A mini review of the imaging modalities in acute pancreatitis

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Mini Review

RADIOLOGY

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Abstract: Acute pancreatitis (AP) is an acute inflammation of pancreatic parenchyma associated with local and systemic complications. It is one of the most common causes of acute abdomen. Alcohol and gall stone disease are the most common causes of acute pancreatitis. It has wide variations in the clinical presentation and severity which ranges from self limiting pancreatic edema to life threatening local complications and systemic organ failure. In most of the patients, AP is a self limiting disease, but in 15-20% of patients disease can progress into severe local complications and systemic organ failure with a high mortality rate of 20-30%.

Multi detector computed tomography (MDCT) is considered as the gold standard imaging modality in AP. MDCT is not only used for diagnosing AP but also for detecting any associated local complications, severity grading and follow up of patients. Radiological severity grading of acute pancreatitis is assessed as per the modified computerized tomography severity index (MCTSI). Apart from MDCT, transabdominal ultrasound, magnetic resonance imaging and endoscopic ultrasound are also used in acute pancreatitis. The present article is a mini review of the various commonly used imaging modalities in acute pancreatitis. Knowledge of the various imaging modalities, their advantages and drawbacks is essential for the clinicians to order the most suitable investigation for the patient.

Keywords: Pancreatitis, CT-scan, Pancreatic imaging.

Introduction

Normal radiological anatomy on imaging

Ultrasonography

Normal ultrasonographic appearance of the pancreas varies in echogenicity, size and texture according to the age. Normal pancreas is isoechoic or mildly hyperechoic [Figure 1]. As age advances, pancreas is uniformly hyperechoic due to fatty infiltration of the pancreatic parenchyma. Pancreatic thickness varies from individual to individual. The normal size of head ranges from 6-28mm, body ranges from 4-23 mm and tail ranges from 5-28 mm [1].

Computed Tomography (CT):

Normal pancreatic measurements on CT range from: Head - 23 ± 3 mm, neck – 19 ± 2.5 mm, body – 20 ± 3 mm and tail – 15 ± 3 mm [2]. Normal pancreatic duct measures 2-4 mm. On non-contrast CT, normal pancreas has an attenuation of 30-50 HU and its attenuation increases to 100-150 HU in the post-contrast images.

Magnetic Resonance Imaging:

Normal pancreas appears as high signal intensity on T1 weighted (W) fat suppressed image as compared to other intra-abdominal organs [3]. This is because of abundant amounts of aqueous protein within the glandular elements of the normal pancreatic parenchyma. On T2 weighted images pancreas appears uniformly low to intermediate signal intense as compared to liver and spleen because of shorter T2 relaxation of pancreatic parenchyma as compared to other visceral organs. On post-contrast T1 weighted images normal pancreas shows uniform enhancement. Magnetic resonance cholangiopacreaticography (MRCP) is used to assess the pancreatic and biliary ductal anatomy and its variations [4].

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Modified CT severity index [9]	
Indicator	**points**
Pancreatic inflammation	
Normal pancreas	0
Intrinsic pancreatic abnormalities with or without inflammatory changes in peri-pancreatic fat	2
Pancreatic or peri-pancreatic fluid collection or peri-pancreatic fat necrosis	4
Pancreatic necrosis	
None	0
30% or less	2
More than 30%	4
Extra pancreatic complications	
One or more of pleural effusion, ascitis, vascular complications, parenchymal complications and/or gastrointestinal involvement	2

Table 1: Table showing the modified CT severity index.

Imaging modalities in acute pancreatitis

Transabdominal Ultrasound

In acute pancreatitis, there may be loss of normal echotexture of the pancreatic parenchyma due to inflammation with focal or diffuse swelling of the pancreatic parenchyma [5]. There may be distortion of the contour. Ultrasound is also useful for identifying peri-pancreatic fluid collection and its characterization. However, it is limited by the bowel gas and fat in obese patients.

Computed tomography

MDCT is the imaging modality of choice for the diagnosis and grading of severity of acute pancreatitis [6].

