DOI: 10.14260/jemds/2015/889

ORIGINAL ARTICLE

ULTRASONOGRAPHY V/S COMPUTED TOMOGRAPHY IN THE EVALUATION OF PANCREATITIS: A PRELIMINARY STUDY

M. Uma Maheswara Rao[1], Sree Lalitha S. P. J[2], D. Sai Raghavendra[3]

HOW TO CITE THIS ARTICLE:
M. Uma Maheswara Rao, Sree Lalitha S. P. J, D. Sai Raghavendra. "Ultrasonography v/s Computed Tomography in the Evaluation of Pancreatitis: A Preliminary Study". Journal of Evolution of Medical and Dental Sciences 2015; Vol. 4, Issue 35, April 30; Page: 6099-6110, DOI: 10.14260/jemds/2015/889

ABSTRACT: INTRODUCTION: The pancreas is a difficult organ to evaluate by both clinical and routine radiological methods. An inflammatory pathology involving the pancreas will form part of the differential diagnosis of other conditions presenting with abdominal pain. The combination of appropriate clinical findings and laboratory tests permit an accurate diagnosis of acute pancreatitis in most patients. Chronic pancreatitis, on the other hand, forms a much more difficult entity to evaluate clinically or biochemically. The clinical and biochemical parameters form a key factor in the diagnosis of Acute Pancreatitis. Cross-sectional imaging with ultrasound and CT has afforded rapid, accurate and noninvasive evaluation of the pancreas. **MATERIALS AND METHODS**: This study included 50 cases of Acute and chronic pancreatitis of 16 to 67 years age of both male and females who were diagnosed on imaging studies (Ultrasound and/or CT) or on a constellation of signs, symptoms and laboratory data indicative of pancreatitis during the period from August 2011 to July 2013. **RESULTS:** A total of 50 cases were studied of which 40 had acute pancreatitis and 10 had chronic pancreatitis. In the 40 cases with acute pancreatitis, ultrasound alone was done in 16 cases, CT alone in 4 cases and both modalities were employed in the remaining 20 patients. All the 10 cases with chronic pancreatitis had an ultrasound study but only one required a CT scan. **CONCLUSION:** Ultrasonography is an initial screening modality in a suspected case of pancreatitis and MDCT is the investigation of choice for definitive diagnosis and estimation of severity of pancreatitis. The pancreas is a difficult organ to evaluate by both clinical and routine radiological methods. An inflammatory pathology involving the pancreas will form part of the differential diagnosis of other conditions presenting with abdominal pain. The combination of appropriate clinical findings and laboratory tests such as serum amylase and lipase levels permit an accurate diagnosis of acute pancreatitis in most patients. Chronic pancreatitis, on the other hand, forms a much more difficult.
KEYWORDS: Pancreatitis, Ultrasound, Computed Tomography.

INTRODUCTION:

- The pancreas is a difficult organ to evaluate by both clinical and routine radiological methods. An inflammatory pathology involving the pancreas will form part of the differential diagnosis of other conditions presenting with abdominal pain. The combination of appropriate clinical findings and laboratory tests such as serum amylase and lipase levels permit an accurate diagnosis of acute pancreatitis in most patients. Chronic pancreatitis, on the other hand, forms a much more difficult entity to evaluate clinically or biochemically.
- The clinical and biochemical parameters form a key factor in the diagnosis of Acute Pancreatitis. But the history / clinical presentation may be misleading and the biochemical parameters particularly serum amylase values may be raised in several other non-pancreatic conditions like intestinal perforation, intestinal obstruction, peritonitis, ectopic pregnancy and cirrhosis of liver etc., All of these conditions form differential diagnosis for acute

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pancreatitis and can be excluded by screening ultra-sonogram estimation of serum lipase levels. Serum amylase level may be normal particularly when the test is performed a few clays after the initial attack of acute pancreatitis. Plain radiograph of abdomen may be useful to diagnose pancreatic calcifications and to exclude Hollow viscus perforation, but may not contribute much in the diagnosis of acute pancreatitis. Nonspecific finding such as adynamic ileus or a sentinel loop may be seen in acute event.

