Routine MR Imaging for Pancreas

Bhavik N. Patel, MD, MBA

KEYWORDS

• MR imaging • Pancreas • T1 weighted • T2 weighted • MRCP

KEY POINTS

- MR imaging with magnetic resonance cholangiopancreatography (MRCP) serves as both a primary diagnostic and problem-solving tool for comprehensive evaluation of the pancreas.
- T1- and T2-weighted images comprise the routine protocol, which are performed at 1.5 T or 3.0 T.
- Higher image quality for evaluation of the pancreas can be achieved with 3.0 T compared with 1.5 T.
- A normal pancreas has a high T1 signal, and pre–contrast- and post–contrast-enhanced T1-weighted images are useful for identifying neoplastic and inflammatory pathologies.
- MRCP allows excellent visualization of the pancreatic duct.

INTRODUCTION

Given the fastidious nature of the gland and the often diagnostically challenging and complex disease processes that can involve the pancreas, a combination of multiple imaging modalities (eg, dual-energy computed tomography, ultrasound, endoscopic retrograde cholangiopancreatography) are often required for diagnostic evaluation.

MR imaging serves as a unique and valuable diagnostic tool allowing high-resolution imaging of the pancreas and simultaneous evaluation of the pancreatic parenchyma, peripancreatic soft tissues, pancreatic duct, biliary duct, and the surrounding rich neurovascular bundles. Recent technical advances have further boosted the clinical utility of MR imaging for the evaluation of the pancreas, now with shorter scan times and larger bores allowing scanning of large and claustrophobic patients.[1] In fact, scanners with a field strength of 7 T, 60-cm bore size, more than 200 coil elements, and up to 128 radiofrequency (RF) channels are now available for clinical use. New sequences, such as diffusion-weighted, 3-dimensional (3D), T1-weighted, and magnetic resonance (MR) cholangiopancreatography (MRCP) images allows accurate detection and characterization of neoplastic as well as inflammatory processes. MR imaging is commonly used for evaluation and further characterization of cystic pancreatic lesions and chronic pancreatitis. It serves as a problem-solving tool in patients with elevated liver enzymes, acute right upper quadrant pain, acute pancreatitis, and pancreatic cancer. This review highlights the routine MR imaging protocol for evaluating the pancreas.

MR IMAGING TECHNIQUE

The author's routine MR imaging protocol of the pancreas includes 2-dimensional (2D) and 3D spin echo (SE) coronal MRCP, T2-weighted 2D axial and coronal fat-suppressed fast SE, non–fat-suppressed T2-weighted axial fast SE, 2D axial diffusion-weighted, T1-weighted 2D axial in-phase and opposed-phase gradient echo (GE), and pre-gadolinium and postgadolinium 3D axial T1-weighted GE sequences. **Tables 1** and **2** outline the technical parameters of these sequences using 1.5 and 3.0 T MR imaging.

1.5 VERSUS 3.0 T MR IMAGING

Signal-to-noise ratio (SNR) varies linearly with field strength. Thus, the largest advantage of scanning

Disclosure Statement: The author has nothing to disclose.
Body Imaging Division, Stanford University Medical Center, 300 Pasteur Drive, H1307, Stanford, CA 94305, USA
E-mail address: bhavikp@stanford.edu

Magn Reson Imaging Clin N Am 26 (2018) 315–322
https://doi.org/10.1016/j.mric.2018.03.009

Table 1
Scanner parameters for routine pancreatic imaging on 3.0-T MR imaging

Parameter	T2 2D SSFSE	T2 2D SSFSE	T2 2D SSFSE (Fat Sat)	2D SE MRCP	3D FSE MRCP	2D SE DWI	2D SPGR I/O	T1 3D SPGR[a]
Plane	Axial	Coronal	Axial	Coronal	Coronal	Axial	Axial	Axial
No. of echoes	1	1	1	1	1	1	2	2
TE/TR (ms)	100/min	120/min	min/min	200/min	min/—	min/3748	—/150	min/—
Flip angle	—	—	—	—	—	—	—	15
RBW	83.33	83.33	100.00	83.33	62.5	—	—	166.67
FOV	34.0	42.0	38.0	38.0	36.0	42.0	38.0	32.0
ST/SP	4.0/2.0	4.0/0.0	7.0/1.0	5.0/0/0	2.0/—	7.0/0.0	5.0/0.5	3.0/—
Frequency direction	R/L	S/I	R/L	S/I	S/I	R/L	R/L	R/L
Matrix	352 × 256	416 × 256	384 × 224	320 × 224	320 × 256	80 × 128	256 × 256	320 × 224
NEX	0.75	1	1	1	1	1	1	1
Respiration	BH	BH	BH	BH	Nav	BH	BH	BH

Abbreviations: DWI, diffusion-weighted images; FOV, field of view; I/O, in- and opposed phase; NEX, number of excitations; RBW, receiver bandwidth; Sat, saturation; SPGR, spoiled gradient echo; SSFSE, single shot fast spin echo; ST/SP, slice thickness/slice spacing; TE/TR, echo and repetition time.
[a] Represents pregadolinium and postgadolinium.

at 3.0 T compared with 1.5 T is the increased SNR.[2] Theoretically, the increase in SNR should be 2-fold. However, because of technical factors, such as RF field inhomogeneities, increased susceptibility effects, and limitations of the amount of energy deposited, the actual SNR is closer to 1.7 times higher than at 1.5 T.[3–5] This increased SNR can be used to improve spatial resolution, increase temporal resolution, or decrease acquisition time, or both.[3,5] Clinically, this could allow improved lesion visibility or reduced motion artifact. At 3.0 T, T1 relaxation of tissues increases; if imaged at similar repetition times (TRs) to 1.5 T, this would result in lower soft tissue contrast

Table 2
Scanner parameters for routine pancreatic imaging on 1.5-T MR imaging

Parameter	T2 2D SSFSE	T2 2D SSFSE (Fat Sat)	2D SE MRCP	3D FSE MRCP	2D SE DWI	2D SPGR I/O	T1 3D SPGR[a]
Plane	Axial	Axial	Coronal	Coronal	Axial	Axial	Axial
No. of echoes	1	1	1	1	1	2	1
TE/TR (ms)	90/min	90/—	90/min	min/—	min/6000	—/150	min/—
Flip angle	—	—	—	—	—	—	15
RBW	35.71	50.00	31.25	62.50	—	—	125.00
FOV	36.0	38.0	36.0	35.0	38.0	38.0	38.0
ST/SP	4.0/0.0	6.0/1/0	4.0/0.0	2.2/—	7.0/0.0	5.0/0.5	5.0/—
Frequency direction	R/L	R/L	S/I	S/I	R/L	R/L	R/L
Matrix	320 × 256	384 × 256	320 × 256	352 × 224	80 × 128	256 × 256	288 × 224
NEX	1	2	1	1	1	1	1
Respiration	BH	BH	BH	Nav	BH	BH	BH

Abbreviations: DWI, diffusion weighted images; FOV, field of view; I/O, in- and opposed phase; NEX, number of excitations; RBW, receiver bandwidth; Sat, saturation; SPGR, spoiled gradient echo; SSFSE, single shot fast spin echo; ST/SP, slice thickness/slice spacing; TE/TR, echo and repetition time.
[a] Represents before gadolinium and after gadolinium.