Pancreatic protocol: A pancreatic protocol includes three phases which include non-enhanced phase, pancreatic parenchymal phase after 30-40 seconds and portal venous phase after 55-75seconds of caontrast injection can be used for the initial assessment of acute pancreatitis. Neutral oral contrast may be administered after the control scan. Non-enhanced phase is useful in detecting calcification or calculi. The pancreatic parenchymal phase is the optimal phase for the assessment of necrosis. The normal pancreatic tissue enhances during this phase whereas necrosis does not. Subsequent imaging is generally performed using a single-phase technique in the portal venous phase.

The pancreas enhances uniformly in mild acute pancreatitis and may be of normal thickness or enlarged with a variable amount of increased attenuation in the adjacent fat, termed as fat stranding. Non enhancement of all or part of the gland is termed as necrosis.

CT detects intrinsic pancreatic abnormalities and categorizes pancreatitis into acute interstitial edematous or necrotizing pancreatitis. CT is also useful in detection of local complications like peri-pancreatic fluid collection, venous thrombosis, arterial pseudo aneurysms, inflammatory thickening of the bowel wall, ascitis and pleural effusion [6]. CT also plays an important role in performing the interventions in acute pancreatitis.

Types of acute pancreatitis

Acute pancreatitis is categorized into acute interstitial edematous pancreatitis (IEP) and necrotizing pancreatitis (NP) [Figure 6] [6]. Both are associated with peri-pancreatic fluid collection. Fluid collection is labeled as acute peri-pancreatic fluid collection (APFC) if the duration is less than four weeks and it is labeled as pseudocyst if the duration is more than four weeks [7]. Fluid collection with solid components and heterogeneous in appearance is called as acute necrotic collection(ANC) if the duration is less than four weeks and walled of necrosis if the duration is more than four weeks.

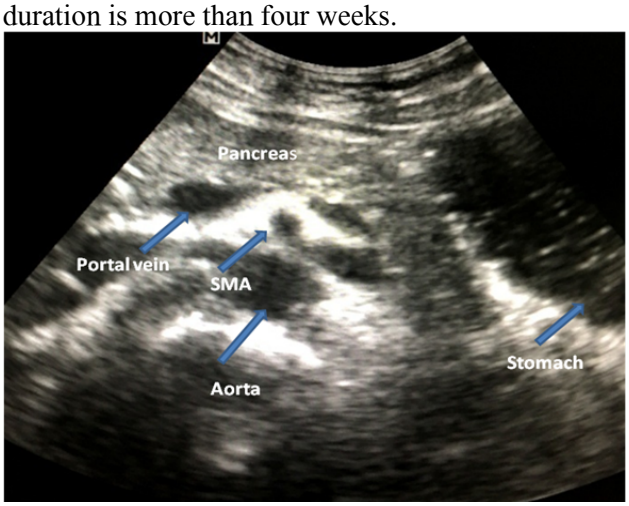

Figure 1: Axial sonographic image showing normal pancreas

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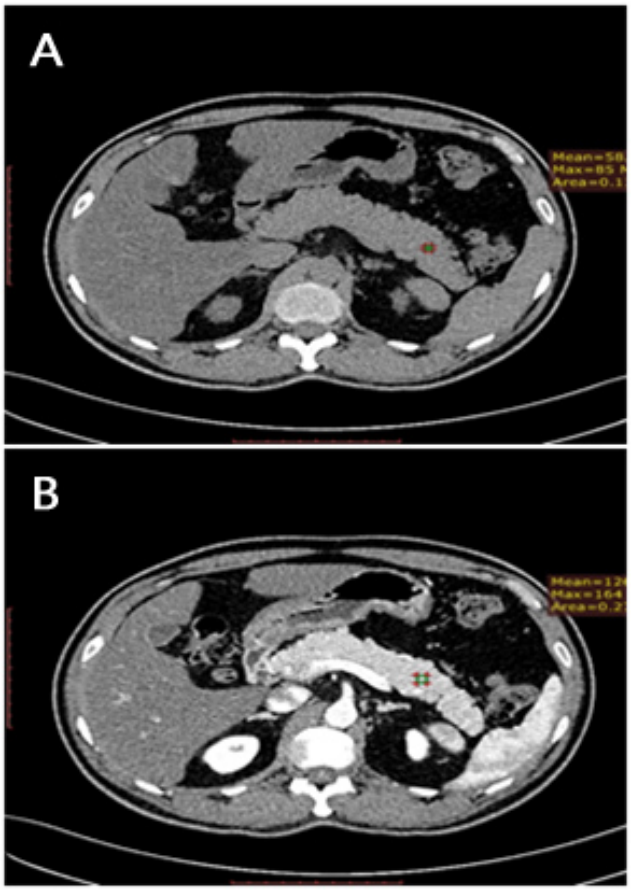

