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Case Series

Adherence to the evidence-based guidelines in the management of acute biliary pancreatitis: A case series

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ABSTRACT

BACKGROUND: Acute pancreatitis (AP) is considered one of the most common gastrointestinal disorders; the annual worldwide incidence for AP is 4.9–73.4 cases / 100,000 people and the total mortality rate is 4–8%, increasing to 33% in patients with infected necrosis. This study aims to assess the outcome of providing standardized evidence-based care to patients with acute biliary pancreatitis.
METHODS: Thirty patients diagnosed with acute biliary pancreatitis, were enrolled in this study and managed according to the Japanese guidelines, 2015 with a complementary scope on other recent guidelines.
RESULTS: Out of 30 patients in the study, 60% were females. Twenty-five cases were presented in the early phase of the disease while the rest presented in the late phase. Gallstones were the commonest cause (80%). The complications encountered were a systemic complication in one case, organ failure in three cases, and the local complications in the form of fluid collections in (43.3%) of cases.Out of 30 patients, 6 patients had an intervention. The main approach was minimally invasive techniques (4 cases), Open approach was performed in 2 cases. The total mortality rate was 10%. Most mild cases were discharged within one week from admission. Cases readmitted with recurrent attacks of acute pancreatitis were 3 cases, one male and 2 females.
CONCLUSION: By applying guidelines in the management of acute biliary pancreatitis, we can reduce disease-related morbidity and mortality. Besides, we can reduce the costs of medical services with the proper investment of healthcare resources.

1. Introduction

Acute pancreatitis (AP) is one of the most common gastrointestinal disorders causing emotional and physical human burdens [1]. The annual incidence worldwide for AP is 4.9–73.4 cases per 100,000 people and the overall mortality rate is 4–8%, which increases to 33% in patients with infected necrosis [1,2].

Long-standing alcohol consumption and gallstones disease incriminated in the majority of cases with AP. Small common bile duct stones, in particular, are the cause of acute pancreatitis in approximately 32–40% of cases [2,3]. In 10–30% of cases, the cause of AP is unknown. Many studies have suggested that about 70% of idiopathic pancreatitis are secondary to biliary microlithiasis [4].

The pathogenesis of biliary AP has been intensively investigated. Many theories explain how gallstones can trigger AP. In general, AP occurs when intracellular protective mechanisms fail to prevent trypsinogen activation or reduce trypsin activity [5].

The management of such a potentially life-threatening condition should be guided by an evidence-based approach [2,6]. After comparing the Japanese (JPN) Guidelines 2015 and its former edition 2010 with the other two guidelines, International Association of Pancreatology/American Pancreas Association (IAP/APA), 2013 and American College of Gastroenterology (ACG), 2013, the JPN Guidelines, 2015 has the highest quality according to systematic reviews and meta-analysis studies [7].

This study aims to assess the outcome of providing standardized evidence-based care to all patients with acute biliary pancreatitis during the study period.

Abbreviations: AP, acute pancreatitis; CECT, contrast-enhanced computed tomography; CT, computed tomography; ERCP, endoscopic retrograde cholangiopancreatography; EUS, endoscopic ultrasound; MRCP, magnetic resonant cholangiopancreatography; US, ultrasound.

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Table 1
Japanese severity criteria for acute pancreatitis [59].

Prognostic factors (one point for each factor)	
1.	Base excess ≤−3 mEq/L or shock (systolic blood pressure <80 mmHg)
2.	PaO_2 ≤60 mmHg (room air) or respiratory failure (respiratory assistance needed)
3.	BUN ≥40 mg/dl or (or creatinine ≥2.0 mg/dL) or oliguria (daily urine output <400 mL even after intravenous fluid resuscitation)
4.	LDH ≥ twice upper limit of normal
5.	Platelet count ≤100,000/mm^3
6.	Serum Ca ≤7.5 mg/dL
7.	CRP ≥15 mg/dL
8.	Number of positive measures in SIRS criteria ≥3
9.	Age ≥70 years
Assessment of severity	
If prognostic factor score is ≥3 the acute pancreatitis is evaluated as 'severe'	

1. Measures in SIRS criteria include body temperature >38 or <36 °C, heart rate >90 beats/min, respiratory rate >20 breaths/min or PaCO2 < 32 torr, and white blood cell counts >12,000 cells/mm3, <4000 cells/mm3, or >10% immature (band) forms.
2. BUN blood urea nitrogen, LDH lactate dehydrogenase, CRP C-reactive protein, SIRS systemic inflammatory response syndrome, CT computed tomography.

