Original Article

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Radiology Section

Association of Pancreatic Pseudocysts and Walled-off Necrosis with Clinical Characteristics and Management in Acute Pancreatitis: A Prospective Analytical Study

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ABSTRACT

Introduction: Acute Pancreatitis (AP) is a common inflammatory condition with a clinical spectrum ranging from mild self-limiting disease to severe necrotising pancreatitis associated with significant morbidity and mortality. Early assessment of disease severity is essential for appropriate management and prognostication. Contrast-Enhanced Computed Tomography (CECT) plays a crucial role in evaluating pancreatic necrosis, peripancreatic changes, and local complications.

Aim: To evaluate the association of pancreatic pseudocysts and Walled-off Necrosis (WON) with clinical characteristics and management in patients with AP using CECT.

Materials and Methods: A hospital-based prospective analytical study was conducted in the Department of Radiology, Dr. Pinnamaneni Siddhartha Institute of Medical Sciences and Research Foundation, Andhra Pradesh, India, from April 2024 to January 2026. A total of 50 consecutive patients with AP who underwent CECT were included. Pancreatic and peripancreatic fluid collections were classified according to the 2012 Revised Atlanta Classification. Demographic, and outcome data were collected, and associations between the type of fluid collection and clinical characteristics, management, hospital stay, organ failure, and mortality were analysed using appropriate statistical tests.

Results: Among 50 patients with AP, 41 (82%) were males, and the 41-50 years age group constituted the largest proportion (32%). Alcohol was the most common aetiology (58%). Pseudocyst was the most frequent fluid collection (58%), while WON was observed in 42% of patients. Moderate and severe pancreatitis was present in 52% and 48% of patients, respectively. A significant association was observed between the type of pancreatic fluid collection and management approach (p-value=0.0449). However, no significant association was found between the type of fluid collection and hospital stay, organ failure, mortality, Modified Computed Tomography Severity Index (MCTSI) score, infection, gender, or aetiology (p-value >0.05).

Conclusion: CECT-based assessment using the Revised Atlanta Classification demonstrated a significant association between the type of pancreatic fluid collection and the management approach in the current study.

Keywords: Acute necrotic collections, Acute pancreatic fluid collections, Modified computed tomography severity index, Revised Atlanta classification

INTRODUCTION

The AP is a common inflammatory disorder with a variable clinical course, ranging from mild self-limiting pancreatic inflammation to severe disease associated with pancreatic necrosis, local complications, multiorgan failure, and increased mortality [1]. An exaggerated Systemic Inflammatory Response Syndrome (SIRS) with subsequent organ dysfunction is considered a major contributor to morbidity and mortality in severe AP [2]. Pancreatic and peripancreatic fluid collections are important local complications of AP and significantly impact clinical management and outcomes. The characteristics, timing, and evolution of these collections determine their clinical significance and need for intervention. Accurate identification and classification of these collections are therefore essential for appropriate treatment planning [1]. The 2012 Revised Atlanta Classification provides a standardised approach for defining pancreatic fluid collections based on their content, the presence of necrosis, encapsulation, and time course of evolution. It categorises collections into Acute Peripancreatic Fluid Collections (APFC), pancreatic pseudocysts, Acute Necrotic Collections (ANC), and WON. This classification has improved the uniformity of radiological reporting and clinical decision-making in patients with AP [1,3].

Although previous study has evaluated the prognostic significance of pancreatic fluid collections according to the Revised Atlanta Classification, evidence correlating specific collection types with clinical characteristics and management remains limited, particularly in Indian populations [4]. Therefore, the present study aimed to evaluate the association of pancreatic pseudocysts and WON with clinical characteristics and management in patients with AP using CECT.

MATERIALS AND METHODS

A prospective analytical study was conducted in the Department of Radiology, Dr. Pinnamaneni Siddhartha Institute of Medical Sciences and Research Foundation, Chinna Avutapalli, Vijayawada, Andhra Pradesh, India, from April 2024 to January 2026. Prior approval for conducting the study was obtained from the Institutional Ethics Committee (IEC) (994/24).