- CT offers a diagnostic method that does not have these limitations. But CT is expensive, exposes patients to ionizing radiation, and has difficulty in defining tissue planes in lean patients. Modern ultrasound machines allow quick and comprehensive evaluation of the abdomen and the pancreas with its ductal system. Because the examination is inexpensive, noninvasive, and well accepted by the patient, it is currently one of the first imaging techniques performed for the evaluation of suspected chronic pancreatitis.

AIMS AND OBJECTIVES:

1. To note the findings on ultra-sonography and MDCT in a case of acute and chronic pancreatitis.
2. To note the advantages of one imaging modality over the other in the diagnosis of acute and chronic pancreatitis.
3. To note the limitations of one imaging modality over the other in the diagnosis of acute and chronic pancreatitis.

MATERIAL AND METHODS: This is a retrospective study done for pain abdomen cases suspected of having Acute or Chronic pancreatitis on clinical examination and confirmed on laboratory investigations and cross sectional imaging over a period of two years, between August 2011 and July 2013.

The study group included 50 patients of both male and female gender between 16 to 67 years of age of which male patients outnumbered female patients. There were 40 patients of acute pancreatitis and 10 patients of chronic pancreatitis.

The sonographic study was done on GE Logic 400 Color Doppler system using a linear 3-12 MHz and a curvilinear 3-5 MHz transducers.. The CT study was done after 72 hours of onset of symptoms using a Philips MX 16 slice MDCT. No preparation was done for Ultra sonogram and the study was performed as and when the requisition was received by the radiology Department. Whereas for CT, patients were asked to come with 5 hours of fasting to give IV contrast. MDCT with IV contrast was performed only if serum creatinine levels were within normal limits. MDCT was differed in patients with elevated serum creatinine and these patients were excluded from the study.

MDCT was performed in Plain, Arterial, portal and venous phases, 40 seconds after IV administration of 100ml of Iopromide 300mg/ml (Ultravist 300) injected at a rate of 3.0ml/sec using a mechanical power injector. Multi planar reconstructed images were reviewed by a Radiologist of more than 5years of experience in Body imaging.

RESULTS: The study group included 50 patients of which 40 patients were diagnosed to have acute pancreatitis and 10 patients were diagnosed to have chronic pancreatitis. Percentages have been rounded off up to two decimals.

The mean age of patients with acute pancreatitis was 37 years (16 to 67 years) while that off for chronic pancreatitis was 31.5 years (16 to 67 years) (Tables 1 and 2). Males outnumbered females in our study.

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Age group	Male	Female	Total	% age
16-20	2	0	2	5.00
21-30	12	1	13	32.50
31-40	8	2	10	25.00
41-50	7	0	7	17.50
51-60	3	2	5	12.50
61-70	2	1	3	7.50
Total	**34**	**6**	**40**	**100.00**

Table 1: Age and gender Distribution for Acute pancreatitis

Age group	Male	Female	Total	% age
16-20	1	2	3	30.00
21-30	2	0	2	20.00
31-40	1	1	2	20.00
41-50	1	0	1	10.00
51-60	0	1	1	10.00
61-70	1	0	1	10.00
Total	**6**	**4**	**10**	**100.00**

Table 2: Age and gender Distribution for Chronic pancreatitis

The most common etiology for pancreatitis in our study was Alcoholism followed by Idiopathic cause. Some of the patients had more than one suspected etiology, but the major etiology has been considered for the purpose of evaluation. (Table 3).

Etiology	No of patients (50)
Alcoholism	21
Idiopathic	12
Gallstones	8
Hyperlipidemia	3
Drug induced	2
Trauma	2
Autoimmune	2

Table 3: Etiology of pancreatitis

Out of 50 patients, Ultrasonogram alone was done for 25 patients, CT alone for 4 patients and Both Ultrasonogram and CT for remaining 21 patients was done. (Table4)

Modality	Acute pancreatitis	Chronic pancreatitis	Total
Ultrasound alone	16 (40 %)	9 (90%)	25
CT alone	4 (10 %)	0 (0%)	4
Both US and CT	20 (50%)	1(10%)	21

Table 4: Modality of investigation

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FINDINGS ON ULTRASONOGRAM:

Intra Pancreatic Findings on Ultra-Sonogram: Out of 50 patients, ultrasonogram was performed for 46 patients where pancreas could be visualized in only 33 patients and not visualized in 13 patients due to bowel gas. There were 23 acute and 10 chronic pancreatitis cases. (Table 5).

