Original Research Article

Acute pancreatitis, its diagnosis with special reference to contrast enhanced CT scan (CECT) and serum enzyme studies: a comparative study in tertiary referral hospital of Odisha, India

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ABSTRACT

Background: Acute pancreatitis is sudden swelling and inflammation of the pancreas. It can be diagnosed on the basis of clinical and laboratory data. At times, it may be difficult to differentiate it from other acute abdominal conditions. In these patients, serum enzymes (amylase and lipase) study, imaging by ultrasonography (USG) and/or computed tomography (CT) is of immense value in arriving at a diagnosis. In this study, we have compared the role of serum enzymes (amylase and lipase) levels, with the imaging studies (US/CECT scan) in relation to early diagnosis of acute pancreatitis and to find out the most specific and sensitive diagnostic modality.
Methods: 300 patients (220 males, 80 females) in age group of 21 to 62 years with a clinical diagnosis of acute pancreatitis, which were admitted to surgical ward of S.C.B. Medical College Hospital, Cuttack during a period from November 2013 to October 2015, were included in the study. All selected cases (clinically diagnosed as acute pancreatitis) were serially subjected to tests of serum amylase and lipase estimation, USG and CECT scan of abdomen.
Results: In our study the most common cause found was gall stone disease followed by chronic alcoholism. Serum amylase test showed diagnostic accuracy of 46.66% whereas serum lipase it was 70 %. Further USG of abdomen diagnostic accuracy was 83.33%, finally CECT scan had a diagnostic accuracy of 93.33%.
Conclusions: Comparing all the diagnostic modalities described above it was found that contrast enhanced CT scan has highest accuracy rate (i.e. about 93% in our study) in detecting acute pancreatitis. This study proved that CECT scan was very important in the following up of the patients in order to detecting regression of disease appearance and complication in relation to acute pancreatitis.

Keywords: Acute pancreatitis, Amylase, Contrast enchanced CT scan (CECT), Lipase, Ultrasonography(USG)

INTRODUCTION

Acute pancreatitis has been recognized since antiquity. It was first described by Reginald Fitz' in 1889 and its essential pathology reported by Rich and Duff in 1936.[1,2]

From mild disease to multi organ failure and sepsis, acute pancreatitis is a disorder that has numerous causes, an obscure pathogenesis, few effective remedies, and an often-unpredictable outcome. But recently according to UK working group for acute pancreatitis, 2005, with

newly emerging diagnostic modalities, recent guidelines have recommended against the diagnosis of idiopathic acute pancreatitis. The mechanism by which enzymes and bioactive substances like trypsin are activated within the pancreatic acinar cells remains a major unanswered question in acute pancreatitis. Acute pancreatitis can be diagnosed on the basis of clinical and laboratory data. At times, it may be difficult to differentiate it from other acute abdominal conditions and in these patients, serum enzymes (amylase and lipase) study, imaging by ultrasonography (USG) and/or computed tomography (CT) is of immense value in arriving at a diagnosis. Contrast-enhanced CT scan (and in particular a contrast enhanced thin-section multidetector-row CT scan) is the best imaging technique to exclude conditions that masquerade as acute pancreatitis, to diagnose the severity of acute pancreatitis and to identify complications of pancreatitis.[3] Along with USG and CECT, endo ultrasound, MRCP and MRI can be used with better specificity and sensitivity.[4] In this study, we have compared the role of serum enzymes (amylase and lipase) levels, with the imaging studies (US/CECT scan) in relation to early diagnosis of acute pancreatitis and to find out the most specific and sensitive diagnostic modality in order to decrease the morbidity and mortality of this fatal disease to an accepted level.

