Comparison between Noncontrast Enhanced and Contrast Enhanced Abdominal CT Scan in Patients with Acute Pancreatitis

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ABSTRACT

Objective: To retrospectively compare between non enhanced and enhanced abdominal CT scan and evaluate sensitivity in diagnosis of acute pancreatitis.
Methods: A total of 150 patients diagnosed with acute pancreatitis between January 2008 and December 2011, were enrolled in this study. Abdominal CT images on both precontrast and postcontrast phase in 141 patients (91 male and 50 female, and age range 4-81 years) were retrospectively reviewed. Single non contrast studies were done in 9 of 150 patients. The time period from clinical onset to imaging was within 4 weeks except for 4 patients. Two observers evaluated the CT findings (intraparenchymal, peripancreatic and locoregional findings) of each phase of image separately. The agreement between non contrast and contrast enhanced CT scan of each finding, CT grade and severity were evaluated.
Results: The percentagess of pancreatic CT findings were pancreatic enlargement, abscess, necrosis and pseudocyst at 75.9/75.9%, 11.3/3.5%, 30.5/17.7%, and 6.4/5.7%, compared between Contrast enhanced computed tomography (CECT) and noncontrast enhanced computed tomography (NECT), respectively. The percentages of peripancreatic findings were irregular pancreatic outline, obliterated peripancreatic fat, retroperitoneal edema, acute peripancreatic fluid (APFC) and acute necrotic collection (ANC) at 82.3/89.4%, 77.3/85.1%, 18.4/0%, 36.9/44.7% and 32.6/14.9%, respectively. The percentages of locoregional findings were Gerota's fascia sign, pancreatic ascites, pleural effusion and adynamic ileus at 75.9/85.8%, 61.0/56.7%, 46.8/48.2% and 2.1/0% respectively. About CT grading, grade A (normal CT findings) was found 7.8% and 8.5% on CECT and NECT, respectively. Grade C, D and E were found 36.9/61.7%, 14.9/10.6% and 40.4/19.1%, respectively. Also for severity, mild level was found 44.7/70.2% and severe level was found 55.3/29.8% on CECT and NECT.
Conclusion: Both NECT and CECT scans of the whole abdomen in patients with acute pancreatitis have concordance in interpretation of the CT findings as well as sensitivity in diagnosis. Moreover, NECT has equivalent efficacy in screening of pancreatic abnormality, as compared with CECT. Therefore, we suggest that NECT can be the initial screening modality in patients with acute pancreatitis to confirm diagnosis, severity assessment or evaluation of the complication.

Keywords: Acute pancreatitis, CT findings of acute pancreatitis

Abbreviations: Contrast enhanced computed tomography (CECT) and noncontrast enhanced computed tomography (NECT), acute peripancreatic fluid (APFC) and acute necrotic collection(ANC)

Siriraj Med J 2013;65:157-162
E-journal: http://www.sirirajmedj.com

INTRODUCTION

Acute pancreatitis (AP) is defined as inflammation of the pancreas with variable secondary involvement of remote organs. The initial diagnosis for AP is made clinically from signs and symptoms of an acute abdomen and elevation of pancreatic enzymes, such as amylase and lipase, in the blood or urine. Once the diagnosis is confirmed, it is usually evident clinically within the first 48-72 h as to whether the condition will be mild or fulminant. Mild pancreatitis is characterised by minimal or absent systemic organ dysfunction and tends to abate by the third day. In contrast, fulminant pancreatitis demonstrates progressive clinical symptoms and signs with associated metabolic and multi-organ dysfunction,

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Received 4 April 2013
Revised 30 May 2013
Accepted 31 May 2013

resulting in a prolonged hospital course, significant morbidity and mortality.[1-4]

Since the 1980s, many clinical scoring systems, such as Ranson's criteria and the APACHE II (Acute Physiology and Chronic Health Evaluation) score, have been used to provide an objective assessment of the severity of pancreatitis.

