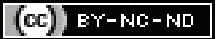


Detection of Locations of Pancreatic Pseudocysts using Computed Tomography: A Retrospective Study

VANESSA FERNANDES¹, ANSTON VERNON BRAGGS²

ABSTRACT

Introduction: The most common cystic lesion of the pancreas are pseudocysts of the pancreas. They are frequently observed in the peripancreatic regions, however, they may appear elsewhere. Knowledge of their varied locations becomes crucial for estimating their size and organising surgical treatments with respect to their mode of drainage and also knowing the exact surgical planes.

Aim: To determine the distribution of pancreatic pseudocysts using a Computed Tomography (CT) scan.

Materials and Methods: This was a retrospective observational time-bound study carried out from December 2018 to December 2020 in Department of Radiology, Father Muller Medical College Hospital, Mangaluru, Karnataka, India. After obtaining ethical clearance, 56 patients with pancreatic pseudocyst diagnosed on ultrasound and later evaluated by CT were included. The protocol used was 128-slice Multidetector Computed

Tomography (MDCT), plain and contrast axial images with multiplanar reformations. The primary outcome was to study the various locations in which these pseudocysts were present. The data was entered in a Microsoft Excel sheet. The frequency distribution of data was calculated.

Results: Out of the 56 patients, 42 (75%) were males and 14 (25%) were females. Incidence of pseudocyst formation was highest in the age group 40-50 years, 23 (41.07%). The most common location of pancreatic pseudocyst was the lesser sac 19 (33.92%). Other sites included peritoneum (n=7, 12.5%), hepatic (n=8, 14.2%) and sub-hepatic (n=3, 5.36%), perinephric (n=5, 8.92%), intrasplenic and perisplenic (n=5, 8.92%), gastric (n=3, 5.36%), subdiaphragmatic regions (n=2, 3.57%), in the Psoas major (n=2, 3.57%) and mediastinum (n=2, 3.57%).

Conclusion: The present study concludes that the most common location of a pancreatic pseudocyst is the lesser sac.

Keywords: Lesser sac, Mediastinum, Peripancreatic regions, Peritoneum

INTRODUCTION

The most common cause of a cystic lesion in the pancreas is pseudocysts of the pancreas. Pseudocysts of the pancreas are localized fluid-filled collections surrounded by a fibrous wall, lacking an epithelial lining, located adjacent or extra-pancreatic in location. The fluid it contains is sterile, amylase rich, and rich in pancreatic enzymes. The common causes include acute and chronic pancreatitis, pancreatic trauma, and surgery [1]. Since, it is enzyme rich, the proteolytic effects of the enzymes can present anywhere from the neck to the scrotum [2]. Studies estimate that the prevalence of pancreatic pseudocyst in cases of acute pancreatitis is 5-16% while in chronic pancreatitis, it is found to be 30-40% [2-5]. Pseudocysts of the pancreas are commonly seen in the peripancreatic areas. However, they can present elsewhere. The knowledge of their location becomes important to know the extent and planning of surgical procedures [6].

Since the present set-up sees a large number of patients hailing from the coastal districts of Karnataka and North Kerala, the present study would help us determine the distribution of pancreatic pseudocysts in this particular population. Hence, the present study was conducted with the aim to determine the distribution of pancreatic pseudocysts using CT scan.

MATERIALS AND METHODS

This retrospective observational time-bound study was carried out after Institutional ethical clearance was sought (Ethics ID: FMIEC/CCM/517/2021) which involved reviewing Computer Enhanced Computed Tomography (CECT) Abdomen studies for a period of two years from December 2018 to December 2020 at Father Muller Medical College Hospital, Mangaluru, Karnataka, India.

Inclusion and Exclusion criteria: Inclusion criteria were patients who were above 18 years old and diagnosed with pancreatic pseudocysts with their CT images stored in Picture Archiving and Communication System (PACS). Patients who had acute necrotic collections, intrapancreatic collections, and those below 18 years were excluded.

Study Procedure

The CT abdomen data were retrieved with pseudocyst as the keyword search from PACS of the hospital. This way, 56 patients with pancreatic pseudocysts was found in this time period.

The imaging protocols included 128-slice MDCT, plain and contrast axial images with multiplanar reformations were used for delineation of the anatomy and the extent of the pseudocysts. A contrast study was done using 40 mL of Iodine based contrast and standard Arterial, porto-venous, and delayed images acquired were studied. Early Arterial Phase was acquired at 15-30 s, the late Arterial Phase was acquired at 30-45 s, the Porto-venous phase was acquired at 45-60 s and delayed images were acquired at three minutes. In addition, the pancreatic parenchyma phase images acquired (40-50 s) were also studied. The primary outcome was to study the various locations in which these pseudocysts were present. The secondary outcomes were age and gender distribution with associated clinical features and probable aetiologies.

STATISTICAL ANALYSIS

Data collected was entered in Microsoft excel sheet. Data analysis was done and frequency distribution was calculated.

RESULTS

In the present study, the pseudocysts were detected in varied locations, the most common location being in the lesser sac in 19 patients (33.92%).

The incidence of the pseudocyst formation was highest in the age group 41-50 years (41.07%) and lowest in 20-30 years age (8.93%) group [Table/Fig-1].

The most common aetiology found was alcoholism (91.07%) followed by gall bladder calculi (5.36%) [Table/Fig-2].