METHODS

In this prospective study, 300 patients (220 males, 80 females) in age group of 21 to 62 years with a clinical diagnosis of acute pancreatitis, which were admitted to surgical ward of S. C. B. Medical College Hospital, Cuttack during a period from November 2013 to October 2015, were included in the study. Cases of acute pancreatitis were selected from all other acute abdominal cases. According to the revised Atlanta classification of acute pancreatitis, acute pancreatitis (regardless of presence or absence of chronic pancreatitis) is clinically defined by at least the first two of three features: (a) abdominal pain suggestive of pancreatitis (epigastric pain often radiating to the back), with the start of such pain considered to be the onset of acute pancreatitis; (b) serum

amylase and lipase levels three or more times normal (imaging is to be used if the elevated values are, 3 times normal); and (c) characteristic findings on CT, magnetic resonance (MR) imaging, or transabdominal ultrasonographic (US) studies. If acute pancreatitis is diagnosed on the basis of the first two criteria with no systemic sign of severe systemic inflammatory response syndrome or persistent organ failure, contrast material-enhanced CT may not be necessary for determining patient care.

Clinical diagnosis of acute pancreatitis in our study included the following features: acute abdominal pain in epigastric region, of short duration radiating to the back. This pain was relieved by stooping forward. In some cases, patients presented with symptoms of vomiting and features of hypovolemic shock and acute abdomen We verified whether the patient presented with a history of alcohol consumption or past history of gallstone disease. All selected cases (clinically diagnosed as acute pancreatitis) were serially subjected to tests like serum amylase and lipase estimation, USG and CECT scan of abdomen. They were compared with respect to early diagnosis of the disease.

Blood was drawn by dry and clean syringe into a dry vial, the serum was separated by centrifuging the clotted blood at 5,000 r.p.m. for 5 minutes. Then serum samples were preserved at 4°C in refrigerator for further analysis for amylase. Similarly, urine and peritoneal fluid were collected in a similar manner as serum and were sent for amylase evaluation. Boehringer Mannheim Amylase PNP Kit was used for amylase estimation.

RESULTS

In present study the most common cause found was gall stone disease which was responsible for 120 cases (40%). Alcohol was responsible for 100 cases (33.33%) and Hyperlipidemia was responsible for 10 cases (3.33%). In females' gallstone is the most common cause (87.5%), and males' chronic alcoholism is the most common cause (45.54%) (Table 1).

Table 1: Distribution of aetiological factors in males and females.

Etiology	Male (n =220)		Female (n =80)		Total (n = 300)	
	Number	%	Number	%	Number	%
Gallstone	50	22.72	70	87.5	120	40
Alcohol	100	45.54	0	0	100	33.33
Idiopathic	60	27.27	10	12.5	70	23.33
Hyperlipidaemia	10	4.5	0	0	10	3.33

Serum amylase study

Out of 300 patients 140 cases had serum amylase level > 1000U/L showing diagnostic accuracy of this test about

46.66%. patients, about 23% (70) had level between 500-1000U/L and 90 patients had level <500U/L. So, present study showed diagnostic accuracy of serum amylase estimation was about 47% (Table 2).

Serum lipase levels in different etiologic groups

Out of 300 patients 210 cases had serum lipase level > 600U/L showing diagnostic accuracy of this test about 70 %., 10 patients (about 3%) had level between 200-

600U/L and 80 patients had level < 200U/L. So, present study showed diagnostic accuracy of serum lipase estimation was about 70% (Table 3). All patients of the study group were subjected to ultrasonography of abdomen and results are shown in the Table 4.

Table 2: Serum amylase levels in different etiologic groups.

Amylase (U/L)	Gall Stone		Alcoholic		Idiopathic		Total	
>1000	n=120	%	n=100	%	n = 70	%	n = 300	%
	70	58.33	20	20	50	71.4	140	46.66
500-1000	30	25	30	30	10	14.2	70	23.33
<500	20	16.60	50	50	10	14.2	90	30.0

Table 3: Serum lipase levels in different etiologic groups.

Lipase (U/L)	Gall Stone		Alcoholic		Idiopathic		Total	
>600	n=120	%	n=100	%	n = 70	%	n = 300	%
	80	66.66	70	70	60	85.71	210	70
200-600	10	8.33	0	0	0	0	10	3.33
<200	30	25	30	30	10	14.2	80	26.66

Diagnostic accuracy of USG abdomen

For diagnosing acute pancreatitis USG finding categorized into (i) Pancreatic enlargement (Focal, diffuse) (ii) Presence of peripancreatic inflammation, (iii) pancreatic and peripancreatic fluid collections, (iv) Presence of associated conditions like cholelithiasis, (v) Presence of ascites.