Nowadays, imaging plays a vital role in the management of pancreatitis. It enables diagnosis and differentiation of the severity of this condition. This is crucial for guiding clinical management and has prognostic value. In addition, it helps to identify and manage the associated complications with image-guided drainage and aspiration. Contrast-enhanced CT is the most clinically useful investigation.

Although contrast enhanced CT scan is the most clinical useful investigation, there are some limitations in patients with contrast media allergy, renal insufficiency as well as in patients with severe pancreatitis with multiorgan failure or unstable hemodynamic or impending shock who cannot be assessed by the IV line.

Therefore, the aim of this study was to compare between non enhanced and enhanced abdominal CT scan and evaluate their sensitivity in diagnosis of acute pancreatitis.

MATERIALS AND METHODS

Patient

The institutional review board approved this study, and informed consent was waived. A total of 150 patients, who were diagnosed with acute pancreatitis between January 2008 and December 2011, were enrolled in this study. All of the patients had CT performed in Siriraj Hospital. Abdominal CT images on both pre-contrast and post contrast phases in 141 patients (91 male and 50 female, and age range 4-81 years) were retrospectively reviewed. Single non contrast studies were performed in 9 of 150 patients.

Clinical criteria

The diagnosis of acute pancreatitis was made clinically from patient history, signs and symptoms of an acute abdomen and an elevation of pancreatic enzymes, such as amylase and lipase, in the blood or urine.

Imaging technique

All patients were imaged with Two 64 slide-CT scanners LightspeedVCT; GEHealthcare or Dual-Source CT; Siemens. The Siriraj pancreatitis protocol was performed; axial, pre-contrast and axial, post contrast, pancreatic phase (40 secs after start of contrast injection) in 1.25 or 1.5 mm. thickness. Intravenous contrast medium used a non ionic contrast media 100 cc and water 20 cc by IV 2cc/sec and oral contrast was also used. Dose care of 120 Kvp, 250 mAs or 500 mAs was set.

Imaging analysis and data collection

The demographic data, age and sex, as well as CT findings were collected in the patient record forms. Two hundred and eighty two studies of 141 patients were randomized into two groups of NECT and CECT sets. The first set of patient with NECT was reviewed and collected separately by two observers, one radiologist with more than 4 years experience in abdominal imaging and one senior radiology resident. Then, the set of patients with CECT were done 2 weeks later to prevent bias. The imaging findings on both NECT and CECT groups were categorized into intrapancreatic findings (enlargement of pancreas, abscess, necrosis and pseudocyst), peripancreatic/extrapancreatic findings (irregular pancreatic outline, obliterated peripancreatic fat, retroperitoneal edema, acute peripancreatic fluid collection (APFC) and acute necrotic collection (ANC)), and locoregional findings (Gerota's fascia sign, pancreatic ascites, pleural effusion and adynamic ileus). The time period from clinical onset to imaging was within 4 weeks except for 4 patients.

Statistic analysis

Statistical analyses of the data were performed using Kappa for evaluation of agreement between non contrast and contrast enhanced CT scans of each finding, CT grade and severity.

RESULTS

A total of 150 patients who were diagnosed with acute pancreatitis, were enrolled in this study. Abdominal CT images on both pre-contrast and post contrast phase in 141 patients (94%) (91 male and 50 female, age range 4-81 years, and mean age 50.64 years). Single non contrast studies were done in 9 of 150 patients (6%) because of emergency condition and impaired renal function. The onset of symptoms until imaging was within 4 weeks after symptom onset except for 4 patients.