Age (in years)	Males	Females	Pseudocyst
20-30	4 (80%)	1 (20%)	5 (8.93%)
31-40	17 (80.96%)	4 (19.04)	21 (37.5%)
41-50	16 (69.5%)	7 (30.6%)	23 (41.07%)
51-60	5 (71.4%)	2 (28.6%)	7 (12.5%)

[Table/Fig-1]: Table showing age and sex-wise distribution of pancreatic pseudocyst.

Aetiology	Number (%)
Alcohol	51 (91.07%)
GB calculi	3 (5.36%)
Idiopathic	2 (3.57%)

[Table/Fig-2]: Table showing etiology of pancreatitis resulting in pseudocysts.

Out of the 56 patients, 44 (78.6%) patients presented with abdominal pain, 7 (12.5%) patients presented with vomiting, while the rest 5 (8.9%) did not present with any significant abdominal symptoms [Table/Fig-3]. A palpable mass was present in 67.95% of the case.

The most common location of pancreatic pseudocyst was the lesser sac (n=19, 33.92%) [Table/Fig-4].

Symptoms	Number (%)
Abdominal pain	44 (78.6%)
Vomiting	7 (12.5%)
Asymptomatic	5 (8.9%)

[Table/Fig-3]: Table showing symptomatology in the study group.

Location	Number (%)
Lesser sac	19 (33.92%)
Peritoneum	7 (12.5%)
Hepatic	8 (14.2%)
Sub-hepatic	3 (5.36%)
Intrasplenic and perisplenic	5 (8.92%)
Perinephric	5 (8.92%)
Gastric	3 (5.36%)
Mediastinal	2 (3.57%)
Psoas major	2 (3.57%)
Sub-diaphragmatic	2 (3.57%)

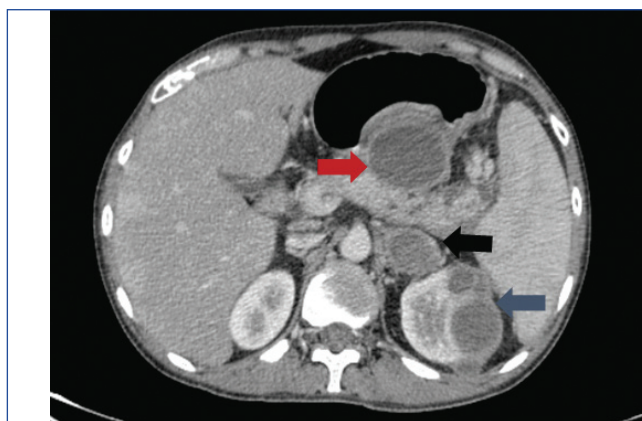
[Table/Fig-4]: Table showing various locations of pseudocysts.

DISCUSSION

The most common cystic lesions of the pancreas are pseudocysts [1]. As defined by the Revised Atlanta Classification, pseudocysts are an abnormal collection of pancreatic fluid following pancreatitis, which are seen after four weeks of interstitial pancreatitis. They are well encapsulated, round, or oval of homogeneously low attenuation with no evidence of necrosis within and essentially contains no solid material [2,7]. The location where the pseudocyst is formed is determined by, where the pancreatic enzymes are released and the path they travel [2].

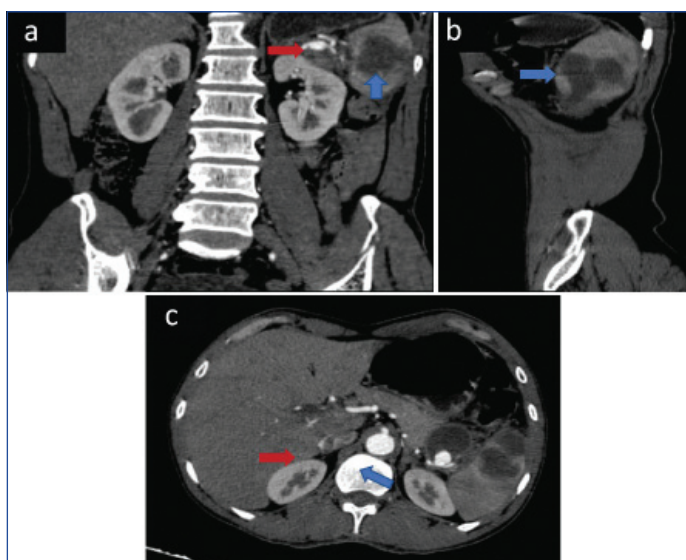
Pancreatic pseudocysts are generally imaged around the pancreas, most commonly formed and located in the lesser omental sac [Table/Fig-5], presenting almost always after pancreatitis [7,8].

Splenic pseudocyst: Acute pancreatitis leading to splenic pathology is rare accounting for about 7% of cases, however splenic pseudocyst is the most common complication when the spleen is involved [9-11]. Cheol Kim H et al., described an intrasplenic pseudocyst in the region of the splenic hilum in close proximity to the pancreatic tail [10]. In the

