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Original Article

PANC Study (Pancreatitis: A National Cohort Study): national cohort study examining the first 30 days from presentation of acute pancreatitis in the UK

PANC Study Collaborative

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Abstract

Background: Acute pancreatitis is a common, yet complex, emergency surgical presentation. Multiple guidelines exist and management can vary significantly. The aim of this first UK, multicentre, prospective cohort study was to assess the variation in management of acute pancreatitis to guide resource planning and optimize treatment.

Methods: All patients aged greater than or equal to 18 years presenting with acute pancreatitis, as per the Atlanta criteria, from March to April 2021 were eligible for inclusion and followed up for 30 days. Anonymized data were uploaded to a secure electronic database in line with local governance approvals.

Results: A total of 113 hospitals contributed data on 2580 patients, with an equal sex distribution and a mean age of 57 years. The aetiology was gallstones in 50.6 per cent, with idiopathic the next most common (22.4 per cent). In addition to the 7.6 per cent with a diagnosis of chronic pancreatitis, 20.1 per cent of patients had a previous episode of acute pancreatitis. One in 20 patients were classed as having severe pancreatitis, as per the Atlanta criteria. The overall mortality rate was 2.3 per cent at 30 days, but rose to one in three in the severe group. Predictors of death included male sex, increased age, and frailty; previous acute pancreatitis and gallstones as aetiologies were protective. Smoking status and body mass index did not affect death.

Conclusion: Most patients presenting with acute pancreatitis have a mild, self-limiting disease. Rates of patients with idiopathic pancreatitis are high. Recurrent attacks of pancreatitis are common, but are likely to have reduced risk of death on subsequent admissions.

Introduction

Acute pancreatitis is a common, yet complex, emergency surgical presentation with an incidence of 56 cases per 100 000 people per year in the UK[1]. The varied aetiologies of pancreatitis mean individuals present from a large range of demographics with a wide spectrum of severity, from mild symptoms to severe disease. Fortunately, as most cases are mild and self-limiting, patients can be managed safely by generalists, supporting the patient in the form of analgesia, fluid balance, and nutrition until the patient's condition sufficiently resolves. The aetiology, while easily apparent in some, is elusive in others; high idiopathic pancreatitis rates (greater than 20 per cent) are felt to be a sign of insufficient searching for a cause, rather than a true phenomenon[2].

Recent changes to the grading of pancreatitis severity have focused on the need for additional organ support as a truer reflection of severity, rather than simply assessing the degree of pancreatic necrosis[3–5]. Most epidemiological papers stating severity and mortality rates are based on populations before this definition changed.

Although management of pancreatitis is supportive for the majority, the variation in aetiology and unpredictability of the severity mean that the management of pancreatitis has significant regional, hospital, and even individual clinician inter-variability, despite a number of guidelines issued by international professional bodies[1,6–9]. The aim of this national, multicentre, prospective cohort study was to assess the current population of patients presenting with acute pancreatitis, to understand trends of presentation and care, and effect on patient outcome across the UK.

Methods

Study approach

This study was a prospective cohort study and was reported according to the STROBE guidelines for observational studies[10]. Ethical approval was not required as only routine, observational data were collected and patient clinical management was not altered in any way.

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Site recruitment

Hospitals were recruited from across the UK, using trainee-led research collaboratives and national surgical organizations such as the Association of Surgeons of Great Britain and Ireland (ASGBI), the Association of Upper Gastrointestinal Surgery (AUGIS), and the Pancreatic Society of Great Britain and Ireland (PSGBI). Any hospital that provides emergency surgical services was eligible to participate. A consultant Principal Investigator was required to register the study at their local hospital to secure Caldicott approval for data sharing, and to supervise a team of up to three trainees or allied healthcare professionals.

Data collection

Data were collected from patients presenting between 1 March and 30 April 2021. Patients aged greater than or equal to 18 years presenting with acute pancreatitis, diagnosed as per the revised Atlanta criteria, were eligible for inclusion[3]. This was defined as meeting two of three criteria: abdominal pain suggestive of pancreatitis; serum amylase or lipase level greater than three times the upper limit of normal; or characteristic findings on imaging[3]. Patients transferred from another hospital after their initial acute presentation were excluded. Once screened for eligibility, local teams entered the anonymized patient data into Research Electronic Data Capture (REDCap, http://www.project-redcap.org/)[11]. All patients were followed up for 30 days after their date of presentation.

Sites failing to submit patients throughout the study interval or achieving less than 95 per cent data completion were excluded from the study. Two centres were excluded before analysis for failing to meet these criteria.

Classification of pancreatitis severity

Grades of severity of pancreatitis were based on the revised Atlanta classification[3]; pancreatitis severity was stratified as mild, moderately severe, and severe. Mild acute pancreatitis was defined as the absence of organ failure or local or systemic complications. Moderately severe acute pancreatitis was characterized by transient organ failure that resolved within 48 h and/or local or systemic complications without persistent organ failure. Severe acute pancreatitis was defined as persistent organ failure lasting longer than 48 h.

