

Role of conventional radiography, duplex ultrasound and MDCT in diagnosis of acute pancreatitis

Nishant Mishra^{1,*}, Kanchan Dhungel², Mukesh Kumar Gupta³, Kaleem Ahmad⁴, Shailesh Adhikary⁵, Raj Kumar Rauniyar⁶

¹Assistant Professor, ^{2,4}Associate Professor, ³Additional Professor, ^{5,6}Professor, ^{1,2,3,4,6}Dept. of Radiodiagnosis & Imaging, ⁵Dept. of General Surgery, B.P. Koirala Institute of Health Sciences, Dharan, Nepal

***Corresponding Author:**

Email: nishant27nepal@gmail.com

Abstract

Introduction & Objectives: For Acute Pancreatitis, Conventional radiography is the initial imaging modality, Ultrasonography (US) is indicated early in an acute episode, and major indications for MDCT (Multi Detector Computed Tomography) in patients with acute pancreatitis are to establish or confirm the diagnosis. Objectives were: (1) To analyse the radiographic features of acute pancreatitis on plain radiograph, considering CT as a gold standard. (2) To assess the accuracy of duplex ultrasound in the diagnosis of acute pancreatitis considering CT as a gold standard. (3) To study the MDCT features of acute pancreatitis.

Materials and Methods: A prospective cross sectional study was conducted on 41 patients in B P Koirala Institute of health sciences, over the period of one year (from July 2012 to June 2013). All the patients with clinical / biochemical suspicion of acute pancreatitis were included in the study. Plain radiography, duplex US & MDCT were done and different parameters were evaluated.

Results: The sensitivity of each signs on X-ray was ranging from 21.43 to 91.8 %. The sensitivity of each parameter of US in diagnosis of acute pancreatitis was ranging from 66.67 to 97.3 %.

Conclusion: Plain radiograph can be used as the initial imaging modality in acute pancreatitis, but not to confirm the diagnosis. Duplex US has good role in evaluating the extra-pancreatic complications of acute pancreatitis & has excellent role in evaluating the biliary status of the patient with acute pancreatitis. MDCT is indicated to grade the severity and prognostication of the disease.

Keywords: Plain radiograph, Duplex US, MDCT.

Introduction

Acute Pancreatitis is defined as an acute inflammatory process of the pancreas with variable involvement of other regional tissues or remote organ systems.⁽¹⁾ 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.⁽²⁻⁴⁾

Gallstones and alcohol abuse are the most common causes of acute pancreatitis, accounting for 60-80% of cases. In approximately 10-25% of patients, no underlying cause is found.⁽⁵⁻⁷⁾ The hallmark symptom of acute pancreatitis is the acute onset of persistent upper abdominal pain, usually with nausea and vomiting.⁽⁸⁾ A raised level of serum amylase activity, at least three times the upper limit of normal, supports the diagnosis of acute pancreatitis. Where lipase is available it is preferred for the diagnosis of acute pancreatitis.^(9,10)

Plain radiograph can be used as initial imaging modality in acute pancreatitis but not to confirm the clinical diagnosis.^(11,12)

Ultrasonography (US) is indicated early in an acute episode of pancreatitis. It can even be used to assess the complications like phlegmon, abscess and pseudocyst. On US, biliary lithiasis can be identified and other causes of medical and surgical acute abdomen can be excluded. When performed by qualified specialists,

ultrasound examination allows making the diagnosis of acute pancreatitis.⁽¹³⁾ Colour Doppler sonography can be used in evaluating flow in different region of the pancreas and in assessment of vascular complications of acute pancreatitis such as pseudo-aneurysm and venous thrombosis. US may be helpful in follow-up of fluid collection and pseudocyst in selected cases.⁽¹⁴⁾ US is an insensitive test in detecting pancreatic necrosis and other complications such as intra-parenchymal and retroperitoneal fluid collection due to overlying bowel gas in 20% of patients and therefore should not be used to assess the severity of pancreatitis.⁽¹⁵⁾