In this study group 250 patients out of 300 patients (i.e. 83.33% of patients) had pancreatic enlargement (Focal, diffuse), 160 patients (i.e. 53.33%) had pancreatic and peripancreatic fluid collection, 110 patients (i.e. 36.66%) had peripancreatic inflammation, 120 patients (i.e. 40%) had evidence of gall stone, 100 patients (i.e. 33.33%) had evidence of ascites and lastly 60 patients (i.e. 20%) had evidence of normal looking pancreas with no pancreatic and peripancreatic fluid collection. So, in this observation diagnostic accuracy of USG came about 83.33%.

Diagnostic accuracy of CECT scan abdomen

All 300 patients in this study group were subjected to contrast enhanced CT scans of abdomen in relation to pancreas.

In this study group 280 out of 300 patients (i.e. about 93.33%) had both pancreatic enlargement (Focal, Diffuse) and peripancreatic inflammation, 250 patients (i.e. 83.33%) had pancreatic and peripancreatic fluid collection, 80 patients (i.e. 26.66%) had evidence of pancreatic necrosis, 100 patients (i.e. 33.33%) had evidence of ascites and 20 patients (i.e. 6.66%) had normal looking pancreas. So, in this study diagnostic

accuracy of CT scan in detecting acute pancreatitis came about 93% (Table 5).

Table 4: Diagnostic features of USG abdomen.

USG Findings	No. of Cases	Percentage
Pancreatic enlargement	250	83.33
Peripancreatic inflammation	110	36.66
Pancreatic fluid collection	160	53.33
Cholelithiasis	120	40
Normal pancreas	60	20
Ascites	100	33.33

Table 5: Diagnostic features of CECT scan abdomen.

CECT Findings	No. of Cases	Percentage
Pancreatic enlargement	280	93.33
Peripancreatic inflammation	280	93.33
Pancreatic and peripancreatic fluid collection	250	83.33
Presence of pancreatic necrosis	80	26.66
Presence of ascites	100	33.33
Normal looking pancreas	20	6.66
Pancreatic abscess	0	0

From CT scan features pancreatitis was classified into Oedematous and Necrotizing varieties. Out of 300 patients in the study sample 220 were classified as Oedematous (73.33%) and 80 as Necrotizing acute pancreatitis. CT severity score was calculated from the Balthazar CT classification and necrosis score were

found to be as follows: Mild (score 0-4), number of patients to be 230 (76.66%) and severe (score 5-10) numbering 70 patients (23.33%) out of the total study sample of 300 patients.

Comparison of different diagnostic modalities

In present study group out of all diagnostic modalities CECT scan abdomen had highest percentage of diagnostic accuracy (about 93.33%) and had least

percentage of false negatively (about 6.67%). Next to it used USG abdomen had 83.33% of diagnostic accuracy.

Followed by serum lipase and serum amylase estimation had 70% and 46.66% of diagnostic accuracy respectively in diagnosing acute pancreatitis in this study group. The study group showed serum amylase estimation had least diagnostic accuracy (i.e. 46.66%) and had highest percentage of false negativity result (i.e. 53.34%) (Table 6).

Table 6: Comparison between different diagnostic modality.

Investigations	Gall Stone		Alcoholic		Idiopathic		Total	
Sr. amylase	n=120	%	n=100	%	n = 70	%	n = 300	%
	70	58.33	20	20	50	71.4	140	46.66
Sr. lipase	30	25	30	30	10	14.2	70	23.33
USG	120	100	70	70	60	85.0	250	83.33
CECT	120	100	80	80	70	100.0	280	93.33

DISCUSSION

The present study discussed about the various aspects of this fatal disease and specially, it compared serum enzyme (amylase and lipase) study with the newer methods like USG and contrast enhanced CT scan (CECT) in order to detect acute pancreatitis at an early stage and to differentiate patients having mild episode from those with severe disease. This is important because this will ensure early institution of definitive treatment, which would reduce complications, morbidity and mortality of this fatal disease.