2. Patient and methods

This is a prospective case series study conducted at the Emergency and Gastrointestinal/Endo-laparoscopic Surgical Units,General Surgery Department, Zagazig University Hospitals (Academic hospital) after obtaining IRB approval in the period from May 2017 to May 2019.This study is registered on Clinical trials.gov (NCT04615702) [8]. This work has been reported following the PROCESS criteria [9].

Thirty patients with a diagnosis of acute biliary pancreatitis, whether presented in the early phase of AP or the late phase of the disease, were enrolled in this study to be managed according to the evidence-based protocols of management of acute biliary pancreatitis after obtaining their informed written consent.

All patients with acute biliary pancreatitis were included in the study while all cases with acute non-biliary pancreatitis were excluded.

Case management based mainly on the Japanese guidelines with a complementary scope of the ACG guidelines, 2013 and the IAP/APA guidelines, 2013. All patients were subjected to the following, confirmation of the diagnosis of AP, diagnosis of the cause either biliary or not, severity scoring, and evidence-based management (Initial management, intervention, prevention of recurrence).

AP was diagnosed when two of three criteria were present including clinical presentation (abdominal pain consistent with acute pancreatitis), laboratory investigations(elevated serumlipase or amylase at least 3 times above the normal limits), and imaging of AP (Ultrasound was done to all cases, CT was done when the diagnosis could not be established based on clinical, laboratory, and ultrasound findings).

On admission, the etiology of AP was determined by detailed history (previous AP, history of biliary colic, alcohol intake, drug intake, known hyperlipidemia, recent trauma, recent intervention such as ERCP, family history of pancreatic disease), Laboratory investigations (bilirubin, ALT, AST, and alkaline phosphatase, calcium, triglycerides). Imaging studies (Ultrasonography for all cases). For idiopathic AP, the imaging protocol was repeating the ultrasonography, endoscopic ultrasound (EUS), and MRCP.

In this study, we adopted the Japanese severity scoring system, 2008 (clinical factors only). The patients had scheduled scoring on admission thenat 24 h, 48 h, and 7 days after admission (Table 1).

A. Initial management

ICU admission for severe cases, our management protocol was implemented in cooperation with the ICU physicians.

Fluid therapy: Ringer lactate solution infusion with the target was the mean arterial pressure of 65 mmHg or more, and urine output of 0.5 ml/kg per hour or more. When these parameters were achieved, the infusion rate decreased to the level that maintains these parameters. For patients with unstable circulation, colloid solution infusion, and catecholamine administration were considered in the ICU guided by CVP.

Nasogastric tube for patients with vomiting and/or paralytic ileus.

Pain control (modified WHO analgesic ladder)

Step1: NSAID/paracetamol, paracetamol 1gm IV infusion/8 h + Diclofenac sodium 75 mg /6 h.

Step 2: Opiates, +/- NSAID/paracetamol, pethidine 25 mg IV/4 h

Step 3: For severe pain not responding to the above analgesia, Interventional treatment (epidural analgesia in the ICU) +/- opiates +/- NSAID/paracetamol.

Nutritional support

- Mild cases: Oral feeding started after the subsidence of abdominal pain and the decline of the serum pancreatic enzyme level. A fat-free solid diet was encouraged from the start
- Severe cases:

When there were no intestinal complications, polymeric feeding formula was delivered through a nasogastric tube. Total caloric requirements were calculated according to body weight (kg) X 30Kcal/day.

Total parenteral nutrition (TPN) was prescribed for patients when the enteral route cannot betolerated and nutritional support is required.

Antibiotics

- Prophylactic:There was no antibiotic prophylaxis for mild cases. For severe attacks, antibiotic prophylaxis was administered to cases presented early within 72 h of disease onset for a period not more than 2 weeks carbapenems ± metronidazole were used.
- Therapeutic (in cases with pancreatic or extrapancreatic infections): In the case of pancreatic infection, carbapenems ± metronidazole were given empirically.

B. Intervention

The timing for intervention varied according to the hemodynamic stability of the patients. For hemodynamically unstable patients, urgent intervention was the role, while delayed after 4 weeks of the initial presentation until the collection became walled off in hemodynamically stable patients.