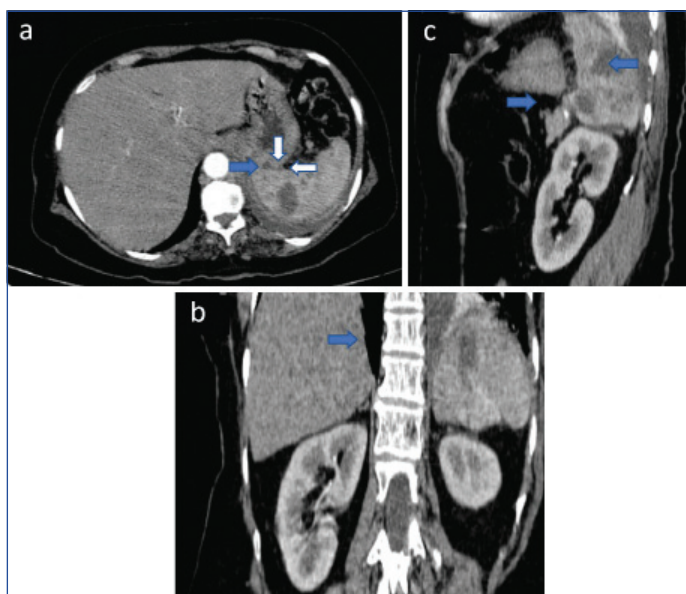


[Table/Fig-5]: Lesser sac pseudocyst. A 43-year-old male with past history of acute pancreatitis presented with epigastric pain. Axial Contrast Enhanced CT showing lesser sac pseudocyst (red arrow), Renal hilar pseudocyst (black arrow) with intra renal extension (dark blue arrow).

present study, splenic pseudocysts were seen as cystic masses in the splenic parenchyma. These were termed as intrasplenic pseudocysts [Table/Fig-6,7]. In two cases, where cystic collections were seen surrounding the splenic parenchyma with sparing of the splenic

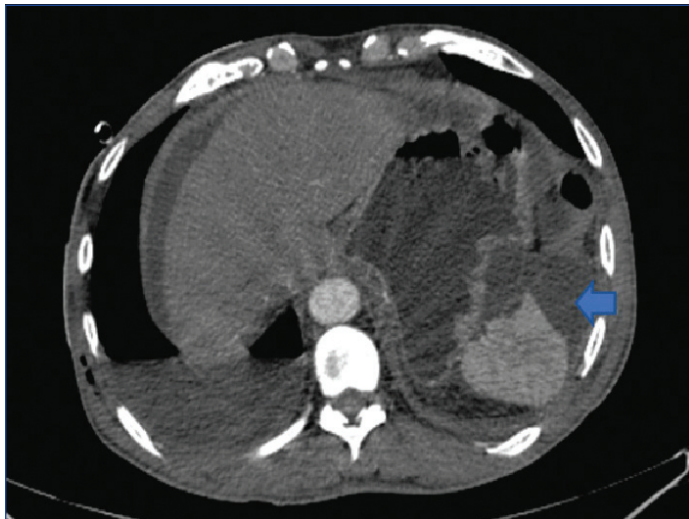


[Table/Fig-6]: Intrasplenic pseudocyst. A 37-year-old male with past history of pancreatitis presented with abdominal pain. (a and b) Coronal and sagittal reformat (c) Axial CECT sections showing splenic artery pseudo-aneurysm (red arrow) and the intrasplenic pseudocyst (blue arrow).



[Table/Fig-7]: Intrasplenic pseudocyst. A 59-year-old female patient with history of multiple episodes of acute pancreatitis, (a) Axial, (b) Coronal reformat, (c) Sagittal reformat, contrast enhanced CT shows multiple well encapsulated cystic lesions (blue arrows), surrounded by splenic parenchyma (white arrows).

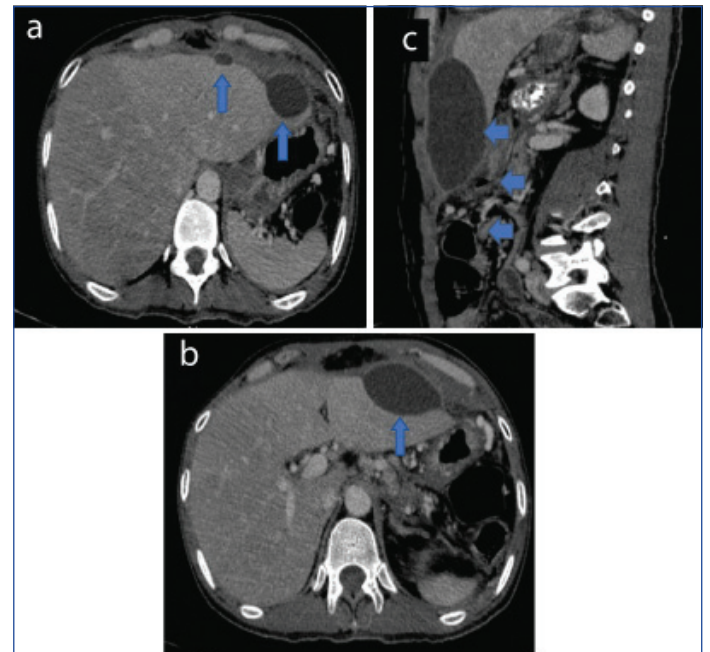
parenchyma [Table/Fig-8] [10]. Splenic artery pseudoaneurysm was also seen in one of the present cases [Table/Fig-6].



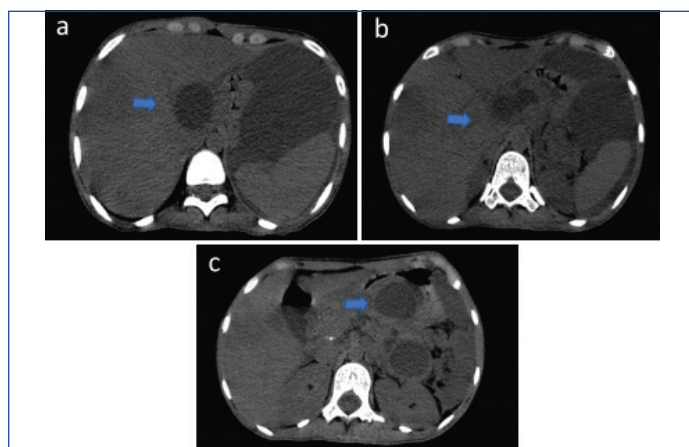
[Table/Fig-8]: Perisplenic pseudocyst. A 32-year-old male who presented with pain abdomen and vomiting underwent CECT for evaluation. Axial CECT sections showing peri-splenic pseudocysts (blue arrow).

