proportion of admissions during which a same-admission cholecystectomy was performed decreased from 48.7% in 2004 to 46.9% in 2009 to 45% in 2014 (trend $p < 0.01$). During the same time interval, the percentage of admissions during which an ERCP was performed decreased from 25.1% to 18.7% (Trend $p < 0.01$).
Conclusions: Adherence to the guidelines for same-admission cholecystectomy for patients admitted with acute gallstone pancreatitis have been declining over the past decade. On the other hand, decline in rate of ERCP in patients with acute gallstone pancreatitis and no signs of cholangitis demonstrates adherence to guidelines in this regard.

Introduction

Gallstones are the most common etiology for acute pancreatitis in developed countries. Prior reports have shown that acute gallstone pancreatitis represents about 50% of all cases of acute pancreatitis worldwide [1,2]. In addition, recurrence rates for acute gallstone pancreatitis have been shown to increase if cholecystectomy is not performed after the index episode, and has been reported to range from 25% to 63% in this setting [3–8]. Recurrence of acute gallstone pancreatitis is associated with significant morbidity and healthcare resource utilization [9].

As a result, the International Association of Pancreatology, American Pancreatic Association, and the American College of Gastroenterology practice guidelines recommend that cholecystectomy should be performed during the index hospitalization after all cases of mild acute gallstone pancreatitis [10,11]. Despite this national and international consensus, adherence to these guidelines is low in routine clinical practice. Nguyen et al. analyzed the

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National Inpatient Sample (NIS) data and found that the overall rate of index hospitalization cholecystectomy after acute gallstone pancreatitis was only 51% in 2003 [12]. Similarly, other reports from different regions of the world have shown that lack of adherence to these guidelines is a global issue [13,14]. In addition, the American College of Gastroenterology and the American Gastroenterological Association recommend that endoscopic retrograde cholangiopancreatography (ERCP) should be performed in acute gallstone pancreatitis patients who have cholangitis or increased suspicion of ongoing biliary obstruction [10, 15].

However, recent national epidemiological data on the extent of the problem is sparse. With the recent shift of healthcare reimbursement from fee-for-service to the different quality-based reimbursement, this issue gains even more importance. Therefore, we set out in the current study to delineate the national trends for same hospitalization cholecystectomy and ERCP after acute gallstone pancreatitis over the last ten years in the United States, in addition to the financial burden and resource utilization associated with acute gallstone pancreatitis.

Methods

Study design

This is a longitudinal study of patients hospitalized with acute gallstone pancreatitis at acute care hospitals across United States. Data was extracted from the Nationwide Inpatient Sample (NIS) database of the years 2004, 2009 and 2014. NIS is created by Agency for Healthcare Research and Quality (AHRQ), as a part of the Healthcare Cost and Utilization project [16]. It is the largest publicly available all-payer inpatient database in the United States [16]. Details of NIS methodology are reported elsewhere [16]. Briefly, hospitals are stratified according to ownership/control, bed size, teaching status, urban/rural location, and geographic region using the American Hospital Association annual hospital survey. A 20% random sample of all patients within each stratum is then collected and information about patients' demographics, diagnoses, resource utilization are entered into the database. Each discharge is then weighted (weight = total number of discharges from all acute care hospital in the United States/number of discharges included in the 20% sample) to make the NIS nationally representative. From 2010 to 2014, NIS included between 7 and 8 million discharges yearly from 1051 to 4411 hospitals in 44–46 states across the United States.

The NIS is the nation's most comprehensive source of hospital data, which enables researchers to study healthcare delivery and patient outcomes [17]. It is a discharge level database which contains de-identified clinical and non-clinical data elements at both the patient and hospital-level. As a result, multiple admissions for a single patient are considered separate discharges and are entered separately in the database. Patient level data includes patient's age, sex, race, income in the patient's zip code, principal diagnosis and up to 29 secondary diagnoses using the International Classification of Diseases, 9th Revision, Clinical Modification (ICD9-CM) coding system, up 15 procedures using the ICD-9 CM procedural codes, discharge disposition including death and resource utilization including length of hospital stay and total hospitalization charges. Hospital level data includes hospital teaching status, bed size, and hospital urban/rural location. From 2004 to 2014, NIS included information on 7–8 million discharges from 1004 to 4411 hospitals across 37–45 states.