Before the intervention, all patients were admitted to ICU care for sepsis. Antibiotics in the form of carbapenems were given. Correction of the coagulation profile was done.

Minimally invasive techniques (percutaneous catheter drainage, endoscopic approach, orretroperitoneal approach) were the main management strategy.Open surgery was reserved for patients for whom the minimally invasive techniques failed. PCD was done by a consultant radiologist with 15 years of experience. Other procedures were done by a consultant of general surgery with 15 years of experience. The success of the techniques was assessed based on clinical, laboratory, and radiological data.

C. Prevention of recurrence

For mild attack, after the resolution of the attack and the patients had normal bilirubin level, laparoscopic cholecystectomy with intraoperative cholangiogram were performed if the patient fit and

Table 2
Demographic distribution and diagnosis of acute biliary pancreatitis in this study.

Gender distribution				
Male	12 (40%)			
Female	18 (60%)			
Age				
Minimum	19			
Maximum	72			
Mean±SD	36.2±15.9			
Causes of biliary pancreatitis				
Gallstones	24/30 (80%)			
Post ERCP pancreatitis	4/30 (13.3%)			
Periampullary cancer	1/30 (3.33%)			
Duodenal diverticulum	1/30 (3.33%)			
Diagnosis of acute pancreatitis				
Phase	**Finding**		**No.**	**%**
Early Phase (< 4w)	Typical pain of AP		25/25	(100%)
	Lipase/Amylase “triple the normal value”		22/25	(88%)
25 cases (83.33%)	US signs of AP		5/25	(20%)
	CT to confirm the diagnosis		3/25	(12%)
	CT done before admission without our request		5/25	(20%)
Late phase (□ 4w)	History of acute pancreatitis		5/5	(100%)
5 Cases (16.66%)	Clinica	Epigastric discomfort related to meals	3/5	(60%)
		Recurrent attacks of vomiting	1/5	(20%)
		Both	1/5	(20%)
	CT diagnosis of Pseudocyst		2/5	(40%)
	CT diagnosis of WON		3/5	(60%)
Diagnosis of gallstones (24 cases)	**No.**			**%**
History of biliary colic	21/24			(87.5%)
Direct hyperbilirubinemia	15/24			(62.5%)
ALT >150 U/L	2/24			(8.3%)
US evidence of gallstones 23/24 cases (95.8%)	Gall bladder stones		17/24	(70.8%)
	Biliary mud		4/24	(16.7%)
	CBD stones		2/24	(8.3%)

willing. Endoscopic sphincterotomy was offered for patients who refuse laparoscopic cholecystectomy.

For severe attack, cholecystectomy was postponed for at least 6 weeks following the attack.

3. Results

From May 2017 to May 2019, thirty patients with a diagnosis of acute biliary pancreatitis were managed at Zagazig University Hospitals. There were 12 (40%) males and 18 (60%) females. The patients' age ranged from 19 to 72 years with a mean age of 36.2 ± 15.9 years (Table 2).

In this study, there were 25 (83.33%) patients presented at the early phase of AP. All patients in the early phase of AP had typical pain. Elevated lipase/amylase, triple the normal value, was found in 22/25 (88%) patients. Ultrasonographic signs of AP were found only in 5/25 (20%) patients. CT was done for 8 patients; for 3 (12%) to confirm the diagnosis and 5 (20%) patients had CT before hospital admission (Table 2).

There were 5 (16.66%) patients presented at the late phase of AP. All these patients 5/5 (100%) gave a history of AP.Three patients presented with epigastric discomfort related to meals. One patient presented with repeated vomiting and another patient presented with both epigastric discomfort and repeated vomiting. CT was done to all cases presented at the late phase, 2/5 (40%) had pancreatic pseudocyst and 3/5 (60%) had walled-off necrosis (Table 2).

In this study, the commonest cause of acute biliary pancreatitis was gallstones 24/30 (80%). Four patients (13.3%) had post-ERCP pancreatitis. One patient was diagnosed with periampullary carcinoma. One patient was diagnosed with duodenal diverticulum (Table 2).