The percentages of pancreatic CT findings were pancreatic enlargement, abscess, necrosis and pseudocyst at 75.9%/75.9% (kappa 0.651), 11.3%/3.5% (kappa 0.446), 30.5%/17.7% (kappa 0.659), and 6.4%/5.7% (kappa 0.812), compared between CECT and NECT, respectively. The percentage of peripancreatic findings were irregular pancreatic outline, obliterated peripancreatic fat, retroperitoneal edema, acute peripancreatic fluid (APFC) and acute necrotic collection (ANC) at 82.3%/89.4% (kappa 0.539), 77.3%/85.1% (kappa 0.379), 18.4%/0%, 36.9%/44.7% (kappa 0.518) and 32.6%/14.9% (kappa 0.531), compared between CECT and NECT, respectively. Also the percentages of locoregional findings; Gerota's fascia sign, pancreatic ascites, pleural effusion and adynamic ileus were 75.9%/85.8% (kappa 0.549), 61.0%/56.7% (kappa 0.620), 46.8%/48.2% (kappa 0.829) and 2.1%/0%, compared between CECT and NECT, respectively. (Fig 1)

About CT grading, grade A (normal CT findings) was found 7.8% and 8.5% on CECT and NECT, respectively. Grade C, D and E were found 36.9%/61.7%, 14.9%/10.6% and 40.4%/19.1%, compared between CECT and NECT, respectively. (Table 1)

We found significant concordance between NECT and CECT in patients with acute pancreatitis in terms of

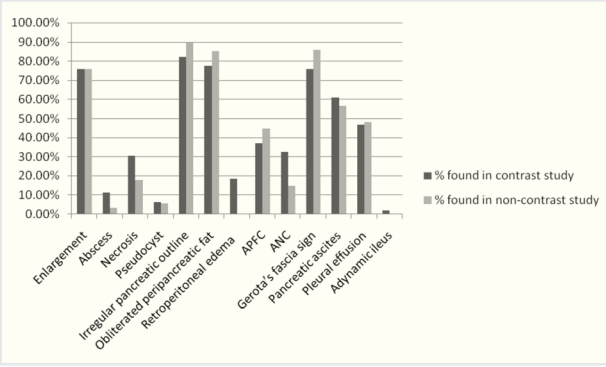

Fig 1. Comparison between frequency of contrast enhanced computed tomography (CECT) and noncontrast enhanced computed tomography (NECT) findings in acute pancreatitis.

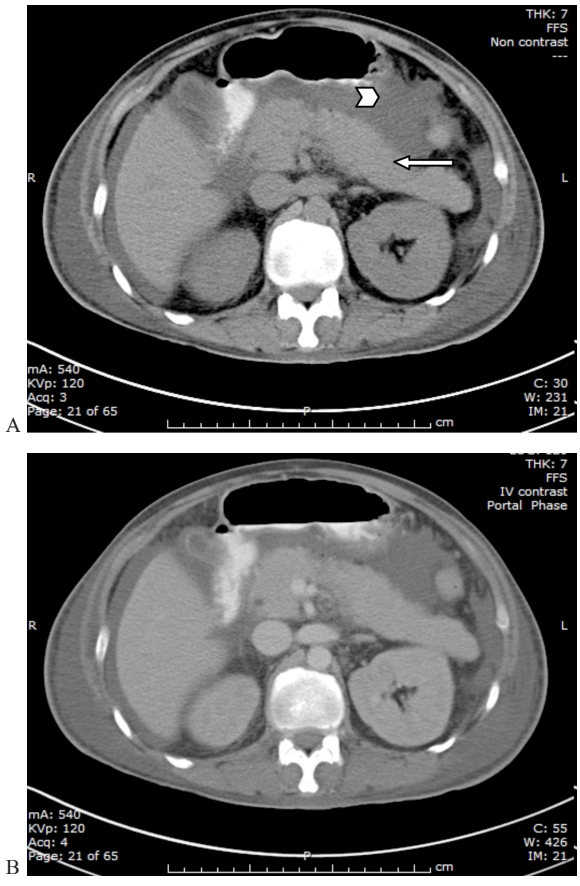

Fig 2. 38-year-old man with acute pancreatitis. Abdominal CT scan of acute pancreatitis patient, both Non contrast enhanced CT (A)and contrast enhanced CT (B)at the same level showed diffused enlarged pancreas (arrow) with ascites (arrowhead).

both intrapancreatic and extrapancreatic features. All of these findings can be conspicuously detected on NECT including enlargement of pancreas and ascites (Fig 2), acute peripancreatic fluid collection (Fig 3), Gerota's fascia sign (Fig 4) pancreatic necrosis (Fig 5, 6), and pleural effusion (kappa 0.6-1.0).

