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Acute Pancreatitis in End-Stage Renal Disease: A Nationwide Database Study

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Abstract

Background: Acute Pancreatitis (AP) is one of the most common gastrointestinal diseases that require hospitalization. The incidence of AP ranges from 13 to 45 per 100,000 persons in the US. In ESRD, AP poses a challenging diagnosis and requires a tailored therapeutic approach. In this study, we aim to assess length of stay and mortality rates in ESRD patients with AP compared to non-ESRD patients with AP.

Methods: Data for hospitalized patients with acute pancreatitis was obtained from the National Inpatient Sample (NIS) database from 2016-2018. Baseline risk factors were identified using ICD-10 codes. Patients were stratified into two groups based on the presence of ESRD. A 1:1 propensity score matching was utilized based on selected risk factors between ESRD and non-ESRD patients and a regression analysis was performed on the matched cases.

Results: Out of 172,601 patients with acute pancreatitis, 8,470 patients were included in the analysis after performing 1:1 propensity score matching based on selected baseline characteristics and risk factors. Patients with ESRD who developed AP had a longer hospital stay (Odds radio=1.029, P=<0.001, 95% CI: 1.023-1.035) and had a higher mortality rate (Odds ratio=1.547, P=<0.001, 95% CI: 1.225-1.954) in comparison to non-ESRD patients.

Conclusion: Patients with ESRD who develop AP have longer hospital stays and increased mortality rates. Further research on AP in ESRD patients is essential to develop a tailored therapeutic approach addressing the challenges and contributing to better outcomes within this patient population.

Introduction

The prevalence and incidence of End-Stage Renal Disease (ESRD) continues to rise worldwide. In 2022, 130,522 individuals were newly diagnosed with End-Stage Renal Disease (ESRD) in the United States (US), according to the United States Renal Data System (USRDS). Patients with ESRD are at an increased risk of developing various comorbidities, including pancreatic diseases such as Acute Pancreatitis (AP) [1].

AP is a leading cause of gastrointestinal hospital admissions worldwide and is associated with significant rates of morbidity and mortality, with hospital deaths occurring in about 3% of mild cases and rising to as much as 30% in severe cases [2-6]. While the mechanisms through which ESRD patients develop AP remains unclear, multiple etiologies are described in the literature. Some studies have suggested that the development of AP in ESRD patients is less related to the disease pathophysiology itself, but rather the method of dialysis utilized to treat their

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ESRD [7]. Other studies have shown that hypercalcemia is the most common cause of AP in ESRD patients, regardless of their dialysis requirement [8].

A retrospective cohort study published in the World Journal of Gastroenterology found that ESRD patients are at an increased risk of post-endoscopic retrograde cholangiopancreatography adverse events, notably bleeding, which has been associated with higher mortality, prolonged hospital stays and higher hospitalization costs [9]. Multiple factors may contribute to these findings.

In this study, we examine AP in ESRD patients using the National Inpatient Sample (NIS) database. Our aim is to assess Length Of Stay (LOS) and mortality rates in ESRD patients with AP compared to non-ESRD patients with AP. This information would help guide treatment strategies for these patients, as well as potentially reduce the mortality associated with ESRD-related AP complications.

Methods

Data source

The Healthcare Cost and Utilization Project's (HCUP) National Inpatient Sample (NIS) database is maintained by the Agency for Healthcare Research and Quality. This US database lists multiple aspects of an in-hospital stay, with variables related to the patients' characteristics (diagnoses and performed procedures) and those related to the hospitals themselves. This study evaluated hospitalization records from the NIS between 2016 and 2018.

Because of the deidentified nature of the NIS database, this study was considered exempt from requiring an IRB review by the Northwell Health Institutional Review Board.

Variables of interests

Patient's variables of interest included age, sex, and multiple comorbidities as such as the presence of hypertension, diabetes mellitus, hyperlipidemia, cholelithiasis, obesity, use of alcohol and tobacco use.

Study design

Using International Classification of Disease, 10th Edition (ICD-10 codes), the NIS was queried to identify adult patients (≥18 years) between 2016 and 2018 and with a diagnosis of ESRD and AP. All AP causes were included: biliary AP, drug induced AP, alcohol induced AP and other causes of AP. Patients were stratified into two groups based on the presence of ESRD. A 1:1 propensity score matching was utilized based on selected risk factors between ESRD and non-ESRD patients.

Statistical analysis

Analyses were conducted using the complex sample feature of SAS Software. SAS Survey Procedures allowed us to account for both hospital stratification and clustering and for discharge weights, these factors being provided yearly in the NIS database.

A multivariate logistic regression analysis was performed to compare AP in non-ESRD patients with AP in ESRD patients, and to assess for strength and significance of the relationship between our predictor variables and our outcome of interest: Length of Stay (LOS), rates of cholecystectomy, biliary drainage, and mortality. Results are presented as Odds Ratio (OR) estimates with 95% confidence intervals. A 2-sided p-value of <0.05 was considered statistically significant. All statistical analyses were performed using the SAS Enterprise Software, Version Studio 9.4.

Results

Out of 172,601 patients with acute pancreatitis, 8,470 patients were included in the analysis after performing 1:1 propensity score matching based on selected baseline characteristics and risk factors.

ESRD patients with AP experienced longer hospital stays (OR=1.029, P<0.001, 95% CI: 1.023-1.035) and higher mortality rates (OR=1.547, P<0.001, 95% CI: 1.225-1.954) compared to non-ESRD patients. In addition, LOS independently increased the risk of mortality in both groups with OR: 1.015 (95% CI: 1.001-1.029, p=0.034).