Classification of AP according to Type, phase, and complications was based on the Revised Atlanta classification of AP, 2013. Risk stratification was based on the JPN severity scoring system (prognostic factors) where severe pancreatitis scores 3 or more. In this study, CT was done for 16/30 (53.3%) patients of whom 7 patients had interstitial pancreatitis and 9 patients had necrotizing pancreatitis (Table 3).

The complications encountered in this study, the systemic complication in the form of exacerbation of bronchial asthma occurred in one case (3.3%), organ failure was evident in three cases (10%) and local complications in the form of fluid collection were detected in 13 (43.3%) of cases (Table 3).

All severe cases were admitted to the ICU (5 patients). Regarding the analgesia, all cases were administered (NSAID/paracetamol) as a 1st step in the modified WHO stepladder protocol followed by the addition of opiates as a 2nd step. Only one case required epidural analgesia. Antibiotic prophylaxis was only considered in cases with sterile necrosis that were admitted within 72 h from the start of the attack (2 cases).

Regarding the nutritional support, early oral intake within the 1st week of admission was administered in (72%) of mild cases, intolerance to oral intake was documented in 2 cases with delay in oral feeding beyond 1 week from admission. In severe cases, 4 cases had enteral nutrition through a nasogastric tube in a continuous feeding pattern, only one case had TPN where enteral nutrition can notbe tolerated and nutritional support was required (Table 4).

Out of 30 patients admitted with acute biliary pancreatitis 6 (20%) patients had an intervention. The main approach for intervention was minimally invasive techniques, open approach was performed in one case with infected necrosis and one case with pseudocyst.Out of five cases that were diagnosed with infected necrosis, only 4 cases had an intervention. In all cases we adopted the step-up approach as the 1st line of treatment; 3 cases were managed early by PCD as a 1st step while the last case was managed by 2 sets of interventional aspiration (EUS then US-guided aspiration). A 2nd step was required in 2 cases, open necrozectomy in one case, and retroperitoneal necrosectomy in the other case. The complications related to different methods of intervention in infected necrosis included pancreatic fistula following retroperitoneal necrozectomy and wound infection, pancreatic fistula, and multiorgan failure following open necrozectomy (Table 4).

Table 3
classification of AP according to phase, type, severity and complications.

Phase			No.	%
Early (less than 4 weeks)			25/30	(83.3%)
Late (more than 4 weeks)			5/30	(16.7%)
Type			No.	%
Interstitial edematous pancreatitis			7/30	(23.3%)
Necrotizing pancreatitis			9/30	(30%)
CT not done			14/30	(46.6%)
Risk stratification of early cases (JPN severity scoring system)			No.	%
Mild			20/25	(80%)
Severe			5/25	(20%)
Complication	Finding		No.	% of total no of cases (30 cases)
Organ failure (3 cases)	Respiratory		2	(6.66%)
	Renal		1	(3.33%)
	Circulatory		3	(10%)
Systemic (one case)	Persistent organ failure		3	(10%)
	Exacerbation of bronchial asthma		1	(3.33%)
	APFC		2	(6.66%)
Local(13 cases)	Pseudocyst		2	(6.66%)
	ANC	Sterile	4	(13.33%)
		Infected	1	(3.33%)
	WON	Sterile	–	–
		Infected	4	(13.33%)

The overall mortality rate was 10%. All diagnosed cases with necrotizing pancreatitis. All cases died because of persistent organ failure (Table 5).

The majority of the mild cases were discharged within one week from admission while the majority of severe cases were hospitalized for more than 2 weeks (Table 5).

Gallstone induced pancreatitis was evident in 24 cases. Prevention of recurrence was considered only in 10 cases after exclusion of late cases (5 cases), deaths (3 cases), and cases that were not reachable for follow up (6 cases). Three patients were managed by index cholecystectomy, 5 patients had interval cholecystectomy and one patient was managed by ERCP and endoscopic sphincterotomy. One patient refused intervention (Tables 2, Table 66).

Cases readmitted with recurrent attacks of AP were 3 cases (10%) with male to female ratio of 1:2. Single recurrence was evident in one case while multiple recurrent attacks were documented in the other 2 cases. Special situations related to the multiple attacks were recognized in the 2 cases where the risk factor was pregnancy (Table 6).

4. Discussion

Several trends in the management of acute pancreatitis, especially the severe form, had emerged and changed our clinical practices; early enteral feeding, selective role of prophylactic antibiotics, avoiding surgery in patients with sterile necrosis, more conservative approach to infected necrosis with delayed intervention, whether endoscopic or surgical management of biliary pancreatitis [10].

