MAYO CLINIC

AUTOIMMUNE PANCREATITIS (AIP): *Pancreatic and Extrapancreatic Findings on CT and MR*

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INTRODUCTION

Autoimmune pancreatitis (AIP) is an autoimmune systemic disease that predominantly involves the pancreas in a unique form of chronic pancreatitis. The most commonly involved organs outside the pancreas are the biliary ductal system causing intra- and extra-hepatic biliary strictures, the retroperitoneum causing retroperitoneal fibrosis, the salivary glands and the kidneys. Involvement of the lungs, liver, lymph nodes, gastrointestinal tract, thyroid, and prostate have also been previously reported.

CLINICAL FEATURES OF AIP

- Mostly male
- 50 years of age or older
- Clinical Manifestations: jaundice (74%), weight loss (47%), and abdominal pain (45%)
- Elevation of serum IgG4 is a good diagnostic marker of AIP with a reported sensitivity and specificity of 95% and 97%, respectively, for the differentiation of the AIP from pancreatic cancer.
- Steroid therapy is effective in relieving symptoms and preserving the pancreatic function as well as other organs effected by AIP.

DIAGNOSTIC CRITERIA OF AIP

The Japan Pancreas Society suggested criteria for AIP. Alternative diagnostic criteria incorporating two additional criteria of other organ involvement and response to the steroid therapy of pancreatic enlargement/biliary strictures have been advocated.

DIAGNOSTIC CRITERIA FOR AUTOIMMUNE PANCREATITIS*

Group I. (Original Features Proposed by the Japanese Pancreas Society)
1. Diffuse gland enlargement by CT or MR
2. Diffuse narrowing of the main pancreatic duct (at least 1/3rd of total length) by ERCP
3. Elevated serum IgG4 or characteristic histologic changes

Diagnosis of autoimmune pancreatitis is established when all 3 criteria are fulfilled

Group II. (Diagnostic Criteria Proposed by Mayo Clinic Investigators)
1. Histologic features of Lymphoplasmocytic Sclerosing Pancreatitis

Diagnosis of autoimmune pancreatitis is established when histological criteria are fulfilled

Group III. (Diagnostic Criteria Proposed by Mayo Clinic Investigators)
1. Typical or atypical pancreatic findings by CT or MR
2. Elevation of serum IgG4 or other organ involvement
3. Response to steroid therapy

Diagnosis of autoimmune pancreatitis is established when all 3 criteria are fulfilled

**Diagnosis of autoimmune pancreatitis using any of the above criteria groups requires exclusion of malignant diseases such as pancreatic or biliary cancers.*

IMAGING

Radiological evaluation is essential in making the diagnosis of AIP. Differentiating AIP from pancreatic cancer is the main role of radiologists to avoid unnecessary surgery or invasive intervention. However, the unique clinical presentation of AIP can be difficult to differentiate from pancreatic cancer. AIP represents 2-6% of patients who undergo pancreatic resection for suspected pancreatic cancer and represents 31% of tumefactive chronic pancreatitis who undergo pancreatic resection. Radiologists should be aware of various pancreatic manifestations of AIP including diffuse enlargement, focal enlargement, and frank mass formation. Extrapancreatic involvement is relatively common in patients with AIP, which may occur synchronously with the pancreatic manifestation or may occur later. One should be aware of imaging appearances of the extrapancreatic involvement. Presence of such extrapancreatic involvement in association with atypical pancreatic findings should raise the possibility of AIP.

PANCREATIC FINDINGS

TYPICAL PANCREATIC FINDINGS

- Diffuse parenchymal enlargement (Fig. 1, 2)
  Decreased enhancement during the pancreatic phase with increasing enhancement during the hepatic phase (Fig. 2). MR appearance: slightly increased T2 signal relative to normal pancreatic parenchyma (Fig 1C).
- Capsule-like rim (Fig. 3)
  Soft tissue surrounding pancreas that is seen in one-third of patients with AIP. This finding is low attenuation on CT, and low signal intensity on both T1and T2-weighted MR.
- Diffuse or focal narrowing of the pancreatic duct.
  This is best appreciated on ERCP and may be difficult to see on CT/MR. On CT/MR, secondary irregular focal duct dilatation may be seen (Fig. 1)
- Featureless border (Fig. 1, 2)
  This is due to swelling and inflammation that distorts the normal architecture of the pancreatic parenchyma.