Outcome measures

Basic admission variables were recorded for all patients, including demographic data, co-morbidities using the Charlson Co-morbidity Index (CCI)[12], details of initial assessment, investigations, and treatment. Initial baseline parameters such as heart rate and blood pressure were recorded using National Early Warning Score 2 (NEWS2)[13]. Patients were followed up to assess the types and frequency of imaging and intervention they received over the initial 30 days post-presentation. Outcomes of interest included admission to critical care, referral to a tertiary specialty unit, necessity for enteral or parenteral nutrition support, length of hospital stay, aetiology of the pancreatitis, and 30-day mortality rates.

Statistical analysis

Differences across groups were tested using the Pearson χ^2 test for categorical variables and using the Kruskal–Wallis test for continuous variables. All numerical data are reported as median (interquartile range (i.q.r.)) unless otherwise stated. Missing data are presented for all categorical variables. Multilevel logistic regression models were constructed to account for case mix (differing patient and disease characteristics), with population stratification by hospital incorporated as random intercepts with constrained gradients.

Models were constructed using the following principles: variables associated with outcome measures in previous studies were accounted for; demographic variables were included in model exploration; population stratification by hospital and country of residence was incorporated as random effects; all first-order interactions were checked and included in final models if found to be influential (reaching statistical significance or resulting in a 10 per cent or greater change in the odds ratio (OR) of the explanatory variable of interest); and final model selection was done using a criterion-based approach by minimizing the Akaike information criterion and discrimination determined using the C-statistic (area under the receiver operator curve). Effect estimates are presented as ORs and 95 per cent confidence intervals (c.i.). All analyses were performed using R (version 4.1.1), using the finalfit and tidyverse packages.

Results

Data were collected from 113 centres on 2580 patients over the 2-month study interval. Nearly one in five (465) did not have a rise in amylase or lipase to indicate pancreatitis as a diagnosis; the diagnosis was made using a combination of clinical history and imaging. In 80 patients (3.1 per cent) the diagnosis was made more than 48 h from presentation.

Most patients presented with mild acute pancreatitis (71.2 per cent), as per revised Atlanta classification, with just over 1 in 20 (145/2580) classified as having severe pancreatitis (*Table 1*).

Patient factors

There was an equal split between male and female patients (1293 : 1287), with a median age of 57 years. Males presented more frequently with moderate or severe acute pancreatitis than females ($P < 0.001$). Differences in BMI, smoking status, and alcohol consumption between the groups are displayed in *Table 1*. There were proportionally more patients living with multiple co-morbidities, frailty, or advanced diabetes in the severe acute pancreatitis group. Over a quarter of patients had previous pancreatitis. A history of previous pancreatitis appeared to be protective of severe pancreatitis during a subsequent attack (20.7 per cent recurrent pancreatitis rate in the mild group *versus* 12.8 per cent in the severe group; $P = 0.018$).

Initial assessment

Patients who went on to develop moderate or severe pancreatitis were seen to present with a higher NEWS2, white cell count, urea level, and creatinine level (*Table 2*). C-reactive protein was increased on admission in those patients with increased severity, although the difference was more pronounced at 48 h.

Management in the first 48 h

Within the first 48 h of admission, over a third of patients had been prescribed antibiotics, with the most common reason given being suspected infection, followed by prophylaxis, with proven infection only accounting for less than 1 in 20 cases, as seen in *Table 3*.

Oral analgesia was tolerated and effective for managing pain in around half of all patients. Oral opiates were the most common choice of analgesia (1985, 76.9 per cent); non-steroidal anti-inflammatories (NSAIDs) were not commonly used (111).

Table 1 Patient factors

		Severity of pancreatitis			Total, $n = 2580$	P
		Mild, $n = 1836$ (71.2)	Moderate, $n = 596$ (23.1)	Severe, $n = 148$ (5.7)		
Age (years), median (i.q.r.)		56.0 (40.0–72.0)	56.5 (43.0–73.0)	65.0 (54.0–78.0)	57.0 (41.0–72.0)	<0.001
Sex						<0.001
Male		855 (46.6)	337 (56.5)	101 (68.2)	1293 (50.1)	
Female		981 (53.4)	259 (43.5)	47 (31.8)	1287 (49.9)	
BMI (kg/m^2)	<18.0	27 (1.5)	11 (1.8)	2 (1.4)	40 (1.6)	0.759
	18.0–24.9	527 (28.7)	182 (30.5)	43 (29.1)	752 (29.1)	
	25.0–29.9	570 (31.0)	177 (29.7)	38 (25.7)	785 (30.4)	
	≥30	672 (36.6)	213 (35.7)	61 (41.2)	946 (36.7)	
	Missing	40 (2.2)	13 (2.2)	4 (2.7)	57 (2.2)	
Smoking status	Never smoked	1049 (57.1)	288 (48.3)	74 (50.0)	1411 (54.7)	0.001
	Current Smoker	392 (21.4)	160 (26.8)	32 (21.6)	584 (22.6)	
	Ex-smoker	348 (19.0)	139 (23.3)	35 (23.6)	522 (20.2)	
	Missing	47 (2.6)	9 (1.5)	7 (4.7)	63 (2.4)	
Alcohol consumption (units/week)	None	825 (44.9)	252 (42.3)	55 (37.2)	1132 (43.9)	<0.001
	1–14	673 (36.7)	193 (32.4)	48 (32.4)	914 (35.4)	
	15–35	129 (7.0)	59 (9.9)	18 (12.2)	206 (8.0)	
	>35	173 (9.4)	88 (14.8)	21 (14.2)	282 (10.9)	
	Missing	36 (2.0)	4 (0.7)	6 (4.1)	46 (1.8)	
Diabetic	None or diet controlled	1631 (88.8)	520 (87.2)	122 (82.4)	2273 (88.1)	0.052
	Tablet or insulin controlled	204 (11.1)	75 (12.6)	26 (17.6)	305 (11.8)	
	Missing	1 (0.1)	1 (0.2)	0 (0.0)	2 (0.1)	
Charlson Co-morbidity Index, median (i.q.r.)		2.0 (0.0–3.5)	2.0 (0.0–4.0)	3.0 (2.0–5.0)	2.0 (0.0–4.0)	<0.001
Frailty state	Non-frail	1478 (80.5)	447 (75.0)	93 (62.8)	2018 (78.2)	<0.001
	Pre-frail	164 (8.9)	65 (10.9)	18 (12.2)	247 (9.6)	
	Frail	175 (9.5)	83 (13.9)	36 (24.3)	294 (11.4)	
	Missing	19 (1.0)	1 (0.2)	1 (0.7)	21 (0.8)	
History of pancreatitis	No	1320 (71.9)	421 (70.6)	122 (82.4)	1863 (72.2)	0.028
	Yes (acute)	380 (20.7)	119 (20.0)	19 (12.8)	518 (20.1)	
	Yes (known chronic)	134 (7.3)	56 (9.4)	7 (4.7)	197 (7.6)	
	Missing	2 (0.1)	0 (0.0)	0 (0.0)	2 (0.1)	