Study patients

The study inclusion criteria were: i) A principal diagnosis of acute pancreatitis ii) A secondary diagnosis of cholelithiasis and/or choledocholithiasis. Exclusion criteria were: i) age less than 18 years, ii) elective admission. The international Classification of Diseases, ninth revision, Clinical Modification (ICD-9 CM) codes were used to identify diagnoses and procedures. Acute pancreatitis was identified using ICD-9 CM code 577.0, and cholelithiasis/choledocholithiasis using the codes 574. XX.

Study variables and outcomes

The primary outcome was the trend in incidence rate of same-admission cholecystectomy from 2004 to 2014. The secondary outcomes were: 10-year trend in 1) Incidence of gallstone pancreatitis, 2) proportion of gallstone pancreatitis compared to all other etiologies, 3) incidence rate of same-admission ERCP, 4) length of hospital stay, and 5) total hospitalization costs and charges.

The incidence of gallstone pancreatitis was calculated as the number of admissions for acute gallstone pancreatitis divided by the United States census population estimate on July 1 of the study year. Same-admission cholecystectomy was identified using the procedure ICD9-CM codes 51.22 and 51.23, ERCP with or without sphincterotomy using the codes 51.10, 51.11, 51.14, and 51.85. Hospital teaching status, length of hospital stay and total hospitalization charges are variables directly coded in NIS. Total hospital charges represent the amount a patient was billed for the entire hospital stay but do not reflect the actual cost of care. The Healthcare Cost and Utilization Project (HCUP) provides data that contain hospital-specific cost-to-charge ratios based on all-payer inpatient cost [18]. Using this information, total hospital costs were calculated by multiplying total hospital charges by the corresponding cost-to-charge ratio. All hospitalization costs and charges were adjusted for inflation over the years using the consumer price index and presented in 2014 US dollars. Multiple potential confounders were collected and accounted for during the analysis. Those variables were: patient's age (in years), sex, race (white, black, Hispanic, Asian or Pacific Islander, Native American and other), median household income in the patient's zip code ($1 - $38,999, $39,000 - $47,999, $48,000–62,999 and $63,000 or more), primary expected payer (Medicare, Medicaid, private insurance and uninsured), hospital bed size (small, medium and large), teaching status, hospital region (Northeast, Midwest, South and West) and urban location [17]. Comorbidity burden was assessed using Deyo's modification of Charlson's co-morbidity index [19].

Statistical analysis

All analyses were performed using STATA, version 13.0 (statacorp, College Station, TX). NIS is based on a complex sampling design that includes stratification, clustering, and weighting. This software facilitates analysis to produce nationally representative unbiased results, variance estimates and P-values. Weighting of patient-level observations was implemented to obtain estimates for the entire population in the United States of hospitalized patients with acute gallstone pancreatitis.

Trend tests were conducted for the 2004 to 2014 period using a bivariate logistic (binary outcome) or linear (continuous outcome) regression models. The models were built with the outcome of interest as the dependent variable and year as the independent variable. Univariable regression analysis was used to calculate unadjusted odds ratios for the primary and secondary outcomes. Subsequently, multivariable regression analyses were used to adjust the results for potential confounders. The multivariable regression models were built by including all confounders that were significantly associated with the outcome on univariable analysis with a cutoff P-value of 0.2. Variables that were deemed to

be important determinants of the outcome based on previous literature were forced into the model. Proportions were compared using the Fisher exact test and continuous variables were compared using the Student *t*-test. All P-values were 2 sided, with 0.05 as threshold for statistical significance.

