Role of computed tomography in diagnosis, follow-up, and minimally invasive treatment of acute pancreatitis

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Background Acute pancreatitis is an inflammatory disease of the pancreas with variable involvement of other regional tissues or remote organ systems. It has a mild, self-limiting course in 80% of patients who recover without complications. The remaining patients have a severe disease with local and systemic complications, and this disease carries a mortality risk of 10–24%.

Objective To examine the role of computed tomography (CT) in diagnosis, follow-up, and guided therapy in acute pancreatitis.

Patients and methods The study was performed on 100 patients with acute pancreatitis from January 2014 to October 2016. There were 80 males and 20 females.

Inclusion criteria Previously known acute pancreatitis attacks, clinically suspected acute pancreatitis, laboratory results suggesting acute pancreatitis, and patients with trauma with suspected pancreatic injury sequelae were the inclusion criteria. All patients were subjected to history taking; laboratory assessment, including serum amylase, lipase, creatinine levels, complete blood count, lipid profile (mainly triglyceride), and blood glucose; as well as CT scan to assess the pancreatic parenchyma, peripancreatic region, extrapancreatic ascites, pleural effusion, lung bases, and intestinal loops.

Results The study included 100 patients whose age ranged from 9 to 83 years old, with a mean of 41.89 years. Overall, 80 (80%) patient were males and 20 (20%) patient were females. The CT showed sensitivity of 99.1% and specificity of 100% with positive predictive value of 100% and negative predictive value of 97% in the diagnosis of acute pancreatitis.

Conclusion Acute pancreatitis can be severe and life-threatening. Imaging is central in the identification of complications, and radiological scoring systems can predict prognosis. With the current move toward minimally invasive treatment, the role of image-guided therapy is increasing and the need for surgical intervention is decreasing. CT is playing a golden role in diagnosis, follow-up, and guided therapy of acute pancreatitis.

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Introduction

Acute pancreatitis is one of the most common diseases of gastrointestinal tract (GIT), leading to tremendous emotional, physical, and financial burden [1].

Epidemiologic incidence for acute pancreatitis increased from 40 per 100 000 in 1998 to 70 per 100 000 in 2002 [2].

Clinically, acute pancreatitis is diagnosed in patients with two of the following three features: (a) sudden onset of upper abdominal pain, (b) serum amylase and/or lipase levels more than three times the upper limit of normal, and/or (c) abdominal computed tomography (CT) or ultrasound characteristic findings of anteroposterior [3,4].

Although most cases are self-limited, 20% of the patients have an exaggerated systemic inflammatory response associated with multiple organ dysfunctions contributing to high morbidity and mortality [5]. Mortality during the first 2 weeks is usually owing to multiorgan failure. Mortality after 2 weeks is usually the result of secondary infection of pancreatic/peripancreatic necrosis [6].

Acute pancreatitis may be classified into two morphological types: acute interstitial edematous pancreatitis and necrotizing acute pancreatitis.

Imaging plays a major role in diagnosing severity of acute pancreatitis including the pancreatic necrosis as well as local and systemic complications. Furthermore, imaging serves as a guide for therapeutic intervention and response to therapy [7].

Patients and methods

This study was carried out on 100 patients having acute pancreatitis who had been admitted to General Surgery Department, Al Azhar University Hospital, Cairo, and

Al Rass General Hospital Saudi Arabia from January 2014 to October 2016. There were 80 males and 20 females. Approved by the ethical committee.

Inclusion criteria

Previously known acute pancreatitis attacks, clinically suspected acute pancreatitis, laboratory results suggesting acute pancreatitis, and patients with trauma with suspected pancreatic injury sequelae were the inclusion criteria.

Exclusion criteria

Increased renal functions; known allergy to intravenous contrast; and patients weighting more than or equal to 130 kg, because of machine weight limit and for better image quality demonstration, were the exclusion criteria.