Patients were selected using a consecutive sampling method. All consecutive patients who fulfilled the eligibility criteria were included. A total of 50 patients were enrolled.

Inclusion criteria: Patients admitted with a clinical diagnosis of AP, male and female patients undergoing CECT abdomen, patients showing imaging features of AP with associated pancreatic or peripancreatic fluid collections on CECT were included in the study.

Exclusion criteria: Patients who did not provide informed consent, patients with contraindications to iodinated contrast administration, including:

- History of significant contrast allergy;
- Renal impairment with elevated serum creatinine levels where dialysis support was not feasible.

Patients in whom CECT abdomen could not be performed due to other contraindications were excluded from the study.

Study Procedure

CECT abdomen images were reviewed by radiologists, and relevant imaging findings were recorded using a structured data collection proforma. All CECT abdomen images were interpreted by a single radiologist with a minimum of three years of experience.

Contrast-Enhanced Computed Tomography (CECT) protocol: CECT was performed using a 128-slice multidetector CT scanner. A non-ionic iodinated contrast agent (350-370 mg iodine/mL) was administered intravenously at a dose of 1.5 mL/kg (maximum 120 mL) using a power injector at 3-5 mL/s, followed by a 30-40 mL saline flush. Images were acquired during the pancreatic parenchymal phase (35-40 seconds) and portal venous phase (70-80 seconds) after contrast administration. Axial images were reconstructed at a slice thickness of 1-1.25 mm, with coronal and sagittal multiplanar reformations. The CECT was performed at least 72 hours after symptom onset, whenever clinically feasible. Pancreatic necrosis was defined as non-enhancing pancreatic parenchyma on contrast-enhanced images and was categorised as involving <30%, 30-50%, or >50% of the gland. Pancreatic and peripancreatic fluid collections were classified according to the Revised Atlanta Classification (2012) [1]. The size of pancreatic and peripancreatic fluid collections was measured on CECT images using the largest maximum diameter in any plane (axial, coronal, or sagittal multiplanar reconstruction). Measurements were recorded in centimeters, and the largest dimension was considered for analysis.

Assessment of disease severity: The severity of AP was assessed using MCTSI. Based on the total score, AP was categorised as mild (0-2), moderate (4-6), or severe (8-10). The MCTSI was calculated for each patient using the CECT findings [5].

Operational Definitions and Management Criteria

Infection: Infection of pancreatic/peripancreatic collections was defined by clinical deterioration, fever, leucocytosis, elevated inflammatory markers, positive culture results when available, or the presence of gas within collections on CECT.

Organ failure: Organ failure was defined according to the Revised Atlanta Classification (2012) as a modified Marshall score ≥2 for respiratory, cardiovascular, or renal dysfunction. Persistent organ failure was defined as lasting >48 hours [1].

Management criteria: Conservative management included supportive care for sterile, asymptomatic collections without complications. Interventional management was considered for infected or symptomatic collections, persistent organ failure, sepsis, obstruction, bleeding, or failure of conservative treatment. Interventions included percutaneous drainage, endoscopic drainage, or surgical management as clinically indicated.

STATISTICAL ANALYSIS

Data were analysed using Microsoft Excel and statistical software called Epi Info version 7.2.6. Continuous variables were expressed as mean±standard deviation. Categorical variables were expressed as frequencies and percentages. The association between categorical variables was assessed using the Chi-square test. Continuous variables were compared using the independent t-test. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 50 patients with AP were included. The majority were males (82%), with the highest proportion in the 41-50 year age group (32%). Alcohol was the most common aetiology (58%). Pseudocyst was the predominant fluid collection (58%), while WON was observed in 42% of patients [Table/Fig-1].