Results

Patient characteristics

Patient and hospital characteristics are summarized in Table 1. From 2004 to 2014, the number of patients with acute gallstone pancreatitis increased from 49,495 to 51,375. There were numerically small, but statistically significant, differences in patient characteristics across the years [Table 1]. The patient mean age varied from 56.6% to 58.3% years. The majority of patients were female, Caucasians, insured by Medicare or through a private insurance, with a low Charlson comorbidity score (0 or 1), and in the lowest two quartiles of income. The majority of patients were treated at medium or large non-teaching (except 2014) in the Midwest and Northeast.

Incidence of acute gallstone pancreatitis

The total number of admissions with acute gallstone pancreatitis was 49495, 51669 and 51375 in 2004, 2009 and 2014, respectively. As a result, the incidence of acute gallstone pancreatitis was constant from 2004 to 2014 at around 17 cases per 100,000 person (trend $p = 0.41$) [Table 2].

Rates of same-admission cholecystectomy

The proportion of admissions during which same-admission cholecystectomy was performed decreased from 48.7% in 2004 to 46.9% in 2009 to 45.0% in 2014 (linear trend $p < 0.01$) [Fig. 1 and Table 2]. Patients who had a cholecystectomy during the same admission were more likely to be younger, female, Hispanic, insured through a private insurance or uninsured and to have a lower Charlson comorbidity index compared with those who did not [Table 3].

Rates of same-admission ERCP

From 2004 to 2014, the percentage of admissions during which an ERCP was performed decreased from 25.1% to 18.7% (Trend p-value: < 0.01) [Fig. 1 and Table 2]. Along the same lines, among the subgroup of patients who did not have a cholecystectomy before discharge, the rate of in-hospital ERCP also decreased, from 22.2% in 2004 to 15.5% in 2014 [Table 2].

The incidence of cholangitis among patients with acute biliary pancreatitis was constant over time: 2.5%, 2.4% and 3.0% in 2004, 2009 and 2014. A significantly higher proportion of patients with cholangitis received ERCP (54.6%–59%) compared with those without cholangitis (24.3%–17.6%). While the rate of in-hospital ERCP remained constant over time for patients with cholangitis, the in-hospital ERCP rate decreased for those without cholangitis from 2004 to 2009 [Table 2].

Resource utilization

Length of hospital stay

The mean length of hospital stay decreased over the study period from 7.2 (7.05–7.51) days to 5.8 (5.62–6.00) days (trend $p < 0.01$) [Table 2].

Table 1
Patient and hospital characteristics.

Variable	2004 n (%)	2009 n (%)	2014 n (%)	P −value
Age	55.8 (55.1–56.6)	53.4 (52.2–54.6)	53.9 (53.4–54.5)	<0.01
Female	31, 478 (63.6)	32, 983 (63.8)	31, 441 (61.2)	0.04
Race				0.73
White	32, 518 (65.7)	33, 636 (65.1)	33, 393 (65)	
Black	5741 (11.6)	5218 (10.1)	5959 (11.6)	
Hispanic	8315 (16.8)	9042 (17.5)	8631 (16.8)	
Asian or pacific islander	1188 (2.4)	1240 (2.4)	1387 (2.7)	
Native American	297 (0.6)	361 (0.7)	359 (0.7)	
Other	1435 (2.9)	2118 (4.1)	1644 (3.2)	
Insurance				<0.01
Medicare	21, 975 (44.4)	20, 874 (40.4)	21, 166 (41.2)	
Medicaid	6038 (12.2)	6716 (13%)	9196 (17.9)	
Private	17, 004 (34.7)	17, 774 (34.4)	16, 696 (32.5)	
Not insured	4306 (8.7)	6303 (12.2)	4315 (8.4)	
Charlson Co-morbidity index				<0.01
0	29, 499 (59.2)	28, 727 (55.6)	27, 434 (53.4)	
1	12, 769 (25.8)	12, 142 (23.5)	11, 919 (23.2)	
2	4751 (9.6)	4960 (9.6)	4880 (9.5)	
3 or more				
Median income in patient's zip code (%)				0.56
$1-$38,999	8661 (17.5)	14, 570 (28.2)	14, 898 (29)	
$39,000 -$47,999	11, 532 (23.3)	13, 640 (26.4)	14, 590 (28.4)	
$48,000–62,999	18, 511 (37.4)	12, 297 (23.8)	11, 816 (23)	
$63,000 or more	10, 789 (21.8)	11, 160 (21.6)	10, 069 (19.6)	
Hospital bed size				<0.01
small	6186 (12.5)	6510 (12.6)	10, 532 (20.5)	
medium	13, 809 (27.9)	13, 588 (26.3)	15, 875 (30.9)	
large	29, 499 (59.6)	31, 569 (61.1)	24, 968 (48.6)	
Teaching hospital	18, 115 (36.6)	21, 597 (41.8)	30, 670 (59.7)	<0.01
Hospital region				0.43
Northeast		9093 (17.6)	9401 (18.3)	
Midwest		10, 592 (20.5)	10, 634 (20.7)	
South		19, 944 (38.6)	19, 419 (37.8)	
West		12, 039 (23.3)	11, 867 (23.1)	