All patients were subjected to the following:

(1) History taking regarding onset of symptoms, previous similar condition, gall blabber (GB) stones, alcohol intake, or smoking as well as clinical examination.
(2) Laboratory assessment of serum amylase, lipase, creatinine levels, complete blood count, lipid profile (mainly triglyceride), and blood glucose.
(3) CT scan to assess the pancreatic parenchyma affection (bulky, edematous, necrotic, focal, or diffuse); peripancreatic region (stranding, single peripancreatic collections, or pseudocysts); GB or common bile duct stones; biliary and pancreatic ducts; masses in the pancreas or ampulla; and extrapancreatic ascites, pleural effusion lung bases, and intestinal loops.
(4) CT machine Toshiba Aquilion (160 slices). The contrast used was water soluble and nonionic (Omnipaque) administered at 300 mg/ml through intravenous injection.

Other data collected included the time of hospital and/or ICU stay; patients who needed intervention by endoscopic retrograde cholangiopancreatography (ERCP) (40 patients), whether for diagnostic or therapeutic sphincterotomy, stone extraction, or stent insertion; and follow-up after discharge (for 6–12 months) by radiological and clinical examination.

Results

The study included 100 patients whose age ranged from 9 to 83 years, with a mean of 41.89 years. Of them, 80 (80%) were males and 20 (20%) were females.

The causes of acute pancreatitis are illustrated in Fig. 1.

Causes of acute pancreatitis

Radiological CT scan was done and is illustrated in Table 1.

The CT showed sensitivity of 99.1% and specificity of 100% with positive predictive value of 100% and negative predictive value of 97% in the diagnosis of acute pancreatitis (Fig. 2).

After collecting all data from CT, we made grading of acute pancreatitis into five grades (A, B, C, D, and E), and this grading was done according to the texture of pancreas and peripancreatic fluid in the abdomen (Fig. 3).

Grade A represented laboratory and clinical evidence of pancreatitis with normal pancreas (score 0), grade B showed bulky pancreas (focal or diffuse) with no peripancreatic changes (score 1) (Fig. 4), grade C showed peripancreatic stranding (score 2) (Fig. 5), grade D showed single peripancreatic fluid (score 3), and grade E showed two or more than two pockets of fluid collection or gases on the retroperitoneal space (score 4) (Fig. 6).

CT data classified acute pancreatitis into two types: interstitial edematous pancreatitis, which was recorded in 80 (80%) patients, and necrotizing pancreatitis with or without peripancreatic necrotic fluid, which was recorded in 20 (20%) patients. Three patients with interstitial edematous acute pancreatitis changed to necrotic type in the follow-up.

The CT extrapancreatic findings were as follows: two points were credited for extrapancreatic complications using the computed tomography severity index (CTSI). There were 51 (51%) patients who had pleural effusion and 22 (22%) patients had ascites only. Pleural effusion or ascites with the presence of vascular complications such as thrombosis of the