DIFFERENTIAL DIAGNOSIS

- Diffuse pancreatic lymphoma (Fig. 4)
- Diffuse pancreatic carcinoma
- Acute pancreatitis (differentiate clinically)

FIGURE 1

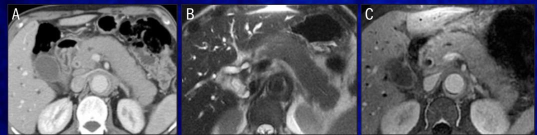

FIG 1: *Typical AIP: Diffuse pancreatic enlargement*
Contrast enhanced CT shows diffuse enlargement and loss of lobulation of the pancreas gland (A). Pancreatic duct irregularity with focal dilatation is seen. Also note intrahepatic bile duct dilatation and retroperitoneal fibrosis in this case.
On MR, the pancreas is slightly hyperintense on T2WI (B) and shows delayed enhancement on dynamic gadolinium enhanced T1WI (C).

FIGURE 2

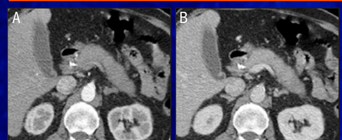

FIG 2: *Typical AIP: Delayed enhancement*
The pancreas is slightly enlarged and has a featureless border. Enhancement of pancreas is diminished in the pancreatic phase (A), but increases slowly over time as seen in the portal phase (B).

FIGURE 3

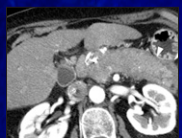

FIG 3: *Typical AIP: Capsule-like rim*
The pancreas is diffusely enlarged and surrounded by low-density rim of soft tissue (arrows).

FIGURE 4

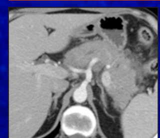

FIG 4: *Diffuse Lymphoma*
The pancreas is diffusely enlarged due to lymphomatous involvement. Lymphoma and diffuse infiltrative adenocarcinoma can be difficult to distinguish from diffuse involvement in AIP. Presence of marked adenopathy or distant metastatic disease favors a diagnosis of malignancy.

RESPONSE TO TREATMENT

Steroid therapy usually results in significant reversal of imaging findings in the pancreas of patients with AIP. The post-treatment pancreas can be normal sized or atrophic.

RECURRENCE

Recurrence of the AIP is not uncommon, and can be seen in 20% after steroid treatment, and 33% after pancreatic resection.

FIGURE 12

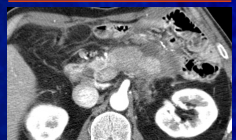

FIG 12: *AIP: Recurrence*
After resection of focal AIP in the tail of the pancreas, this patient experienced recurrence of AIP in the body of the pancreas, which is enlarged and shows diminished enhancement. There is also extensive soft tissue infiltration around the body of the pancreas.

FIGURE 13

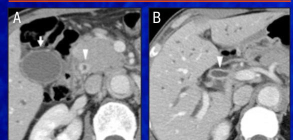

FIG 13: *Typical biliary involvement*
Diffuse thickening and enhancement of the extrahepatic bile duct with stricture of the pancreatic segment (A), (B). There is also intrahepatic biliary dilatation. Additionally, the gallbladder wall is diffusely thickened.

ATYPICAL PANCREATIC FINDINGS

- Focal, mass-like enlargement (Fig. 5-7)
- Involvement of adjacent vascular structures
- Normal or atrophic parenchyma (Fig. 9)
- Pseudocyst formation (Fig. 10)
- Calcification

DIFFERENTIAL DIAGNOSIS

- Pancreatic malignancy (Fig. 8)
- Other forms of pancreatitis

FIGURE 5

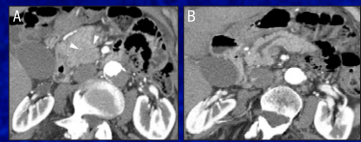

FIG 5: *Atypical AIP: Low-density mass*
There is an ill-defined, low density area in the head of the pancreas (arrows) (A) causing dilatation of the pancreatic duct in the body and tail (B). This appearance of AIP can be particularly difficult to

FIGURE 6

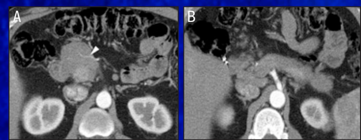

FIG 6: *Atypical AIP: Focal enlargement*
A focally enlarged pancreatic head with diminished enhancement (A). Note that a blood vessel courses through this enlargement (arrow), a feature that is not typical of pancreatic carcinoma. Focal area of sparing suggested by relatively increased enhancement in the uncinate process. Relatively normal size of the body and tail of the pancreas, but the enhancement is diminished, suggesting these segments are also involved (B).