Multi Detector Computed Tomography (MDCT) is considered to be the gold standard imaging modality in the evaluation of patients with acute pancreatitis.⁽¹⁶⁾ The major indications for MDCT in patients with acute pancreatitis are to establish or confirm the diagnosis when clinical signs and laboratory investigations are indeterminate, to determine the severity of acute pancreatitis and to detect pancreatic and peri-pancreatic complications, to guide percutaneous interventions, such as catheter drainage of fluid collections.⁽¹⁷⁾ In Computed Tomography (CT) all the ultrasound findings and extra-pancreatic complications such as effusion, ascites, haemorrhage, sub capsular fluid collection can be studied with much certainty. CT is nearly 100% specific for necrosis if greater than 30% of the gland is non-enhancing.⁽¹⁸⁻²⁴⁾ In our part of world, study

correlating plain radiography, Duplex US with MDCT results is not available; hence this study has been planned with aims and objective to analyse the radiographic features of acute pancreatitis on plain radiograph, considering CT as a gold standard, to assess the accuracy of duplex ultrasound in the diagnosis of acute pancreatitis considering CT as a gold standard and to study the MDCT features of acute pancreatitis.

Materials and Methods

The study was carried out on prospective basis in the Department of Radiodiagnosis and Imaging, B P Koirala Institute of Health Sciences, over the period of one year (from July 2012 to June 2013) after obtaining ethical clearance from the institutional review committee (IRC). Patients with the clinical/biochemical suspicion of the acute pancreatitis were included in the study. Females who were pregnant were excluded (because of the risk of radiation injury). After taking informed consent details of clinical history, biochemical parameters, general and systemic examination were recorded. Plain abdominal radiograph, Duplex ultrasonography and MDCT were done and different parameters were recorded as per structured proforma.

Plain radiograph of the abdomen was taken in erect and supine position. X-ray of the chest was also done where ever required. US of the abdomen were done on Phillips HD-7 machine using 3.5-5 MHz convex probe. If required, 7-12 MHz linear probe was also used. After evaluating the pancreas, US of entire abdomen was done to evaluate the secondary sign of acute pancreatitis. Colour doppler sonography was used to assess parenchymal vascularity and vascular complications.

MDCT was done on ECLOS 16, HITACHI, Japan after excluding contraindications to CT. Non-contrast CT followed by biphasic contrast CT were done positioning the patient supine on to the table. For IV contrast non-ionic contrast media, Iohexol 300 mg I/ml (50-100 ml), (Omnipaque™ 300, GE Healthcare) were used. NECT volumetric acquisition (16x1.25 mm collimation) was done covering the entire abdomen from xiphisternum to pubic symphysis. For contrast CT, volume acquisition of image data were acquired in two phases (arterial and portal venous) after injecting 100 ml of non-ionic contrast media intravenously at the flow rate of 3-4ml/sec. The raw data was subsequently processed for reconstruction. The collected data were entered in computer through Microsoft Excel programme 2007 and converted it into SPSS 11.5 version for statistical analysis. For descriptive statistics, proportion and percentage were calculated and also graphical & tabular presentation was made. For inferential statistics, sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated to find out the relationship with

Gold Standard test & other related test. 'P' value was calculated using chi-square test and value of < 0.05 was considered significant. Finally duplex US and radiographic findings were compared with MDCT findings considering MDCT as a gold standard.

Results

Out of total 41 patients, 30 (73.2%) were males and 11 (26.8%) were females with male to female ratio of 2.7:1. Age of the patients with acute pancreatitis ranged from 15 year to 58 years and mean age was 37 year. The present study showed that acute pancreatitis is common in age group of 21-40 years in this part of Nepal.

Frequent alcohol consumption followed by biliary lithiasis was the commonest etiological factor in the present study. 2 (4.9%) cases had history of blunt trauma abdomen. Other 2 (4.9%) cases had Systemic Lupus Erythematosus (SLE) with history of exacerbation and remission & no definite etiology was identified in rest 2 (4.9%) cases.

Table 1: Aetiological Factor in Acute Pancreatitis

Etiology	Frequency	Percentage (%)
Alcohol consumption	21	51.2
Biliary lithiasis	18	44
Cholelithiasis	14	34
Chledocholithiasis	4	10
Abdominal Trauma	2	4.9
SLE	2	4.9
Unknown etiology	2	4.9

Table 1 shows frequent alcohol consumption and biliary lithiasis were the commonest etiological factor in our study.