Values are n (%) unless otherwise indicated. i.q.r., interquartile range.

Table 2 Initial assessment

	Severity of pancreatitis			Total, $n = 2580$	P
	Mild, $n = 1836$ (71.2)	Moderate, $n = 596$ (23.1)	Severe, $n = 148$ (5.7)		
NEWS2 on admission	1.0 (0.0–2.0)	1.0 (0.0–3.0)	2.0 (1.0–4.0)	1.0 (0.0–2.0)	<0.001
Highest NEWS2 in first 48 h	2.0 (1.0–3.0)	3.0 (2.0–5.0)	6.0 (4.0–8.0)	2.0 (1.0–4.0)	<0.001
White cell count (x 10^9/L)	11.6 (8.9–14.6)	14.1 (10.7–18.0)	15.8 (11.6–19.6)	12.3 (9.3–15.8)	<0.001
Urea (mmol/L)	5.0 (3.7–6.5)	5.2 (3.9–7.5)	7.7 (5.4–11.2)	5.1 (3.8–6.9)	<0.001
Creatinine (μmol/L)	71.0 (59.0–86.0)	74.0 (60.0–95.0)	108.5 (76.2–167.8)	72.0 (60.0–89.5)	<0.001
CRP on admission (mg/dl)	10.0 (3.5–37.0)	20.7 (5.0–102.0)	23.0 (5.0–127.0)	12.0 (4.0–51.0)	<0.001
Highest CRP value in first 48 h (mg/dl)	76.5 (16.0–171.0)	211.5 (108.0–301.1)	286.0 (179.4–343.0)	113.0 (25.6–229.0)	<0.001

Values are median (i.q.r.) unless otherwise indicated. NEWS2, National Early Warning Score 2; CRP, C-reactive protein; i.q.r., interquartile range.

Imaging

Ultrasonography was performed in three of five patients, most commonly performed during day 1 of admission (*Table 4*). In those who did not undergo ultrasonography, 482 (18.6 per cent) had known gallstones and 119 (4.6 per cent) had previously undergone a cholecystectomy.

On average, patients with moderate or severe pancreatitis had one CT scan. However, 31.2 per cent had two or more CT scans over the first 30 days of presentation; 39.4 per cent of mild cases underwent at least one CT scan.

Magnetic resonance cholangiopancreatography (MRCP) scans were performed in two in five patients, but less commonly in severe pancreatitis, even when death was accounted for (*Table 4*). MRCP scans were performed within a median of 3 days from admission.

Aetiology

The relationship between patient characteristics and aetiologies (alcohol, gallstones, and idiopathic) can be seen in *Table 5*. The most common aetiology was gallstones (1306/2580). No aetiology