Intrahepatic pseudocyst: Intrahepatic pseudocyst is a rare phenomenon, with very few cases reported in literature [10,12,13]. Cheol Kim H et al., published a case of a large cystic lesion in the left lobe of the liver associated with peripancreatic collections [10]. Casado D et al., described a case of acute pancreatitis with multiple liver cystic lesions. CT and MRCP revealed lesions in left lobe of liver and showed a normal common bile duct [12]. In the present study, the intrahepatic pseudocysts were seen in the porta hepatis and in the left lobe [Table/Fig-9,10]. Gupta D et al., described two cases of

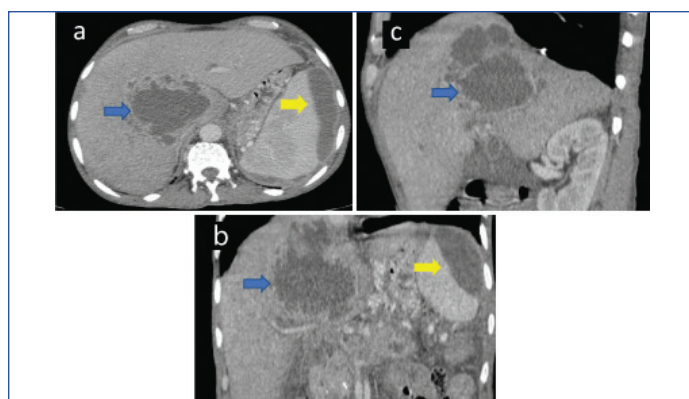
intrahepatic pseudocysts, one in the subcapsular region of left left lobe of the liver and another in the subcapsular region in the right lobe occupying majority of liver parenchyma [13]. Three cases in the present study had subhepatic collections [Table/Fig-11]. According to Gupta D et al., single pseudocyst in the left lobe of liver is the most common form of presentation of hepatic pseudocysts which was also seen in present study [13].



[Table/Fig-11]: Subhepatic pseudocyst. A 29-year-old male with past history of pancreatitis presented with a palpable mass in the epigastric region. CECT showed (a,b), Axial CECT sections, (c) Sagittal reformat CECT images, showing subhepatic pseudocysts (blue arrows).

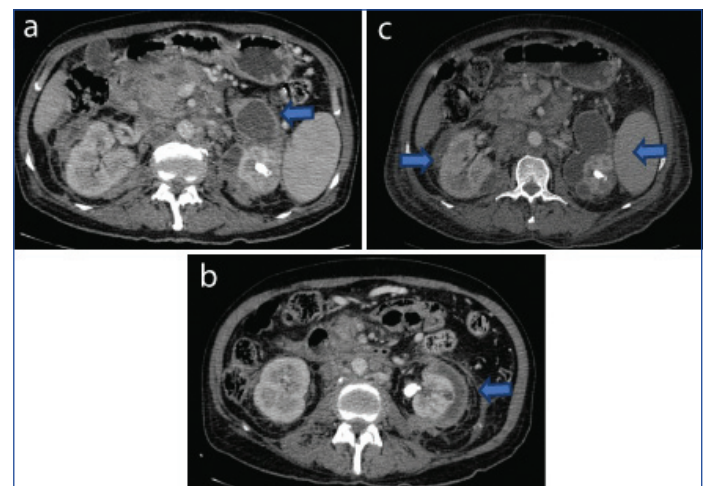


[Table/Fig-9]: Intrahepatic pseudocyst. Axial CT sections. A 46-year-old male male with previous history of acute pancreatitis on follow-up had abdominal pain. CECT showed intrahepatic pseudocyst. (a) In the porta hepatis (blue arrows), (b)(c) noted to arise from the region of the lesser sac.

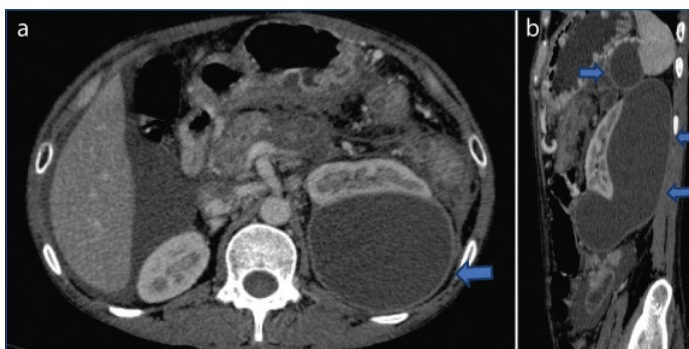


[Table/Fig-10]: Intrahepatic pseudocyst. A 46-year-old male presented with pain abdomen. Contrast enhanced CT sections, (a) Axial, (b) Coronal reformat, (c) sagittal reformat showing intrahepatic pseudocyst (blue blocked arrows) along with peri-splenic pseudocyst (yellow arrows).