The size was assessed in the 33 pancreas visualized cases in whom 13 patients had bulky pancreas, 9 patients had normal size (2 of these were cases of traumatic pancreatitis). In one patient, a case of acute on chronic pancreatitis, the pancreas was atrophic/contracted. In the remaining 10 cases of chronic pancreatitis, the pancreas was atrophic/contracted in 6 cases and of normal size in 4 cases (Table 5).

In the 23 patients of acute pancreatitis with a visualized pancreas, 11 patients had a hypoechoic pancreas whereas none of the patients with chronic pancreatitis had a hypoechoic pancreas. 3 patients with acute pancreatitis and 3 patients with chronic pancreatitis had a heterogeneous echotexture of pancreas. Normal echogenicity of the pancreas was noted in 9 patients with acute and 3 patients with chronic pancreatitis. 4 patients with chronic pancreatitis, a hyper echoic pancreas was seen.

Duct dilatation was seen in 3 patients with acute pancreatitis, of whom 2 patients were cases of acute on chronic pancreatitis. Duct dilatation was seen in 9 out of 10 cases of chronic pancreatitis, indicating it as the most common finding on solography in chronic pancreatitis.

Calcification was seen in 2 cases of acute pancreatitis, both of whom were cases of acute on chronic pancreatitis and in 8/10 patients with chronic pancreatitis. Calcification was the 2nd most common finding in cases of chronic pancreatitis.

Focal lesions were seen in 4 patients with acute pancreatitis of whom 2 patients were cases of traumatic pancreatitis and had focal lesions in the form of contusions or hematomas (Table 5). In the remaining 2 patients fluid collections/ necrosis were seen as focal lesions.

		Acute Pancreatitis	Chronic Pancreatitis
Visualization of pancreas		23	10
Size	Bulky	13	0
	Normal size	9	4
	Contracted	1	6
Echotexture	Hypoechoic	11	0
	Heteroechoic	3	3
	Normal	9	3
	Hyperechoic	0	4
Ductal dilatation		3	9
Calcification		2	8
Focal lesions		4	0

Table 5: Intra pancreatic findings on Ultrasonogram

Extra Pancreatic Findings on ultra-sonogram: Out of 50 patients, ultra sonogram was performed in 46 patients, of which 36 had acute and 10 had chronic pancreatitis. In the remaining 4 patients only CT scan was done. Ascites was the most common finding, being seen in 14 patients with acute and one patient with chronic pancreatitis. Pleural Effusion, usually on the left side (3 cases), was seen

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in 5 cases of acute pancreatitis. Other findings include fatty liver in 12 patients and gallstones in 5 patients (Table 6).

	Acute pancreatitis (36 patients)	Chronic pancreatitis (10 patients)
Ascites	14	1
Pleural effusion	5	0
Fatty liver	12	0
Gall stones	5	0

Table 6: Extra pancreatic findings on Ultra sonogram

FINDINGS ON CT:

Intra pancreatic findings on CT: The pancreas was visualized in all cases evaluated by CT, this included 24 patients of acute and one patient of chronic pancreatitis.

Size alterations were noted in 24 of 25 patients evaluated and one patient of acute pancreatitis had normal sized pancreas. The pancreas was bulky in 22 patients with acute pancreatitis. In the remaining two cases the pancreatic parenchyma was atrophic of which one was acute on chronic pancreatitis case and the other was of chronic pancreatitis case.

Other intra pancreatic findings includes duct dilatation which was seen in 3 patients with acute pancreatitis and one patient with chronic pancreatitis; calcification seen in 2 patients with acute pancreatitis and one patient with chronic pancreatitis; focal lesions which were noted in 5 patients with acute pancreatitis; and a normal pancreas in one patient with acute pancreatitis .

Extra pancreatic findings on CT: These were observed only in acute pancreatitis cases and not observed in chronic pancreatitis patients in our study. Findings like exudates were seen in 18 patients, Stomach wall thickening in 20 cases, Gerota's fascia thickening in 16 patients with acute pancreatitis. Portal vein thrombosis was observed in one case of acute pancreatitis. (Table 7).

