

Original Research Article

Risk factors for critical care admission in acute pancreatitis

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ABSTRACT

Background: Acute pancreatitis is one of the most common gastrointestinal causes of emergency hospital admissions. One in four patients will develop severe acute pancreatitis requiring critical care admission (CCA) frequently for a prolonged period leading to a considerable burden on health care resources. The main objective of this study was to analyse factors that may predict the need for CCA in patients diagnosed with acute pancreatitis.

Methods: In this study, authors analyzed the health records of all patients (154 patients) admitted to Salmaniya Medical Complex (SMC) with the diagnosis of acute pancreatitis.

Results: A total of 10 (6.5%) and 24 (15.6%) patients were admitted to the intensive care unit (ICU) and surgical high dependency unit (SHDU) respectively. There were no differences between different admission locations when it came to age, gender, comorbidities, frequency of attacks and number of computed tomography (CT) scans. After adjusting for all covariates in a multivariate binary logistic regression, the following factors were found to predict CCA: Nationality OR (95% CI): 7.64 (1.14-51.29), dyslipidaemia etiology OR (95% CI): 0.025 (0.001-0.755) and CT severity index - CTSI (95% CI): 1.463 (1.014-2.111). CCA was associated with higher length of stay (6 days vs. 9 day) OR (95% CI): 0.79 (0.015-0.413) and higher in-hospital mortality (1.7% versus 17.6%) OR (95% CI): 5.58 (3.38-7.78).

Conclusions: This study results indicate that nationality, dyslipidaemia etiology and CTSI were associated with higher CCA. ICU admission was associated with longer length of hospital stay and higher mortality rates.

Keywords: Acute pancreatitis, Bahrain, Computerized tomography severity index, Critical care, Prognosis, Retrospective study

INTRODUCTION

Acute pancreatitis is one of the most common gastrointestinal cause of emergency hospital admissions with an increasing incidence that fluctuates between 4 and 45 patients per 100,000 population in western countries with the highest seen in the United States.¹⁻⁴ Mostly explained by higher alcohol consumption. However, the global population mortality rate has persisted unaffected as the case fatality rate has decreased over time. The hospital mortality rate of patients with severe acute pancreatitis has plummeted to 20% (from 30-50%) even in the most severe forms of the disease.⁵⁻⁷

Although most cases are mild and self-limiting, one in four patients (around 30%) with acute pancreatitis develop severe acute pancreatitis which form an immense challenge to the health care system requiring admission to a Surgical High Dependency Unit (SHDU) or Intensive care unit (ICU), frequently for a prolonged period, with a mean of hospital length of stay of greater than 1 month, leading to a considerable burden on resources.^{5,7-11}

While ICU patients comprise a small proportion of the total patients in the hospital, they account for a significant amount of hospital resources. Severe cases requiring intensive care still carry a high mortality hence; attempts

to reduce the incidence of severe acute pancreatitis, the development of enhanced prognostic models and more efficient treatment might not result only in a superior outcome for the patient, but also produce vast savings in health care expenses. In a Budget-oriented society, it is essential to address the overall performance of ICUs.¹⁰

The epidemiological data of acute pancreatitis remains limited in developing countries, even more so in Kingdom of Bahrain. To this date no published research has addressed acute pancreatitis incidence, admissions, length of hospital stay or outcome in the Kingdom of Bahrain and only a few case reports of rare causes of acute pancreatitis are found in the English literature.¹²⁻¹⁵

The main objective of this study was to analyze factors that may predict the need for critical care admission (CCA) in patients diagnosed with acute pancreatitis and to investigate differences in mortality and length of stay according to the level of CCA.

Authors hypothesized that CCA might result in a lengthier hospital stay and higher mortality and that patient factors such as age, gender, comorbidities, etiology, recurrent attacks and computerized tomography severity index (CTSI) might predict the need of an acute pancreatitis patient for CCA.

