

Comparative study of ultrasonography versus computed tomography in evaluation of pancreatitis

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Introduction

Pancreatitis is one of the commonest causes of morbidity and mortality in patients presenting to the emergency.¹ It is an infrequent disease exemplified by pancreatic inflammation. It is classified into acute and chronic pancreatitis according to clinical and morphological criteria. The Southern states of India have reported to have highest incidences of Pancreatitis, ranging from 114-200/100,000 population.³ Acute pancreatitis occurs in approximately 50,000–80,000 Americans each year.⁴ However, true prevalence of chronic pancreatitis is not known as many patients with unexplained abdominal pain may have been suffering from chronic pancreatitis that eludes diagnosis. Chronic pancreatitis can be demonstrated in 0.04% to 5% of autopsies.⁵ Incidence of chronic pancreatitis in western population ranges from 8 to 10 cases per year per 100,000 population, and the overall prevalence is 27.4 cases per 100,000 population.⁶

Acute or chronic pancreatitis may possibly be correlated with pancreatic calcification, pseudocysts, extra pancreatic phlegmons, haemorrhage and pancreatic necrosis/abscess formation which can help the radiologist to make an accurate diagnosis.⁷

It is important to define and stratify the severity of acute pancreatitis for the appropriate management of the patients. Based on transient or persistent organ failure, and local or systemic complications, the severity of acute pancreatitis is classified into three degrees: mild acute pancreatitis, moderately severe acute pancreatitis, and severe acute pancreatitis.⁸

According to the Atlanta classification (2012), acute pancreatitis can be classified as interstitial edematous pancreatitis (IEP) and necrotizing pancreatitis. Pancreatic and peripancreatic collection can be categorized into acute peripancreatic fluid collection (APFC), pancreatic pseudocyst, acute necrotic collection (ANC), and walled-off necrosis (WON), based on location (pancreatic, peripancreatic), the nature of the content (liquid, solid, gas), and the presence of wall.⁸

Complications of acute pancreatitis are categorized as the following: (1) organ failure, (2) systemic complications, and (3) local complications.⁹ Chronic pancreatitis are recognized as a large-duct type and a small-duct variant based on the diameter of the main pancreatic duct (MPD). Abdominal pain is the most predominant clinical finding in patients. Other associated findings seen are nausea, vomiting, fever and pain radiating to the back. Patients can also present with additional complications of the disease (e.g., pseudocyst, vascular thrombosis, or obstruction of adjacent organs); or additional complaints that suggests endocrine or exocrine pancreatic failure, or both.¹⁰

USG is used in the diagnosis and assessment of imaging of organs and soft tissue structures. Because of its non-invasive nature and continuing improvements in the imaging quality, ultrasound imaging is progressively achieving a significant role in assessing pancreas. It can diagnose pancreatitis and eliminate additional reasons of abdominal pain. With increasing operator experience and advances in technology USG can evaluate pancreatitis in majority of cases. USG is operator dependent but has its own limitation in overweight persons and individuals including substantial volume of bowel gas. Contrast-enhanced ultrasound (CEUS) can additionally be utilized for diagnosing severe acute pancreatitis.¹¹

Computed tomography (CT) is a reliable modality and provides good definition of lesions and facilitates the visualization of the entire extent of pancreatic pathology. Diagnostic confusion in USG for diagnosis of pancreatitis can be further clarified in CT evaluation. Multiplanar three-dimensional reconstruction techniques involving volume rendering, maximum intensity projection (MIP) and shaded surface display delivers a thorough information regarding the interactions and potential engagement of vascular structures and demonstrating local extension.

Wider availability and good image quality make CT one of the most used imaging technique, but on contrary it is expensive, exposes the person to ionizing radiation, and may have difficulty in defining fat planes in lean patients.¹²

Although pancreatitis is amongst the most leading presentations to a clinical emergency yet there is dearth of radiological literature in evaluation of pancreatitis by USG. This study has been undertaken to evaluate the efficacy of USG in pancreatitis and compare with the CT finding.

Materials and method

The present study was a prospective study carried out in the department of Radio-diagnosis, Rohilkhand Medical College and Hospital, Bareilly. The study was conducted from 31st October 2019 to 1st November 2020.