Variable	n (%)/Mean±SD
Age (years)	
<40	5 (10.0)
41-50	16 (32.0)
51-60	14 (28.0)
61-70	10 (20.0)
>70	5 (10.0)
Gender	
Male	41 (82.0)
Female	9 (18.0)
Aetiology	
Alcohol	29 (58.0)
Gallstones	5 (10.0)
Iatrogenic	2 (4.0)
Idiopathic	11 (22.0)
Trauma	3 (6.0)
Type of collection	
Pseudocyst	29 (58.0)
Walled-Off Necrosis (WON)	21 (42.0)
MCTSI severity	
Moderate	26 (52.0)
Severe	24 (48.0)
Infection present	21 (42.0)
Organ failure	7 (14.0)
Mortality	6 (12.0)
ICU stay (days)	
0	4 (8.0)
1	21 (42.0)
2	14 (28.0)
3	11 (22.0)
Collection size (cm)	2.52±0.46

[Table/Fig-1]: Demographic and clinical characteristics of the study participants.

There was no statistically significant association between the type of pancreatic fluid collection (pseudocyst vs WON) and gender (p=0.3629), alcohol use (p-value=0.4933), aetiology (p-value=0.6087), MCTSI severity (p-value=0.9634), or infection (p-value=0.2057) [Table/Fig-2].

Variable	Pseudocyst (n=29)	WON (n=21)	p-value
Gender			
Male	25 (86.2%)	16 (76.2%)	**0.3629**
Female	4 (13.8%)	5 (23.8%)	
Alcohol use			
Yes	18 (62.1%)	11 (52.4%)	**0.4933**
No	11 (37.9%)	10 (47.6%)	
Aetiology			
Alcohol	18 (62.1%)	11 (52.4%)	**0.6087**
Gallstones	4 (13.8%)	1 (4.8%)	
Iatrogenic	1 (3.4%)	1 (4.8%)	
Idiopathic	5 (17.2%)	6 (28.6%)	
Trauma	1 (3.4%)	2 (9.5%)	
MCTSI severity			
Moderate	15 (51.7%)	11 (52.4%)	**0.9634**
Severe	14 (48.3%)	10 (47.6%)	

Infection			
Present	10 (34.5%)	11 (52.4%)	**0.2057**
Absent	19 (65.5%)	10 (47.6%)	

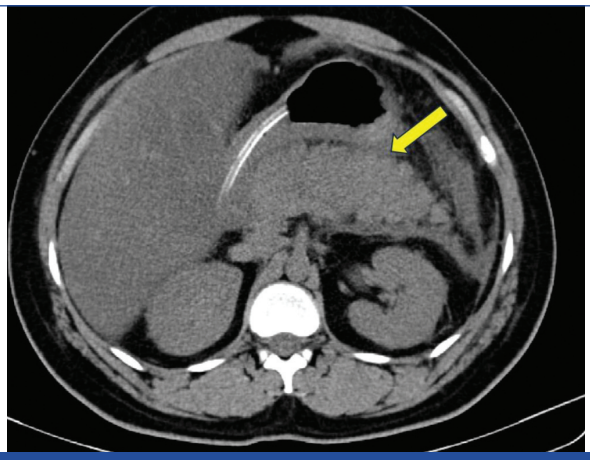
[Table/Fig-2]: Association between type of pancreatic fluid collection and baseline clinical characteristics.
Values are presented as n (%). Percentages are calculated within each fluid collection group. The p-values were obtained using the Chi-square test

The mean collection size was significantly larger in patients with pseudocysts than in those with WON (2.80±0.33 cm vs 2.12±0.27 cm, p-value <0.001). The type of fluid collection was significantly associated with the management approach (p-value=0.0449), with intervention being required more frequently in patients with WON [Table/Fig-3].