Table 3 Management in first 48 h

		Severity of pancreatitis			Total, $n = 2580$	P
		Mild, $n = 1836$ (71.2)	Moderate, $n = 596$ (23.1)	Severe, $n = 148$ (5.7)		
Antibiotics prescribed in first 48 h after admission	No	1306 (71.1)	316 (53.0)	53 (35.8)	1675 (64.9)	<0.001
	Yes - prophylactically	172 (9.4)	54 (9.1)	21 (14.2)	247 (9.6)	
	Yes - for suspected infection	286 (15.6)	183 (30.7)	56 (37.8)	525 (20.3)	
	Yes - for proven infection	63 (3.4)	40 (6.7)	18 (12.2)	121 (4.7)	
	Missing	9 (0.5)	3 (0.5)	0 (0.0)	12 (0.5)	
Urinary catheter inserted in first 48 h	No	1512 (82.4)	348 (58.4)	36 (24.3)	1896 (73.5)	<0.001
	Yes	303 (16.5)	243 (40.8)	112 (75.7)	658 (25.5)	
	Missing	21 (1.1)	5 (0.8)	0 (0.0)	26 (1.0)	
Oral intake tolerated on admission	No	60 (3.3)	54 (9.1)	31 (20.9)	145 (5.6)	<0.001
	Placed Nil By Mouth	127 (6.9)	52 (8.7)	16 (10.8)	195 (7.6)	
	Fluids only	471 (25.7)	221 (37.1)	58 (39.2)	750 (29.1)	
	Fluids and diet	1154 (62.9)	259 (43.5)	42 (28.4)	1455 (56.4)	
	Missing	24 (1.3)	10 (1.7)	1 (0.7)	35 (1.4)	
Oral analgesia tolerated	Yes	1020 (55.6)	211 (35.4)	25 (16.9)	1256 (48.7)	<0.001
	No - ineffective	693 (37.7)	323 (54.2)	93 (62.8)	1109 (43.0)	
	No - cannot tolerate oral	86 (4.7)	55 (9.2)	28 (18.9)	169 (6.6)	
	Missing	37 (2.0)	7 (1.2)	2 (1.4)	46 (1.8)	

Values are *n* (%).

Table 4 Imaging (excluding those who died)

		Severity of pancreatitis			Total, $n = 2580$	P
		Mild, $n = 1826$	Moderate, $n = 583$	Severe, $n = 97$		
Ultrasound was performed	Yes	1127 (62.0)	320 (55.3)	49 (50.5)	1496 (60.0)	0.002
	No	688 (37.9)	259 (44.7)	48 (49.5)	995 (39.9)	
	Missing	2 (0.1)	0 (0.0)	0 (0.0)	2 (0.1)	
MRCP performed	Yes	785 (43.2)	205 (35.4)	29 (29.9)	1019 (40.9)	<0.001
	No	967 (53.2)	359 (62.0)	68 (70.1)	1394 (55.9)	
	Requested (not performed)	65 (3.6)	15 (2.6)	0 (0.0)	80 (3.2)	
Endoscopic ultrasound was performed	No	1759 (96.8)	565 (97.6)	93 (95.9)	2417 (97.0)	0.229
	Yes	21 (1.2)	5 (0.9)	3 (3.1)	29 (1.2)	
	Requested (not performed)	34 (1.9)	9 (1.6)	0 (0.0)	43 (1.7)	
	Missing	3 (0.2)	0 (0.0)	1 (1.0)	4 (0.2)	
Patients receiving CT during admission	0	1092 (60.1)	66 (11.4)	7 (7.2)	1165 (46.7)	<0.001
	1	675 (37.1)	356 (61.5)	32 (33.0)	1063 (42.6)	
	2	37 (2.0)	97 (16.8)	29 (29.9)	163 (6.5)	
	>2	7 (0.4)	59 (10.2)	27 (27.8)	93 (3.7)	
	Missing	6 (0.3)	1 (0.2)	2 (2.1)	9 (0.4)	
Time between admission and first CT performed (days)	Median (i.q.r.)	1.0 (0.0–2.0)	1.0 (0.0–2.0)	1.0 (0.0–2.0)	1.0 (0.0–2.0)	0.234
Findings on first CT	Normal	150 (20.9)	29 (5.7)	8 (9.1)	187 (14.2)	<0.001
	Interstitial pancreatitis	566 (78.7))	483 (94.3)	80 (90.9)	1129 (85.6)	
	Missing	3 (0.4)	0 (0.0)	0 (0.0)	3 (0.2)	

Values are *n* (%) unless otherwise indicated. MRCP, magnetic resonance cholangiopancreatography; i.q.r., interquartile range.

was identified in 22.9 per cent of patients within the first 30 days; the full list of aetiologies can be seen in *Table S1*.

Alcohol accounted for less than one in five presentations of acute pancreatitis (452/2580) and was more prevalent in males (*Table 5*). Over half of those with alcohol-induced pancreatitis also smoked, as opposed to only one in eight in the gallstone pancreatitis group. Only 59.7 per cent of alcohol-induced pancreatitis cases were classed as mild pancreatitis.

Idiopathic pancreatitis was seen equally between the sexes. The recurrence rate was high in the idiopathic group, with one in four having previously had at least one attack of acute pancreatitis.

Patients with gallstones identified as the main aetiology were more likely to be older, female, and more co-morbid than those with alcohol as an aetiology or those classed idiopathic. Median amylase levels were higher in gallstone pancreatitis.

Management of gallstone pancreatitis

Of the 1306 patients with gallstone pancreatitis, 34 patients had undergone a previous cholecystectomy, and, despite having undergone 'definitive treatment', pancreatitis had been caused by retained stones.

Endoscopic retrograde cholangiopancreatography (ERCP) was performed in 204 patients, of which 164 (80.4 per cent) had bile duct stones found, 39 had the procedure as definitive treatment for gallstones with sphincterotomy, and a further one had suspected stones, but nil found at time of procedure.