Perinephric pseudocyst: Peri-renal pancreatic pseudocysts are a rare phenomenon and are a diagnostic dilemma unless the patient presents with features of pancreatitis. They tend to mimic necrotic tumours as they are avascular. Cheol Kim H et al., described a left-sided well-encapsulated perinephric pseudocyst with multiple septations [10]. In the present study, four cases had left perinephric pseudocysts. [Table/Fig-12]. One case had bilateral perinephric pseudocysts [Table/Fig-13]. Left-sided peri-renal pancreatic pseudocysts are common when compared to the right, this is due to the relation between the tail of pancreas and the left kidney. Many a time this has led to unwarranted left nephrectomy. Pancreatic peri-renal pseudocysts are thought to form by virtue of their spread through the fascial planes (peri-renal fascia of Gerota) [14].

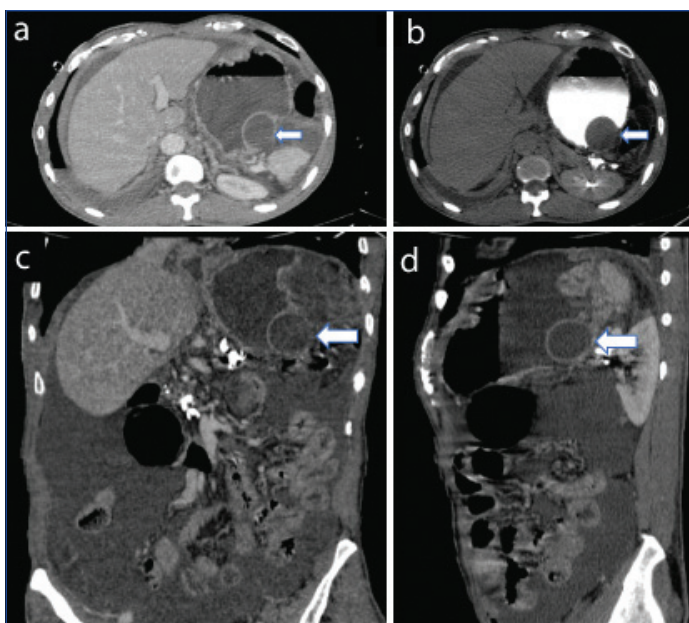


[Table/Fig-12]: Bilateral perinephric pseudocyst. A 33-year-old male with previous history of pancreatitis, complained of pain abdomen and vomiting, Contrast enhanced Axial CT sections, show left perinephric pseudocyst (blue arrows) in (a), (b) and (c). Left renal calculus also noted.



[Table/Fig-13]: Perinephric pseudocyst. A 26-year-old male with history of pancreatitis presented with pain abdomen. CECT sections (a) Axial (b) Sagittal reformat showing a large perinephric pseudocyst (blue arrows) in a case of pancreatitis.

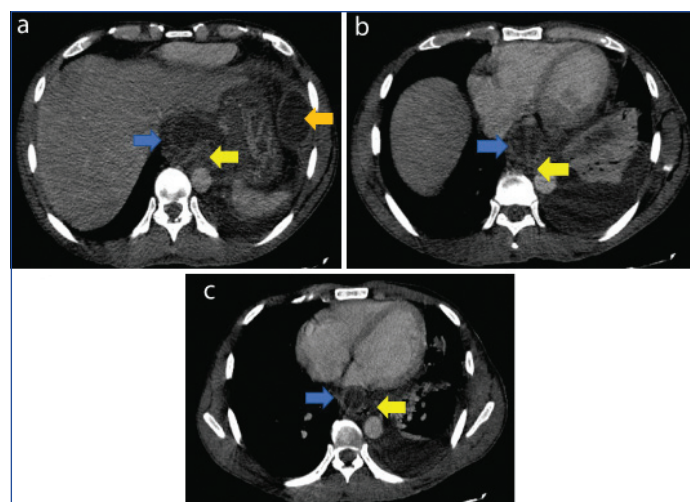
Gastric wall pseudocyst: Gastric intramural pseudocysts are rare. Gastric wall pseudocysts may be formed, due to rupture of the pseudocyst into the wall or presence of a fistula between the stomach and the pancreas or inflammation of the extra-pancreatic tissues in the stomach wall [15,16]. Waghlikar GD et al., published a case of gastric intramural pseudocyst which was seen as hypoattenuating collection in wall of the gastric antrum [15]. In present study, two cases showed the involvement of the greater curvature [Table/Fig-14] and had involvement of the fundus. CECT is said to be superior to others in evaluation of the lesion and providing adequate information regarding the features of pancreatitis [16].



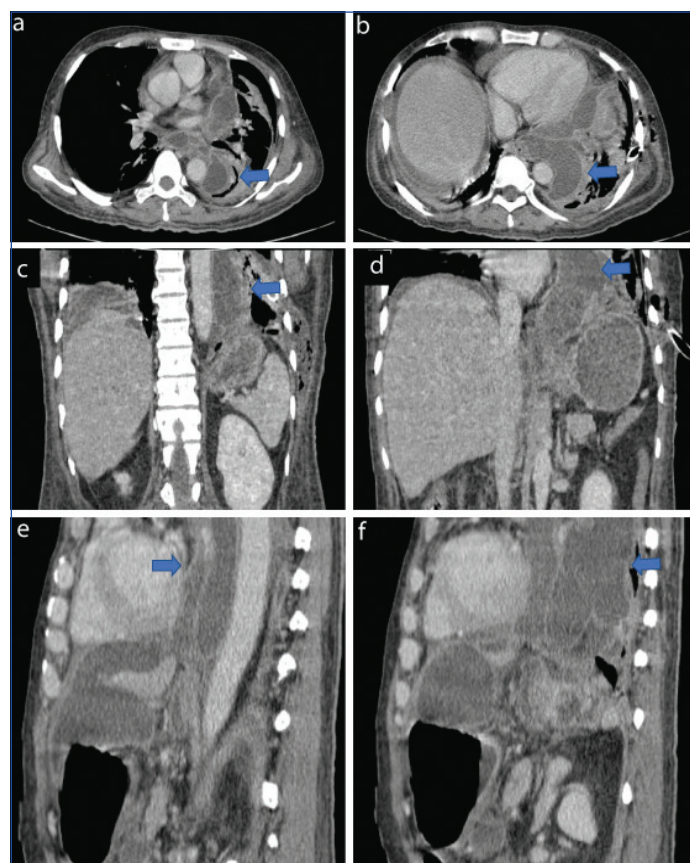
[Table/Fig-14]: Gastric intramural pseudocyst. A 48-year-old male with multiple episodes of pancreatitis complained of pain abdomen and vomiting. (a) Axial Contrast Enhanced CT sections, (b) Axial Non Contrast CT sections with positive oral contrast, (c) and (d) Coronal and sagittal reformat images showing a gastric intramural pseudocyst in the greater curvature of the stomach projecting into the lumen of the stomach.