FIGURE 7

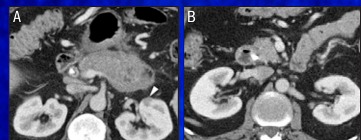

FIG 7: *Atypical AIP: Focal enlargement*
Focal involvement of the pancreatic body and tail (A). Note the capsule-like rim and the small focus of renal involvement (arrow). Normal appearing pancreatic head with biliary stent in place status-post biliary obstruction (B). This suggests that the head of the pancreas is also involved by AIP.

AUTOIMMUNE PANCREATITIS VS MALIGNANCY

Differentiating AIP from malignancy can be challenging, particularly when AIP is focal and mass-like in appearance. Imaging features that are most helpful to differentiate AIP from malignancy include:

FAVORING AIP

- Capsule-like rim
- Extrapancreatic involvement
  Bile duct, renal involvement or retroperitoneal fibrosis
- In focal enlargement, remaining normal-sized pancreas showing changes of AIP such as diminished enhancement (Fig. 6b) or biliary obstruction (Fig. 7b)
- Increasing enhancement in hepatic phase

FAVORING MALIGNANCY

- Pancreatic duct dilatation with cut-off sign due to focal mass effect
- Distant metastatic disease
- Prominent lymphadenopathy

FIGURE 8

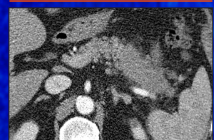

FIG 8: *Pancreatic adenocarcinoma*
Pancreatic carcinoma spreading along the axis of pancreas may simulate focal involvement of AIP.

FIGURE 9

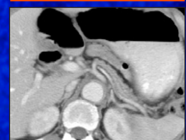

FIG 9: *Atypical AIP: Diffuse pancreatic atrophy*
This is the same patient seen in Figure 1, imaged six months later. This patient experienced spontaneous remission. Normal or atrophic pancreatic size in AIP may represent a "burned-out" state equivalent to remission.

FIGURE 10

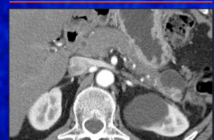

FIG 10: *Atypical AIP: Pseudocyst formation*
Pseudocyst is present in the tail of pancreas. The enhancement of the pancreas is diffusely diminished and the pancreatic head is slightly enlarged. Pseudocyst formation can simulate more common forms of pancreatitis.

FIGURE 11

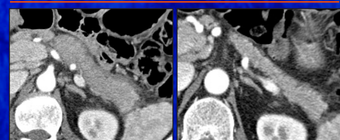

FIG 11: *AIP: Treatment change*
Appearance of AIP in the pancreas before (A) and after (B) steroid therapy illustrates a significant interval decrease in the size of the enlarged pancreas.

EXTRAPANCREATIC FINDINGS

BILIARY FINDINGS

Biliary involvement is seen in about 80% of patients with AIP and is the most common form of extrapancreatic involvement. It mostly involves the lower common bile duct causing biliary stricture. Multifocal intrahepatic or upper extrahepatic bile duct strictures resembling primary sclerosing cholangitis (PSC) can be present in 10-35% of patients. Rarely, a soft tissue mass develops which can resemble cholangiocarcinoma. Findings include:

- Biliary strictures (Fig. 13-16)
- Bile duct enhancement and thickening (Fig. 13)
- Associated areas of biliary dilatation (Fig. 13-16)
- Soft tissue mass (Fig. 16)
- Diffuse gallbladder wall thickening (Fig. 13)

DIFFERENTIAL DIAGNOSIS

- Primary schlerosing cholangitis
- Other secondary causes of cholangitis
- Cholangiocarcinoma

ERCP findings: The biliary strictures in AIP tend to be longer (3 mm or longer) compared to the band-like strictures (2 mm or less) typical of PSC. Beaded appearance or diverticulum-like outpouching of the bile duct, typical findings of PSC, are absent in patients with AIP. These features are difficult to characterize on MRCP.

FIGURE 13

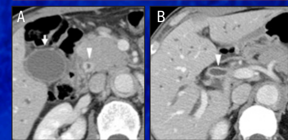

FIG 13: *Typical biliary involvement*
Diffuse thickening and enhancement of the extrahepatic bile duct with stricture of the pancreatic segment (A), (B). There is also intrahepatic biliary dilatation. Additionally, the gallbladder wall is diffusely thickened.

FIGURE 14

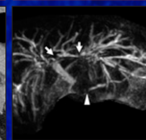

FIG 14: *Biliary involvement (simulating PSC)*
MRCP image demonstrates focal areas of stricture in the intrahepatic bile ducts (arrows). Presence of a focal stricture of the pancreatic duct in the head (arrow head) help to differentiate AIP from PSC.