		Acute pancreatitis 24 patients	Chronic pancreatitis one patient
Size	Bulky	22	0
	Contracted	1	1
	Normal size	1	0
Intra pancreatic findings	Duct dilatation	3	1
	Calcification	2	1
	Focal lesions	5	0
Extra pancreatic findings	Fluid Collections	7	0
	Exudates	18	0
	Stomach Wall Thickening	20	0
	Gerota's Fascia Thickening	16	0
	Pleural Effusions	10	0
	Fatty Liver	10	0
	Cholecystitis	1	0
	Portal Vein Thrombosis	1	0

Table 7: Intra & Extra pancreatic findings on CT

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DISCUSSION: The study was done on 50 patients who were diagnosed to have pancreatitis which includes 40 patients with acute and 10 patients with chronic pancreatitis.

Age and Sex Distribution: The majority of patients with acute pancreatitis were in the 21 to 40 years age group who represented 50% of the total patients with acute pancreatitis. The average age of patients in acute pancreatitis was 37 years. In patients with chronic pancreatitis, the majority of patients were aged below 30 years and the average age of patients with chronic pancreatitis was lower (31.5 years) as compared to acute pancreatitis. The majority of patients with pancreatitis were males (40 out of 50 patients) representing 80% of the total.

It was also noted that females with acute pancreatitis tend to be older (47.8 years) as compared to males (35.9years). Studies by Silverstein et al have noted that males with acute pancreatitis were older (Mean age 41 years) than females (Mean age 32 years) 40. In studies by Luetmer, Stephens and Ward and by Alpern et al. have found that the mean age of patients with chronic pancreatitis to be 54.3 years and 47 years respective.[1]

The serum and / or ascitic fluid amylase was elevated in all the cases of acute and in none of the cases of chronic pancreatitis.

PRESENTATION: Majority of the patients are presented with abdominal pain and vomiting. Most of the patients had a history of alcohol consumption (21 out of 40 patients with acute pancreatitis) and 5 patients gave a history of an alcoholic binge prior to onset of symptoms. Trauma was seen as an etiological factor in two cases, both following a road traffic accident. In two cases, one of whom was positive for rheumatoid factor, an autoimmune etiology was proposed. One patient was an epileptic on carbamazepine and this was suggested as a cause of pancreatitis. In 10 patients, no cause could be found and these were labeled as being idiopathic in nature. In other causes hyperlipidemia and cholelithiasis were present.

Ultrasound Findings in Acute Pancreatitis: Ultrasonogram was done in 36 out of 40 patients of acute pancreatitis in our study. The pancreas was visualized in 23 patients and obscured in the remaining 13. This was a better yield for a visualized pancreas as compared to a study reported by Calleja and JS Barkin which stated that in acute pancreatitis, overlying bowel gas disturbances may obscure the pancreas in 40% of patients.[2]

In acute pancreatitis an enlarged pancreas is due to the interstitial edema. A bulky pancreas was seen in 13 patients in our study, which were more than that reported by RB Jeffrey Jr. where only one third of patients with acute edematous pancreatitis had an enlarged gland.[3,4]

Due to the edema, a bulky, hypoechoic pancreas is characteristic of edematous pancreatitis. However, this may not be the case always and one series has shown this finding only in a one third of patients with edematous pancreatitis.[4] in the present study, hypoechoic pancreas was seen in 11 patients but as many as 9 patients had a normal echogenicity of the pancreas. In the remainder, the pancreas had a heterogenous echo texture representing 13.1% of the cases. Of the 3 patients with a heterogenous echo texture of pancreas, 1 was a case of acute on chronic pancreatitis.

The presence of duct dilatation and calcification in acute pancreatitis is very variable.[5] In our study, it was seen in only 3 patients of whom 2 were cases of acute on chronic pancreatitis.