Out of 30 patients included in this study, 18 cases (60%) were females. Female predominance was also reported in a study by **Reid et al.** [11]**, 2017** (female were 76.9%), and **Nesvaderani et al.** [6]**, 2015** (females were 50.4%). Male predominance was reported in other studies such as **Nagarjuna and Prasad** [12], 2016 (males were 55%), **Krishna et al.** [13]**, 2017** (Males were 52.19). This can be explained by the rising incidence of biliary disease among females in our community.

Patients' age in this study ranged from 19 to 72 years. The mean age was 36.2 years with the majority of cases in the age group of 21–40 years (40%). The mean age of the study population of 36.2 years appears significantly lower when compared to other studies in which the mean age was in the sixth decade **Nagarjuna and Prasad** [12]**, 2016, O'Farrell** et al., [14]**, 2007 and Francisco et al.** [15]**, 2013**. A possible explanation of the lower age in this study is the ethnic disparity, the differences in food habits, and that chronic calcular cholecystitis is more common in this age group in our locality.

Twenty-five patients were presented in the early phase of AP. The typical pain of AP was evident in 100% of cases. In a study by **Phillip et al., 2013** and **Reid et al., 2017**, characteristic abdominal pain of AP was reported in, 97% and 79.1% respectively [11,16]. **Kiriyama et al., 2009,** reported that more than 90% of patients with AP complain of characteristic abdominal pain [17].

In this study, 3/25 cases (12%) showed normal levels of pancreatic enzymes (lipase/amylase) while the level in the other 22/25 cases (88%) fulfilled the criteria for the diagnosis of AP. **Cartier et al., 2006**, **Mayersakand et al, 1997**, and **Shah et al., 2010** reported normal serum lipase in their studies with the number of reported cases in each study, one case, 2 cases, and 3 cases respectively. These studies diagnosed AP based on clinical suspicion and CT findings. Multiple factors may contribute to the absence of increased enzymatic levels on admission [18–20]. Normal serum enzymatic level may be contributed to either the inability of the inflamed pancreas to produce lipase/amylase or return of enzyme level to normal before hospitalization [21].

In this study, US signs of AP in the early phase were only evident in 5/25 cases (20%). In other studies such as **Bhatt et al., 2017** and **Panda et al., 2017**, **Lalith and Ilangovan, 2019,** US signs of AP were detected in 52%, 80%, and 88% of cases respectively. The wide variation in results can be explained by the obscured vision of the pancreas by the overlying bowel gas and the operator's expertise and on the refinement of the equipment [22–24]. Regarding CT use for diagnosis in this study, it was done in 8/25 cases (32%) presented in the early phase of AP. CT signs of AP in the eight cases (100%) were evident. This finding was consistent with the results of other studies such as **Randenand et al., 2011** and **Lalith and Ilangovan, 2019,** which were 88% and 100% respectively [24,25].

In this study, five cases were presented in the late phase of AP. CT scan was done for all cases. The CT diagnosis and differentiation between pseudocyst and WON was accurate in all cases, which was confirmed following later intervention. In a study implemented by **Takahashi et al., 2008,** differentiation of WON from pancreatic pseudocyst by CT criteria was possible in 79.5–83.6% [26].

The most common cause of AP in this study was gallstones 24/30 (80%). Many studies matched this study where gallstones as the cause of AP were more prevalent [6,27–29]. Post-ERCP pancreatitis in this study was 4/30 (13.3%) which is high if compared to other studies where it represents less than 4% of cases [6,30,31].

Table 4
Management of cases with acute biliary pancreatitis in this study.