In this study out of 300 patients, 220 patients were males and 80 patients were females. So acute pancreatitis occurring nearly three times more commonly in males than females (i.e. M:F = 3:1) in this study which is almost coinciding with the Western Literature as given by Marks and Bank in 1963 (Table 1).[5]

Majority of the patients in this study group were between 3rd to 6th decades of their life. According to Fan et al, stated that disease is more common in 3rd to 5th decade and is rare below the age or 30 years and after 6th decade.[6] Age of the patients is also important because according to Trapnell mortality of the disease increases with age particularly in patients above 60 years.[7] Pollock noted that the mortality was 15% in patients below 50 years whereas it was 29% in patients over 60 years and 40% in 22 patients over 70 years.[8] Pollock's data have remained standard but recently Fan have presented a different analysis.[6] In their study the hospital mortality rate for patients aged below 50 years was 5.9% and for those above 70 years, 21.3%. The high mortality rate was accounted for by a higher incidence of deaths related to concomitant diseases in the same hospital admission

rather than to complications resulting directly from the pathological process of acute pancreatitis. When only deaths due to complication of acute pancreatitis were analysed we found that, the mortality rate was not significantly different between the young and the elderly groups.

Coming to the aetiological factors responsible for acute pancreatitis in this study, we found biliary tract diseases and chronic alcohol abuse responsible for 40% cases and in 33.33% cases respectively and no cause could be identified in 23.33% cases (Table 1). When this study was compared with that of Western population, it was found that chronic alcohol abuse and biliary tract disease account for 81% of cases of acute pancreatitis in the Western population. In USA gall stone pancreatitis accounts for 90% of cases of acute pancreatitis. According to Corfield et al, Thomson et al, in most centres in the UK gall stone account for well over half the cases of acute pancreatitis and alcohol accounts for about one fifth to one quarter.[9,10] The etiologic role of gallstones in the pathogenesis of acute pancreatitis was first suggested by Opie and according to him transient obstruction of pancreatic duct by a gall stone in the CBD at ampulla of vater responsible for a suggested that acute pancreatic injury is initiated by the migration of gallstone.[11]

According to Marks biliary pancreatitis which is more common in females (male: female ratio 1:3) has a poorer prognosis.[5] In present study out of 120 biliary pancreatitis cases 70 cases were females so in this study males and females were almost affected equally. Etiologically mortality in biliary pancreatitis has been reported to be higher than in alcoholic pancreatitis which may partly be due to increased mean age for biliary pancreatitis.[5,12]

However, Gauthier contrary to experience of others, reported markedly higher mortality for alcoholic pancreatitis.[13] So, study on various etiologies of this disease is important because early detection of the cause lead to early institution of definitive treatment which not only decrease the mortality and morbidity but also prevent various complications of this fatal disease.

In this prospective study almost, all patients had epigastric pain (100%) associated with nausea (77%) and abdominal distension (84%). Next common symptoms exerted by the patients were radiation of epigastric pain to back associated with vomiting (near about 74%). Around 70 patients (i.e. 23%) had features of shock, 90 patients (i.e. 30%) had fever, and rigor mostly associated with biliary pancreatitis. 100 patients (33%) had features of ascites. In western study most, patients of acute pancreatitis around 90% had features of mild epigastric pain radiating to back associated with nausea and vomiting, which is comparable to our study. According to Ammann and Warstaw higher mortality rates have been reported in pancreatitis with shock, ascites, prolonged paralytic ileus, fever and leukocytosis, cholestasis of >7 days, positive Cullen's or Grey-Turner's sign, cyanosis or other systemic/ local complications.[14]

In this present study various diagnostic modalities especially elevation of serum amylase and lipase, USG and CECT scan in respect to acute pancreatitis were extensively studied in order to detect acute pancreatitis in its early stage to minimize the mortality and morbidity or this fatal disease.