Sample Size

50 patients referred from clinical department with clinical features of acute and chronic pancreatitis was included in the study. The sample size for the study was calculated by considering prevalence of pancreatitis cases in our hospital which is approx. 10%, and the final sample size was taken by using PASS software by setting power at 80% and p-value at 0.05. The presumptive diagnosis is centred on a combination of clinical and laboratory parameters like pain in upper abdomen, pain radiating to back, fever, nausea, vomiting, raised serum values of pancreatic enzymes like Amylase and Lipase.

Selection of study subjects

The study included male and female patients of all ages who are referred to the department with complaints of abdominal pain and suspected diagnosis of pancreatitis. The patients already diagnosed with pancreatitis and referred to the radiology department.

The patients excluded were patients refusing consent to participate in the study, history of hypersensitivity to intravenous contrast agent, Post-surgical patients, Pregnant women and eGFR < 30 mL/min/1.73 m² (13)

Statistical analysis

The data was entered into Microsoft Excel and analysed using SPSS (Statistical Package for Social Sciences) package 26.0 for relevant statistical comparisons. Results will be presented in the form of tables and graphs. Descriptive statistics was performed by calculating mean,

standard deviation, frequencies and percentages for the Continuous variables. Categorical variables will be summarized as frequencies and percentages.

Results

The present prospective study included 50 patients of which 31 patients were diagnosed with acute pancreatitis and 19 patients were diagnosed with chronic pancreatitis. Percentages were rounded off by two decimals. The following are the conclusions of this study:

Majority of patients with acute pancreatitis were between 31 to 50 years of age groups who represented more than 50% of the total populace with acute pancreatitis. The median age of patients in acute pancreatitis was 38 years. In patients with chronic pancreatitis, most patients were aged between 41-50 years representing around 47.37% of the total chronic pancreatitis patients. The median age of patients with chronic pancreatitis was higher (41 years) as compared to acute pancreatitis. Most patients with pancreatitis were males (36 out of 50 patients) representing approximately 80% of the total. It was additionally observed that females with acute pancreatitis have a propensity to be older as compared to males whereas vice versa was observed in chronic pancreatitis cases.

Most patients presented with abdominal pain and vomiting. Alcoholism was determined as the most frequent etiology in the study followed by Idiopathic cause. Several patients had more than one suspected etiology, however the primary etiology was considered for the objective of evaluation.

Ultrasonogram was done in 28 out of 50 patients of acute pancreatitis in the current research. In acute pancreatitis, an enlarged pancreas is caused by the interstitial edema.

CT imaging of the pancreas was possible in all cases due to noninterference by the overlying bowel gas. There was bulky pancreas in 66.66% patients of AP.

Discussion

Age and sex distribution

In our study, majority of patients with acute pancreatitis were between 31 to 50 years of age groups who represented more than 50% of the total populace with acute pancreatitis. Females with acute pancreatitis have a propensity to be older as compared to males whereas vice versa was observed in chronic pancreatitis cases.

Silverstein et al¹³ also noted that males with acute pancreatitis were older (mean age 41 years) than females (mean age 32 years).¹⁴ In studies by Luetmer, Stephens and Ward¹⁵ and by Alpern et al¹⁶ similar findings were observed where the mean age of male and female patients with chronic pancreatitis was 54.3 years and 47 years, respectively.

Presentation

In present study, majority had a record of liquor consumption (20 out of 50 patients with acute pancreatitis) and 5 patients provided a record of an alcoholic bender preceding to onset of symptoms. Trauma was regarded as an etiological factor in three cases, following a road traffic accident. In one case, the patient was positive for rheumatoid factor and hence an autoimmune etiology was suggested. In 12 patients, no cause could be found, and these were categorised as idiopathic. Other cause was the presence of cholelithiasis in 9 patients. The serum and / or ascitic fluid amylase was elevated in all the instances of acute and in none of the instances of chronic pancreatitis.

Ultrasound findings in acute pancreatitis

Ultrasonogram was done in 28 out of 50 patients of acute pancreatitis in the current research. The pancreas was visualized in 25 patients and obscured in the remaining 3.