DISCUSSION

Acute pancreatitis is the inflammation of the pancreas from various causes mainly related to gallstone and alcoholic ingestion. Radiological imagings in particular computed tomography (CT) is considered as the primary current modality to diagnose and assess the severity of acute pancreatitis. CT is also recommended to be conducted in those individuals with questionable diagnosis, increased amylase with severe clinical pancreatitis, Ranson score greater than 3 or an APACHE II score greater than 8, minimal improvement in clinical status over 72 hours of conservative treatment and/or initial treatment response followed by acute change indicating complication.

Between noncontrast enhanced contrast CT (NECT) and contrast enhanced CT (CECT), it has long been generally accepted that CECT provided improved diagnostic accuracy in patients with acute pancreatitis. Normally intravenous contrast medium is necessary for differentiation of the pancreas from adjacent organs as well as for characterization of intrapancreatic abnormality, pancreatic necrosis, peripancreatic fluid collection or other inflammatory process.

However, it is not unusual to encounter some complicated acute pancreatitis with renal failure, allergic to contrast medium and/or inaccessible for intravenous line. In this regard, NECT may be the only imaging of choice. Taken into consideration, there are still many advantages of NECT over CECT including risk free from contrast medium adverse reaction and nephrotoxicity, in high risk

TABLE 1. Comparison of CT grade found in contrast enhanced computed tomography (CECT) and noncontrast enhanced computed tomography(NECT) in acute pancreatitis.

			CT grade NECT				Total
			A	C	D	E	
CT grade CECT	A	Count	11	0	0	0	11
		% of Total	7.80%	0%	0%	0%	7.80%
	C	Count	1	51	0	0	52
		% of Total	0.7%	36.20%	0%	0%	36.9%
	D	Count	0	15	6	0	21
		% of Total	0%	10.60%	4.30%	0%	14.9%
	E	Count	0	21	9	27	57
		% of Total	0%	14.90%	6.40%	19.10%	40.4%
Total		Count	12	87	15	27	141
		% of Total	8.50%	61.70%	10.60%	19.10%	100%