Basic management in early cases of acute pancreatitis 25 patients					
ICU admission			5/25 cases (20%)		
Analgesia			**Mild** (20/25 cases)		**Severe** (5/25 cases)
- Start with 1st step (NSAID/paracetamol)			20/20 (100%)		5/5(100%)
- Shift to 2nd step (add opiates)			20/20 (100%)		5/5(100%)
- Shift to third step (epidural analgesia)			-		1/5(20%)
Antibiotics administration		-			
Mild attack		-			
	Severe attack	Sterile pancreatic necrosis [< 72 hrs. from initial presentation]			2 patients
		Infected pancreatic necrosis		1	
Nutrition					
Mild cases (20 patients)		**Oral**	**Early oral** (within one week from admission)		18/25 (72%)
			Delayed oral (beyond 1 week from admission)	2(8%)	
		Persistent pain	Intolerance to oral feeding		
		-	2		
Severe cases (5 patients)			**Enteral nutrition**		4(16%)
	Formula		Polymeric formula	4(100%)	
	Route		Nasogastric tube	4(100%)	
	Pattern		Infusion	4(100%)	
	Parenteral nutrition (TPN)			1(4%)	
Interventional management					
Diagnosis		**Method of intervention**			**No.**
Infected necrosis (5 cases)		PCD alone			1
	Percutanous+EUS guided aspiration			1	
	PCD+Retroperitonealnecrozectomy			1	
	Open necrozectomy			1	
Pancreatic pseudocyst (2 cases)		Open drainage			1
	EUS guided drainage to stomach			1	

Complications related to different methods of intervention in infected necrosis

Approach	**Total no.**	**Local complications**				**Organ failure**
		Hemorrhage	**Wound infection**	**Enteric fistula**	**Pancreatic fistula**	
PCD	3	-	-	-	-	-
Endoscopic*	**1**	-	-	-	-	-
Retroperitoneal approach	**1**	-	-	-	1case	-
	1	-	**1 case**	-	1case	1case

* EUS guided aspiration.

Table 5
Mortality and length of hospital stay.

Risk factors for mortality		
Mortality in relation to age		
1st case	58 year	
2nd case	71 year	
3rd case	68 year	
Cause of pancreatitis	**No.**	
Gallstones	3 cases	
Others	-	
Type of pancreatitis	**No.**	
IEP	-	
Necrotizing pancreatitis	3cases	
Complications	**No.**	
Infected pancreatic necrosis	2 cases	
MOD	2 cases	
Persistent organ failure	3 cases	
Intervention	**No.**	
Open necrosectomy	1 case	
Minimally invasive	-	
No intervention	2 cases	
Length of hospital stay No. %		
Length of hospital stayin mild cases		
<1 week	18	(90%)
1–2 weeks	2	(10%)
>2weeks	-	-
Length of hospital stayin severe cases		
<1 week	-	-
1–2 weeks	1	(20%)
>2weeks	4	(80%)

In this work, the history of biliary colic was evident in 21/24 (87.5%) of gallstone cases. Direct hyperbilirubinemia in 15/24 (62.5%), ALT > 150 IU/L was detected in 2/24 (8.3%) with US evidence of cholelithiasis in 23/24 (95.8%) of cases. It was reported ALT level >150 U/L within 48 h after onset of symptoms can diagnose biliary pancreatitis with a high positive predictive value exceeding 85% [32]. In a study by **Agarwal et al., 1990**, the specificity of a serum ALT level of more than 150 IU/L in the diagnosis of gallstone-induced pancreatitis was 96% but with low sensitivity, only 48% [33]. It was reported that the sensitivity and specificity of the US in the diagnosis of gallstones more than 2 mm is greater than 95% [34–36].

Inthis study, the severe cases were 5/25 (20%). This incidence was higher than the published figure by **Anand et al., 2012**, 15% [37]. In a study by **Reid and his colleagues, 2017,** the severe cases represented 12.2% [11].

In this research, local complications, defined as the presence of APFC, pancreatic pseudocyst, ANC, and WON were observed in 13/30 (43.3%) of cases based on the findings of US and CT. Pancreatic necrosis was evident in 9/30 (30%) of patients. Organ failure occurred in 3/30 (10%) of patients; respiratory 2 patients, renal 1 patient, and 3 patients with circulatory failure. **Turkvatan et al., 2015**, reported that APFC and pseudocyst developed in 30–50% and 10–20% of cases with AP respectively, while the incidence of pancreatic infection was 60% of cases with above 3 weeks hospital stay [38]. In a study by **Reid et al., 2017**, local complications were observed in 25% of cases, pancreatic necrosis occurred in 15% of cases and organ failure occurred in 22% of cases with respiratory failure (66.7%) and renal failure (14.3%) [11].