According to Imrie and Shearer serum amylase elevation is the diagnostic sheet anchor of acute pancreatitis despite lack of specificity.[15] The normal level of serum amylase is 70-300 U/L Steinberg et, al using the upper limit of normal serum-amylase level as the cut off, found sensitivity of 89% and specificity of 86%, in cases of patients supposed to have suffering from acute pancreatitis. But most studies conducted in UK showed that level of serum amylase > 1000 U/L is diagnostic of acute pancreatitis. Level between 500-1000 U/L is suspicious of acute pancreatitis in patients showing features of acute pancreatitis. By taking this level as diagnostic level, specificity of this test came about 47% (Table 2).

This is important because hyperamylasemia can occur in various conditions especially mimicking acute pancreatitis e.g. perforated peptic ulcer, mesenteric ischemia, intestinal obstruction giving false positive to the above test but in these cases serum amylase doesn't exceed 1000 U/L. According to Levine serum amylase may be normal in 10-15% of patients with acute pancreatitis.[16] In present study out of 300 patients, diagnostic accuracy of 140 patients had serum-amylase level > 1000 U/L giving rise of this test about 46.66% which was comparable to the Australian study by John Treacy (sensitivity 45%) and Toouli et al.[17,18]

Patients had serum level less than 500U/L, so percentage of false negativity was found to be 30%. Out of 140 patients showing level >1000U/L majority (70 cases) were suffering from biliary pancreatitis. Out of 90 patients showing level less than 500U/L majority (50 cases) were alcoholic pancreatitis. 70 patients out of 300 patients (i.e. 23%) had serum level between 500U/L-1000 U/L. According to Salt et al, hyperamylasemia in acute pancreatitis is at least partially related directly to the degree of ductal obstruction (as in biliary pancreatitis) had inversely to the degree of acinar secretory failure (as in alcoholic pancreatitis).[19] The present study also extensively studied the diagnostic importance of serum lipase. Out of 300 cases 210 had raised serum lipase at presentation amounting to a diagnostic accuracy of 70%. This is consistent with the study by John Treacy where they found the sensitivity about 67%.[17] It was an important observation in the study that all those cases where amylase was raised lipase was also raised. This is consistent with the UK-working group on Acute Pancreatitis 2005 who state although amylase is widely available and provides acceptable accuracy, where lipase is available it is preferred for the diagnosis (Table 3).

Early diagnosis of acute pancreatitis is greatly modified after advent of USG and CECT scan because the pancreas is a difficult organ to evaluate by conventional radiologic techniques. In the past, pancreatic pathology was inferred through identification of secondary changes in the adjacent organs visualized through routine roentgenographic studies. With modern techniques like, USG and contrast enhanced CT scan visualization of normal and abnormal pancreas has greatly improved. Our study thoroughly studied the role of USG and CECT in acute pancreatitis. In our study out of 300 patients who were undergone USG, we found 17% of USG scan (i.e. of 50 patients) to be unsatisfactory for evaluation of the pancreas which was nearing the reported range of 13-37% (Table 4). The variation in different series suggested technique dependence on the operator's expertise and of the refinement of equipment. The success rate also decreased with increasing severity of the disease. In comparison, a satisfactory evaluation by CECT was reported by Silverstein et. al. 1981 in 98% of examinations.[21] This was 93.33% in our study. There are several potential limitations of USG like obesity, ileus, overlying bowel gas, marked epigastric tenderness, epigastric wounds and dressings in post-operative patients all of which comprise the quality of the USG study which was supported by Buehler.[14] Also, the extent of involvement of the retroperitoneal compartments is poorly evaluated. USG has low sensitivity in differentiating liquid collections from necrotic parenchyma. Even in expert hands, using meticulous techniques and high-resolution real-time scanners, USG could identify only 53% of abnormalities in the anterior pararenal space as compared to 84% evaluation on CECT in our study. However, USG is useful in selected patients, particularly for the evaluation of coexisting biliary disease, differentiation of cystic from solid inflammatory

masses and for the detection and serial evaluation of fluid collections. Ultrasonography is also valuable in directing needle aspiration of a pancreatic inflammatory collection to rule out an abscess or to drain a fluid collection.