METHODS

In this retrospective cohort study, we analyzed the health records of all patients admitted with the diagnosis of acute pancreatitis treated in Salmaniya Medical Complex (SMC) from January 1st, 2012 till December 31st, 2013. The SMC admission and discharge database were used to identify these patients. Where an individual was admitted with the diagnosis of acute pancreatitis on more than one occasion, the earliest episode was taken as the index episode. Exclusion criteria were patients that were misclassified as acute pancreatitis and incomplete documentation of this study specified parameters.

Based on published guidelines and consensus, the diagnosis of acute pancreatitis was accepted when the patient records confirmed the presence of at least two of the following three parameters: a positive clinical presentation for acute pancreatitis (characteristic pain), serum amylase values three times the upper normal level on admission or characteristic findings on abdominal cross-sectional imaging.^{16,17}

In study institution, the use of CT scan abdomen on the day of admission is not mandatory and is done based on admitting surgeon preference. Moreover, there are no criteria specifying when to consider these patients for each level of CCA and therefore this decision is based on the clinical condition and hemodynamic stability of the patient and admitting physician preference. CCA was defined as admission to either intensive care unit (ICU) or surgical high-dependency unit (SHDU).

The primary outcome of interest was the level of CCA. The following details were recorded for each patient: age, gender, nationality, etiology of pancreatitis, comorbidities (which were aggregated into the CCI - Charlson comorbidity index), length of stay in hospital, attack frequency, CT severity index and in-hospital mortality.

The Charlson comorbidity index (CCI) was used to quantify common chronic pre-existing diseases and comorbidities along 19 health-conditions as it has been proven to be an effective predictor of hard outcomes in several acute and chronic conditions.¹⁸⁻²⁰ Every CCI item has a weight according to the severity of comorbidities covered and the total CCI score was calculated by compiling the weighted items.¹⁸

The Balthazar CT severity index (CTSI) was used to objectively quantify the severity of acute pancreatitis on CT abdomen.^{21,22} Zero to four points are assigned according to the grade of pancreatitis with an additional two points for necrosis of up to 30%, four points for necrosis of 30%-50%, and six points for necrosis of more than 50%.

Research ethics committee approval was obtained and individual informed consent was not required or sought for this study. Patient data was coded using unique and anonymous patient identifiers in order to maintain confidentiality.

Statistical analysis

Statistical package for social sciences (SPSS®) Statistics for Windows, Version 23.0. (IBM Corp, NY, USA) was used for all analyses. Categorical variables were reported as the absolute frequency and percentage. Continuous variables were reported as median, minimum and maximum due to non-normal distribution of data indicated by the Kolmogorov-Smirnov and Shapiro-Wilk tests.

Univariate analysis of the non-normally distributed continuous variables was performed using the non-parametric tests Mann-Whitney U test while those for categorical variables was performed with Chi-squared and Fishers exact tests. To identify joint effect of the different variables associated with CCA for acute pancreatitis patients, multivariate binary logistical multinomial regression model analysis was applied. All univariate covariates believed to influence admission were candidates for modeling (enter method). A significance level of probability (p value) of less than 0.05 was considered statistically significant.

RESULTS

A search through SMC admission and discharge database yielded 167 patients with the principal diagnosis of acute pancreatitis during the study period. Authors excluded 13 patients as 11 of them were miscoded and did not meet

this study definition of pancreatitis, while the remaining two were excluded due to incomplete documentation of this study specified parameters. This meant that 154

(92.2%) were eligible for inclusion in this analysis and their demographics are presented in (Table 1).

Table 1: Demographics, clinical picture and outcomes of included patients.