This was in concordance with a study reported by *Calleja and JS Barkin*¹⁷ that asserted in acute pancreatitis overlying bowel gas disturbances may obscure the pancreas in 40% of patients.

In the present study, hypoechoic pancreas was witnessed in 15 patients but as many as 6 patients had a normal echogenicity. While the remainder, the pancreas had a heterogenous echotexture representing 14.3% of the acute cases. Of the 4 patients with a heterogenous echotexture of pancreas, 1 was a case of acute on chronic pancreatitis.

The manifestation of duct dilatation and calcification in acute pancreatitis is very variable.^{18,19} In the current study, ductal dilation was observed in 7 cases of whom 5 cases also demonstrated calcifications. Focal lesions were witnessed in 9 patients with AP of whom 3 patients were cases of traumatic pancreatitis and had focal lesions in the manner of contusions or hematomas. In the remaining 6 patients fluid collections/ necrosis were seen as focal lesions.

CT findings in acute pancreatitis

CT imaging of the pancreas was possible in all cases due to noninterference by the overlying bowel gas. The current study revealed bulky pancreas in 18 cases out of 27 (66.66%) patients of AP in whom CT was performed like the study by Silverstein¹⁶ where 70/98 (71%) patients revealed bulky pancreas.

On CT duct dilatation and calcification were observed in 9 and 5 patients of whom 5 were cases of acute on chronic pancreatitis. Focal intra pancreatic lesions were seen in 11 patients (41%) which is contrary to that reported by EJ Balthazar²⁰ where 18% of patients were seen to have focal lesions.²

Extra pancreatic findings like fluid collections were seen in 7 patients (25.92%), and exudates in 9 patients (33.33%) with AP on CT. Stomach wall thickening was viewed in 11 patients (40.74%) and Gerota's fascia thickening, seen in 13 patients (48.14%). Free intraperitoneal fluid representing ascites was spotted in 4 patients (16%) in our study which was more than that reported by EJ Balthazar (7%).²⁰ Pleural effusions were seen in 10 patients (37.03%) in the current study which was also more than that reported by EJ Balthazar.²⁰

Comparison between Ultrasonography and CT in acute pancreatitis

Comprehensively image of the pancreas was considerably greater by CT than by ultrasound. With advancement in technology, morphological depiction of pancreas has improved in both modalities. Pancreas in AP was seen in upto 89.28% patients on ultrasonography and in 100% of patients on computed tomography on our study.

Alterations in size were better appreciated on CT. On CT, 18 subjects with acute pancreatitis (66.66%) were seen to have a bulky as matched to USG where only 14 cases (50%) were seen to have bulky pancreas. Amongst the remainder, 1 patient showed atrophied pancreas attributable to underlying chronic pancreatitis: and in 8 patients the size of pancreas was normal. The clinical and biochemical findings of these subjects were also reminiscent of AP, and they were conservatively managed. During discharge patients were asymptomatic. Incidentally, the ultrasound study of these patients was also normal.

Duct dilatation was witnessed in seven patients on USG and nine patients on CT whereas calcification was picked up in five patients on both modalities. Hence, CT ascertaining to be further effective in detection of ductal dilatation. Nevertheless, because of the availability of injecting intravenous contrast, the complication of portal vein thrombosis was detected during the CT scan of one patient. However, the ultrasonogram failed to detect it. The sensitivity of ultrasonography in identifying acute pancreatitis was 59 % in the patients where pancreas remained visualized. However, if all the sonographic studies were considered, sonography diagnosed acute pancreatitis in only 17 of 36 cases representing 41.5% of

cases. CT showed sensitivity of 96% mainly due to better visualization (100%) and better assessment of size. The specificity could be determined as all the subjects had pancreatitis. Although, the positive predictive value was 100% on both imaging modalities. This drives us to the inference that on ultrasound a bulky and hypoechoic pancreas denotes acute pancreatitis. This must be noted that five patients endured surgery and two amongst them showed no morphological changes in pancreas on ultrasonography.