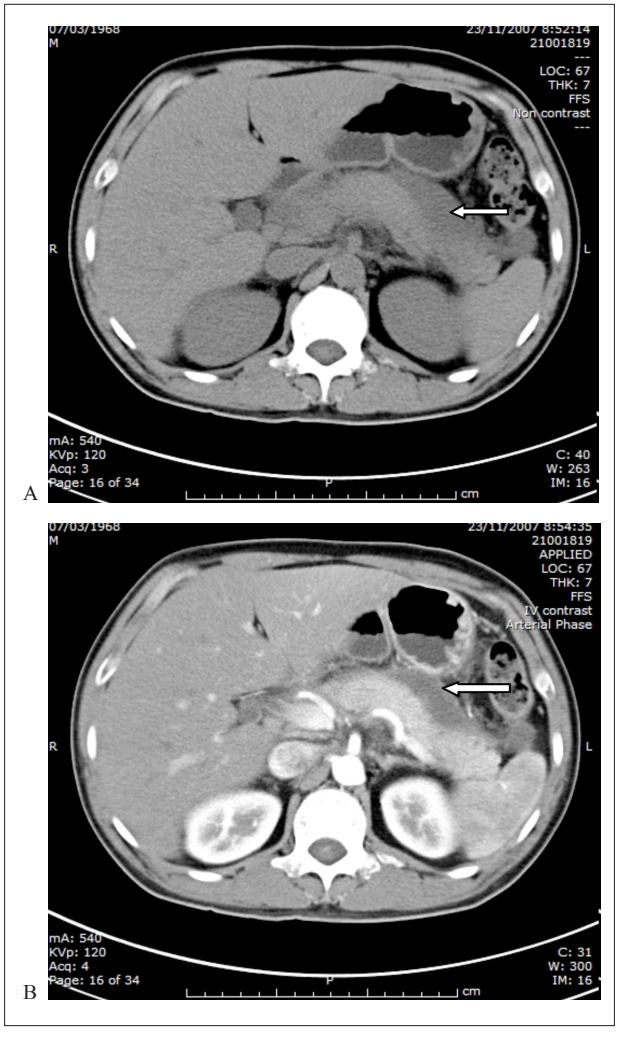

Fig 3. A 39-year-old man with acute pancreatitis. Non contrast-enhanced CT (A) and contrast-enhanced CT scan of abdomen (B) showed mild diffused enlarged pancreas with acute peri-pancreatic fluid collection (arrow).

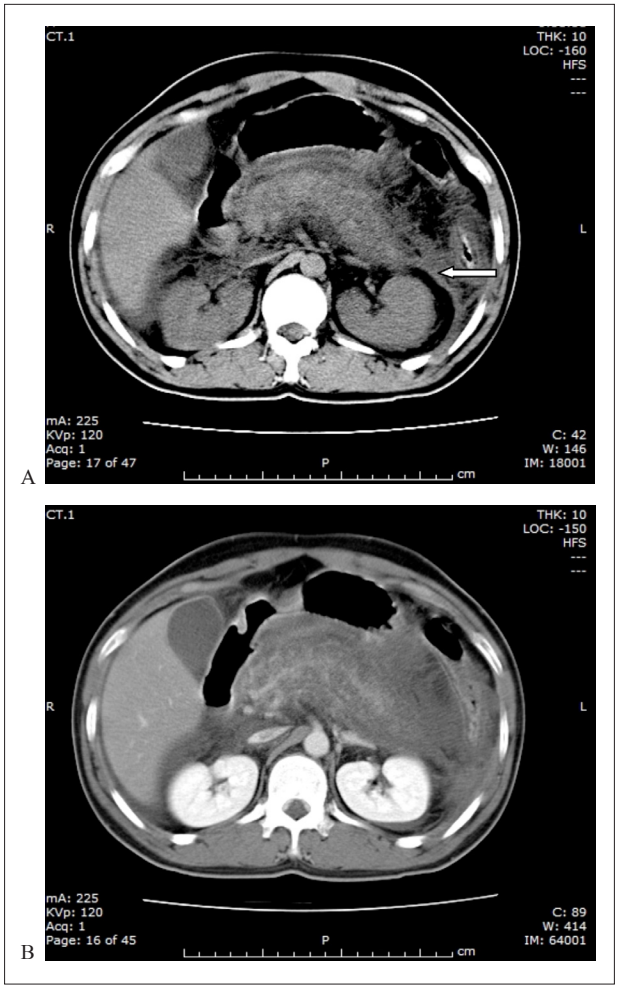

Fig 4. A 30-year-old man with acute pancreatitis. Non contrast enhanced CT (A) shows mildly enlarged pancreas with irregular outline. Gerota's fascia sign is positive (arrow). Scattered foci of low density areas are also detected almost entirely pancreatic parenchyma on both noncontrast. Enhanced CT and contrast enhanced CT (B). Acute necrotic fluid collection was detected at peripancreatic region.

patients such as longstanding DM and HT, with optionally no need for oral contrast that often takes several hours and reduced imaging cost expense.[5,6]

In addition, contrast medium has been shown to impair the microcirculation and increase acinar necrosis and mortality in animal models of pancreatitis. However, a recent study in clinical patients reported that contrast enhanced abdominal CT did not appear to aggravate the severity of acute pancreatitis.[7,8]