Of the 1272 patients that were eligible for a cholecystectomy, 441 (34.7 per cent) had a cholecystectomy performed within 30 days and for 275 (21.6 per cent) no decision had been made by the time of discharge regarding whether they would proceed to

Table 5 Relationship between aetiology and patient characteristics

		Main cause of acute pancreatitis			Total, $n = 2337$†	P
		Alcohol, $n = 452$ (19.3)	Gallstones, $n = 1306$ (55.9)	Idiopathic, $n = 579$ (24.8)		
Age (years), median (i.q.r.)		47.0 (38.0–55.0)	61.0 (45.2–75.0)	62.0 (46.0–73.5)	57.0 (42.0–72.0)	<0.001
Sex						<0.001
Male		332 (73.5)	545 (41.7)	291 (50.3)	1168 (50.0)	
Female		120 (26.5)	761 (58.3)	288 (49.7)	1169 (50.0)	
BMI (kg/m^2)	<18.0	10 (2.2)	13 (1.0)	9 (1.6)	32 (1.4)	<0.001
	18.0–24.9	189 (41.8)	308 (23.6)	177 (30.6)	674 (28.8)	
	25.0–29.9	142 (31.4)	398 (30.5)	176 (30.4)	716 (30.6)	
	≥30	98 (21.7)	561 (43.0)	204 (35.2)	863 (36.9)	
	Missing	13 (2.9)	26 (2.0)	13 (2.2)	52 (2.2)	
Smoking status	Never smoked	113 (25.0)	831 (63.6)	327 (56.5)	1271 (54.4)	<0.001
	Current smoker	257 (56.9)	164 (12.6)	113 (19.5)	534 (22.8)	
	Ex-smoker	72 (15.9)	278 (21.3)	126 (21.8)	476 (20.4)	
	Missing	10 (2.2)	33 (2.5)	13 (2.2)	56 (2.4)	
Alcohol consumption (units/week)	None	42 (9.3)	661 (50.6)	293 (50.6)	996 (42.6)	<0.001
	1–14	83 (18.4)	516 (39.5)	228 (39.4)	827 (35.4)	
	15–35	99 (21.9)	58 (4.4)	41 (7.1)	198 (8.5)	
	>35	225 (49.8)	41 (3.1)	9 (1.6)	275 (11.8)	
	Missing	3 (0.7)	30 (2.3)	8 (1.4)	41 (1.8)	
Diabetes	None or diet controlled	416 (92.0)	1154 (88.4)	503 (86.9)	2073 (88.7)	0.030
	Tablet or insulin controlled	36 (8.0)	150 (11.5)	76 (13.1)	262 (11.2)	
	Missing	0 (0.0)	2 (0.2)	0 (0.0)	2 (0.1)	
Charlson Co-morbidity Index, median (i.q.r.)		1.0 (0.0–2.0)	2.0 (0.0–4.0)	2.0 (1.0–4.0)	2.0 (0.0–4.0)	<0.001
History of pancreatitis	No	220 (48.7)	1089 (83.4)	391 (67.5)	1700 (72.7)	<0.001
	Yes (acute)	136 (30.1)	190 (14.5)	139 (24.0)	465 (19.9)	
	Yes (known chronic)	95 (21.0)	26 (2.0)	49 (8.5)	170 (7.3)	
	Missing	1 (0.2)	1 (0.1)	0 (0.0)	2 (0.1)	
Amylase* (U/L)	Median (i.q.r.)	419.0 (167.2–1186.0)	1403.0 (672.8–2695.2)	926.0 (324.5–2572.0)	1071.0 (415.0–2477.0)	<0.001
Length of stay (days)	Median (i.q.r.)	4.5 (3.0–8.0)	6.0 (3.0–9.0)	4.0 (3.0–7.0)	5.0 (3.0–8.0)	<0.001
Severity of pancreatitis	Mild	270 (59.7)	972 (74.4)	433 (74.8)	1675 (71.7)	<0.001
	Moderate	150 (33.2)	275 (21.1)	111 (19.2)	536 (22.9)	
	Severe	32 (7.1)	59 (4.5)	35 (6.0)	126 (5.4)	
30-day outcome	Discharged	419 (92.7)	1216 (93.1)	538 (92.9)	2173 (93.0)	0.147
	Still admitted	13 (2.9)	50 (3.8)	14 (2.4)	77 (3.3)	
	Transferred to other hospital	6 (1.3)	7 (0.5)	4 (0.7)	17 (0.7)	
	Died	11 (2.4)	27 (2.1)	21 (3.6)	59 (2.5)	
	Missing	3 (0.7)	6 (0.5)	2 (0.3)	11 (0.5)	

Values are n (%) unless otherwise indicated. *Eight sites used lipase rather than amylase. †Other aetiologies excluded. i.q.r., interquartile range.

cholecystectomy in the future. In addition, 161 (12.7 per cent) were deemed unfit, or declined surgery.

Of those with recurrent gallstone pancreatitis, 173 of the 184 patients still had their gallbladder *in situ* at the time of the subsequent presentation (94.0 per cent).

Outcomes

At 30 days, the majority of patients had been discharged (93.0 per cent), 3.3 per cent remained as inpatients (which equated to one in five when focusing on those classed as severe), and 0.7 per cent were transferred to a tertiary centre. Further information can be seen in *Table 6*.

The median length of stay was 4 days for mild cases, 8 days for moderate cases, and 17 days for severe cases. Only 150 patients had an admission of less than 2 days. Of the severe cases, 60.1 per cent required intensive care unit (ICU) admission, with a median stay of 7 days.