In the other 3, the pancreas was obscured. Hence, as mentioned by SJ Hessel et al,²¹ a negative ultrasound study does not eliminate substantial and, at occasions, life-threatening pancreatic disease.¹⁹

Ultrasound and CT findings on Chronic Pancreatitis

Size alterations

The size in chronic pancreatitis is believed to link with the activity or chronicity of the disease process. The current study showed an atrophic pancreas in 10 patients (55.55%) and a normal sized pancreas in the left over 8 patients (44.44%) during USG whereas on CT 16 patients (94.11%) were detected with atrophied pancreas and one with normal pancreas (5.55%). This indicates that CT imaging is further sensitive than USG. Additionally, studies reported by MB Alpern et al²² and L. Bolondi et al,²³ have shown that size alterations do not aid in the diagnosis.¹

Calcifications

Calcifications was observed in 8 patients (44.44%) on USG, 9 patients (52.94%) on CT-Scan, and very common finding along with a dilated main pancreatic duct in chronic pancreatitis. Studies reported by MB Alpern et al²² and L Bolondi et al²³ have demonstrated a detection rate of 40-57% and mentioned that CT is superior for detecting calcification supporting the current findings.¹

Duct dilatation

This is the most consistent sign in chronic pancreatitis⁷. It was noticed in 11 out of 18 patients of chronic pancreatitis, indicating it as the highly popular finding on sonography in chronic pancreatitis. The incidence of abnormal main pancreatic duct varies from 20% to 52.3% of cases.²⁴ This study showed this finding to be most common along with calcifications / calculi and was witnessed in 61.11% cases. However, ERCP is more sensitive than ultrasound for detecting ductal changes.

Echogenicity

The infiltration by retroperitoneal fat may alter the echogenicity of the pancreas making it hyperechoic. Acute inflammation may produce areas of decreased echogenicity. In the study CP showed echotexture abnormalities that were seen in 14 patients (77.77%) with 6 patients (33.33%) being heterogenous in echotexture. Studies have shown echotexture alterations in 55-57% of cases.

Other findings

Out of 18 patients, five patients had Ascites, five patients had gall stones, five patients had pleural effusion and the remainder three were diagnosed with fatty liver. Cholecystitis and portal vein thrombosis were least common findings.

CT was done only in 17 cases which showed majorly atrophic pancreas, calcifications and dilated main pancreatic duct which were the most common findings noted by PH Luetmer, David H. Stephens²⁵ in 54%, 50% and 68% of cases respectively.²⁶

Comparison between Ultrasonography and CT in Chronic Pancreatitis

All the patients who were detected with chronic pancreatitis on ultrasonography were treated as such and findings were confirmed by CT in each instances apart from one. The sensitivity was 100%, higher than the sensitivity reported by L. Bolondi et al²³ which was 70%.²⁴ The patients in the current study were fewer due to low incidence (0.2-3%) in the general population.⁸

Nevertheless, in all the patients, the ultrasound visualization was satisfactory, and the observation of a dilated duct combined with an atrophic pancreas was diagnostic of chronic pancreatitis. Hence, as L. Bolondi et al,²³ study suggested that in suspected pancreatic disease patient ultrasound must be the first imaging modality to be used. Ultrasound may lead to a definite diagnosis and visualize complications of CP. In fact, the most accurate assessment of CP is achieved by a blend of medical evaluation (symptoms and pancreatic function tests) and radiologic definition of duct and parenchyma changes.¹² In the current study, the findings were furthermore evident during CT-Scan with increased diagnosis of atrophied pancreas, ductal dilatation, and calcification. Hence, adhering that CT has increased sensitivity than USG.

Summary and conclusion

Ultrasonography is a non-invasive, economical, and safe modality for the imaging of pancreatitis. The limits are non-visualization of pancreas from bowel gas, incapability to evaluate extra pancreatic spread of inflammation and vascular complications. During ultrasonography, enlargement, changed echogenicity, adjacent edema is indicative of acute pancreatitis, however calcification, ductal dilatation and atrophy are significative of chronic pancreatitis.

CT captures all the constraints of ultra-sonogram. It is a confirmatory investigation in diagnosis and staging of Acute or Chronic pancreatitis and further effective for evaluation of severity.

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