Figure 2: A. Axial non-contrast image showing normal pancreas with lobulated outline and HU-85. B. Post-contrast image in pancreatic phase showing homogenous enhancement of pancreas having HU-164.

APFC: On CT, APFC appears as an ill-defined homogenous non-enhancing collection in the peri-pancreatic region and is confined by the normal facial planes in the retroperitoneum [Figure 5]. There is no well defined wall. Most of the APFC's are sterile and resolve spontaneously without any intervention. If they persist even after a prolonged period and are symptomatic they need to be treated.

ANC: It contains a variable amount of fluid and necrotic component. On imaging it appears as an ill- defined non-encapsulated non-enhancing collection in the peri-pancreatic region having solid component and extending into the retroperitoneal space. If it persists for more than four weeks it is labeled as walled of necrosis [Figure 6].

Radiological scoring systems in severity assessment of acute pancreatitis

The severity of AP by CT imaging can be evaluated using unenhanced or contrast-enhanced CT studies. Unenhanced CT scoring systems evaluate the extent of pancreatic and peri-pancreatic inflammatory changes (Balthazar grade and pancreatic size index or PSI, and the more recently developed extrapancreatic inflammation on CT or EPIC score. In addition, two

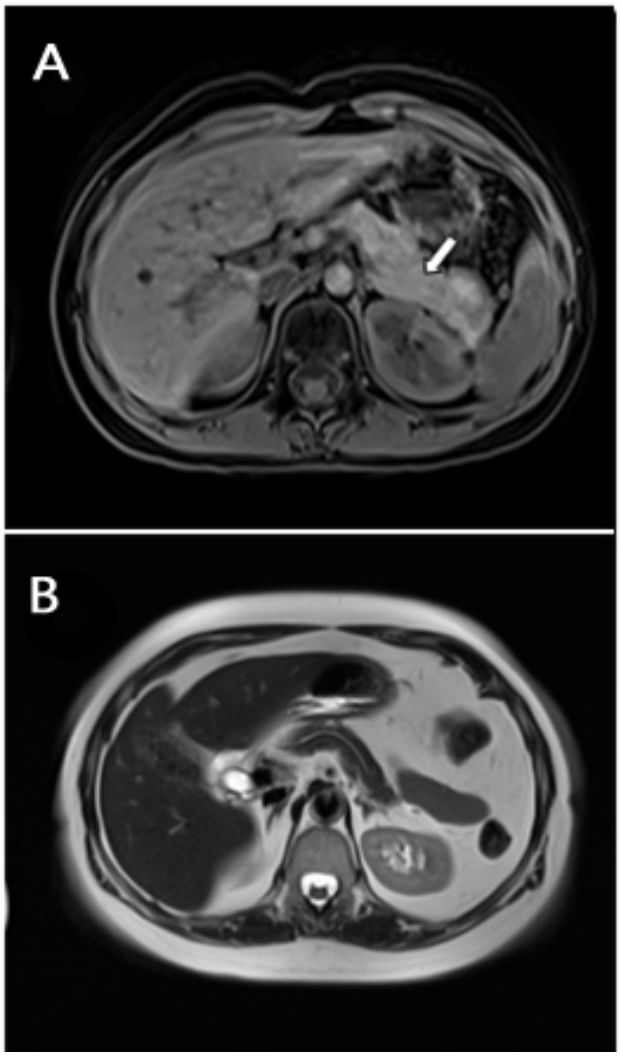

Figure 3. A. Normal pancreatic parenchyma appearing as high signal intensity (arrow) on axial T1WI. B. Normal pancreatic parenchyma appearing as low signal intensity on axial T2WI