Table 2
Outcome trends over time from 2004 to 2014.

	2004	2009	2014	Trend p-value
Number of patients with acute biliary pancreatitis (n)	49,495	51,669	51,375	
Incidence of acute biliary pancreatitis	17/100,000 person	17/100,000 person	16/100,000 person	0.41
Same admission cholecystectomy rate (n)	24,114 (48.7%)	24, 252 (46.9%)	23, 145 (45%)	<0.01
Same admission ERCP rate (n)	12, 447 (25.1%)	10,761 (20.8%)	9635 (18.7%)	<0.01
Same admission ERCP rate (n) for patient who did not have same admission cholecystectomy	10, 988 (22.2%)	8784 (17.0%)	7963 (15.5%)	<0.01
Same admission ERCP for patients with acute cholangitis	29, 202 (59.0%)	28, 211 (54.6%)	28, 513 (55.5%)	0.07
Same admission ERCP for patients without acute cholangitis	12, 027 (24.3%)	10, 334 (20.0%)	17.6%	<0.01
For patients who had same admission cholecystectomy	0.7%	0.6%	0.2%	<0.01
Mean length of stay (95% confidence interval)	7.2 (7.05–7.51) days	6.5 (6.35–6.80) days	5.8 (5.62–6.00) days	<0.01
Mean total hospitalization costs (95% confidence interval)	$14,115 (13564.5 –14734.6)	$15,139 (14573.7 –15703.9)	$15,862 (15225.4 –16498.1)	<0.01
Mean total hospitalization charges (95% confidence interval)	$38,945 (36895.6 –40993.8)	$51,599 (48182.8 –55014.5)	$63,560 (60402.0 –66717.6)	<0.01

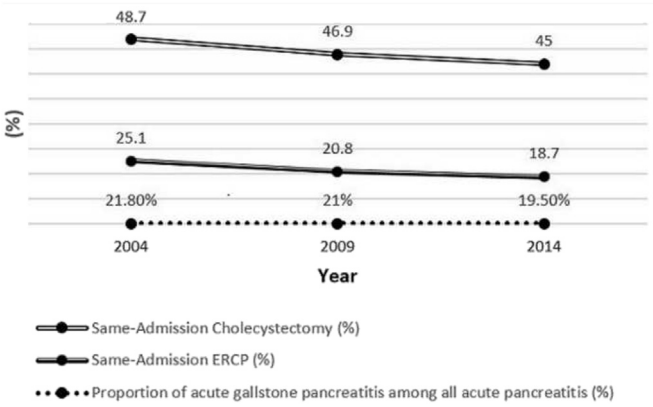

Fig. 1. Trend in same-hospitalization cholecystectomy and endoscopic retrograde cholangiopancreatography after an acute pancreatitis episode from 2004 to 2014. P-value < 0.01.
The percentage of admissions during which a same-admission cholecystectomy or endoscopic retrograde cholangiopancreatography were performed decreased over time from 2004 to 2014. The percentage of gallstone pancreatitis among all causes of acute pancreatitis also slightly decreased over the same time period.