FIGURE 15

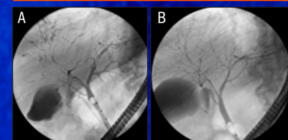

FIG 15: *Biliary involvment on ERCP*
ERCP demonstrates multiple focal areas of stricture and dilatation in the intrahepatic bile ducts (A). After steroid therapy, the biliary abnormalities resolved to near-normal (B).

FIGURE 16

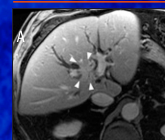

FIG 16: *Recurrent biliary involvement (simulating cholangiocarcinoma)*
T1-weighted post-gadolinium MR image demonstrates an ill-defined mass-like soft tissue at the confluence of the intrahepatic bile ducts. This is a less common form of biliary involvement in AIP and the appearance is particularly difficult to differentiate from cholangiocarcinoma.

FIGURE 17

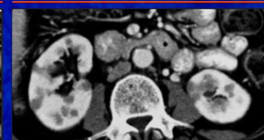

FIG 17: *Renal involvement: Well-defined round lesions*
Multiple well-defined round low density lesions are present in both kidneys in a patient with AIP.

RETROPERITONEAL FIBROSIS

Retroperitoneal Fibrosis occurs in about 5-10% of patients with AIP.

FIGURE 22

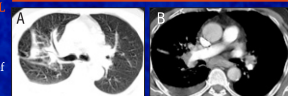

FIG 22: *Lung and medastinal involvement*
Interstitial pneumonitis (A) and mediastinal lymphadenopathy (B) are other possible types of extrapancreatic involvement in AIP.

RENAL FINDINGS

Renal involvement is seen in approximately 35% of patients with AIP, with renal parenchyma involved in 30% and renal sinus or renal pelvis wall involved in 10-15%. Renal parenchymal lesions are often bilateral and multiple, and predominantly involve the renal cortex. Findings include:

- Parenchymal involvement:
  1. well-defined or ill-defined round lesions (Fig. 17)
  2. well-defined wedge-shaped lesions (Fig. 18)
  3. small (<1cm) peripheral cortical nodules (Fig. 19)
  4. diffuse involvement (Fig. 20)
- Perinephric involvement:
  1. circumferential perinephric rim
  2. renal sinus nodule
  3. renal pelvis wall thickening
- CT appearance: low attenuation in the pancreatic phase with gradually increasing enhancement in the portal phase
- MR appearance: isotensity on T1WI and low intensity on T2WI, low intensity on T1WI after gadolinium administration

DIFFERENTIAL DIAGNOSIS

- Pyelonephritis
- Lymphoma
- Vascular insult

FIGURE 18

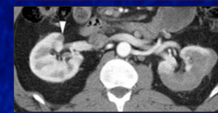

FIG 18: *Renal involvement: Well-defined wedge-shaped lesions*
A large wedge-shaped low-density lesion in the left kidney is present in a patient with AIP. Also, note a small wedge-shaped low-density lesion in the right kidney (arrow) (A). After steroid treatment, the large lesion in the right kidney evolved to a smaller area of scar and the small lesion in the left kidney resolved completely (B).

FIGURE 19

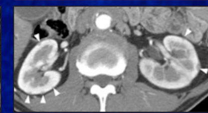

FIG 19: *Renal involvement: Small peripheral cortical nodules*
Multiple small cortical low-density nodules are present in both kidneys in a patient with AIP.

FIGURE 20

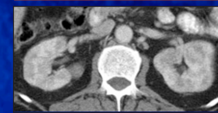

FIG 20: *Renal involvement: Diffuse involvement*
Diffusely abnormal, irregular nephrogram in both kidneys in a patient with AIP.

FIGURE 21

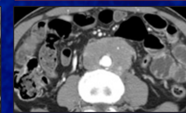

FIG 21: *Retroperitoneal fibrosis*
Extensive soft tissue is seen surrounding the lower abdominal aorta in a patient with AIP.

OTHER EXTRAPANCREATIC FINDINGS

Salivary Glands
- Sialadenitis (Sjogren-like syndrome)

Lymphatic System
- Hilar, mediastinal, and retroperitoneal lymphadenopathy

Lung
- Interstitial pneumonitis
- Inflammatory pseudotumor

Other
- Thyroiditis
- Hepatic inflammatory pseudotumor
- Inflammatory bowel disease
- Prostatitis
- Idiopathic thrombocytopenic purpura

FIGURE 23

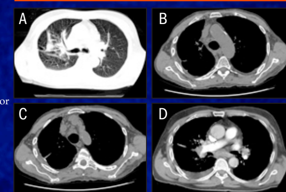

FIG 23: ???

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