Magnetic resonance imaging in pancreatitis: review of 100 patients admitted and monitored in a general hospital in Niteroi-Rio de Janeiro, Brazil.

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Learning objectives

The purpose of this exhibit is to offer an overview of the disease and a spectrum of imaging findings in patients with pancreatitis, emphasizing the role of magnetic resonance imaging according to the appropriate clinical context and their advantages and limitations.
Background

- Pancreatitis is one of the more commonly encountered etiologies in the emergency setting.
- Pancreatitis can occur in acute and chronic forms. Magnetic resonance imaging (MRI) plays an important role in the early diagnosis of both conditions and complications that may arise from acute or chronic inflammation of the gland.
- Acute pancreatitis is a common disease that causes inflammation and necrosis in the pancreas and peripancreatic regions and is a common cause for hospitalization that carries a substantial burden of disease in worldwide.
- When acute pancreatitis is suspected in patients with acute onset of abdominal pain and tenderness mainly in the upper abdomen, the diagnosis of acute pancreatitis is made on the basis of elevated levels of pancreatic enzymes in the blood and/or urine.
- If there is suspicion of acute pancreatitis: amylase and lipase levels should be measured and analyzed. Measurement of blood lipase is recommended, because it is reported to be superior to all other pancreatic enzymes in terms of sensitivity and specificity.
- For measurements of the blood amylase level, it should be cautioned that, because of its low specificity, abnormal high values are also often obtained in diseases other than pancreatitis.
- Acute pancreatitis affects around 40 per 100,000 of the general population and 20-30% of attacks are severe.
- While in the majority of cases it is a self-limiting disease which responds rapidly to conservative management, in some cases acute pancreatitis may present with a more pronounced, sometimes dramatic, clinical picture and requires immediate medical care to avoid fatal complication.
- Clinical researchers have reported new methods to assess disease severity, innovative techniques for management of local complications, the importance of early recognition of pancreatic or extrapancreatic infection, and prevention of disease recurrence.
- The radiologist plays a key role in the management of such patients, from diagnosis and staging to identification and treatment of complications, as well as in determining the underlying aetiology.
- Standard MRI techniques including T1-weighted and T2-weighted fat-suppress imaging sequences together with contrast-enhanced imaging can both aid in the diagnosis of acute pancreatitis and demonstrate complications as pseudocysts, hemorrhage, and necrosis.
- MRI has an important role in defining the peripancreatic changes in the evaluation of fluid collections, biliary system and the duct of Wirsung (MR cholangiopancreatography), with sensibility 83% and Specificity 91%.
- We followed 134 patients with a confirmed diagnosis of pancreatitis and selected 100 who underwent magnetic resonance imaging at the Hospital
de Clinicas Niterói (HCN), state of Rio de Janeiro, Brazil, and their main findings are presented.

• The equipment used was SymphonyR of 1.5 tesla, with a surface coil.
• Protocol: T1W and T2W sequences with and without fat suppression (VIBE and HASTE), and intravenous paramagnetic contrast. 65 patients were also MR cholangiopancreatography to remove gallstones as a cause of pancreatitis.
IMAGING FINDINGS

• The increased frequency of death in acute pancreatitis is directly correlated with the degree and progress of pancreatic necrosis.
• For imaging of pancreatic necrosis, the combination of T1-weighted and T2-weighted findings with dynamic contrast-enhanced imaging gives a comprehensive evaluation of the extent of necrosis and full range of inflammatory extension.
• Mortality is usually associated to septic multiorgan dysfunction syndrome caused by secondary infection of pancreatic or peripancreatic necrosis.
• MRI including fat-suppressed T1-weighted images is more accurate to predict the severity and prognosis of acute pancreatitis in comparison with CT (FIG 1).
• Given the technologic advances of the past decade, pancreatic MRI protocols have evolved. Most sequences can now be performed in one or a few breath-holds; 3D sequences with thin, contiguous slices offer improved spatial resolution; and better fat and motion suppression allow improved contrast resolution and image quality.
• MRI has an important role in defining the peripancreatic changes in the evaluation of fluid collections, biliary system and the duct of Wirsung (FIGs 2,3,4).