Parameter	Ward	Critical care admission			Total	P value
		SHDU	ICU	Total CCA		
	N (%)	N (%)	N (%)	N (%)	N (%)	
Number of patients	120 (79)	24 (15.6)	10 (6.5)	34 (22.1)	154 (100)	
Age						0.67
Median	43	42.5	37.5	42	43	
Min-Max	11-92	21-87	18-78	18-87	11-92	
Gender						0.51
Male	79 (80.6)	14 (14.3)	5 (5.1)	19 (19.4)	98 (63.6)	
Female	41 (73.2)	10 (17.9)	5 (8.9)	15 (26.8)	56 (36.4)	
Nationality						0.09
Bahraini	55 (75.3)	10 (13.7)	8 (11)	18 (24.7)	73 (47.4)	
Non-Bahraini	65 (80.2)	14 (17.3)	2 (2.5)	16 (19.8)	81 (52.6)	
Etiology						0.3
Biliary	51 (81)	11 (17.5)	1 (1.5)	12 (19)	63 (40.9)	
Not determined	41 (78.8)	6 (11.6)	5 (9.6)	11 (21.2)	52 (33.8)	
Alcohol	16 (76.2)	4 (19)	1 (4.8)	5 (23.8)	21 (13.6)	
Dyslipidaemia	10 (66.7)	3 (20)	2 (13.3)	5 (33.3)	15 (9.7)	
Others	2 (66.7)	0	1 (33.3)	1 (33.3)	3 (1.9)	
Comorbidities CCI score						0.29
Median	0	0.5	1	1	0	
Min-Max	0-4	0-4	0-2	0-4	0-4	
CCI score value						0.59
0	73 (82)	12 (13.5)	4 (4.5)	16 (18)	89 (57)	
1	33 (76.7)	6 (14)	4 (9.3)	10 (23.3)	43 (27.9)	
2	8 (57.1)	4 (28.6)	2 (14.3)	6 (42.9)	14 (9.1)	
3	4 (80)	1 (20)	0	1 (20)	5 (3.2)	
4	2 (66.7)	1 (33.3)	0	1 (33.3)	3 (1.9)	
Attack frequency						0.12
1 st attack	108 (80)	18 (13.3)	9 (6.7)	27 (20)	135 (87.7)	
Recurrent	12 (63.2)	6 (31.6)	1 (5.2)	7 (36.8)	19 (12.3)	
CT						0.362
Done	58 (75.3)	15 (19.4)	4 (5.2)	19 (24.7)	77 (50)	
Not done	62 (80.6)	9 (11.5)	6 (7.9)	15 (19.4)	77 (50)	
CT severity index (CTSI)						0.027
Median	2	3	4	3	2	
Min-Max	0-6	0-10	2-4	0-10	0-10	
CTSI grades						0.036
Mild	46 (80.7)	10 (17.5)	1 (1.8)	11 (19.3)	57 (74)	
Moderate	12 (63.2)	4 (21.1)	3 (15.8)	7 (36.8)	19 (24.7)	
Severe	0	1 (100)	0	1 (100)	1 (1.3)	
Length of stay						0.001
Median	6	10	9	9	7	
Min-Max	2-20	2-31	4-62	2-62	2-62	
Death						0.001
Yes	2 (25)	2 (25)	4 (50)	6 (75)	8 (5.2)	
No	118 (80.8)	22 (15.1)	6 (4.1)	28 (19.2)	146 (94.8)	

Of the 154 patients admitted with acute pancreatitis to SMC, 34 (22.1%) required CCA and of those 10 (6.5%) were admitted to the ICU (Figure 1). The median age for patients requiring CCA was 42 years old and those who were admitted to the ICU had a tendency to be younger (median of 37.5 years old) although this was not statistically significant. Overall, more male patients presented with acute pancreatitis (63.6%), however, the percentage of female patients required CCA (26.8%) was more than that of the males (19.4%) although this was not statistically significant (Figure 2).

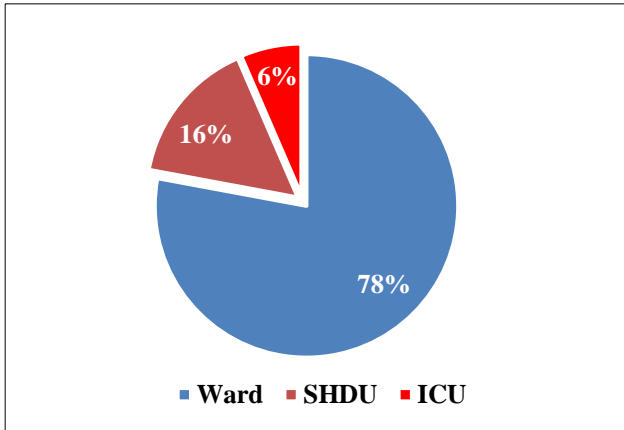


Figure 1: Admission location.