Only a few prior studies have been done to evaluate the benefit of NECT to evaluate patients with acute pancreatitis. Austin, et al, assessed that early non contrast enhanced abdominal CT in mortality prediction in severe acute pancreatitis was a valuable prognostic indicator of mortality in acute pancreatitis, even among patients without clinical features of severe acute pancreatitis. These data supported the suggestion that intravenous contrast medium may be reserved for individuals with high grade Balthazar CT scores on initial CT examination and/or high clinical suspicion for severe pancreatitis.[9] J Dario Casas, et al, also assessed the prognostic value of CT in the early assessment of patients with acute pancreatitis. They concluded CT grade was sensitive for predicting outcome in acute pancreatitis and suggested that the use of iodinated contrast material to assess necrosis could be reserved for only those patients classified as having severe disease on unenhanced CT.[10]

In our study, we found significant concordance between NECT and CECT in patients with acute pancreatitis. Moreover, NECT has equivalent efficacy in screening of pancreatic abnormality, as compared with CECT. Therefore, we suggest that NECT can be the initial screening with sufficient modality in patients with acute pancreatitis to confirm diagnosis or evaluation of the complication.

Basically, pancreatic necrosis is one of the worse prognostic factors in acute pancreatitis, which is described by hypoenhancing or nonenhancing area in the pancreatic parenchyma following contrast medium administration. Therefore NECT seems to have some limitations to depict pancreatic necrosis. However, we designed our study to include pancreatic necrosis as one of the imaging param-

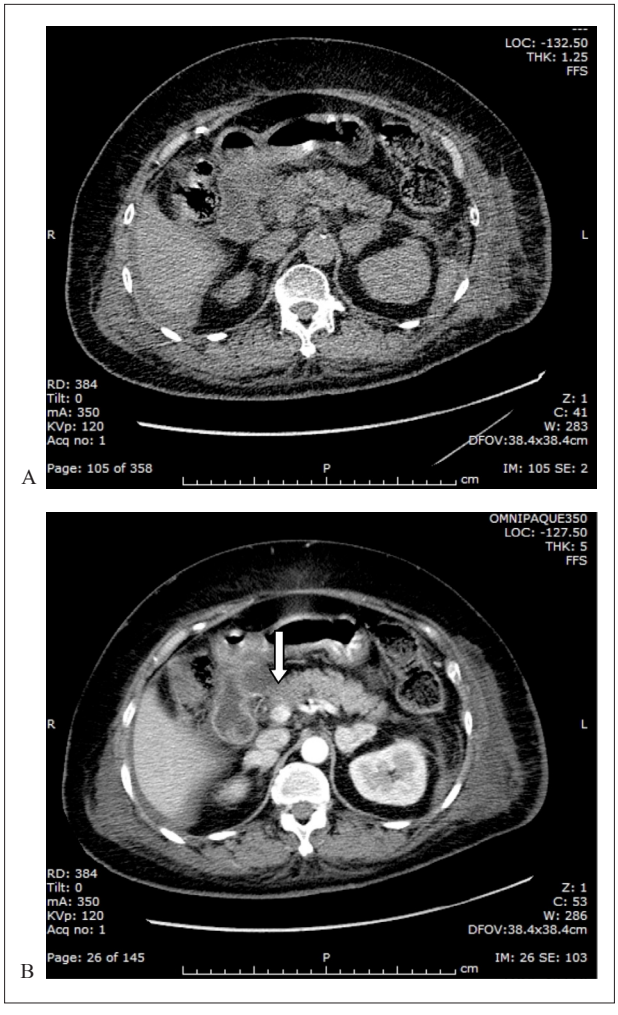

Fig 5. A 60-year-old woman with acute pancreatitis. Noncontrast enhanced CT (A) shows normal size and attenuation of pancreas but thickening left Gerota's fascia and minimal ascites at subhepatic and left anterior pararenal space. Contrast enhanced CT (B) there is a small area of non-enhancing lesion at pancreatic head (arrow), highly suspicious of acute necrotizing pancreatitis.