Indications of MR cholangiopancreatography:

• Study of congenital anomalies pancreatic ducts.
• Detects Choledocholithiasis in 81-100% of cases (FIG5).
• Negative Predictive Value: 98%
• Positive Predictive Value: 94%
• Can not detect lithiasis <3mm

• Choledochal cysts are benign congenital cystic dilatations of the common bile duct.
• They are usually associated with pancreatobiliary malunion resulting in long-term complications, such as acute pancreatitis.
• The occurrence of chronic pancreatitis with a choledochal cyst is rarely reported. nAbdominal pain was the most common presentation.
• MRI/MRCP helped to confirm the diagnosis

Pancreas divisum:
• Most common congenital anomaly of the pancreatic ductal system, occurring in approximately 7% of autopsy-based studies.
• Complete or incomplete failure of the fusion of the ventral and dorsal duct system results in pancreas divisum.
• Association with pancreatitis. Young or middle-aged adults with recurrent acute pancreatitis or chronic pancreatitis with no apparent cause (cholelithiasis or alcohol).

Complications in pancreatitis:

• For imaging of infectious complications in pancreatitis, dynamic contrast MR enhanced examinations might help differentiate pancreatic cellulitis or abscesses, from pancreatic fluid collection or simple pseudocysts.
• Pancreatic pseudocyst: Necrotic material inside the tissue causes granulation tissue and fibrotic pseudocapsule (FIGs 6,7,8).
• Complicated pseudocysts and other pancreatic collections may contain solid debris, which is best depicted by MRI.
• Differential diagnosis of pseudocyst can be encountered as Intraductal Papillary mucinous neoplasm and Unilocular serous cystadenoma.
• Abscesses are suggested when gas is present in a pancreatic or peripancreatic collection. MRI can reveal air-fluid levels or large pockets of gas.
• For vascular abnormalities, the combination of cross-sectional pancreatic parenchyma imaging with MRA represents a single diagnostic modality for the full evaluation of peripancreatic artery and vein involvement, such as arterial pseudoaneurysms and venous thromboses.

Pancreatic hemorrhage:

• MRI is better than CT in the evaluation of pancreatic hemorrhage, because demonstrates signal abnormalities resulting from hemoglobin degradation (FIG.9).

Focal pancreatitis:

• Focal pancreatitis is a confined inflammation that mimics a pancreatic mass.
• Focal pancreatitis presents in most cases with hypo- to isointense SI on T1-weighted images, and iso- to hyperintense SI on T2-weighted images compared to remaining pancreas.

Chronic pancreatitis:
Chronic pancreatitis is a progressive, irreversible inflammatory and fibrosing disease of the pancreas with clinical manifestations of chronic abdominal pain, weight loss, and permanent pancreatic exocrine and endocrine insufficiency.

Chronic pancreatitis is characterized by continuing inflammation, destruction, and irreversible morphological changes in the pancreatic parenchyma and ductal anatomy.

MRI with gadolinium contrast enhancement, MRI with magnetic resonance cholangiopancreatography (MRI/MRCP), MRI/MRCP with secretin-stimulation (S-MRCP), allow earlier diagnosis of chronic pancreatitis.

The differential diagnosis of pancreatic carcinoma and tumor-forming pancreatitis remains difficult, and this situation can cause serious problems because the management and prognosis of these two focal pancreatic masses are entirely different.

The sensitivity and specificity of MRI including T1-weighted 3D-GE sequences for differentiating pancreatic carcinoma from chronic pancreatitis were 93% and 75% respectively.