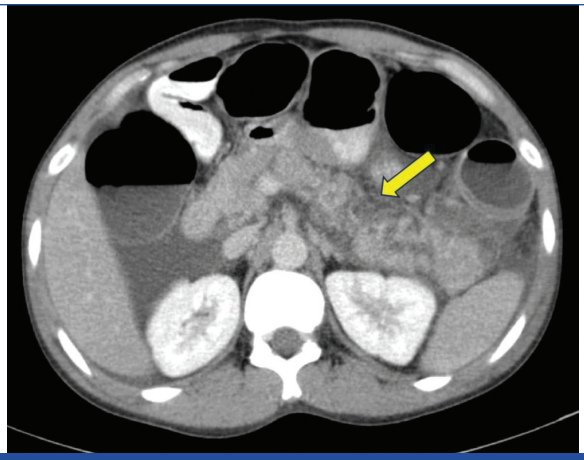
Representative CT images illustrating the spectrum of pancreatic involvement [Table/Fig-4-7].

Variable	Pseudocyst (n=29)	WON (n=21)	p-value
Collection size (cm)	2.80±0.33	2.12±0.27	**<0.001**
Hospital stay (days)	2.38±1.18	2.43±1.29	**0.8889**
Management			
Conservative	18 (62.1%)	7 (33.3%)	**0.0449**
Intervention	11 (37.9%)	14 (66.7%)	
Organ failure			
Yes	5 (17.2%)	2 (9.5%)	0.437
No	24 (82.8%)	19 (90.5%)	
Mortality			
Yes	3 (10.3%)	3 (14.3%)	**0.6721**
No	26 (89.7%)	18 (85.7%)	

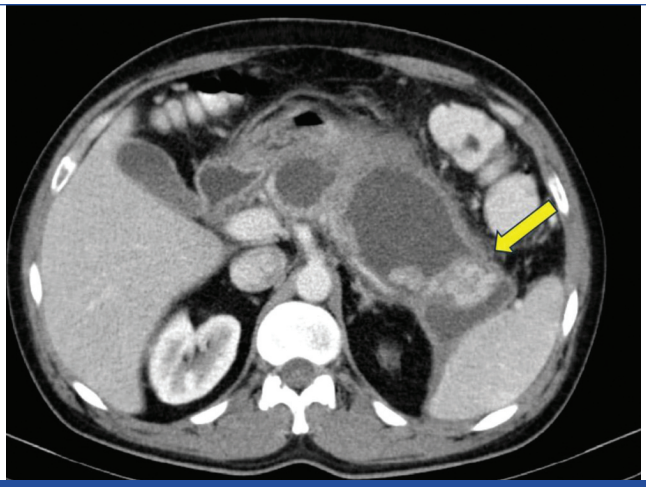
[Table/Fig-3]: Association between type of pancreatic fluid collection and clinical outcomes.



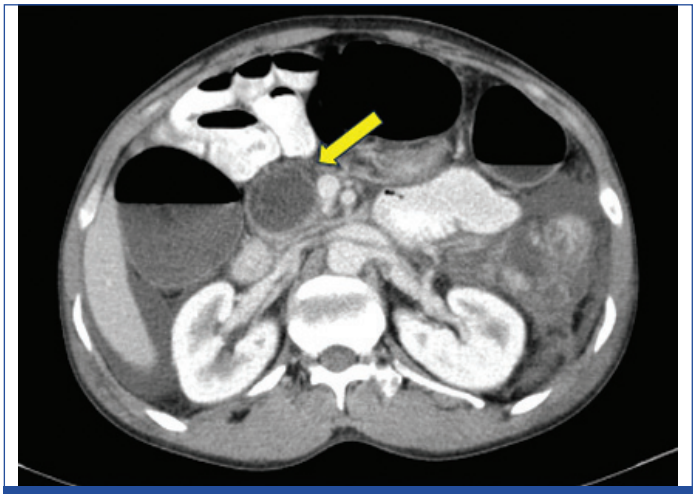
[Table/Fig-4]: Axial CT abdomen shows pancreas appears to be bulky representing- Acute interstitial oedematous pancreatitis.