Mediastinal pseudocysts: Mediastinal pseudocysts generally are known to occur in the posterior mediastinum. Patients present with pain abdomen and chest/back pain along with dyspnoea. The other modes of presentation include cardiac tamponade. Drescher R et al., described a large mediastinal pseudocyst that was seen compressing the heart predominantly on the left ventricle associated with multiple cystic lesions extending from the pancreatic head and/or body. MRCP showed the communication of these abdominal cysts with the mediastinal cyst via the esophageal hiatus [17]. Other possible routes abdominal pseudocysts extend to the mediastinum are via the aortic hiatus, retroperitoneum by the rupture of pancreatic duct or the diaphragm [17-19]. Jeung MY et al., described a mediastinal pseudocyst in the periaortic region displacing the esophagus anteriorly this causing dysphagia [18]. In the present study, in one case the mediastinal pseudocyst

was noted to compress on the oesophagus [Table/Fig-15]. In the second case, the mediastinal extension of the pseudocyst through the aortic hiatus was seen [Table/Fig-16].

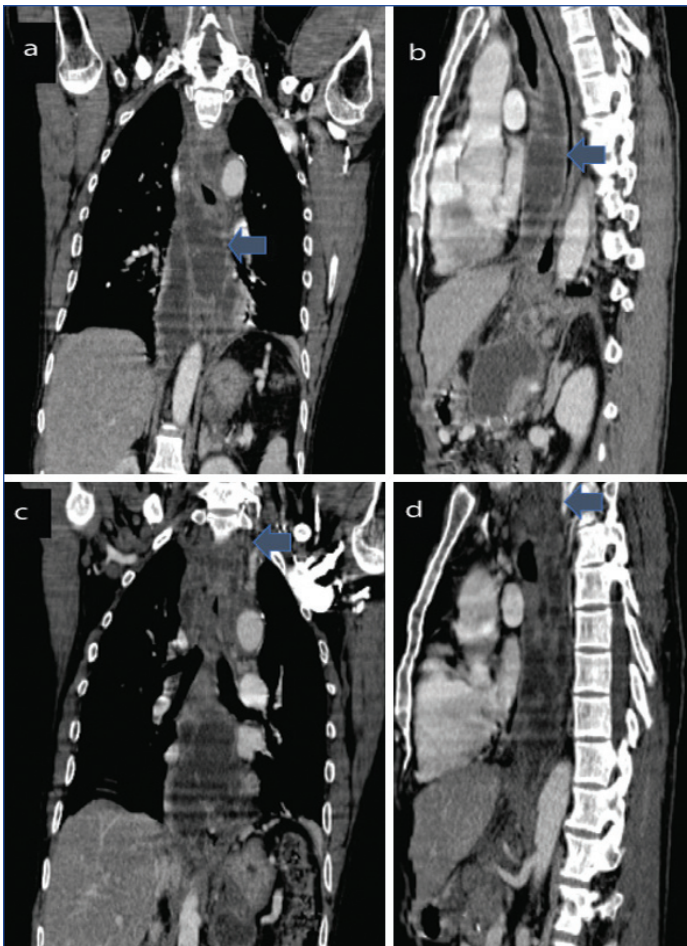


[Table/Fig-15]: Mediastinal pseudocyst via oesophageal hiatus. A 56-year-old male gave history of pancreatitis, currently presented with abdominal pain and vomiting with chest pain. Axial CECT sections: (a), (b), (c) Showing a pseudocyst arising from the lesser sac extending through the oesophageal hiatus into the mediastinum (blue arrow). The oesophagus is noted to be compressed anteriorly by the pseudocyst (yellow arrows). Also, note the left diaphragmatic pseudocyst (orange arrow) and left pleural effusion.