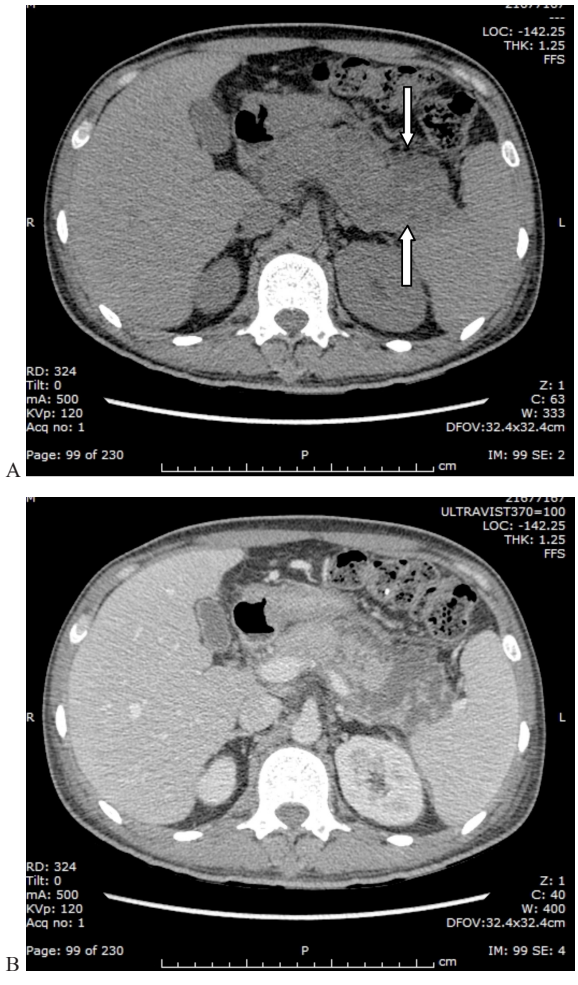

Fig 6. A 33-year-old man with acute pancretitis. Noncontrast enhanced CT (A) shows diffused enlarged pancreas with irregular outline. Scattered foci of low density areas are also seen at pancreatic body to tail (arrow). Contrast enhanced CT (B), the scattered foci of low density on non contrast study were non enhancing area which was likely necrosis. Acute necrotic fluid collection was detected at peripancreatic region.

eters in our NECT evaluated paradigm. Surprisingly the outcome of our study has shown that pancreatic necrosis can be at least detected as intrapancreatic hypoenhancing lesion, as we detected it in 25/141 patients (17.7%) in the NECT group compared to 43/141 patients (30.5%) (Kappa 0.659) in the CECT group.

We assumed that there were three reasons including, necrotic pancreatic parenchyma has inflammation producing extracellular fluid formation which causes more hypodensity on adjacent pancreatic parenchyma on NECT, necrotic area is large enough to be detected and awareness of radiologists who interpreted the imaging in this study.

Actually the hypodensity area that is discovered on NECT may be seen in other conditions such as focal fat infiltration, pancreatic cystic lesion or necrotic pancreatic tumor. However, in our study, all included patients had been clinically and biochemically confirmed acute pancreatitis, so we assumed that the hypodensity area that was found on NECT were pancreatic necrosis by using other clues of imaging findings for instance pancreatic enlargement, irregular pancreatic outline, acute peripancreatic fluid collection and/or Gerota fascia sign.

The limitation of this study included the retrospective way of collecting data and interpretative bias of pancreatic necrosis because of non blinded clinical information of acute pancreatitis

CONCLUSION

Both non-enhanced CT and contrast enhanced CT scan of the whole abdomen in patients with acute pancreatitis are significantly concordant in interpretation of the CT finding, both intrapancreatic and extrapancreatic findings. Moreover, NECT has equivalent efficacy in screening pancreatic abnormality, as compared with CECT. Therefore, we suggest that NECT can be the initial screening modality in patients with acute pancreatitis to confirm diagnosis, severity assessment or evaluation of any complication.

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