**Groove pancreatitis:**

- Groove pancreatitis is a segmental chronic pancreatitis that affects the anatomical area between the pancreatic head, the duodenum, and the common bile duct, referred to as the groove area (FIG. 10).
- Most patients with groove pancreatitis are males aged 40-50 years with a history of alcohol abuse.
- The clinical symptoms are weight loss, upper abdominal pain, postprandial vomiting, and nausea due to duodenal stenosis.
- The pathogenesis of groove pancreatitis is thought to be anatomical or functional obstruction of the minor papilla.
- A differential diagnosis of groove pancreatitis from peripancreatic cancer is clinically important.
- Cystic lesions in the duodenal wall and smooth stenosis of the bile duct are important findings of groove pancreatitis.
- The portal venous phase is helpful for the differential diagnosis of groove pancreatic carcinomas and groove pancreatitis. Patchy focal enhancement in the portal venous phase was more commonly observed in groove pancreatitis than groove pancreatic carcinoma.

**Pancreatitis in Cystic Fibrosis:**

- Cystic fibrosis (mucoviscidosis) is an autosomal recessive disease that presents with recurrent pulmonary infections and respiratory failure.
- Exocrine pancreatic insufficiency in young people: most common cause.
- It presents with pancreatic atrophy (93% of cases), calcifications, cysts and bile duct strictures.
- Signs of acute pancreatitis is rare.
Autoimmune pancreatitis:

- Autoimmune pancreatitis (AIP) is the pancreatic manifestation of a systemic fibroinflammatory disorder with a wide range of pancreatic and extrapancreatic imaging findings. These findings can mimic those of other diseases in the pancreas or other organs and therefore are commonly misdiagnosed and mistreated.
- Obstructive jaundice is the most common presenting symptom.
- Are described two distinct subtypes of Autoimmune pancreatitis: type 1 and type 2. Type 1 AIP is the pancreatic manifestation of a systemic fibroinflammatory disease called immunoglobulin G4-associated systemic disease. Type 2 AIP affects younger patients, does not have a gender predilection and is associated with normal serum immunoglobulin G4 levels.
- There are established diagnostic criteria to diagnose AIP, most of which rely on a combination of clinical presentation, imaging of the pancreas and other organs (by CT scan, MRI and endoscopic retrograde pancreatography), serology, pancreatic histology and response to steroids to make the diagnosis.
- It is imperative to differentiate AIP from pancreatic cancer owing to the vastly different prognostic and therapeutic implications. AIP responds dramatically to steroid treatment but relapses are common.
- Autoimmune pancreatitis is a unique form of chronic pancreatitis characterized by a variety of extra-pancreatic involvements which are frequently misdiagnosed as lesions of corresponding organs.
- Characteristic findings in CT and MRI included lymphadenopathies of the hilar, peri-pancreatic, and para-aortic regions; wall thickening of the bile duct; and soft tissue masses in the kidney, ureters, aorta, paravertebral region, ligamentum teres, and orbit.
- Recognition of the diagnostic features in the images of various involved organs will assist in the diagnosis of autoimmune pancreatitis and in differential diagnoses between autoimmune pancreatitis-associated extra-pancreatic lesions and lesions due to other pathologies.

Pancreatitis in pancreas transplant:

- After decades of controversy surrounding the therapeutic validity of pancreas transplantation, the procedure has become accepted as the preferred treatment for selected patients with type 1 diabetes mellitus.
- The history of transplantation of the pancreas, unlike that of transplantation of other abdominal organs, has largely been shaped by the associated surgical complications.
- Simultaneous pancreas and kidney transplantation is associated with great postoperative morbidity, including the need for relaparotomy in up to 40% of cases.
• The incidence of pancreatic fistula after pancreas transplantation is high and seems to be associated with ischemia-reperfusion injury.
• Nicoluzzi et al in 100 pancreas transplants performed in the Brazilian institution (PUC-PR Brazil), had only five cases of pancreatitis in the graft.
• Bladder drainage (BD) of exocrine secretions is associated with urological and pancreatitis complications (reflux pancreatitis) FIG.11-14.
• Fungal infections after kidney transplantation are a major cause of morbidity and mortality, and Candida infection of the pancreas is considered an infrequent but important agent in necrotizing pancreatitis.
• Peripancreatic fluid collections are among the common post pancreas transplant complications, which are mainly due to leakage from the anastomosis site to bowel and graft pancreatitis. Differentiation between these two entities is important because they are treated differently.
• Alkaade et all, reported that secretin stimulated magnetic resonance cholangiopancreatography revealed gradual intraperitoneal fluid collection and accumulation of fluid in small bowel excluded leakage from the anastomosis of the pancreas to bowel and changed the management from surgery to medical treatment.