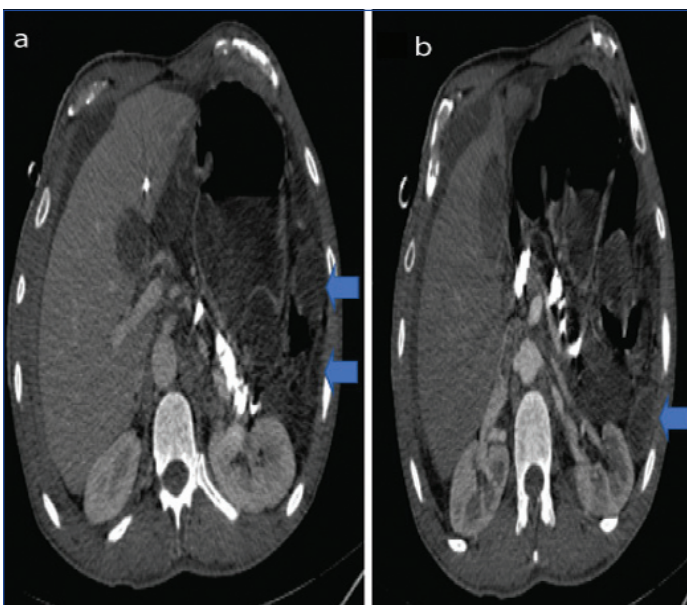
[Table/Fig-16]: Mediastinal pseudocyst via aortic hiatus. A 48-year-old male with pancreatitis three months ago complained of chest pain and vomiting. CECT sections, Axial (a) and (b), Coronal reformat (c) and (d), Sagittal reformat (e) and (f), showing the mediastinal extension of the pseudocyst through the aortic hiatus (blue arrow).

Extension of pseudocyst to the neck: Pseudocyst can extend through the mediastinum gain access to the neck. Harish CS et al., described a pseudocyst extending into the mediastinum and the neck causing dysphagia and neck stiffness. It involved retropharyngeal and prevertebral space and extended into extension to the anterior cervical and visceral space [19]. In the present study, mediastinal extension of the pseudocyst was seen up to the root of the neck [Table/Fig-17].



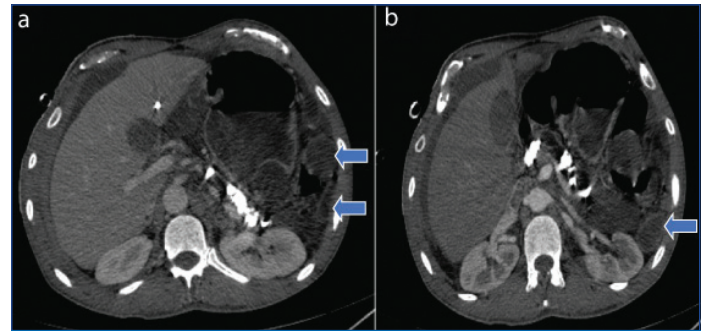
[Table/Fig-17]: Extension into neck. A 52-year-old male with past history of pancreatitis on follow-up. CECT Sections: (a) and (b) Coronal reformats, (c) and (d) Sagittal reformat showing mediastinal extension of the pseudocyst up to the root of the neck (blue arrows).

Other locations of pseudocysts: Pancreatic pseudocysts can extend into any organ or tissue that it comes across due to the proteolytic effect of the enzymes it contains, anywhere from the neck to the scrotum. Here are few other rare locations we show the pseudocyst can occur in. Seven cases of pseudocysts involving the peritoneal lining were seen [Table/Fig-18,19]. Authors had two cases involving the diaphragm and subdiaphragmatic region. One case had multiple cystic lesions in the left hemidiaphragm, [Table/Fig-20] while the other had a right-sided subdiaphragmatic

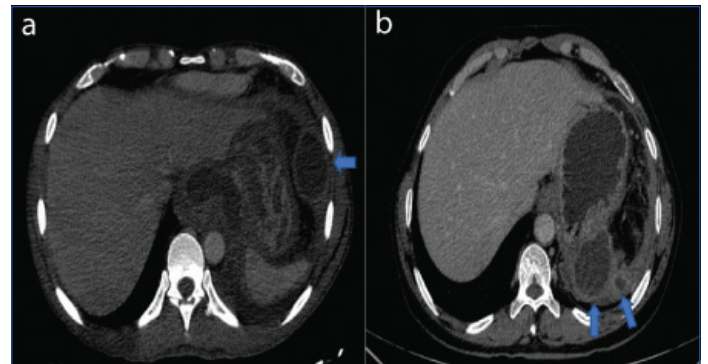


[Table/Fig-18]: Peritoneal pseudocyst. A 52-year-old male with abdominal pain who had previous history of pancreatitis. (a) and (b), Axial CECT sections showing peritoneal pseudocysts (blue arrows) in the lateral pelvic wall.

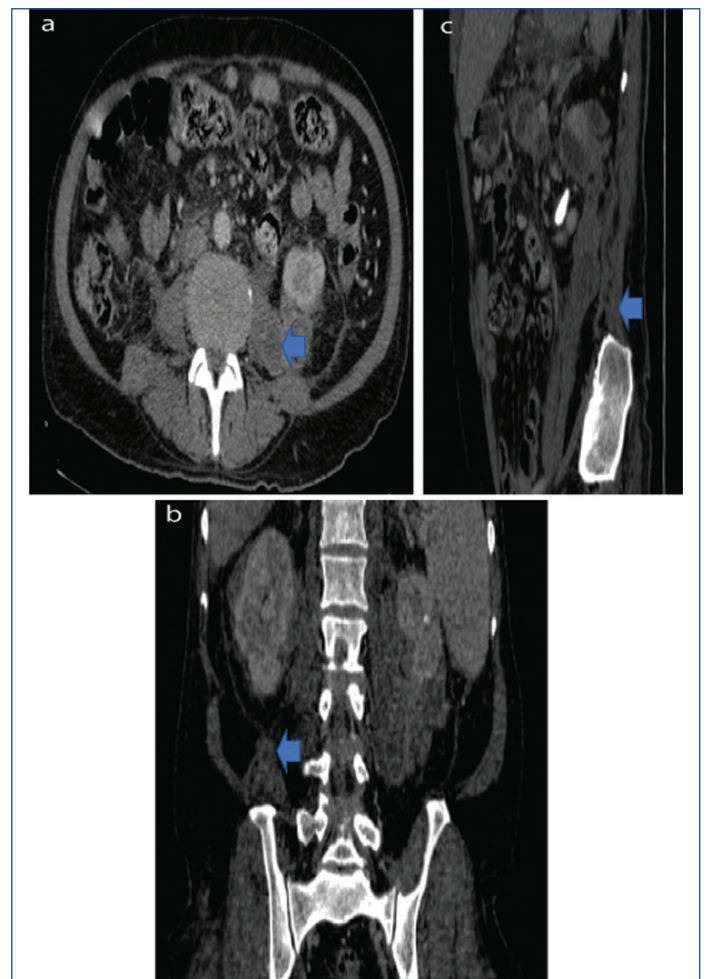
lesion. The authors had two cases of pseudocyst formation within the left psoas muscle [Table/Fig-21]. Khaladkar SM and Waghmode