On conventional radiography, pleural effusion was the most common finding seen in 35 (85 %) among which 30 (86%) had left sided, 3 (9 %) had bilateral and 2 (6 %) had right sided pleural effusion. Other radiographic signs were basal atelectasis in 24 (58.5 %), absence of left psoas shadow in 10 (24.4 %), distension of stomach and duodenum in 6 (14.6 %), sentinel loop sign in 6 (14.6 %) and colon cut-off sign in 3 (7.3 %) cases.

The individual conventional radiographic findings were compared with MDCT findings in each patient. Considering the MDCT as gold-standard, the TP, TN, FP and FN of the cases for individual radiographic parameter were found out and sensitivity, specificity, PPV, NPV and accuracy were calculated. (Table 2)

Table 2: Diagnostic index of individual radiographic parameter for acute pancreatitis

Parameters	FP	FN	TP	TN	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)	P-value
Pleural Effusion	1	3	34	3	91.89	75	97.14	50	90	<0.05
Basal Atelectasis	0	10	24	7	70.59	100	100	41.18	75.6	<0.05
Distension of stomach and duodenum	3	8	3	27	27.27	90	50	77.14	73.17	<0.05
Sentinel loop sign	1	8	5	27	38.46	96.43	83.33	77.14	78.04	<0.05
Colon cut-off sign	0	11	3	27	21.43	100	100	71.05	73.17	<0.05

(TP: True positive, TN: True negative, FP: False Positive, FN: False negative, PPV: Positive predictive value, NPV: Negative Predictive value)

On US, enlargement of pancreas was the most common pancreatic finding seen in 26 (63 %) out of the 41 patients, 15 (58 %) had diffuse and 11 (42 %) had focal enlargement, marked parenchymal hypoechoogenicity of pancreas (necrosis) with absent vascularity was detected in 19 (46 %) patients, 10 (24 %) had heterogeneous echotexture of pancreas, 9 (22 %) had hypoechoic pancreas and the remaining 3 (7%) patients had normal parenchymal echotexture. Increased surrounding vascularity were seen in 12 (29 %) of cases on color Doppler and 4 (10 %) had dilated MPD on duplex US.



Fig. 1: Duplex study in a patient with acute pancreatitis showing parenchymal hypoechoogenicity with minimal vascularity.

Extra-pancreatic findings in acute pancreatitis on duplex US in decreasing order of frequency were pleural effusion in 36 (88%), peripancreatic fluid collection in 29 (71%), ascites in 28 (68.29%) and pseudocysts in 2 (4.8%) cases. Biliary findings in acute pancreatitis on duplex US were cholelithiasis in 14 (34.14%) and choledocholithiasis with dilated CBD in 4 (9.75%) cases.

The individual duplex US findings were compared with MDCT findings in each patient. Considering the MDCT as gold-standard, the TP, TN, FP and FN for individual duplex US parameter were calculated and sensitivity, specificity, PPV, NPV and accuracy were calculated. We found that accuracy of each parameter on duplex US was ranging from 90 to 98 % and the sensitivity was ranging from 66.67 to 97.3 %.

Table 3: Diagnostic index of individual Duplex US parameters of acute pancreatitis.

Parameters	FP	FN	TP	TN	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)	P-value
Enlargement of pancreas.	0	2	26	13	66.67	100	100	13.33	95	<0.05
Dilated MPD	0	2	4	35	66.67	100	100	94.59	95	<0.05
Necrosis	1	3	18	19	85.71	65.52	64.29	86.36	90	<0.05
Peripancreatic Fluid collection	0	1	29	11	96.67	100	100	91.67	98	<0.05
Pleural effusion	0	1	36	4	97.3	100	100	80	98	<0.05
Ascites	0	1	28	12	96.5	100	100	92.31	98	<0.05
Pseudocyst	0	1	2	38	66.67	100	100	97.4	98	<0.05
Peripancreatic fat inflammation	0	4	28	9	87.5	100	100	69.23	90	<0.05
Anterior para-renal space inflammation	0	4	22	15	84.62	100	100	78.95	90	<0.05
Perinehric space inflammation	0	1	9	31	90	100	100	96.88	98	<0.05
Transverse mesocolon/ mesentery inflammation	0	2	6	33	75	100	100	94.29	95	<0.05

