TRA-MINW

MRI Abdomen Protocol – Pancreas/MRCP with Contrast

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Standard uses:

1. Characterization of cystic and solid pancreatic lesions
2. Evaluation of biliary tree pathology *(to be used for anything other than choledocholithiasis* – such as: jaundice, cholestatic LFTs, elevated Alk Phos, elevated bilirubin, bilirubinemia, etc.)

NOTE #1: If indication is to FOLLOW-UP pancreatic cyst, use the MRCP without contrast protocol

- If this is INITIAL pancreatic cyst evaluation, *contrast is required*

NOTE #2: Unless indication for MRCP is "choledocholithiasis" or "FOLLOW-up pancreatic cyst", then MR Pancreas/MRCP with contrast should be used

- It is important to understand that we cannot assess for subtle biliary tree findings without the administration of contrast. In the setting of non-specific elevated bilirubin (or jaundice), *contrast is required* (See Radiologist's Perspective for further details).

FYI: This is similar to a liver protocol MRI but FOV tailored to pancreas with addition of MRCP sequences. Try to cover as much liver as possible as this is a common organ for metastases from pancreatic cancers.

Patient prep: Should be NPO for >4 hours prior to study if possible. Have patient void before examination.

Oral contrast: None.

Coil: Body coil.

Coverage: Position the coil such that there is good coverage and signal from the pancreas.

Intravenous contrast: Single dose gadolinium @ 2 cc/sec (Gadavist).

Anti-peristaltic agent: None.

Sequences:

1. **Localizer**

2. **Coronal T2 Ultra fast SE (HASTE, SSFSE, FASE)**
    a. Multi-breath hold as needed
    b. Complete front to back coverage
    c. Goal parameters
        i. Large FOV (400-450 mm)
        ii. 7 mm thickness, 25% gap (1.5 mm)

3. **Axial in and out of phase T1 GRE**
    a. Perform as 1 acquisition
    b. Multi-breath hold as needed
    c. Full FOV
    d. Slices extend from dome of liver to inferior aspects of liver and pancreas
        i. 6 mm thickness, 25% gap (1.5mm)
        ii. Ensure entire liver is covered

4. **Axial T2 Ultra fast SE (HASTE, SSFSE, FASE) thin slice withOUT fat suppression**
    a. Multiple breath holds as needed
    b. Slices should include coverage of the intrahepatic biliary tree, extrahepatic biliary tree and pancreatic duct
        i. Include all of liver if indication is “Primary sclerosing cholangitis (PSC)”
    c. Goal parameters
        i. Slice thickness 3-4 mm, 0% gap

5. **Axial T2 Ultra fast SE (HASTE, SSFSE, FASE) thin slice with fat suppression**
    a. Multiple breath holds as needed
    b. Slices should include coverage of the intrahepatic biliary tree, extrahepatic biliary tree and pancreatic duct
        i. Include all of liver if indication is “Primary sclerosing cholangitis (PSC)”
    c. Goal parameters
        i. Slice thickness 3-4 mm, 0% gap

6. **Coronal T2 Ultra fast SE (HASTE, SSFSE, FASE) thin slice with fat suppression**
    a. Core “MRCP” sequence
    b. Multiple breath holds as needed
    c. Slices should include coverage of the intrahepatic biliary tree, extrahepatic biliary tree and pancreatic duct
        i. Include all of liver if indication is “Primary sclerosing cholangitis (PSC)”
    d. Goal parameters
        i. Slice thickness 3-4 mm, 0% gap

7. **Coronal 3D T2 TSE (SPACE, CUBE, VISTA)**
    a. First choice if available, preferred “MRCP” sequence
    b. Respiratory navigated
    c. Slices should include coverage of the intrahepatic biliary tree, extrahepatic biliary tree and pancreatic duct
        i. Include all of liver if indication is “Primary sclerosing cholangitis (PSC)”

d. 3D MIP recons with 2 plane rotation

8. **OPTIONAL – Perform when coronal 3D T2 TSE (#7) not of high quality**
   Oblique - 15 degree Coronal T2 Ultra fast SE (HASTE, SSFSE, FASE) **thin slice with fat suppression**
   a. Slices include central intrahepatic ducts, CBD and pancreatic duct
   b. Goal parameters
      i. TE ~ 120 ms (less for 3T)
      ii. Slice thickness 3-4 mm, 0% gap

9. **OPTIONAL – Perform when coronal 3D T2 TSE (#7) not of high quality**
   Oblique + 15 degree Coronal T2 Ultra fast SE (HASTE, SSFSE, FASE) **thin slice with fat suppression**
   a. Slices include central intrahepatic ducts, CBD and pancreatic duct
   b. Goal parameters
      i. TE ~ 120 ms (less for 3T)
      ii. Slice thickness 3-4 mm, 0% gap

10. **Coronal T2 Ultra fast SE (HASTE, SSFSE, FASE) thick slab (30 mm)**
    a. Repeat at least 15 times
    b. Multiple breath holds as needed
    c. Slices include distal CBD/Pancreatic duct and duodenum
    d. Goal: Obtain at least 1 image with an open sphincter of Oddi

11. **Axial T1 Ultra fast 3D-GE with fat suppression (VIBE, LAVA, TIGRE) precontrast**
    a. Breath hold
    b. Slices extend from dome of liver to inferior aspects of liver and pancreas to include all intrahepatic biliary tree, extrahepatic biliary tree and pancreatic duct.
    c. Goal parameters
       i. Slab slices <= 3 mm