Figure 1

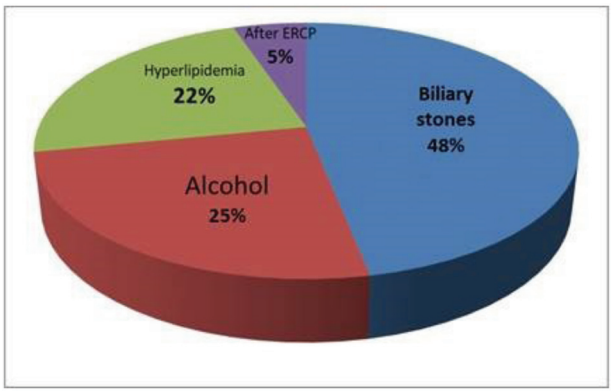


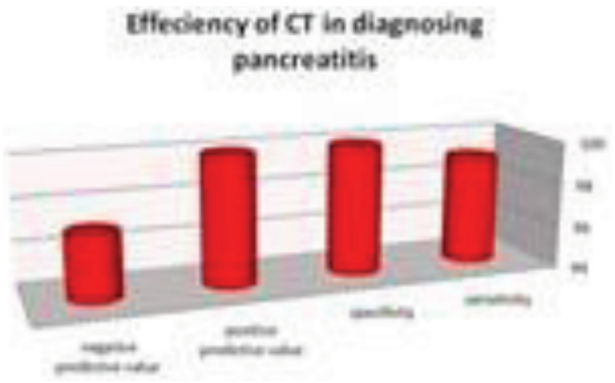
Chart showing causes of acute pancreatitis.

Table 1 Radiological findings in computed tomography scan

Radiological findings	CT patients [*n* (%)]
Pancreatic inflammation	
Normal pancreas	1 (1)
Pancreatic enlargement	6 (6)
Pancreatic inflammation±peripancreatic fat stranding	43(43)
Single peripancreatic fluid collection	24 (24)
≥2 fluid collection±retroperitoneal gas	26 (26)
Pancreatic necrosis	
None 0	69 (69)
<30%	14 (14)
>30–<50%	12 (12)
>50%	5 (5)
Extrapancreatic complications	
Pleural effusion	51 (51)
Ascites	22 (22)
Vascular complications (thrombosis of the splenic vein)	6 (6)
GIT involvement (thickened intestinal wall)	21 (21)

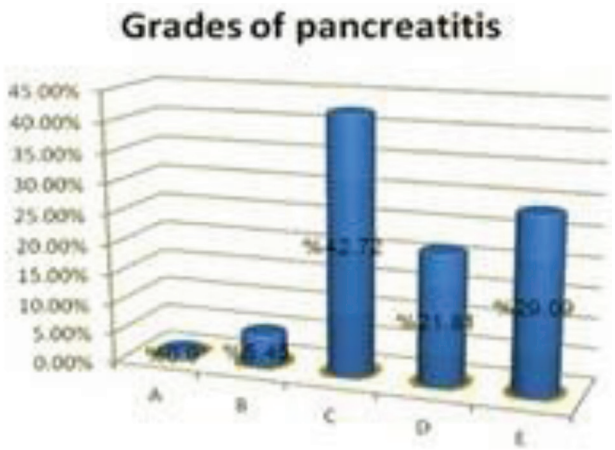
CT, computed tomography; GIT, gastrointestinal tract.

Figure 2



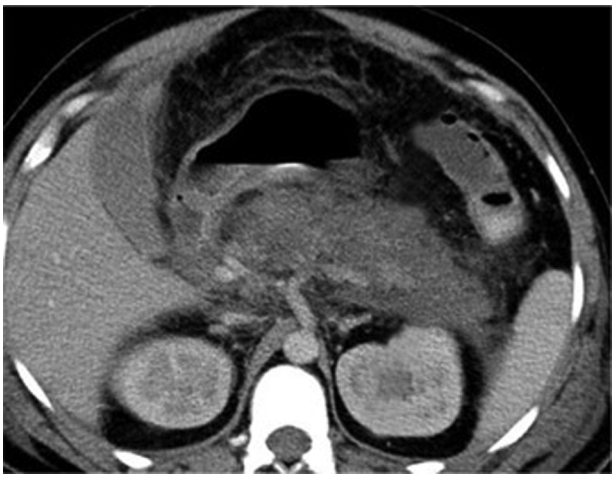
Column chart showing the efficiency of CT in diagnosing pancreatitis. CT, computed tomography.