Computed tomography is the most sensitive imaging modality, and has become the procedure of choice in the evaluation of patients suspected of having acute pancreatitis. The chief advantage is a complete cross-sectional image that permits an accurate assessment of the primary lesion and also of the extent of inflammation along various anatomical planes. According to White et. al CECT scan of pancreas in acute pancreatitis can give rise to typical CECT appearance which includes diffuse enlargement of the gland, decreased central density and a thick rim producing a sac like configuration especially in later states.[22] In our study peripancreatic inflammation was observed in 83% of patients, which is much higher than the reported incidence of 25%. This inflammation was mostly multi compartmental and there was a significantly higher incidence of involvement of the transverse mesocolon, small bowel mesentery, left paracolic gutter and perirenal space as compared to other reported studies.

The CECT appearance of a fluid collection depends on its stage of involvement. Acute or early collections are seen as poorly marginated areas of diminished attenuation or as a focal collection within the pancreatic parenchyma. As they mature, they become well marginated round or oval, with a discernible wall or capsule. In our study pancreatic and peripancreatic fluid collection was observed in 83% of patients, which is higher than the reported incidence of 58% (Table 5). This is better delineated compared to USG scan (in which 53% patients have shown features of pancreatic and peripancreatic fluid collection), making CECT superior for its detection which is fairly correlating with study conducted in AIIMS in 2015 by Garg, Fluid collection have a spontaneous resolution rate of about 40-50% within the first six weeks of follow up.[21]

According to Block, who used contrast enhanced CT in diagnosing pancreatic necrosis which appear as areas of low perfusion in the pancreatic necrosis in the pancreas at an early stage in the disease.[23] In our study 26% of patients had pancreatic necrosis which is not shown by USG so CECT was superior to USG scan in this respect. CECT had another advantage that by CECT studied needle aspiration we could know whether the necrosis is infected or sterile which was a deciding factor in deciding operation in pancreatic necrosis according to Albridge.[24] Pancreatic abscess is the end result of the pancreatitis spectrum and is often life threatening, multifocal and multi bacterial. These patients are extremely vulnerable and there is a high mortality rate of 32-65%. The reported overall incidence is 1-9% and is related to the severity of acute pancreatitis. In our study no patients had developed pancreatic abscess simply because majority of patients were detected at early stage of pancreatitis and treated

expeditiously. For follow up computed tomography was definitely superior in evaluating the improvement or worsening of inflammation and was more accurate than USG in assessing the disease evolution.

In different groups lipase had a better sensitivity (70%) in diagnosing alcoholic pancreatitis in comparison to amylase (20%). After diagnosis all patients were subjected to conservative treatment. Out of 300 patients 150 patients (i.e. 50%) required operative treatment along with conservative treatment. Details of conservative treatment described in the management of acute pancreatitis.[25] In the study group 150 patients (i.e. 50%) were cured only by conservative treatment. Out of 150 patients who required operative treatment along with conservative treatment, 100 patients required cholecystectomy, 40 patients required cholecystectomy with choledocholithotomy and 20 patients required necrosectomy. There was one death reported in this study group. In case of operative patients, intra peri and post-operative periods were uneventful.

Comparing all the diagnostic modalities described above it was found that contrast enhanced CT scan has highest accuracy rate (i.e. about 93% in present study) in detecting acute pancreatitis followed by USG which had diagnostic accuracy about 83% followed by serum lipase evaluation which had diagnostic accuracy 70% followed by serum amylase evaluation which had least diagnostic accuracy i.e. about 46% (Table 6).

CONCLUSION

In all respects imaging studies particularly CECT scan had highest diagnostic accuracy compared to laboratory. investigations which were supported by reported literatures. This study proved that CECT scan was very important in the following up of the patients in order to detecting regression of disease appearance and complication in relation to acute pancreatitis. Finally, it was concluded that treatment planning is based on severity of acute pancreatitis and presence or absence of infection combined with clinical signs. The revised Atlanta classification system with CECT helps guide management and monitor the success of treatment.

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