12. **Axial T1 Ultra fast 3D-GE with fat suppression (VIBE, LAVA, TIGRE) post-contrast x3 (late arterial, portal venous, equilibrium phases)**
    a. Breath holds
    b. Slices extend from dome of liver to inferior aspects of liver and pancreas to include all intrahepatic biliary tree, extrahepatic biliary tree and pancreatic duct.
    c. Goal parameters
       i. Slab slices <= 3 mm
       ii. If available, all studies should be performed with bolus tracking in the abdominal aorta.
          1. Bolus tracking, start image acquisition with delay listed below after bolus arrives in aorta
             a. Late arterial = +5 s, portal venous = +35 s, equilibrium = +100 s
          2. Fixed scan delay (time from beginning injection until center of k-space)
             a. No heart disease: Late arterial = 30 s, portal venous = 60 s, equilibrium = 120 s

   b. Heart disease: Late arterial = 35 s, portal venous = 65 s, equilibrium = 125 s

13. **Coronal T1 Ultra fast 3D-GE with fat suppression (VIBE, LAVA, TIGRE) postcontrast**
    a. Breath hold
    b. Slices extend from dome of liver to inferior aspects of liver and pancreas to include all intrahepatic biliary tree, extrahepatic biliary tree and pancreatic duct.
    c. Timing – performed immediately after 3rd postcontrast VIBE (equilibrium phase) in 12

14. **Axial DWI with ADC map**
    a. Free breathing
    b. Slices extend from dome of liver to inferior aspects of liver and pancreas to include all intrahepatic biliary tree, extrahepatic biliary tree and pancreatic duct.
    c. Goal parameters
        i. B-values of 0, 100, 500, 1000, and ADC map

15. **Axial T1 Ultra fast 3D-GE with fat suppression (VIBE, LAVA, TIGRE) 5 minute delay**
    a. Breath holds
    b. Slices extend from dome of liver to inferior aspects of liver and pancreas to include all intrahepatic biliary tree, extrahepatic biliary tree and pancreatic duct.
    c. Goal parameters
        i. Slab slices <= 3 mm

16. Post-contrast subtractions should be included for all phases (4 total)

Radiologist's perspective:

Pancreatic lesions:
Technological improvements in MRI and CT have improved imaging spatial resolution, allowing us to better visualize patient anatomy but also greatly increasing the number of incidental lesions seen on CT and US. Unfortunately, CT and US frequently cannot adequately characterize some of these lesions, particularly cystic pancreatic lesions, due to volume averaging on CT and limited imaging windows on US. MRI provides superior soft tissue contrast resolution and allows for dynamic post-contrast imaging and creation of subtraction images that increase radiologist confidence in the detection of solid enhancing components, which are used to differentiate benign lesions from malignant lesions.

One of the most common incidentally detected pancreatic lesions is the intraductal papillary mucinous neoplasm (IPMN), which are dilated side branches of the pancreatic duct due to ductal cells producing too much mucin/fluid (hence the name and need for MRCP sequences to evaluate for communication with the main pancreatic duct). These lesions have a small chance of malignant transformation (turning into cancer) and are followed by MRI to detect this transformation if it occurs. Guidelines for follow-up are constantly evolving and are subject to change.

Biliary abnormalities (other than choledocholithiasis):

MRCP with contrast is the mainstay for evaluation of lesions of the biliary tree (with exception of common duct stones). Contrast can help delineate subtle enhancing lesions of the biliary tree wall that would otherwise be invisible. In patients with primary sclerosing cholangitis (or concern for PSC), contrast helps to demonstrate abnormal biliary radicals. These patients are at risk for biliary malignancy and subtle contrast enhancement can play a major role in their management.

Unless the indication of MRCP is "choledocholithiasis", contrast is required for a complete examination. This includes indications such as: elevated bilirubin, elevated alkaline phosphatase, jaundice, dilated biliary tree (without mention of bile duct stone), etc. *When in doubt, please contact a body radiologist to determine if contrast is necessary.*

Different scanners have different capabilities to perform various MRCP sequences:

-All scanners have the capability to perform the thick slab heavily T2 weighted sequences. These should be performed in the coronal on all patients. If the coronal is not optimal or otherwise compromised, this should be performed in the RAO, and LAO planes.

-Some newer scanners have the ability to perform a 3D acquisition T2 weighted turbo spin echo sequence. This is acquired with respiratory triggering.

Please direct any questions or concerns to any of the body radiologists.

Table 1 Summary of MRCP imaging parameters

Parameter	T2-weighted breath-hold HASTE (liver down to ampulla)	3D T2-weighted FSE with respiratory triggering	T2 weighted breath-hold HASTE fat-saturated thick slab
TR/TE (ms)	1,000/83	1,800/678	4,500/752
Number of averages	1	1	1
Flip angle	150	180	180
Field of view (mm)	350 × 263	380 × 380	350 × 350
Matrix size	256 × 146	384 × 380	384 × 300
Slice thickness (mm)	7 mm	1.5 mm	40 mm
Slice gap (mm)	0.7 mm	0 mm	N/A
Number of slices	20	40	1
Acquisition plane	Axial	Coronal oblique	Coronal
Half-Fourier factor	5/8	Phase-encoding: off Slice-encoding: 6/8	Phase encoding: 7/8
Parallel imaging acceleration factor	2	2	2
Receiver bandwidth (Hz/pixel)	391	260	150
Turbo factor	146	127	307
Oversampling	None	Slice: 20%	Phase: 33%

HASTE half-Fourier acquisition single shot turbo spin echo, *FSE* fast spin echo

References

1. Griffin, N., Charles-Edwards, G. & Grant, L. A. Magnetic resonance cholangiopancreatography: the ABC of MRCP. Insights Imaging 3, 11–21 (2011).