The Basic initial treatment was implemented based mainly on the Japanese guidelines with a complementary scope of the ACG guidelines, 2013 and the IAP/APA guidelines, 2013. It should be noted that most of the recommendations of the three guidelines were in line with each other, the main differences were in the protocol of antibiotic prophylaxis in severe cases and the scoring system used for risk stratification.

Numerous studies were done discussing antibiotic prophylaxis in severe AP, the results were not consistent. The JPN guidelines stated that the mortality rate and infectious complications in severe cases were significantly reduced when antibiotic prophylaxis was administered within 72 h of disease onset. The ACG and the IAP/APA guidelines don't support the routine use of antibiotic prophylaxis in AP [39,40].

All patients with mild or severe attacks had a combination of opiates and NSAIDs for analgesia with one case required epidural analgesia. Despite many randomized controlled trials (RCTs), uncertainty about the preferred analgesic, and the best method of administration still exists [41]. A systematic review conducted by **Meng et al., 2013**, involving 8 randomized controlled trials with a total of 356 patients, comparing different analgesics reported that the results were of low quality and did not favor any particular analgesic for pain relief in acute pancreatitis [42]. The three guidelines didn't emphasize certain analgesia for pain relief as well and so, we adopted the modified WHO analgesic ladder [43].

Regarding nutritional support, 4/5 patients (80%) with severe attack received enteral nutrition, polymeric formula through a nasogastric tube. One case received TPN. A meta-analysis including 20 RCTs concluded that there is no specific type of enteral nutrition that improves outcomes in AP. The relatively inexpensive polymeric feeding formulations were comparable to the more expensive (semi) elemental in terms of food tolerance and benefit in reducing the risks of infectious complications and mortality [44]. Two RCTs have suggested that nasogastric tube feeding is feasible and safe [45,46].

In this study, two cases were admitted with a pancreatic pseudocyst. One case was managed by EUS guided drainage after a failed trial of non-EUS guided drainage and one case was managed by open drainage. No complications related to the endoscopic or surgical drainage were encountered.

Table 6
Prevention of recurrence and recurrence of acute biliary pancreatitis in this study.

	Procedure	No.	%
Prevention of recurrence (10 cases)	Index Cholecystectomy	3	(30%)
	Interval Cholecystectomy	5	(50%)
	Refused Cholecystectomy	1	(10%)
	ERCP&ES	1	(10%)
	Gender		
	Male	1	
	Female	2	
	Cause of pancreatitis		
Recurrence of acute biliary pancreatitis (3 cases)	Gallstones	2	
	Others (duodenal diverticulum)	1	
	No. of attacks		
	Single attack of recurrence	1	
	More than one recurrent attack	2	
	Risk factor related to multiple recurrence		
	Absent	1	
	Present (pregnancy)	2	

In this work, 5 cases were diagnosed with infected necrosis. Only 4 cases had an intervention and the 5th case deteriorated rapidly and died from multiorgan failure before any intervention except for inaccessible PCD. In all cases, step up approach was applied; 3 cases were managed early by PCD as a 1st step while the last case was managed by 2 sets of interventional aspiration. Of these three cases, one case didn't require any other intervention while the other two cases required further intervention, one case had open necrozectomy and the other one had retroperitoneal necrosectomy, as a 2nd step.

It was reported that PCD alone can prevent up to 50% of necrozectomies in patients with infected necrosis [47–50].

In this research, One case was managed with a retroperitoneal approach. Regarding the post-procedural complications, pancreatic fistula developed and resolved spontaneously after 6 months. **Brunschot et al., 2013**, compared many studies describing the retroperitoneal necrozectomy and reported that the overall success rate with retroperitoneal necrozectomy alone was 61% [51].

In this study, one case had open necrozectomy after failed PCD. The preoperative CT study showed multiple abdominal collections. The case was old (71 years) with a history of transient renal failure following the onset of the attack. Following open necrozectomy, the patient suffered many complications ended by interactable chest infection then multiorgan failure and died. In a study by **Bausch et al., 2012**, it was reported that the mortality rate following open necrozectomy was 60% [52].

In this research, 90% of cases were discharged within the 1st week following admission. The delay (2 cases) was attributed to intolerance to oral feeding in these patients; one patient had a history of peptic ulcer and the other was pregnant.