While the number of non-Bahraini patients (19.8%) requiring CCA did not differ significantly than their

Bahraini counterparts (24.7%), the number of Bahraini patients admitted to the ICU in specific was significantly higher than non-Bahraini patients (11% versus 2.5% respectively, p value: 0.03). In general, there was a statistically significant difference in the need for CCA based on etiology of pancreatitis, with biliary pancreatitis patients requiring such admission the least (19%) when compared with acute pancreatitis patients due to dyslipidemia who required the most CCAs (33.3%). Interestingly, 5 out of 10 (50%) patients admitted to the ICU were of undetermined etiology on discharge. This difference in admission to ICU based on nationality could be explained by the different distribution of etiology of pancreatitis by nationality.

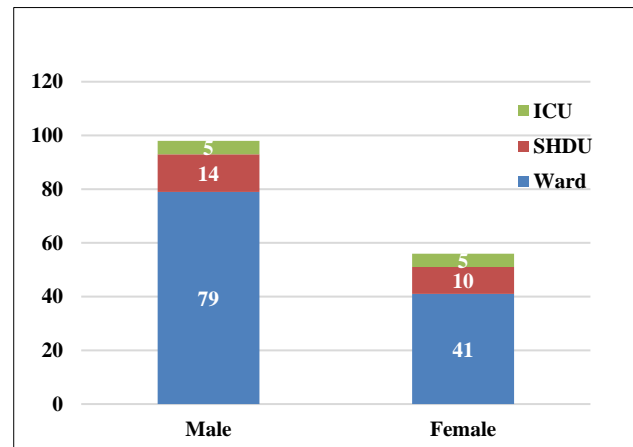


Figure 2: Gender distribution.

Table 2: Etiology of acute pancreatitis stratified by nationality.

	Alcohol abuse	Biliary stones	Dyslipidaemia	Not determined	Others	Total
	N (%)	N (%)	N (%)	N (%)	N (%)	
Bahraini	4 (5.5)	33 (42.2)	12 (16.4)	22 (30.1)	2 (2.7)	73
Non-Bahraini	17 (21)	30 (37)	3 (3.7)	30 (37)	1 (1.2)	81
Total	21 (13.6)	63 (40.9)	15 (9.7)	52 (33.8)	3 (1.9)	154

Table 3: Summary of multivariate analysis.

Parameter	Adjusted odds ratio	P value
Age	0.983	0.416
Gender	0.868	0.863
Nationality	0.206	0.037
CCI score	1.199	0.683
Etiology		
Biliary	0.22	0.361
Not determined	0.361	0.22
Alcohol	1	
Dyslipidaemia	0.025	0.044
Others	0.423	0.292
Attack frequency	0.404	0.943
CT	0.446	0.287
CT severity index (CTSI)	1.463	0.042

More Bahraini patients presented with acute pancreatitis due to dyslipidemia than non-Bahrainis (16.4% versus 3.7%) and Bahraini patients constituted 80% of the cases load of acute pancreatitis due to dyslipidemia which is the etiology with the highest requirement for ICU admission Table 2. Moreover, non-Bahrainis constituted 80.1% of the patients presenting with alcoholic acute pancreatitis which constituted the least etiology (10%) that required admission to the ICU.

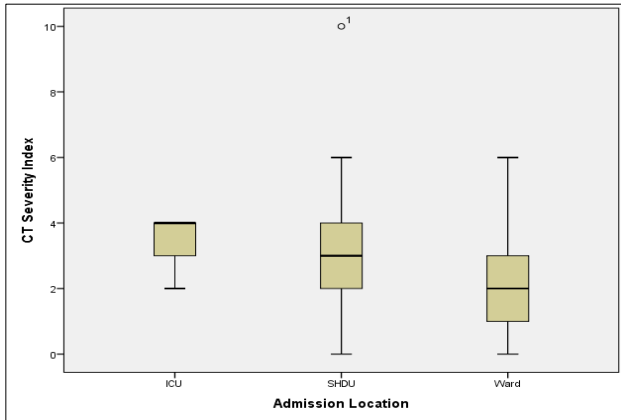


Figure 3: CT severity index by admission location.