Total hospitalization costs and charges

Both the inflation adjusted total hospitalization charges and costs increased from 2004 to 2014. However, while total hospitalization costs increased slightly from $14,115 in 2004 to $15,862 in 2014, the increase in total hospitalization charges was substantial over the same period, from $38,945 in 2004 to $63,560 in 2014 [Table 2].

Teaching versus non-teaching hospitals

Table 4 summarizes the combined differences in outcomes in teaching versus non-teaching hospitals across 10 years. Patients admitted to teaching hospitals had higher odds of undergoing same admission ERCP as compared to those admitted to non-teaching hospitals [OR: 1.2, p-value<0.01], even after adjusting for confounders including age, sex, race, income in the patient's zip code, patient's insurance, comorbidities (Charlson score), total parenteral nutrition (TPN), hospital volume, urban location, region, teaching status and size. However, there was no significant difference in same-admission cholecystectomy rates among teaching and non-teaching hospitals [OR: 1.07, p-value: 0.09] after adjusting for confounding factors mentioned above. Patients admitted to teaching hospitals had higher mean length of stay and total hospital costs/charges as compared to those admitted to non-teaching hospitals.

Discussion

In the current study, we use the largest publicly available national database in the United States to demonstrate that the rates of both same-admission cholecystectomy and ERCP after an episode of acute gallstone pancreatitis have been decreasing over the past decade. In addition, we show that the population incidence of acute gallstone pancreatitis is constant. Patients who had a cholecystectomy during the same admission were more likely to be younger, female, Hispanic, insured through a private insurance or uninsured, and had a lower Charlson comorbidity index compared with those who did not. As expected, a significantly higher proportion of patients with cholangitis received ERCP compared to those without cholangitis. While the rate of in-hospital ERCP remained constant over time for patients with cholangitis, the in-hospital ERCP rate decreased for those without cholangitis from 2004 to 2009. As far as resource utilization trend, despite length of hospital stay becoming shorter over the past 10 years, both the total hospitalization charges and costs increased over time. Compared to non-teaching hospitals, teaching hospitals were associated with higher odds of same admission ERCP, higher mean length of stay and total hospitalization costs and charges. However, there was no significant difference in same-admission cholecystectomy rates among teaching and non-teaching hospitals.

Consensus guidelines from the major national and international societies unanimously recommend same-admission cholecystectomy after an episode of acute gallstone pancreatitis [10,11,15]. Previous studies have shown that overall adherence to the societal guidelines in the management of acute gallstone pancreatitis is low [20–22]. To our knowledge, the current study is the first national study in the United States to assess the adherence to treatment guidelines in this setting longitudinally for the past 10-years. It is also the first to demonstrate that the adherence is both low and decreasing with time. Our findings are consistent with those of Nguyen et al. who reported same-admission cholecystectomy and ERCP rates of 51% and 27.5%, respectively in 2003 [12]. We report similar rates for both cholecystectomy (49%) and ERCP (25.1%) in 2004. This downward trend in rates of same-admission cholecytsectomy, although slow, is concerning. The widespread use of electronical medical records and improved access to decision support systems and information using internet and smart phones, decreasing adherence to guidelines is an unexpected finding. Further research is urgently needed to identify the barriers to

Table 3
Patient and hospital characteristics of patients who underwent same admission cholecystectomy versus those who did not (10 years combined).