[Table/Fig-5]: Axial CT abdomen: Pancreas shows few non-enhancing areas, representing acute necrotising pancreatitis.



[Table/Fig-6]: Axial CECT abdomen shows acute necrotic pancreatitis with infected pseudocyst/necrotic collection.



[Table/Fig-7]: Axial CECT abdomen shows a well-defined cystic density lesion with enhancing walls at the head of the pancreas- pseudocyst of the pancreas.

DISCUSSION

The CT is the primary imaging modality for diagnosing and evaluating AP, enabling differentiation between Acute Interstitial Pancreatitis (AIP) and necrotising pancreatitis.

In the present study, 60% of patients were aged 41-60 years, and 82% were males. Kumar AH and Griwan MS reported a mean age of 48.4 years with a female predominance (66%), largely attributed to gallstone-related pancreatitis (74%) [6]. Baig SJ et al., reported a younger study population with a mean age of 30 years and a male predominance (33/45; 73.3%), which was comparable to the male predominance observed in the present study [7]. Similarly, Alex A et al., reported a mean age of 45 years, with the largest proportion of patients in the 40-49 years age group (32.8%) and a male predominance of 83.6% (56/67), closely resembling the findings of the present study [8].

Alcohol was the predominant aetiology in the present study, accounting for 29 of 50 patients (58%). A similar trend was reported by Baig SJ et al., where alcoholism was the leading cause of AP, occurring in 16 of 45 patients (35.6%), including 14 of 34 (41.1%) patients with mild pancreatitis and 2 of 11 (18.1%) with severe pancreatitis [7]. In Alex A et al., 50.7% of patients had acute necrotising pancreatitis, 25.4% had APFC, 23.8% had WON, 7.4% had pseudocysts, and 17.9% had no fluid collections [8]. Compared with Alex A et al., the present study demonstrated a higher proportion of pseudocysts (58% vs 7.4%) and WON (42% vs 23.8%). These differences are likely attributable to variations in patient selection, as the present study included only patients with pancreatic fluid collections, whereas Alex A et al., evaluated all patients with AP, including those without fluid collections, in addition to differences in disease severity and the timing of CT imaging.

In a study by Kejriwal A et al., a total of 120 patients with AP-associated fluid collections were included. Of 51 patients with pseudocysts, 34 (66.6%) required hospital admission, while 17 (33.3%) did not. In contrast, 68 of 69 patients (98.5%) with WON were admitted, demonstrating a significant association between WON and hospital admission (p-value <0.05). The mean hospital stay was 4.2 days for pseudocyst patients and 6.4 days for those with WON, indicating a longer hospital stay in the latter group [4].

These findings are consistent with Alkareemy EAR et al., who reported a mean hospital stay of 6.89 days (range 3-10 days) in AP patients. In their study, 21 of 51 pseudocyst patients and 46 of 69 WON patients required ICU admission, with WON showing a significantly higher ICU admission rate (p-value=0.005). The mean ICU stay was also longer in the WON group (1.59 days) compared to the pseudocyst group (0.72 days) [9].

Limitation(s)

The sample size was relatively small and derived from a single tertiary care centre which may limit the generalisability of the findings. Long-term follow-up of patients after discharge was not performed therefore delayed complications and outcomes could not be assessed. Larger multicentric studies with longer follow-up and independent image interpretation are required to validate these findings.

CONCLUSION(S)

The CECT, based on the 2012 Revised Atlanta Classification, is a valuable tool for the characterisation of pancreatic and peripancreatic fluid collections in AP. In the present study, pseudocysts were the most frequently observed type of fluid collection. The type of pancreatic fluid collection showed a significant association with the management approach, and WON demonstrated significantly larger mean collection size compared with pseudocysts. These findings highlight the role of CECT in guiding the assessment, classification, and management planning of pancreatic fluid collections in AP.

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