CT scoring systems require the use of intravenous contrast agents to determine the presence and extent of pancreatic parenchymal necrosis. In 1990 'CT severity index (CTSI) was designed by Balthazar et al which is a numerical scoring system combining the quantification of pancreatic and/or peri-pancreatic inflammation with the extent of pancreatic necrosis [8]. Mortele et al. in 2004 designed the modified CTSI which assigns points for extra-pancreatic complications also [9].

- Mild pancreatitis has a score of 0-2
- Moderate pancreatitis has a score of 4-6
- Severe pancreatitis has a score of 8-10

Magnetic resonance imaging (MRI)

Magnetic resonance imaging technique for assessment of the pancreas is usually used for

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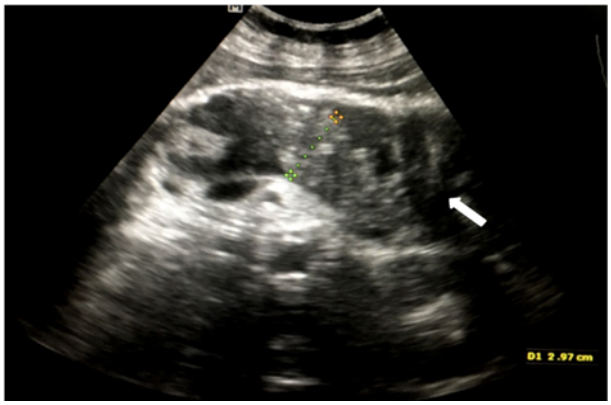

Figure 4. Axial sonographic image showing bulky and heterogeneous pancreas with an ill-defined heterogeneous peri-pancreatic collection (arrow) suggestive of acute pancreatitis.

diagnosing and follow-up of chronic pancreatitis patients and has a limited role in the emergency setting [10]. MRI has an advantage over CT in the ability to detect bile duct calculi. The bulky pancreas appears as low signal intensity on T1W1 and high signal on T2W2. T2 weighted images are also helpful in identifying the pancreatic ductal dilatation, acute peri-pancreatic collections, pseudocyst or walled off necrosis and choledocholithiasis [Figure 7]. MRI (T2W1) is especially helpful in determining the local hemorrhage and consistency of collection which are important for planning appropriate management. MRI has not been widely used in the care of patients with acute pancreatitis while CT scan remains the primary imaging technique to evaluate patients with AP.