Nine per cent of patients who had been discharged were readmitted within 30 days of presentation; 3.6 per cent had recurrent pancreatitis in this time.

Overall, 30-day mortality rate was 2.3 per cent, increasing to one in three in the severe group.

Risk prediction

A multivariable model, clustering patients by hospital, demonstrated that age, frailty, and aetiologies, including alcohol and post-ERCP pancreatitis (PEP), increase the risk of 30-day mortality rate. BMI and smoking status did not have any effect on death, and therefore were removed from the model. Recurrent pancreatitis was shown to be protective of severity of disease. Results are presented in *Fig. 1* and *Tables S2 and S3*.

Discussion

Acute pancreatitis is a common surgical presentation in the UK, and affects a wide range of patients, with varying aetiologies and varying outcomes. Most cases recorded by this study were mild; depending on aetiology, there was a one in four chance of recurrence of pancreatitis, but, importantly, subsequent attacks of pancreatitis were likely to be less severe.

Table 6 Outcomes

		Severity of pancreatitis			Total, $n = 2580$	P
		Mild, $n = 1836$ (71.2)	Moderate, $n = 596$ (23.1)	Severe, $n = 148$ (5.7)		
30-day outcome	Discharged	1789 (97.4)	537 (90.1)	58 (39.2)	2384 (92.4)	<0.001
	Still admitted	21 (1.1)	37 (6.2)	30 (20.3)	88 (3.4)	
	Transferred to other hospital	7 (0.4)	5 (0.8)	9 (6.1)	21 (0.8)	
	Died	9 (0.5)	13 (2.2)	51 (34.5)	73 (2.8)	
	Missing	10 (0.5)	4 (0.7)	0 (0.0)	14 (0.5)	
Length of stay (days), median (i.q.r.)		4.0 (3.0–7.0)	8.0 (5.0–13.0)	17.0 (10.2–24.8)	5.0 (3.0–8.0)	<0.001
ICU admission	No	1824 (99.3)	543 (91.1)	59 (39.9)	2426 (94.0)	<0.001
	Yes	9 (0.5)	52 (8.7)	89 (60.1)	150 (5.8)	
	Missing	3 (0.2)	1 (0.2)	0 (0.0)	4 (0.2)	
Time spent in ICU (days), median (i.q.r.)		3.0 (1.0–8.0)	3.0 (2.0–5.2)	7.0 (3.8–20.2)	5.0 (2.0–13.0)	<0.001
Cholecystectomy performed*	Performed during admission	254 (26.4)	33 (12.2)	3 (5.1)	290 (22.4)	<0.001
	Performed after discharge	124 (12.9)	25 (9.3)	2 (3.4)	151 (11.7)	
	Not performed within 30 days of admission	584 (60.6)	211 (78.1)	54 (91.5))	849 (65.7	
	Missing	5 (0.3)	1 (0.2)	0 (0.0)	6 (0.2)	
Unplanned readmission	Readmission unrelated to pancreatitis	32 (3.3)	9 (3.3)	1 (1.7)	42 (3.3)	0.788
	Readmission for recurrence of pancreatitis	34 (3.5)	12 (4.4)	1 (1.7)	47 (3.6)	0.558
	Readmission for pancreatitis complication	17 (1.8)	8 (3.0)	5 (8.5)	30 (2.3)	0.003

Values are *n* (%) unless otherwise indicated. i.q.r., interquartile range; ICU, intensive care unit. *Denominator is number of patients with gallstone pancreatitis, who have not previously undergone a cholecystectomy.

In terms of diagnosis, nearly one in five patients did not have a diagnostic raised amylase or lipase level, and were therefore diagnosed using a combination of history and imaging. National UK guidelines mandate that acute pancreatitis be diagnosed within 48 h[2]. Failure to diagnose using blood markers and delays in access to CT scanning may have contributed to not all patients receiving their diagnosis of acute pancreatitis within the first 48 h of presentation. Only eight centres included in this study use serum lipase to diagnose acute pancreatitis. Although there is no single diagnostic test that would prevent imaging being necessary in some patients, serum lipase has advantages over serum amylase, including a higher sensitivity and a larger diagnostic window, potentially reducing the amount of imaging required for diagnosis[14,15]. For this reason lipase is recommended as the blood marker of choice; despite this, the majority of trusts do not have routine access to this test[2].

In line with the current literature, gallstones were the primary aetiology, accounting for over 50 per cent of cases[16]. The number of cases labelled as idiopathic is higher than previously recommended, with the aetiology of pancreatitis still unknown in over 22 per cent of patients 30 days after diagnosis. The use of advanced imaging modalities such as MRCP and endoscopic ultrasound (EUS) is expected to raise proven aetiology to over 80 per cent of cases[2,17]. This data set demonstrates that, despite International Association of Pancreatology (IAP)/American Pancreatic Association (APA) guidelines regarding the need to utilize EUS in patients with idiopathic pancreatitis, EUS remains infrequently utilized in the UK, and, for the small number who it had been requested, there were delays to test (60 per cent of those awaiting EUS had not had their investigation by 30 days from presentation)[8]. Overall, when accounting for death, patients with severe acute pancreatitis had fewer imaging investigations to define aetiology than those in the less severe group. This may reflect a lack of opportunity, or that the search for an aetiology is more likely to be overlooked, when the focus has been taken to organ support.