[Table/Fig-19]: Peritoneal pseudocyst. A 49-year-old male with multiple episodes of pancreatitis in the past presented with abdominal pain. (a) and (b), Axial CECT sections showing peritoneal pseudocysts (blue arrows) in the left lateral aspect.



[Table/Fig-20]: Diaphragmatic pseudocysts. A 39-year-old male complained of abdominal pain and left-sided chest pain. (a) and (b), Axial CECT sections showing diaphragmatic pseudocysts (blue arrows).



[Table/Fig-21]: Psoas major pseudocyst. A 39-year-old male with past history of pancreatitis on follow-up had epigastric pain. (a), (b) and (c) Axial, coronal and sagittal reformat CECT sections showing a pseudocyst along the psoas major muscle (blue arrow).

AM had also described a case of pancreatic pseudocyst extending into right psoas muscle, lumbar triangle, intercostal space, and obturator externus [2]. In the present study, however the size of these pseudocysts were much smaller compared to the lesions in the study by Khaladkar SM and Waghmode AM [2].

The ability of pancreatic pseudocysts' to cut across tissue planes and boundaries, enclose, and infect nearby vascular structures and organs can result in inflammation of peripancreatic tissues. Splenic vascular involvement is very common since the pancreatic tail reaches the splenic hilum. Due to this intimate anatomical link, pancreatitis frequently involves the splenic vascular system and splenic parenchymal involvement can also occur rarely. Intrasplenic pseudocysts may occur as a result of pseudocyst dissection along splenic vessels [20].

Mediastinal extension of pancreatic pseudocysts can lead to pleural or pericardial effusion, cardiac compression due to mass effect and dysphagia. Pseudocysts are due to leakage of pancreatic secretions into surrounding tissues, the rest have occasionally been found involving stomach wall, liver, spleen, mediastinum, neck and pelvis. Although very rare intrasplenic pseudocysts have been reported [21].

The author found that the most common location of pseudocysts is in the lesser sac, peritoneal cavity and in the hepatic and sub-hepatic regions. Less common locations are in the spleen, perisplenic and in perinephric areas. Pseudocysts are rare sites in mediastinum and along the psoas major muscle. Compared to the study done by Jardosh Y et al., the most common location was the retroperitoneal space (39.2%) [6].

In the study done by Hamm B and Franzen N, 85 patients, who had pancreatic pseudocysts had atypical localisation in the liver, spleen, stomach wall or mediastinum were diagnosed in 19 (22.4%) of the 85 patients [21]. Compared to the present study, the atypical location in the liver, spleen and stomach wall or mediastinum also collectively had 21 patients (37.5%).

Khaladkar SM and Waghmode AM published a case report of pancreatic pseudocysts extending to lumbar triangle, psoas muscle, intercostal space and obturator externus muscle. These locations are rare [2]. In the present study, authors have found pseudocysts in the perinephric space in five cases, involving psoas muscle in two cases and with extension into the mediastinum in two cases.

Rasch S et al., in their study found that the most common cause for pancreatitis was alcohol (43.4%) and was more commonly seen in females than in males (2:1) [22]. In present study too alcohol was the most common cause seen in 91.07% of the cases, however pancreatitis was more common in males than in females (3:1). Pseudocysts were mainly located in the pancreatic head (47.3%) according to the study by Rasch S et al., [22]. However, this study comprised of cases before the Revised Atlanta Classification was used and no new cases were added in the study after Revised Atlanta Classification [22]. In the present study, the authors followed the Revised Atlanta Classification and found that most common location was the lesser sac (33.92%).

The present study highlights the importance of imaging of the chest and abdomen in the setting of pancreatitis. Since extension of pseudocysts into the mediastinum and neck can present with atypical symptoms, the possibility of pseudocyst as a diagnosis must be kept in mind. It makes a radiologist aware that the pseudocysts can extend into extra-abdominal locations, hence, due diligence is required, while interpreting a CT study of pancreatitis with large pseudocysts for the better patient care.

Limitation(s)

Since the present study was a time-bound study for two years, the number of cases that could be collected after fulfilling the inclusion and exclusion criteria was small (n=56). Further studies would be required to compile data over a longer period of time across a larger population in this regional belt.

CONCLUSION(S)

Pancreatic pseudocyst contains fluid rich in proteolytic enzymes that gives the ability to the pseudocyst to extend into distant places. The basic knowledge of the various typical and atypical locations of the pseudocyst in the setting of pancreatitis must raise the suspicion of a pseudocyst, preventing the patient from unwanted further investigations. Computed tomography plays a major and vital role not only in the diagnosis, but also in the planning of treatment (in case of drainage) and prognosis of the patient.

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