Figure 3



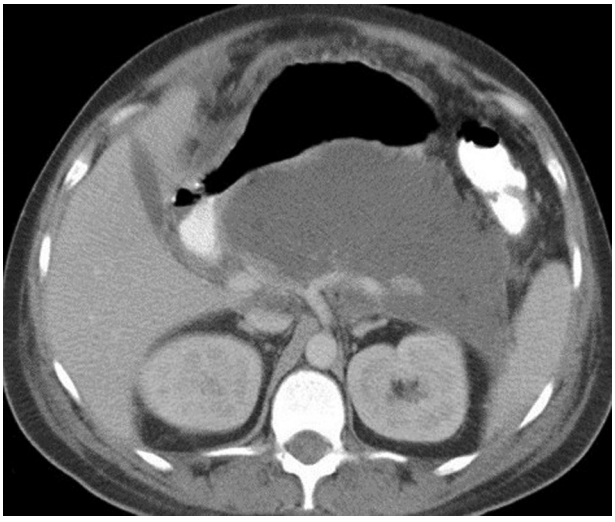
Column chart showing grades of pancreatitis.

Figure 4



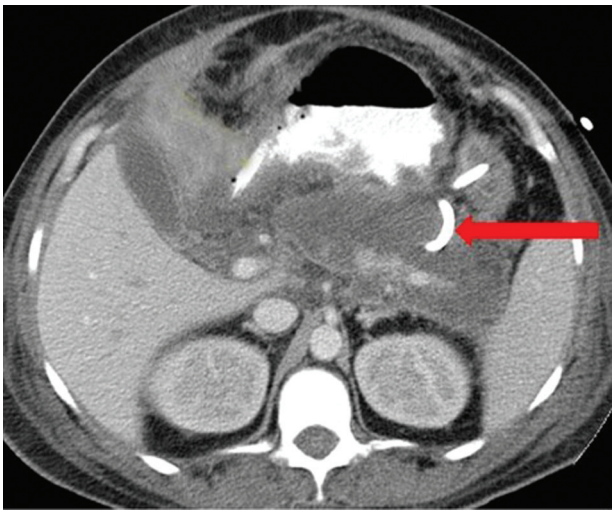
Grade B showed bulky pancreas.

Figure 5



Grade C showed peripancreatic stranding and fluid collection.

Figure 6



Demonstration of pig tail tube drainage (pockets of fluid collection).

splenic vein were seen six (6%) patients, GIT involvement in the form of thickening in the intestinal wall was seen in 21 (21%) patients; or extrapancreatic parenchymal complications were found in nine (9%) patients.

The full hospital data (severity parameters including length of hospital stay, ICU stay, need for intervention, organ failure, pancreatic infection, clinically severe acute pancreatitis, and death) were collected and compared these data with the CTSI (Table 2), which illustrated a relationship between the severity parameters and morphological severity of CTSI.

Discussion

Acute pancreatitis is an inflammatory disease of the pancreas. It has a mild, self-limiting course in 80% of patients who recover without complications [8]. The remaining patients have a severe disease with local and systemic complications, and this disease carries a mortality risk of 10–24% [9]. The treatment of mild acute pancreatitis is conservative, but severe episodes may require minimally invasive techniques or even surgical intervention. Thus, the accurate classification of the severity of acute pancreatitis is crucial to monitor the course of the disease and to make informed clinical decisions [10].

The acute pancreatitis mortality during the first 2 weeks is usually owing to multiorgan failure. Mortality after 2 weeks is usually the result of secondary infection of pancreatic/peripancreatic necrosis. Therefore, the first 12 h are extremely important to provide appropriate management, which will decrease morbidity and mortality [11].

The incidence of acute pancreatitis is 4.8–24.2 cases per 100,000 populations, according to data from England, Denmark, and the USA [12].

CT has been the initial imaging modality of choice for evaluating pancreatic pathology. Multidetector computed tomography improved temporal and spatial resolution, facilitated the precise timing of multiphasic imaging, and also increased the accuracy for lesion detection and characterization in the pancreas.

This study was conducted from January 2014 to October 2016. It included 100 patients having symptoms and signs of acute pancreatitis and who had been admitted to general surgery department AL Azhar University hospital, Cairo, and EL-Rass General Hospital, Saudi Arabia. Their age ranged from 9 to 83 years, with a mean of 41.89 years. The highest prevalence was among 40–50 years age group (28%), which coincides with Lenhard and Balthazar [13] who reported the average age was 49 years, with male predominance.