Contrary to current guidelines, 34 per cent of acute pancreatitis patients were prescribed antibiotics within the first 48 h, a third of which were prescribed prophylactically; this is well before pancreas necrosis is normally identified and other infections will have not yet been confirmed[1,2]. The prophylactic administration of antibiotics when there is no clear source of infection has not been shown to reduce either morbidity rate or death in acute pancreatitis[18]. Indeed, there are concerns that the early use of prophylactic antibiotics may lead to antibiotic-resistant infected pancreatic necrosis and their use should be avoided[19]. It has not been routinely recommended in recent guidance[8]. It is difficult to pick out the subtleties of decision-making in these patients, and whether other factors, such as concerns over potential development of cholangitis, rather than just infected necrosis, may have swayed the decision-making. It is important to note that antibiotics are recommended in severe necrotizing pancreatitis, as this can decrease the risk of infected necrosis, sepsis, or need for surgery. However, use of antibiotics within the first 48 h that this study reflects does not encompass pancreatic necrosis and should be reappraised in further studies[20].

CT scans were performed in over half the patients presenting with pancreatitis. The majority of scans were performed within the first day of admission, suggesting that the focus is on confirming the diagnosis rather than assessing the extent of pancreatitis damage, which is normally not assessable until several days into the disease course[21]. CT scanning for diagnostic purposes was required in around 20 per cent of cases due to the lack of a significant rise in the biochemical markers, but it may call into question the need for a proportion of the other scans still done at this stage, despite adequate ability to

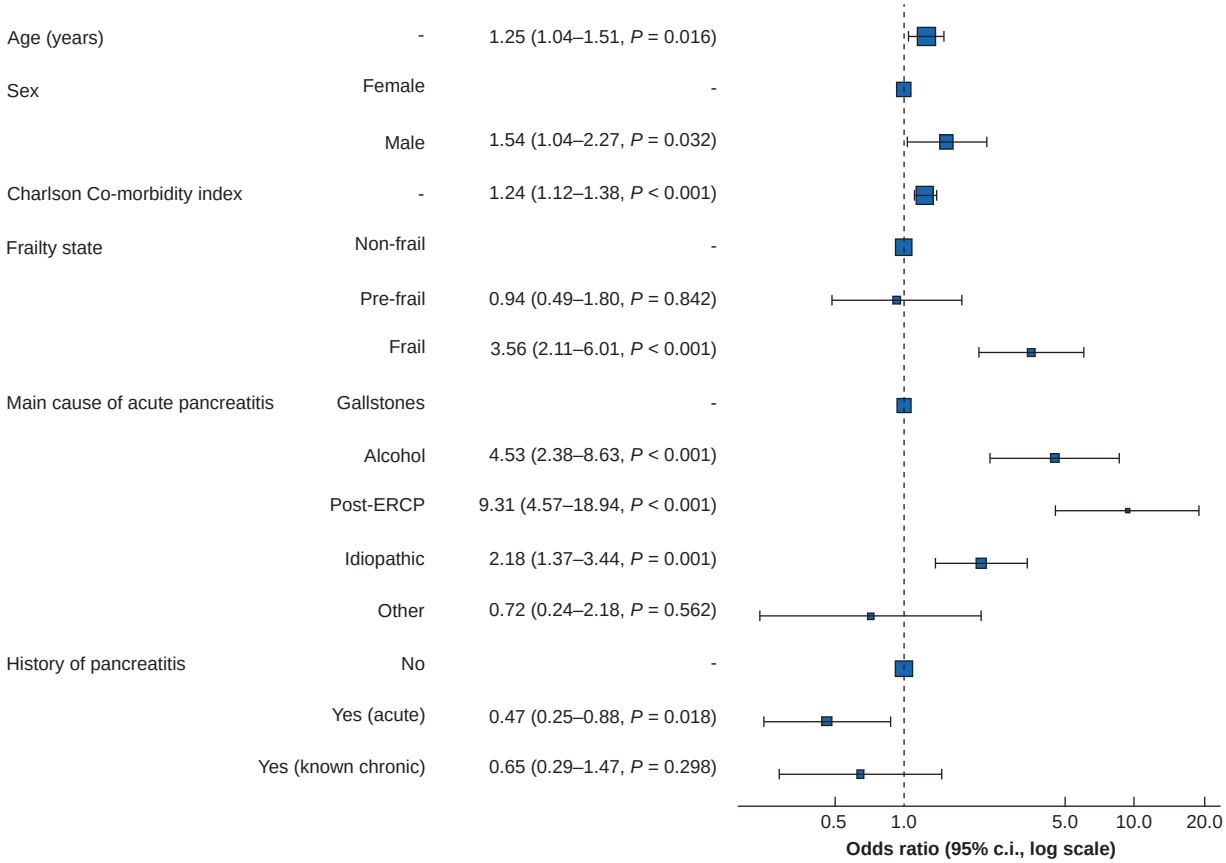

Fig. 1 Multilevel logistic regression model for predictors of death after hospital admission for pancreatitis

ERCP, endoscopic retrograde cholangiopancreatography.

diagnose the patient from history and blood results. Access to early scanning in the emergency department may have led to scans being ordered empirically before biochemical markers were available to guide the diagnosis, leading to the high number of scans requested around admission. This change in practice may either lead to peri-pancreatic complications being missed due to false reassurance of early scans, or an unnecessary radiation dose in patients needing to undergo a repeat scan later in their clinical course.