(TP: True positive, TN: True negative, FP: False Positive, FN: False negative, PPV: Positive predictive value, NPV: Negative Predictive value)

On MDCT, decreased parenchymal enhancement was found in 36 (87.8 %) out of 41 cases, enlargement of the pancreas in 28 (68 %) patients, pancreatic necrosis in 21 (51%). Out 21 cases of necrosis, 9 (22 %) had >30 % necrosis and 12 (29.3 %) had <30 % necrosis. Dilated MPD were observed in 6 (15 %) patients in our study. 2 out of the 6 dilated MPD on MDCT, had acute on chronic pancreatitis with calcification predominately in the head and body of pancreas and 1 out of 2 had intraductal calculus of size approx. 3.5 mm.

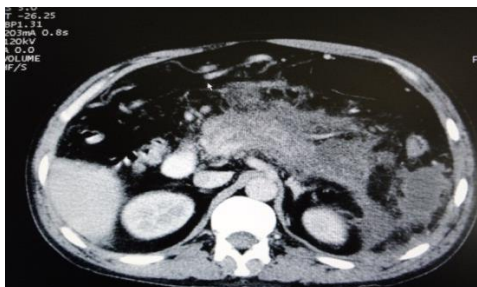


Fig. 2: Axial MDCT image in a patient with acute pancreatitis showing diffuse pancreatic necrosis involving entire parenchyma with peripancreatic and mesenteric fat stranding and thickened left Gerota's fascia and lateroconal fascia.

Extra-pancreatic features of acute pancreatitis on MDCT were pleural effusion in 37 (90%), basal atelectasis in 34 (83%), peripancreatic fluid collection in 30 (73.17%), ascites in 29 (71%), distension of stomach and duodenum in 14 (34%), sentinel loop sign in 13 (32 %), colon cut-off sign in 14 (34%) & pseudocysts in 3 (7.3%) cases.

On MDCT, peripancreatic fat inflammation was seen in 32 out of the 41 (78%), anterior pararenal space inflammation in 26 (63%), perinephric space inflammation 10 (24%) and inflammation of the transverse mesocolon / mesentery in 8 (20%) cases.

On MDCT, out of 41 patients, thickening of anterior renal fascia was seen in 32 (78%) cases, posterior renal fascia in 22 (54%) cases and latero-conal fascia in 14 (34%) cases.

Table 4: Pancreatic necrosis on MDCT

Pancreatic necrosis	Frequency (n=21)	Percentage (%)
< 30 %	12	29.3
>30 %	9	22
Distribution of pancreatic necrosis in different regions of pancreas.		
Body and Tail	7	33
Body	5	24
Head, Body and Tail	4	19
Head	3	14
Tail	2	10