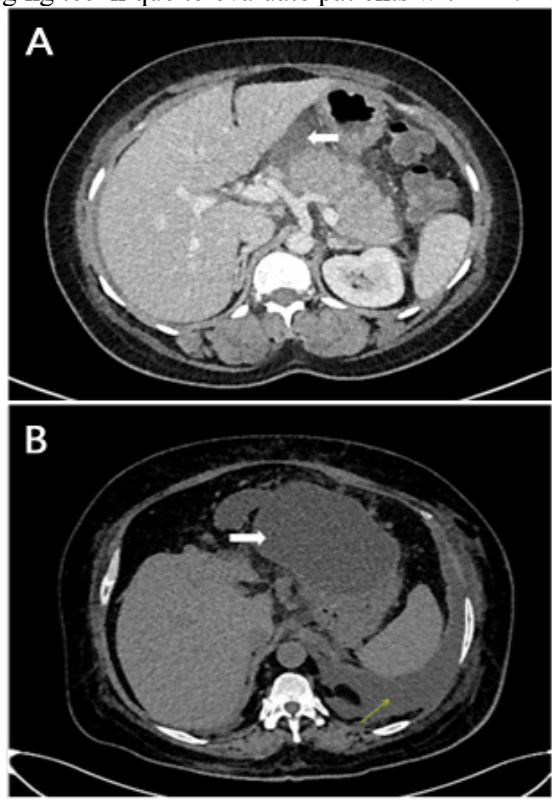

Figure 5.A. Post-contrast axial image showing diffuse enlargement of the pancreas with homogenous post-contrast enhancement and an ill-defined non-enhancing acute peri-pancreatic fluid collection.Imaging findings are suggestive of acute interstitial oedematous pancreatitis (IEP). B. CT axial image showing well-defined encapsulated collection noted in the peri-pancreatic region in a known case of acute pancreatitis in the follow-up scan after four week suggestive of pseudocyst of pancreas.

Endoscopic ultrasound

Endoscopic ultrasound can done through transgastric and trasnduodenal window. The main role of endoscopic ultrasound in acute pancreatitis is to diagnose idiopathic recurrent pancreatitis and biliary cause of acute pancreatitis. Endoscopic ultrasound reveals etiology of pancreatitis such as microlithiasis, sludge, bile duct stones, pancreatitis divisum and solid and cystic pancreatic lesions. Endoscopic ultrasound can be used to perform interventions such as endoscopic drainage of peri-pancreatic collection, necrosectomy, retrograde cholangiography and common bile duct stone removal. Endoscopic guided fine needle aspiration cytology may help to characterize the solid and cystic lesions of the pancreas [11,12]. Two main systems used in the endoscopic ultrasound. They are linear array and radial array endoscopes. Radial array endoscopic imaging uses high frequency (7.5 - 12 MHz) radial scanner and has 360 degree cross sectional view. A linear array works at low frequency (5- 7 MHz) and it acquires images parallel to the long axis of the endoscope. The advantage of linear array endoscope that it can be used to perform biopsies and doppler evaluation.

Conclusion

Knowledge of the various imaging modalities, their advantages and drawbacks is essential for the clinicians to order the most suitable investigation for the patient. MDCT is the main stay of pancreatic imaging and other imaging modalities are adjunct to it.

Conflicts of interests

The authors have no conflicts of interest to declare

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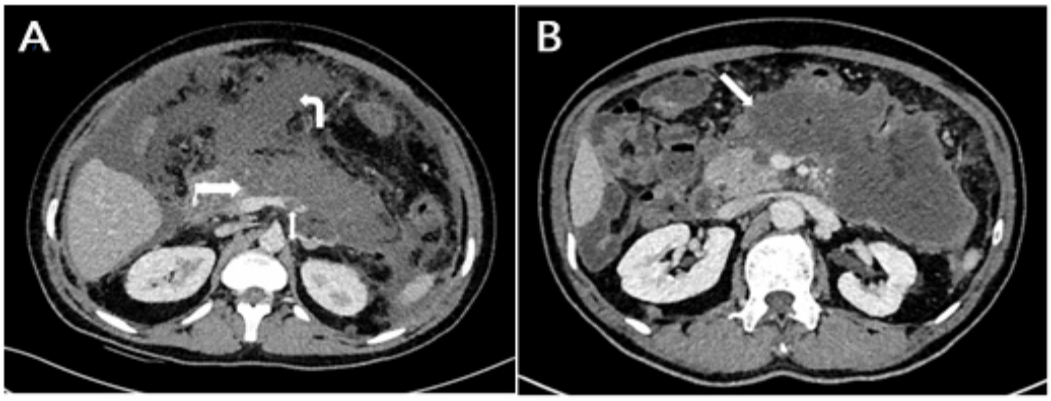

Figure 6. A. Axial CECT image showing more than 30% of the pancreatic parenchyma replaced by ill-defined non-enhacing necrotic tissue (straight arrow) with peri-pancreatic acute necrotic collection (curved arrow) extending into the lesser sac, bilateral para renal space and peritoneal cavity. Non- enhancing filling defects (thrombus) are also seen in the splenic vein. B. CECT axial image showing encapsulated peripherally enhancing collection noted in the peri-pancreatic region which is seen replacing the pancreatic parenchyma (body and tail) in a known case of acute necrotizing pancreatitis patient in a follow up scan suggestive of walled of necrosis.