Finally, younger age and female sex were negatively associated with the presence of acute pancreatitis in ESRD patients. Additionally, non-ESRD patients had lower rates of diabetes, gallstones, smoking, and alcohol use compared to their ESRD counterparts. Factors such as hypertension, hyperlipidemia, obesity, biliary drainage, and cholecystectomy did not show statistically significant differences between the groups, as detailed in Table 1.

The model demonstrated reasonable fit with a Cox & Snell R Square of 0.081 and Nagelkerke R Square of 0.108, indicating that the predictors explained roughly 10.8% of the variance in the outcome. The Hosmer and Lemeshow test had a chi-square value of 14.034 with p-value=0.081, indicating that the model had a good fit.

Table 1: Regression analysis on matched cases and outcomes.

	Lower CI 95%	Higher CI 95%	OR	p-value
Age	0.992	0.998	0.995	<0.001
Died	1.225	1.954	1.547	<0.001
Female	0.783	0.939	0.857	<0.001
Cholecystectomy	0.159	19.804	1.776	0.641
Drainage	0.575	1.706	0.988	0.964
Hypertension	0.809	1.467	1.089	0.574
Diabetes	0.828	0.998	0.909	0.045
Hyperlipidemia	0.917	1.115	1.011	0.826
Gallstones	0.576	0.740	0.653	<0.001
Morbid obesity	0,757	1.097	0.911	0.326
Obesity	0.784	1.096	0.927	0.375
Smoking	0.630	0.794	0.707	<0.001
Alcohol	0.190	0.260	0.222	<0.001
LOS	1.023	1.035	1.029	<0.001

Discussion

This study aimed to evaluate the outcomes of patients with AP and ESRD, compared to those with AP but without ESRD. Several significant findings emerged from the analysis, particularly regarding LOS and morality rates.

The study found that ESRD patients with AP had a significantly longer LOS and higher mortality rates compared to non-ESRD patients. These findings are consistent with prior literature, which have shown that ESRD patients are at higher risk for com-

plications and poor outcomes when experiencing acute conditions such as pancreatitis [8]. The longer LOS may be attributed to the need for more intensive management, including dialysis and other supportive care measures, while the increased mortality risk likely reflects the added physiological burden of renal failure, compounded by the effects of pancreatitis.

Our findings also highlight the significant role that hospital LOS plays in patient outcomes. Each additional day of hospitalization was associated with a 1.5% increase in the odds of mortality. This result emphasizes the importance of early intervention and efficient management in reducing prolonged hospitalization, which may increase the risk of nosocomial infections, additional comorbidities, and overall patient deterioration, particularly in ESRD patients who are already at increased risk for complications.

LOS is often used as a proxy for disease severity, with longer stays indicative of more severe or complicated cases. In this study, patients with prolonged hospitalization had more severe pancreatitis or ESRD-related complications, which likely contributed to higher mortality. Therefore, strategies aimed at reducing LOS, such as early intervention when indicated and aggressive management of complications, could improve survival and outcomes in this population.

Additionally, we also noted that younger age and female sex were both inversely associated with the presence of AP in ESRD patients, suggesting that older age and male sex may confer additional risks in this population. This is an expected finding as both AP and ESRD independently are known to be more prevalent in male sex and older adults [10,11].

Comorbidities such as diabetes, cholelithiasis, smoking and alcohol use are well-known contributors to the development of pancreatitis and may play a larger role in the ESRD population due to the underlying metabolic derangements associated with renal failure. Although, previous studies have shown that ESRD patients tend to have more hypercalcemia-related AP, while non-ESRD patients tend to develop alcohol-related, gallstone-related, and hypertriglyceridemia-related AP [8].

Interestingly, several other variables, including hypertension, hyperlipidemia, obesity, biliary drainage, and cholecystectomy, were not significantly associated with differences in outcomes between the ESRD and non-ESRD groups. This suggests that while these factors are important in the general population, their impact may be overshadowed by the severity of renal disease in ESRD patients. The wide confidence interval for cholecystectomy (OR=1.776, 95% CI: 0.159-19.804, p=0.641) indicates substantial variability, likely due to a small number of cases, and highlights the need for further investigation into its role in managing AP in ESRD patients.

Clinical implications

The results of this study suggest several important clinical implications. The association between prolonged LOS and increased mortality emphasizes the need for efficient and effective inpatient management. Hospital protocols that facilitate early identification of complications, timely intervention, and prompt discharge planning could reduce LOS and potentially improve survival rates.

Finally, addressing modifiable risk factors, such as smoking cessation, alcohol cessation as well as gallstone management, may further improve outcomes in ESRD patients with AP. These patients could benefit from multidisciplinary care teams that focus on optimizing renal, pancreatic, and overall health.

Limitations

Despite the strengths of this study, several limitations must be acknowledged. First, although propensity score matching was used to adjust for confounding factors, the observational nature of the study limits our ability to establish a causal relationship. There may be unmeasured confounders such as clinical judgment or patient-specific factors that were not captured in the dataset.

Second, the generalizability of our results may be limited to similar healthcare settings. Differences in practice patterns, resource availability, and patient demographics could influence outcomes in other settings.

Conclusion

In summary, this study highlights the outcomes experienced by ESRD patients with acute pancreatitis, including longer hospital stays and higher mortality rates. These findings underscore the need for tailored management strategies in ESRD patients with pancreatitis, considering their unique risk profiles and the potential benefits of conservative versus interventional approaches. Further research is warranted to explore the underlying mechanisms driving these differences and to identify strategies that may improve outcomes in this vulnerable population.

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