Index cholecystectomy is appropriate and safe and does not increase the length of the hospital stay [53]. The three guidelines indicate index cholecystectomy in mild cases with acute gallstone induced pancreatitis. In this study, 24 cases were diagnosed with acute gallstone induced pancreatitis. Prevention of recurrence was considered only in 10 cases after exclusion of late cases (5 cases), deaths (3 cases), and cases that were not reachable for follow up (6 cases). Only 3 cases had an index cholecystectomy. This can be attributed to patient special circumstances such as unfitness for surgical intervention, pregnancy, and patient preference.

There were three deaths in the current study with an overall mortality rate of 10%. One case with sterile necrotizing pancreatitis that developed ARDS. Multiorgan failure with evident infected necrosis was the cause of death in the other 2 cases. One of them died after open necrozectomy and the other died before any successful intervention. The common risk factor in the three cases was the advanced age (more than 55), pancreatic necrosis, and severe attack. A prospective study by **Popa et al., 2016** over 4 years involving 238 patients with AP reported 21.1% overall mortality rate [54]. Another retrospective study by **Carnovaleand et al., 2005**, involving 1135 patients with AP over 16 years reported 4.8% overall mortality rate [55].

In our work, out of three cases that were readmitted with recurrent attacks of acute biliary pancreatitis, there were two pregnant females. The 1 st admission for the 2 cases was in the 1 st trimester of pregnancy. One case was diagnosed with gallstone induced pancreatitis. All attacks were mild in severity and managed conservatively and both patients had uneventful delivery. Pancreatitis is considered a rare event in pregnancy, estimated to occur in 3 in 10,000 pregnancies [56]. AP usually manifests in the 3rd trimester of pregnancy [57]. With conservative treatment, pregnant females with gallstone induced pancreatitis appear to have a high recurrence rate. Index cholecystectomy is appropriate and safe and does not increase the length of hospital stay [53]. Cholecystectomy is indicated in the 2nd trimester as organogenesis is complete. Laparoscopic cholecystectomy has good efficacy and low rate of preterm delivery [58].

5. Conclusion

By applying guidelines in the management of acute biliary pancreatitis, we can reduce disease-related morbidity and mortality. Besides, we can reduce the costs of medical services with proper investment of the effort of healthcare providers; the application of the guidelines helped us to avoid the unnecessary use of healthcare resources such as CT study for the diagnosis of AP in all cases, the administration of the prophylactic antibiotic and resolve the conflicts regarding early oral feeding and index cholecystectomy in mild cases.

The recent tools used in the diagnosis of local complications helped us in early detection and adequate management of cases with necrotizing pancreatitis and its sequelae.

The introduction of minimally invasive techniques in the management of cases with acute pancreatitis such as pseudocyst or necrotizing pancreatitis gave encouraging results with minimal complications.

6. Limitations and recommendations

The major limitation of this study was the resistance to implement the guidelines instead of the deeply rooted old-fashioned thoughts regarding the management of cases with acute pancreatitis (e.g. the regular use of prophylactic antibiotics, delay of enteral nutrition, and the fear of index cholecystectomy). We insisted on applying the guidelines supported by the authority of general surgery council. Another limitation of this study is that it was conducted in a single center. As the ZUH is a tertiary institution, there might have been referral bias influencing the incidence and severity.

We are in the era of evidence-based medicine with the emergence of minimally invasive techniques. it is recommended to apply the guidelines in different surgical centers throughout Egypt for better patient outcomes. Regional multicentre, prospective studies are also recommended to expand the knowledge gained from the guidelines.As we are emphasizing gallstones as the main etiology of acute pancreatitis in this study, we should manage gallstones early to avoid the recurrence of acute gallstone induced pancreatitis.

Declaration of competing interest

No conflict of interest.

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Ethical approval

Permissions were obtained from Institutional Review Board at Faculty of Medicine, Zagazig University hospitals

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Consent

Written informed consent was obtained from the patients for publication of this case series and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on reasonable request.

Author contribution

Yasmine Hegab: Conceptualization, Methodology, Software, writing - Reviewing and Editing. **Yasser Orban:** Data curation, Writing - Original draft preparation, Reviewing and Editing. **Ahmed Osama:** Visualization, Investigation. **Joseph Awad:** Supervision. **Abd-Elrahman M. Metwalli**: Software, Validation and Supervision.

Registration of research studies

Clinical trial.gov, NCT04615702 available at: https://clinicaltrials.gov/ct2/show/NCT04615702

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