Variable	Same-admission cholecystectomy (n = 71,511)	No cholecystectomy (n = 81,028)	P-value
Age	54.4 (53.9–54.9)	59.9 (59.5–60.3)	<0.01
Female	44,980 (62.9%)	44,808 (55.3%)	<0.01
Race			
White	45,480 (63.6%)	53,964 (66.6%)	<0.01
Black	6865 (9.6%)	9966 (12.3%)	
Hispanic	14,373 (20.1%)	11,668 (14.4%)	
Asian or pacific islander	1502 (2.1%)	2350 (2.9%)	
Native American	501 (0.7%)	567 (0.7%)	
Other	2789 (3.9%)	2512 (3.1%)	
Insurance			
Medicare	25,815 (36.1%)	38,164 (47.1%)	<0.01
Medicaid	10,869 (15.2%)	11,101 (13.7%)	
Private	26,888 (37.6%)	24,713 (30.5%)	
Not insured	7866 (11.0%)	6968 (8.6%)	
Charlson Co-morbidity index			<0.01
0	44,694 (62.5%)	40,838 (50.4%)	
1	16,519 (23.1%)	20,257 (25.0%)	
2	5578 (7.8%)	8994 (11.1%)	
3 or more	4712 (6.6%)	10,939 (13.5%)	
Median income in patient's zip code (%)			0.31
$1-$38,999	20,237 (28.3%)	23,741 (29.3%)	
$39,000 -$47,999	19,594 (27.4%)	21,715 (26.8%)	
$48,000–62,999	16,948 (23.7%)	18,555 (22.9%)	
$63,000 or more	14,660 (20.5%)	17015 (21.0%)	
Hospital bed size			<0.01
small	9654 (13.5%)	13532 (16.7%)	
medium	19808 (27.7%)	23417 (28.9%)	
large	41,977 (58.7%)	43998 (54.3%)	
Teaching hospital	33106 (46.3%)	37273 (46.0%)	0.79
Hospital region			<0.01
Northeast	10369 (14.5%)	16853 (20.8%)	
Midwest	14,660 (20.5%)	18150 (22.4%)	
South	29606 (41.4%)	28279 (34.9%)	
West	16,877 (23.6%)	17826 (22.0%)	

Table 4
Subgroup analysis: Teaching versus non-teaching hospitals (all years combined).

	Adjusted odds ratio[a] (95% confidence interval)	p-value
Same admission cholecystectomy	1.07 (0.98–1.18)	0.09
Same admission ERCP	1.23 (1.12–1.35)	<0.01
For patients who had same admission cholecystectomy		
In-hospital mortality	0.94 (0.54–1.63)	0.83
	Adjusted mean difference[a] (95% confidence interval)	
Mean difference in length of stay	0.28 days (0.009–0.566)	0.04
Mean difference in total hospitalization costs	$1380 (587.3–2172.3)	<0.01
Mean difference in total hospitalization charges	$7498 (3580.1–11416.5)	<0.01

[a] Odds ratios and means were adjusted to the following confounders: age, sex, race, income in the patient's zip code, patient's insurance, comorbidities (Charlson score), total parenteral nutrition (TPN), hospital volume, urban location, region, teaching status and size.

adopting the guidelines among healthcare providers and effective strategies to address this problem.

Our results might point to a possible reason for this poor adherence to the guidelines. It is the pressure to control healthcare expenditure, especially at the hospital level. From 2004 to 2014, we find that hospital length of stay has been decreasing and the cost of care increasing. Postponing cholecystectomy till after discharge decreases length of stay and potentially can curb the rapid rise in-hospital healthcare expenditure. However, this immediate financial gain has to be balanced against the risk of recurrent biliary disease with subsequent readmission and further in-hospital healthcare costs. As quality of care continues to gain importance as a determinant of reimbursement, it can conceivably be used to improve adherence to guidelines not only through the readmission metric, but also through a direct targeting. Similarly to the rate of angiotensin receptor antagonist use among patients with congestive heart failure, same-admission cholecystectomy rate can also be used to determine reimbursement among patients with acute gallstone pancreatitis. Of course this is only one possible strategy out of many others that should be tested in this setting.