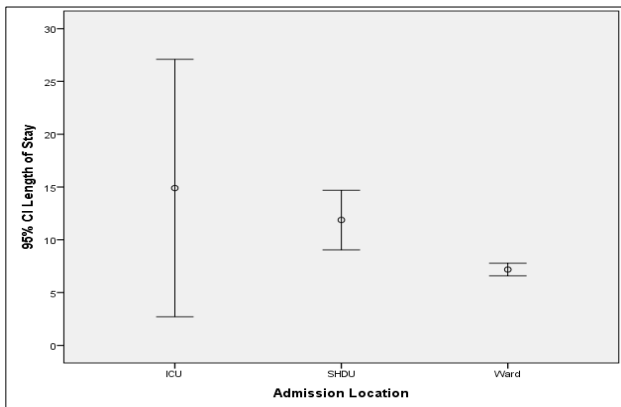


Figure 4: Length of stay by admission location.

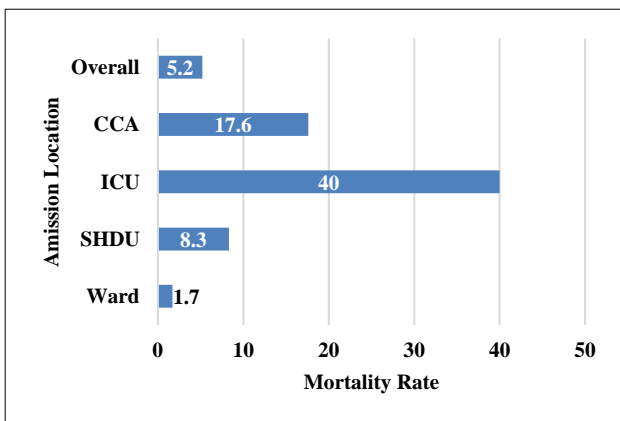


Figure 5: Admission location specific mortality rate.

Acute pancreatitis case with higher Charlson comorbidity index (CCI) values significantly required more CCA than their counterparts. Of note, out of 8 patients that had a CCI of three and above, 6 (75%) were admitted to the general surgery ward, 2 (25%) were admitted to the SHDU while none were admitted to the ICU. There was no statistically significant difference in the proportion of patients who presented with a first attack of pancreatitis and those who had recurrent attacks.

A total 60% of the patients admitted to the ICU did not have a CT scan abdomen; however, there was no statistically significant difference in the proportion of patients that had a CT scan abdomen between those who need a CCA and those who were admitted to the general ward (55.5% versus 48.3%). When a CT abdomen was performed; however, there was a statistically significant difference in the median CTSI score of patients that undergo a CCA and those who are admitted to the general ward (Figure 3).

For acute pancreatitis patients a critical admission was associated a statistically significant higher length of stay (6 days versus 9 day) OR (95% CI): 0.79 (0.015-0.413) (Figure 4) and higher in-hospital mortality (1.7% versus 17.6%) OR (95% CI): 5.58 (3.38-7.78) (Figure 5).

Summaries of multivariate analysis are presented in (Table 3). The only significant predictors of CCA were: Nationality OR (95% CI): 7.64 (1.14-51.29), dyslipidemia etiology OR (95% CI): 0.025 (0.001-0.755) and CTSI (95% CI): 1.463 (1.014-2.111).