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CT Findings in Acute Pancreatitis: CT visualization of the pancreas was possible in all cases due to noninterference by the overlying bowel gas. Most of the acute pancreatitis patients 22/25 (92%) in whom CT was performed in our study revealed bulky pancreas. But in the study by Silverstein 70/98 (71%) patients revealed bulky pancreas.[6]

On CT duct dilatation and calcification were observed in 3 patients (13%) of whom 2 were cases of acute on chronic pancreatitis. Focal intra pancreatic lesions were seen in 5 patients (21%) which is comparable to that reported by EJ Balthazer where 18% of patients were seen to have focal lesions.[7]

Extra pancreatic findings like Fluid collections were seen in 7 patients (28%), and exudates in 18 patients (72%) with acute pancreatitis on CT.

Whereas stomach wall thickening was seen in 20 patients (80%) and Gerota's fascia thickening, usually on the left (14 patients), seen in l6 patients (64%). Free intraperitioneal fuild representing pancreatic ascites was seen in 4 patients (16%) in our study which was more than that reported by EJ Balthazar (7%).[8] Pleural effusions were seen in 10 patients (40%) in our study which was also more than that reported by EJ Balthazar. It was seen more often on the left side (60%).[9]

COMPARISON BETWEEN ULTRASONOGRAPHY AND CT IN:

Acute pancreatitis: The overall visualization of the pancreas was far better by CT than by ultrasound.[10] In a study done between 1979-1980 on 102 patients, good to excellent visualization of the pancreas was present in 64% of CT scans as compared to 20% of sonographic studies.[11] With improvements in technology, visualization of the pancreas is better on both modalities. This study showed that the pancreas is visualized in as many as 70.7% of patients on ultrasonography and in 100% of patients on CT in acute pancreatitis.

Alterations in size were better appreciated on CT. On CT, 22 patients with acute pancreatitis (92%) were seen to have a bulky pancreas. Of the remainder, one had a contracted pancreas due to underlying chronic pancreatitis; and in one case, the pancreas was normal. This patient had clinical features and laboratory findings suggestive of acute pancreatitis and was managed conservatively. He was asymptomatic at the time of discharge. Incidentally, the ultrasound study of this patient was also normal.

Duct dilation and calcification were picked up in three patients on both modalities. Ultrasound proved more useful in detecting free fluid as seen in 14 patients, in contrast to CT which picked up the same finding in 4 patients. However, due to the facility to inject intravenous contrast, the complication of portal vein thrombosis was picked up on the CT scan of one patient this finding could not be demonstrable on ultra-sonogram.

The sensitivity of ultrasonography in detecting acute pancreatitis was 59% in those patients in whom the pancreas was 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 had a sensitivity of 96% mainly due to better visualization (100%) and better assessment of size.[12] As all the patients had pancreatitis, the specificity could be estimated. However, the positive predictive value of both ultrasound and CT was 100%.[13] This means that all patients with a bulky, hypoechoic pancreas on ultrasound have acute pancreatitis. It must be pointed out that 5 patients were taken up for surgery and of these 2 had a normal pancreas on ultrasound. In the other 3, the pancreas was

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obscured. Hence, as mentioned in the study by SJ Hessel et al, a negative ultrasound study does not exclude significant and, at times, life-threatening pancreatic disease.[14]

Size alterations: The size of the pancreas in chronic pancreatitis is considered to correlate with the activity or chronicity of the disease process.[15] Our study showed an atrophic pancreas in 6 patients (60%) and a normal sized pancreas in the remaining 4 patients (40%). However studies reported by MB Alpem et al and L. Bolondi et al, have shown that size alterations do not aid in the diagnosis

Calcifications: Calcifications was seen in 4 patients (40%), and it is the most common finding along with a dilated system in chronic pancreatitis. Studies reported by MB Alpem et al and L Bolondi et al have shown a detection rate of 40-57%, and mentioned that CT is superior for detecting calcification.[1,16]

Duct dilatation: This is the most reliable sign in chronic pancreatitis.[17] the incidence of abnormal main pancreatic duct varies from 20% to 52.3% of cases. This study showed this finding to be most common along with calcifications / calculi and was seen in 9 patients (90%). However, ERCP is considered to be more sensitive than ultrasound for detecting ductal changes.[18]

Echo genecity: The infiltration by retroperitoneal fat may alter the echogenicity of the pancreas making it hyperechoic. Acute inflammation may cause areas of decreased echogenicity. Echotexture abnormalities were seen in 7 patients (70%) with 4 patients (40%) being heterogenous in echo texture. Studies have shown echotexture alterations in 55-57% of cases.