Additionally, our study showed there has been a significant decrease in rates of inpatient ERCP and sphincterotomy in patients with acute gallstone pancreatitis over the past decade. There are several possible reasons for that. One is that the role of ERCP has changed over the past decade from a diagnostic and therapeutic procedure to primarily a therapeutic procedure. With wide availability of magnetic resonance imaging and CT scans, and advances in endoscopic ultrasound (EUS), the role of ERCP is limited to patients with acute gallstone pancreatitis who have documented or increased suspicion of choledocholithiasis and/or cholangitis, or in patients who are too sick to tolerate a cholecystectomy [10, 15]. Our study did show that in acute gallstone pancreatitis patients with

cholangitis, the rates of in-hospital ERCP remained constant over the past decade, while in patients who did not have cholangitis, the rates of in-hospital ERCP decreased. Another reason for the decrease in same-admission ERCP rates could also be the increase in surgical expertise to perform intra-operative cholangiograms and common bile duct explorations. In patients with acute gallstone pancreatitis who are too sick to undergo cholecystectomy or cholecystectomy is contraindicated, an ERCP with endoscopic sphincterotomy is the preferred approach to prevent recurrence of acute gallstone pancreatitis.

Interestingly, although both the rate of same-admission cholecystectomy/ERCP and mean length of stay has decreased over the past decade, we found that the inflation-adjusted total hospitalization costs and charges have increased over the same time period. These results imply that the attempt to control inpatient healthcare spending by performing those procedures in the outpatient setting did not seem to succeed. The importance of this finding on healthcare economics is even greater when coupled with the fact that patients with acute gallstone pancreatitis discharged without a cholecystectomy experience increased 30-day readmission rates [23]. Therefore, adherence to treatment guidelines not only improves patients' outcomes in this setting, but also decreases healthcare spending.

There are some limitations to our study. Firstly, our study is a retrospective analysis due to the nature of the NIS database. Secondly, while most patients with acute gallstone pancreatitis tend to have mild disease [4,24], the NIS database does not allow to separate patients with mild to moderate disease versus those with severe acute gallstone pancreatitis. This is an important consideration as patients with severe disease are more predisposed to complications that may warrant delay in cholecystectomy (beyond the index hospitalization) as part of the standard of care. One systematic review of the literature showed that while there was no compelling evidence to delay cholecystectomy in mild acute gallstone pancreatitis, there was no evidence to support or refute early cholecystectomy in patients with severe pancreatitis [25]. We did however adjust for confounders including patient's co-morbid conditions using the previously validated Charlson's comorbidity score and accounting for the use of TPN. Another limitation of our study is that recurrence rates of acute gallstone pancreatitis in patients who did not undergo cholecystectomy and/or ERCP could not be obtained. Recurrence of acute gallstone pancreatitis is a key endpoint in these patients, and unfortunately the NIS database does not have information pertaining to this outcome. Similarly, we could not assess mortality related to recurrence of acute gallstone pancreatitis in patients who did not undergo same-admission cholecystectomy and/or ERCP. Finally, we could not differentiate if failure to undergo same-admission cholecystectomy was due to physician-related factors or due to patient-related factors such as patient's refusal of the surgical procedure.

Despite these limitations, our study has several strengths. The use of a national database such as the NIS eliminates biases generated from local resources and practice patterns that can be seen with single center or even smaller multi-center studies. The results of the study are therefore generalizable throughout the country. Since our study spans over a ten year trend using the database from three separate years, i.e. 2004, 2009 and 2014, the steady decline in rates of same-admission cholecystectomy in patients with acute gallstone pancreatitis is concerning. Based on the current available data, there are no definitive explanations for this trend. Ours is the first study that is highlighting the trend of increase in healthcare delivery gaps in patients with acute gallstone pancreatitis.

In conclusion, our study showed significant decline in rates of same-admission cholecystectomy and ERCP in patients with acute gallstone pancreatitis over the past decade despite a relatively constant rate of acute gallstone pancreatitis. Multi-disciplinary efforts are needed at national level between gastroenterology organizations, hospital administration and surgical societies to ensure that patients with acute gallstone pancreatitis receive standard of care. Further investigation is warranted to evaluate potential barriers in achieving optimal care for these patients.

Conflicts of interest/financial disclosures

The authors have no conflicts of interest or financial disclosures to report.

Author contributions

MB, SP and MA were involved in concept design, interpretation of data and drafting and revising the manuscript. MA performed statistical analysis. KK, JT, HS and MD wrote critical portions of the manuscript and helped in the revision process.

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Not applicable.

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