The vast majority of patients were successfully managed in non-specialist centres, with less than 1 per cent requiring transfer to tertiary centres within the first 30 days. Indications for transfer were not recorded, but other factors such as access to dialysis may have also affected the need to transfer in some cases, rather than specific pancreatitis expertise. The recent NCEPOD (National Confidential Enquiry into Patient Outcome and Death) guidance has suggested that focus should be in strengthening pancreatic networks between specialist centres and surrounding, non-specialist centres; the data suggest only a very small percentage of patients are discussed with tertiary centres, and even less require transfer[22]. This is in keeping with the proportion of patients who have mild or moderate pancreatitis and improve without intervention.

At presentation, several patient factors were identified to be potential predictors of death, including male sex, age, and frailty. Raised BMI, which has been thought to be an indicator of poor prognosis, was not found to affect death in our series. Some studies have reported there may be a paradox, that, despite a worse systemic inflammatory response in this patient group, obesity has not clearly been shown to be an independent indicator of death[23]. Other studies that show death associated with an increased BMI state in their limitations that the complexities of co-morbidities and demographics are not taken into consideration and so cannot conclude if it is an independent risk factor[24].

This study has shown a significantly higher rate of PEP leading to death than other causes of pancreatitis. This is despite the model taking into account this patient group as commonly elderly and frailer than other patient groups. One factor contributing to this may be patients with milder PEP may be either not identified at all, or may be managed under medical teams without referral to surgeons, the teams that commonly manage acute pancreatitis in Great Britain and Ireland (and predominately identifying patients for this study). The overall mortality rate of 12 per cent seen in this paper is higher than previously stated (4.4 per cent), but there has been reported a trend towards increased incidence of PEP over time, despite accepted interventions such as rectal diclofenac to reduce the incidence[25]. Overall, PEP accounted for only just over 2 per cent of cases in this study, so a small difference in mortality rate was magnified by the small sample size, and therefore it would be useful to look at this group more closely in a larger cohort.

With respect to the use of ERCP as definitive treatment for gallstone pancreatitis, there was a small proportion of patients who underwent sphincterotomy in the absence of choledocholithiasis. There is a lack of consensus in the current literature regarding prophylactic sphincterotomy in patients with gallstone pancreatitis in the absence of stones within the

common bile duct[26]. A supporting recommendation is seen in guidance published within the UK two decades ago, and, without a clear consensus to refute this practice, this recommendation is still a common part of definitive management[2]. Conflicting recommendations suggest that sphincterotomy should not be performed in the absence of choledocholithiasis or cholangitis due to the increased risk of the procedure[27,28]. Other studies recommend sphincterotomy as definitive treatment in patients who are deemed unfit for cholecystectomy[29] and as an indication for gallbladder drainage[30].

This study has confirmed that previous episodes of pancreatitis are protective of subsequent severe attacks, with those with a previous attack being half as likely to develop severe pancreatitis compared with those experiencing their first episode[31]. Although this does not mitigate against the fact that all should be done to remove a trigger, where possible, it will be reassuring to patients and clinicians to understand that risks are lower for any subsequent episodes when making decisions on timing of cholecystectomy.

This study is limited by the short follow-up of patients, necessitated by the large amount of data collection over many sites; it is acknowledged that a proportion of patients with severe pancreatitis may die from this acute disease process, and this is not captured by our data set. The primary aim of our study was to collect a snapshot of current practice in acute pancreatitis, and by focusing too closely on the long-term outcomes of the small section of patients with more complex disease, this risked limiting the engagement of hospitals in providing us with good-quality short-term data. The lack of longer follow-up does not provide the true picture of investigations undertaken on those with idiopathic disease, and the extent of interventions on those with cholelithiasis.

In terms of other limitations, data were collected during the COVID pandemic, which may have affected practice in management of patients, especially in the timing of cholecystectomy. It is unclear how the ongoing pressures on health services will affect patient access to care in the years to come, and whether a delay in further investigation and treatment may become more normalized.

Acute pancreatitis has a low 30-day death, which is dramatically higher, up to one in three, in those who require organ support for more than 48 h. Patients who are male, elderly, and living with frailty are likely to have a higher risk of death; those with gallstone pancreatitis or those with previous pancreatitis have a lower death rate. More work needs to be done to understand how variation in practice between clinicians and centres affects patient outcomes.

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REDCap was run by Aditya Borakati and data analysis was performed by Stephen R. Knight. Write up was performed by Angeliki Kosti, Hannah Javanmard-Emamghissi, Stephen R. Knight, Blazej Rybinski, Susan J. Moug, Gillian M. Tierney, Paul Marriott and Marianne Hollyman.

Disclosure

The authors declare no conflict of interest.

Supplementary material

Supplementary material is available at *BJS Open* online.

Data availability

Data sharing requests will be considered by the management group upon written request to the corresponding author.

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