In Our study out of 10 patients, one patient had Ascites and one more patient had Pseudocyst. But in the literature pseudocysts are very commonly described in chronic pancreatitis.

CT was done only in one case which showed an atrophic pancreas, calcifications and a dilated main pancreatic duct which were the most common findings noted by PH Luetmer, David H. Stephens in 54%, 50% and 68% of cases receptivity.[19]

Study	Alpem et al (1985)	Cotton P. B. et al (1980)	Bolondi et al (1989)	Present Study
Hyper echoic	53%	98%	57.1%	70%
Calcification	40%		57%	90%
Atrophy			4.6%	60%
Main Pancreatic duct dilatation	20%	54%	52.3%	90%
Sensitivity	87%	88.6%	70%	100%

Table 8: Comparison of Ultrasound Findings of Chronic Pancreatitis

COMPARISON BETWEEN ULTRASONOGRAPHY AND CT IN:

Chronic Pancreatitis: All the patients who were diagnosed as having chronic pancreatitis on ultrasonography were treated as such and findings were confirmed by CT in one case. The sensitivity

was 100%, higher than the sensitivity reported by L. Bolondi et al which was 70%.[16] The number of patients in the current study was small due to low incidence (0.2-3%) in the general population.

However, in all the patients, the ultrasound visualization was adequate and the observation of a dilated pancreatic duct and an atrophic pancreas was diagnostic of chronic pancreatitis. Hence, as suggested by L. Bolondi et al, ultrasound, should be first diagnostic step when pancreatic disease is suspected. Ultrasound may lead to a definite diagnosis and visualize complications of chronic pancreatitis.[20] In fact, the most accurate assessment of chronic pancreatitis is achieved by a combination of clinical evaluation (Symptoms and pancreatic function tests) and radiologic definition of duct and parenchyma changes.[21]

CONCLUSIONS:

- Ultrasonography visualized pancreas on about 70% patients whereas CT visualized pancreas in 100% patients and hence CT is the investigation of choice for pancreatitis evaluation.
- Bulky hypoechoic pancreas for acute pancreatitis and Duct dilatation and calcification for chronic pancreatitis were considered diagnostic on ultrasonography. Ultra sonography has a PPV of 100% and Sensitivity of 59% in patients in whom pancreas were visualized.
- Extra pancreatic spread of inflammation was better noted on CT. CT has a PPV of 100% and Sensitivity of 96%.
- Ultrasonography and CT have roles to play in the diagnosis of acute and chronic pancreatitis where ultra-sonogram is useful as initial screening modality and CT as definite diagnostic tool.

SUMMARY:

- Ultrasonography is non-invasive, inexpensive and a safe tool in the imaging of pancreatitis. The limitations are non-visibility of pancreas from bowel gas, inability to assess extra pancreatic spread of inflammation and vascular complications. On ultrasonography enlargement, altered echogenicity, surrounding edema are suggestive of acute pancreatitis, whereas calcification, ductal dilatation and atrophy are suggestive of chronic pancreatitis.
- CT overcomes all the limitations of ultra-sonogram and is a confirmative investigation in diagnosis and staging of Acute or Chronic pancreatitis and more useful for assessment of severity.

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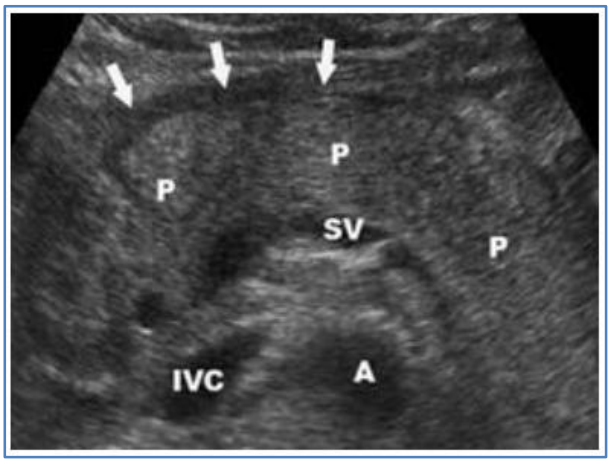