In our study, 80% were males and 20% were females, and this agree with Apodaca *et al*. [14], who had 27% female and 73% male, as well as with Bollen *et al*. [15].

Ramzan *et al*. [16] stated that alcohol abuse is the leading cause of acute pancreatitis in the Western world, whereas gallstone or biliary pancreatitis is the predominant type in Saudi Arabia.

Our study found that the most common cause was GB stones (biliary), being present in 48 (48%) patients. This agrees with the study by Simoesa and colleagues, which reported that for predicting acute pancreatitis severity, the most common etiology was gallstones.

In our study, the first leading cause of acute pancreatitis was GB stones (biliary), found in 48 (48%) patients, and second cause was alcohol abuse in 25 (25%) patients, and the third cause was hyperlipidemia in 22 (22%) patients and post-ERCP in five (5%)

Table 2 The relationship between the severity parameters and morphological severity of computed tomography severity index

Severity parameters	CTSI		
	Mild 0–3 (*N*=61)	Moderate 4–6 (*N*=28)	Severe 7–10 (*N*=21)
Length of hospital stay (days)	3–33 (8.2)	3–60 (19.3)	10–51 (24.6)
ICU stay (days)	0 (0)	4–60 (25)	5–49 (25.2)
Need for intervention	0 (0)	3 (10.7)	10 (27.6)
Organ failure [*n* (%)]			
Transient	3 (4.91)	5 (17.85)	5 (23.8)
Persistent	1 (1.6)	3 (10.71)	12 (57.14)
Non	57 (93.44)	20 (71.42)	4 (19)
Pancreatic infection	0 (0)	1 (3.57)	8 (38)
Clinically severe acute pancreatitis	0 (0)	6 (21.42)	15 (71.4)
Death	0 (0)	1 (3.57)	7 (33.33)

CTSI, computed tomography severity index.

patients. This agrees with Fisher *et al*. [17], as they stated hyperlipidemia was the third leading cause of acute pancreatitis after biliary and alcoholic causes. In our study, there were five (5%) patients who had acute pancreatitis after ERCP. This is in agreement with Pavlidis *et al*. [18] who found that 3% had acute pancreatitis after ERCP.

In our study, amylase level less than or equal to 210 U/l was seen in 29 (29%) patients and more than 210 U/l in 71 (71%) patients, whereas lipase level less than or equal to 180 U/l in 20 (20%) patients and more than 180 U/l in 80 (80%) patients. There were two (2%) patients who showed normal levels of amylase and lipase. Moreover, six (6%) patients showed increased lipase level with normal amylase serum level, and in only two (2%) patients, there was increased level of serum amylase with no elevation of serum lipase.

This agrees with Gomez *et al*. [19] as they found the majority of their patients (113 patients, 97%) had raised levels of both amylase and lipase.

In our study, all patients were examined by CT scan and found that the pancreas looked normal in one (1%) patient, and pancreatic enlargement was seen only in six (6%) patients. Pancreatic inflammation with/without peripancreatic fat stranding was seen in 43 (43%) patients. On the contrary, single peripancreatic fluid collection was seen in 24 (24%) patients. There were 26 (26%) patients who showed more than or equal to two fluid collection±retroperitoneal.

Extrapancreatic complications included pleural effusion on CT scan in 51 (51%) patients, ascites in 22 (22%) patients, vascular complications in six (6%) patients, and GIT involvement in 21 (21%) patients.

CT showed a sensitivity of 100% for common bile duct dilation, whereas regarding the GB stones detection, CT sensitivity is 8.18%. The study by Matar [20] showed similar percentages in his sample.