Diffusion in Pancreatitis:

• Diffusion-weighted imaging (DWI) is a new magnetic resonance imaging (MRI) technique that evaluates the random motion of water molecules in biological tissues.
• Diffusion-weighted imaging can be helpful as a complementary imaging method in the differentiation between mass-forming focal pancreatitis and pancreatic adenocarcinoma.
• Shinya et al studied 11 patients with pancreatitis using CT, MRI with conventional and diffusion and showed that the diffusion pancreatitis detected more clearly than CT without contrast, as it was useful in cases where pancreatic cancer was associated with pancreatitis and concluded that DWI can be a powerful tool for the evaluation and follow-up of acute pancreatitis.
• The measurement of apparent diffusion coefficient (ADC) can help to characterize solid pancreatic masses in differentiating pancreatic cancers from mass-forming pancreatitis.
• According to Lee SS et al, normal pancreas had significantly higher mean ADC, than either pancreatic cancer or mass-forming pancreatitis. ADC of mass-forming pancreatitis were significantly lower than those of pancreatic cancer
• Sensitivities and specificities in the diagnosis of pancreatic cancer were 72.3% and 76.9% for ADC(500), 87.2% and 69.2% for ADC(1000), respectively.
Fig. 0: Fat-suppressed T1-weighted images showing hypointense areas of pancreatic necrosis

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Fig. 0: Female 59y: MRI AXIAL T2W: Acute biliar pancreatitis. T2W axial: Pleural effusion, multiple gallstones, enlargement of the pancreas, which is heterogeneous, with infiltration of peripancreatic tissues

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**Fig. 0:** Same patient fig.2: Biliary pancreatitis with infiltration of fluid bilaterally, extending to the pelvis. Coronal T2W.

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**Fig. 0:** Acute pancreatitis with dilated duct of Wirsung in the entire length of the pancreas, choledocholithiasis with dilated common bile duct and gallbladder containing biliary sludge.

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**Fig. 0:** Small gallstones and inside common bile duct which is dilated to its intrapancreatic portion. Choledocholithiasis (arrows): T2 Axial and MR cholangiopancreatography

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**Fig. 0:** Male, 55 y. Pseudocyst.

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**Fig. 0:** Same patient: Pseudocyst - axial T2W

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**Fig. 0:** Same patient: Pseudocyst: Coronal T2W and MR cholangiopancreatography

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Fig. 0: Pancreatic hemorrhage characterized by hyperintensity on T1W

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**Fig. 0:** Groove pancreatitis.

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**Fig. 0**: Male patient 49 years, transplanted kidney and pancreas for type 1 diabetes mellitus and pancreatic insufficiency developed pancreatitis in pancreas transplant located in the left pelvis.

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Fig. 0: Pancreatitis in pancreas transplant located in the left pelvis.

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Fig. 0: Ultrasonography of the same patient showing free fluid in the abdominal cavity, pancreas transplant in the pelvis on the left, with heterogeneous echotexture with hypoechoic areas suggesting necrosis. Atrophic pancreas in its usual topography. Small stones in the gallbladder.

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Fig. 0: Comparison between ultrasound and MRI of pancreatitis in the transplanted pancreas.
Conclusion

- MRI is a method that can be used in the staging of pancreatitis and assessing its complications, with the advantage of not using iodized contrast and no radiation.
- MRI has a potential advantage over CT in detecting bile duct lithiasis and pancreatic hemorrhage.
- MRI can differentiate pancreatitis from pancreatic cancer successfully in most cases.
- The use of diffusion may become a useful tool in the evaluation and follow-up of specific cases of pancreatitis.
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Potential Conflict of Interest

No potential conflict of interest relevant.

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