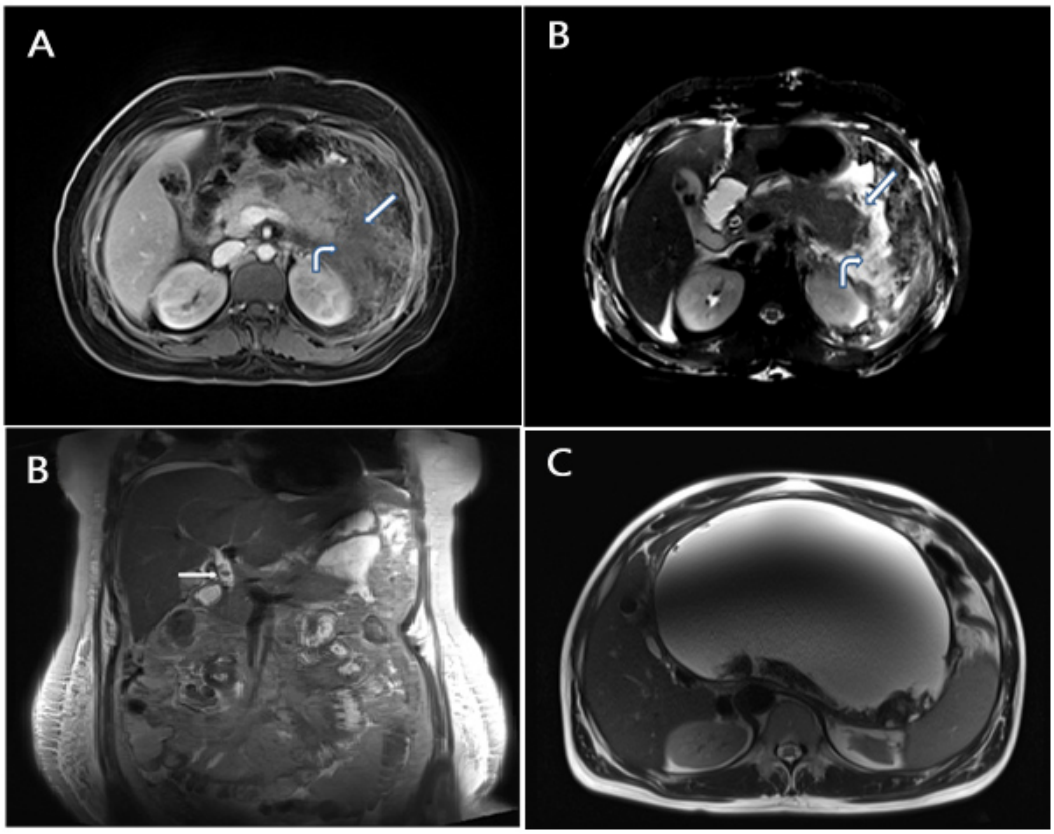

Figure 7. A. Post-constrast T1WI axial image showing an ill-defined non-enhacing collection replacing the distal body and tail of pancreatic parenchyma (curved arrow) and in the peri-pancreatic region extending into the lesser sac and left anterior pararenal space (straight arrow). B. T2W fat suppresed image showing non capsulated hyperintese collection in the peri-pancreatic region with parenchymal necrosis involving the pancreatic body and tail region with multiple filling defects (calculus) noted in the gall bladder. C. Coronal T2-HASTE image showing choledocolithiasis (filling defects in CBD). D. Axial T2W images of same patient after eight weeks follow-up scan showing encapsulated well-defined hyper intense collection in the peri-pancreatic region which is seen replacing the normal pancreatic parenchyma with hypo intense debris noted in the depended part likely necrotic component or hemorrhage. Imaging findings are suggestive of walled-off necrosis.

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