Discussion

Acute pancreatitis is an acute inflammatory process of the pancreas that frequently involves peripancreatic tissues and/or remote organ systems. In the present study, age of the patients with acute pancreatitis ranged from 15 year to 58 years and mean age was 37 year. The maximum numbers of cases were in the range of 2-40 years. Incidence of acute pancreatitis was more common in males than females with male to female ratio of 2.7:1. Out of total 41 patients; 21 (51.2%) had history of alcohol consumption, 18 (44%) had biliary lithiasis and 2 (4.9%) cases had possible traumatic etiology. Other 2 (4.9%) cases had SLE with history of exacerbation and remission and we presumed that SLE may be the etiologic factor in these cases. No definite etiology was identified in rest 2 (4.9%) cases. Both history of alcohol consumption and biliary lithiasis were present in 4 (10 %) cases. The present study is comparable to the study done by Dufour MC et al.⁽²⁵⁾ In the present study study, epigastric pain was the commonest presenting feature in 38 (92.68 %) out of 41 patients followed by abdominal distension in 17 (41.4%) patients. 16 (39%) patients had history of vomiting and 10 (24.3%) patients had history of fever. The present study is comparable to the study done by Lankisch PG et al⁽²⁶⁾ and Triester SL et al.⁽²⁷⁾ In the present study, while assessing the conventional radiographic features of acute pancreatitis, it was found that pleural effusion was the most common finding seen in 35 (85%) out of total 41 patients. Out of those 35 patients, 30 (86%) had left sided, 3 (9%) had bilateral and 2 (6%) had right sided pleural effusion. Absence of left psoas shadow in 10 (24.4%), distension of stomach and duodenum in 6 (14.6%) sentinel loop in 6 (14.6%) and colon "cut-off" sign in 3 (7.3%). The present study is comparable to Davis S et al,⁽²⁸⁾ Chishty IA et al⁽²⁹⁾ and Rifat M et al.⁽³⁰⁾ Sun HA et al⁽³¹⁾ conducted a study on total of 871 patients undergoing abdominal radiography, out of them 188 underwent abdominal CT. In their study, abdominal radiography had 0% sensitivity for pancreatitis. In this study, it was found that the accuracy of each parameter on X-ray was ranging from 73.17 to 83% and the sensitivity was ranging from 21.43 to 86% in diagnosis of acute pancreatitis. This higher sensitivity and specificity of radiograph in our study may be due to referral of more complicated cases as our institute is a tertiary care referral center and also we evaluated radiographic features on diagnosed case of acute pancreatitis. Khanna AK et al⁽²⁰⁾ conducted a study on pancreatic pseudocyst on US examination. They concluded that sensitivity rates for US in the detection of pancreatic pseudocysts were from 75% to 90%. According to their study, US were inferior to CT, which had a sensitivity rate of 90%–100%. In our study, out of total 2 cases of pseudocyst on US, CT showed pseudocyst in both of them. Of 39 cases, which were negative for pseudocyst

on US, CT showed pseudocyst in 1 case. The sensitivity of duplex US in diagnosis of pseudocyst was 66.67 and specificity nearly 100 % with an accuracy of 98 %. Kumar Pet al⁽¹⁸⁾ Conducted a study on 57 patients with a clinical diagnosis of acute pancreatitis were serially evaluated by ultrasonography (US) and computed tomography (CT). 22% of US scans were unsatisfactory for the evaluation of pancreas whereas CT was uniformly satisfactory. Peripancreatic inflammation was detected in only 29% patients on US compared with 91% on CT. Pancreatic abscesses were detected in 8 patients on CT and gas was present in all of them. In our study peripancreatic inflammation were detected in 28 (68%) of the cases on US compared with 30 (73.3%) on CT. Considering as gold standard, our study showed sensitivity of duplex US to be 87.5% and accuracy of 90% to detect peripancreatic inflammation. In Lucia C et al⁽³²⁾ study on imaging techniques for acute necrotizing pancreatitis in 539 patients, 163 of whom (30.2%) had necrotizing pancreatitis, presence of pulmonary or pleural alterations had a sensitivity of 60% and a specificity of 88% in evaluating the presence of necrosis, a sensitivity of 73% and a specificity of 75% in evaluating the presence of infected necrosis. Chishty IA et al⁽²⁹⁾ conducted a study on the role of computed tomography in acute pancreatitis and its complications among age groups in 40 patients. In their study, pancreatic necrosis was detected in 28 patients on the basis of CT assessment. In patients with mild acute pancreatitis, 5 out of 17 had one third necrosis of the pancreas. In patients with moderate acute pancreatitis all 10 had pancreatic necrosis, 4 patients had one-third necrosis, 3 one-half necrosis and 3 more than one-half necrosis. In severe acute pancreatitis, according to CTSI, all 13 patients had pancreatic necrosis. In our study on MDCT, out of 41 cases pancreatic necrosis was found in 21 (51%). 9 (22%) had >30 % necrosis and 12 (29.3 %) had <30 % necrosis.

Conclusion

In strong clinical and biochemical suspicion of the acute pancreatitis, plain radiograph can be used as the initial imaging modality in acute pancreatitis, but not to confirm the diagnosis. Duplex US is useful in evaluating the extra-pancreatic & vascular complications of acute pancreatitis & is excellent in evaluating the biliary status of the patient with acute pancreatitis. Although duplex US is useful, MDCT is indicated for grading the severity and prognostication of acute pancreatitis. MDCT is excellent in evaluating the pancreatic necrosis. In the situation such as presence of bowel gas or findings in the region of the tail of pancreas, MDCT has an excellent role.

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