DISCUSSION

In this study 6.5% of patients with acute pancreatitis were admitted to the ICU and when combined with admissions to SHDU this number rose to 22.1% which is much less than the 38-52% ICU admission rate for such patients reported in the literature.^{5,7,11,23} Moreover, the overall mortality in this series was 5.2% which is well within the range of reported overall mortality of 2-10%.^{6,7,16,22,24-26} This study 17.6% CCA mortality is less than the 21.0%-53.6% ICU mortality reported in the literature.^{5,23} ICU admission prolonged the median length of hospital stay from 6 days amongst acute pancreatitis patients cared for in the ward to 9 days amongst ICU treated patients (p<0.001) which is consistent with other studies.⁵

This study shows that the risk of ICU admission due to acute pancreatitis is predominantly determined by nationality, CTSI and dyslipidemia etiology. This is contrary to other reports that alcoholic and undetermined etiologies were stronger risk factors.²³ Bile stone disease, although the most frequent cause of acute pancreatitis, is associated with one of the lowest risks of ICU admission in this series which is consistent with the literature.^{7,11,23,27}

Age, gender, comorbidities and frequency of attacks of acute pancreatitis were not found to be risk factors for ICU admission in contrast to other reports.²³

While a number of studies cited better outcomes by more admissions to ICU, this is associated with increased hospitalization and high resource utilization.^{5,8-11,28-31} This is why we believe in selecting patients predicted to have severe complications of acute pancreatitis for ICU admission to make the best of the available resources and saves ICU beds.

It has been estimated that experienced clinicians can correctly predict a severe attack of acute pancreatitis in only 34-39% of patients at the time of admission.^{32,33} Moreover, it has been estimated that clinical evaluation alone may result in diagnosing a mild attack of acute pancreatitis in 30%-40% of patients with fatal necrotizing pancreatitis.³⁴

A number of studies have demonstrated the superiority of CT prognostic criteria (CSTI), owing to greater sensitivity and specificity, when compared to clinical prognostic scores (Ranson, Glasgow, Simplified Acute Physiology and Acute Physiology and Chronic Health Evaluation - APACHE II scores) or biochemical markers in predicting disease severity and potential complications by proxy the need for CCA.^{21,22,27,32,33,35-38}

There was a statistically significant correlation, with a continuous increasing incidence of morbidity and mortality in patients stratified according to CT severity index groups. Patients who had a severity index of 0 or 1 exhibited a 0% mortality rate and no morbidity, while patients with severity index of 2 had no mortality and a 4% morbidity rate. In contrast, a severity index of 7-10 yielded a 17% mortality rate and a 92% complication rate.^{21,22}

Authors therefore advocate for more liberal use of CT scan in patients with acute pancreatitis and recommend the utilizing CTSI as an objective prognostic criterion to aid in selecting patients most in need of special attention.

Some of the limitation of this study is that we could not collect all the relevant clinical (vitals, Ranson and APACHE-II scores, timing of CT, timing of admission to ICU) and laboratory data (serum glucose, albumin, calcitonin, white cell counts and others) which may be of prognostic value.^{7,39} The retrospective nature may introduce recall, mis-classification or information biases and subject the results to confounding from risk factors that were not measured or known.⁴⁰ There were a relatively small number of severe cases in this series but this may reflect the milder course of acute pancreatitis in this study population.

The strength of this paper is that it the inclusion of almost all patients during the study period as only 2 patients who met this study definition of acute pancreatitis were excluded which minimized the attrition bias and therefore, this study conclusions are applicable and generatable for this patient cohort.⁴⁰ Prognostic factors were identified from the literature and their effects were tested and adjusted in a multivariate regression analysis. This study is the first published audit of acute pancreatitis

in the Kingdom of Bahrain and it identified prognostic factors specific to the local population. It has implications for health care policy decision making and quality of patient care as the information generated can be used to develop local standardized guidelines and clinical care pathways. Further work is needed to create a prospective data base to follow acute pancreatitis patients and collect cost data to quantify the economic burden of this fatal disease.

CONCLUSION

This study results indicate that nationality, dyslipidemia etiology and CTSI were associated with higher CCA. However, the increased CCA due to nationality might be explained by the deferential etiology. Admission to ICU was associated with longer length of hospital stay and higher mortality rate.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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