After collecting all radiological data from CT images, grading was done of the conditions according to the grade of pancreatitis (five grades: A, B, C, D, and E), and this grading was made according to the texture of pancreas and peripancreatic fluid in the abdomen.

In our study, acute pancreatitis according to CT grading scale showed the following: grade A included one (1%) patients, grade B included six (6%) patients, grade C included 42 (42%) patients, grade D included 21 (21%) patients, and grade E included 30 (30%) patients.

In the presented study, follow-up CT of the patients after 4weeks of symptoms of acute pancreatitis. 38 patients received intravenous contrast (omnipaque 300 mg water soluble nonionic) and one patient did not receive intravenous contrast due to renal failure, 12 patients were followed by CT without contrast for detection the position of the tube drainage. Follow-up CT revealed no detected complications in groups A, B, and C, whereas groups D and E had complication. This agrees with Lenhart and Balthazar [21] as they found in their study the overall incidence of acute and chronic complications such as acute pancreatitis is 5.3%, exclusively in the more severe forms, grades D and E pancreatitis, after the extravasation of pancreatic secretions.

In our study, complications were pseudocyst in two (2%) patients, infected fluid in one (1%) patients, chronic pancreatitis in three (3%) patients, groove pancreatitis in one (1%) patients, whereas group E had pseudocyst in six (6%) patients, walled off necrosis in 10 (10%) patients, hemorrhage in one (1%) patients, and abscess or infected fluid in seven (7%) patients.

Our results agree with Bharwani *et al*. [22] who found in their study that pseudocysts occur as a complication of pancreatitis in 10–20% of patients.

In our study, ERCP was done for 39 (39%) patients for diagnostic indication, whereas in only 15 (15%) patients for therapeutic indication. Furthermore, Magnetic Resonance Cholangiopancreatography (MRCP) was done for 12 (12%) patients for diagnostic purpose.

In our study, 21 (21%) patients needed intervention for local complications, five (5%) patients underwent percutaneous needle aspiration, nine (9%) patients underwent percutaneous tube drainage using pig tail tube drainage, and seven (7%) patients underwent surgical debridement.

Summary

Acute pancreatitis is defined as an acute inflammatory process of the pancreas with variable involvement of other regional tissues or remote organ systems. Acute pancreatitis is classified into mild and severe forms. Mild acute pancreatitis is associated with minimal organ dysfunction and uneventful recovery. Severe acute pancreatitis is associated with pancreatic necrosis and may lead to organ failure and/or local complications.

Gallstones and alcohol abuse are the most common causes of acute pancreatitis, accounting for 60–80% of cases.

CT is the standard imaging for the evaluation of acute pancreatitis and its complications. It allows complete visualization of the pancreas and retroperitoneum, even in the setting of ileus or overlying bandages from a recent surgical procedure. It can detect almost all major abdominal complications of acute pancreatitis, such as fluid collections, pseudocysts, abscesses, venous thrombosis, and pseudoaneurysms. It can be used to guide percutaneous interventional procedures such as diagnostic fine-needle aspiration or catheter placement.

Recommendations

The diagnosis of acute pancreatitis is most often established by the presence of two of the three following criteria: (a) abdominal pain consistent with the disease, (b) serum amylase and/or lipase greater than three times the upper limit of normal, and (c) characteristic findings from abdominal imaging.

CT should be reserved for patients with unclear diagnosis or who fail to improve clinically within the first 48–72 h after hospital admission.

In the absence of gallstones or history of alcohol use, a serum triglyceride should be obtained and considered the etiology if it is increased.

In older patient, a pancreatic tumor should be considered as a possible cause of acute pancreatitis.

Conclusion

Acute pancreatitis can be severe and life-threatening. Imaging is central in identification of complications, and radiological scoring systems can predict prognosis. With the current move towards minimally invasive treatment, the role of image-guided therapy is increasing and the need for surgical intervention is decreasing. CT is playing a golden role in diagnosis, follow-up, and guided therapy in acute pancreatitis.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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