FIG. 1: Ultrasound Acute Pancreatitis: Bulky Hypoechoic Pancreas with Peri pancreatic fluid

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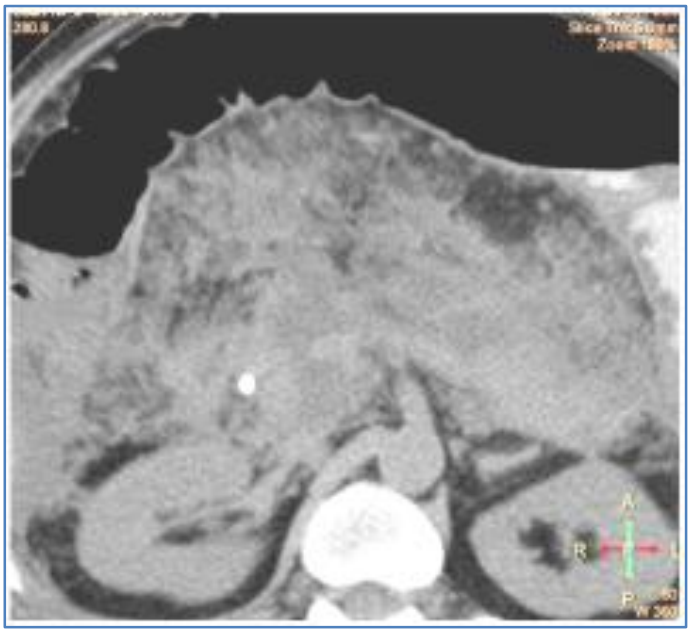

FIG. 2: CT-Acute Pancreatitis: Bulky Pancreas with intra pancreatic necrosis and peripancreatic stranding /facial thickening

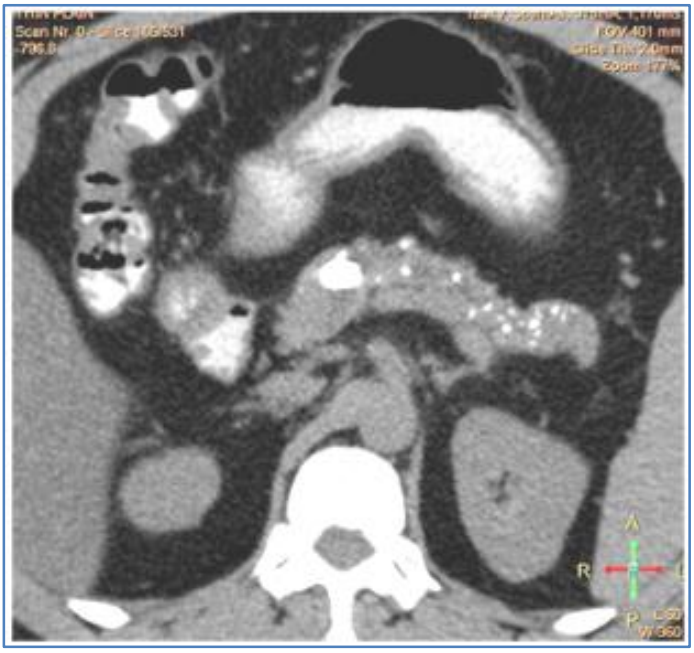

FIG. 3: CT-Chronic pancreatitis: Atrophic parenchyma with duct and parenchymal calcifications

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AUTHORS:

1. M. Uma Maheswara Rao
2. Sree Lalitha S. P. J.
3. D. Sai Raghavendra

PARTICULARS OF CONTRIBUTORS:

1. Associate Professor, Department of Radiodiagnosis, Andhra Medical College.
2. Senior Resident, Department of Radiodiagnosis, Andhra Medical College.
3. Post Graduate, Department of Radiodiagnosis, Andhra Medical College.

FINANCIAL OR OTHER COMPETING INTERESTS: None

NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:
Dr. M. Uma Maheswara Rao,
#55-6-24, Siva Sankar Nagar,
Venkojipalem,
Visakhapatnam-530022.
E-mail: mallaumahe@gmail.com

Date of Submission: 26/03/2015.
Date of Peer Review: 27/03/2015.
Date of Acceptance: 23/04/2015.
Date of Publishing: 29/04/2015.