Breath-held 3D Steady State Free Precession MRCP: Preliminary Experience and Comparison with Respiratory-triggered 3D FRFSE

C. U. Lee[1], and J. F. Glockner[1]
[1]Radiology, Mayo Clinic, Rochester, MN, United States

Introduction: Respiratory-triggered 3D fast recovery fast spin echo (FRFSE) pulse sequences have rapidly become a primary MRCP technique in many practices since their introduction a few years ago. The excellent background suppression, high spatial resolution, and ease of 3D reconstruction are important benefits when compared with 2D SSFSE sequences. While 3D FRFSE image quality is usually excellent, a small but significant percentage of patients have an irregular breathing pattern that can introduce substantial motion artifact and degrade the resulting images. 3D steady state free precession (SSFP) pulse sequences have high fluid signal intensity and can be performed rapidly during suspended respiration. We investigated breath-held 3D SSFP as an alternative to respiratory-triggered FRFSE in 19 patients referred for MRCP.

Materials and Methods: Sequence parameters for the 3D SSFP sequence include: coronal or axial acquisition, FOV 32-42cm, section thickness 1-3mm, matrix 256x224, TR/TE 2.5/1.0ms, flip angle 45, receiver bandwidth 125 kHz, and parallel imaging acceleration factor 2. 3D FRFSE was performed with the following parameters: FOV 26-36 cm, section thickness 1.4-1.6 mm, matrix 256x224, TE 750 ms, flip angle 90, receiver bandwidth 62 kHz and ETL 140. For each of the 19 patients, both 3D SSFP and 3D FRFSE MRCP's were performed. Images were evaluated qualitatively to assess visualization of pathology, image artifact, and overall image quality on a scale of 1 (uninterpretable) – 5 (ideal). In addition, a preferred sequence was selected.

Results:
Clinical indications for MRCP included primary sclerosing cholangitis, cholangiocarcinoma, pancreatitis, Caroli disease, post liver transplant, and abdominal pain. In one patient, the FRFSE acquisition failed to complete due to poor respiratory triggering. Two patients had no identifiable pathology and were not included in the assessment for visualization of pathology. All 3D SSFP MRCP's and the remainder of the 3D FRFSE MRCP's were of diagnostic quality. Table 1 summarizes the qualitative image assessment: 3D SSFP had higher quality scores for image artifact, overall image quality, and visualization of pathology. SSFP outperformed FRFSE mainly in soft tissue or tumor visualization, and intraductal pathology. Excluding the one patient where the FRFSE was not completed due to poor respiratory triggering, 3D SSFP images were preferred in 10/18 cases. Figs. 1-2 shows representative reformatted images from 3D SSFP and 3D FRFSE MRCP's.

		3D SSFP	3D FRFSE
Artifact	(n=19)	3.6	3.4
Image Quality	(n=19)	3.8	3.6
Pathology Seen	(n=17)	94%	82%

Table 1. Qualitative image assessment scores for SSFP and FRFSE.

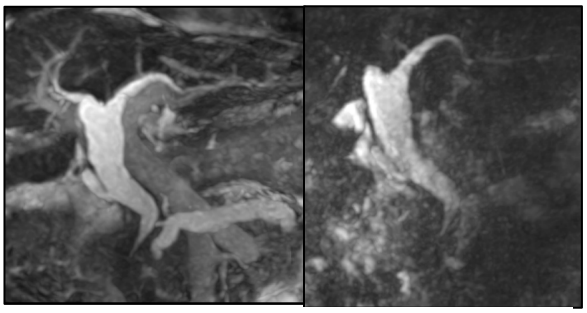

Fig 1. Subvolume MIP images from 3D SSFP MRCP (left) and 3D FRFSE MRCP (right) in a patient with chronic pancreatitis reveal dilated biliary and pancreatic ducts with focal stricture of the common duct in the pancreatic head. The FRFSE image is degraded by motion artifact and has extensive signal loss in the region of the pancreatic duct.

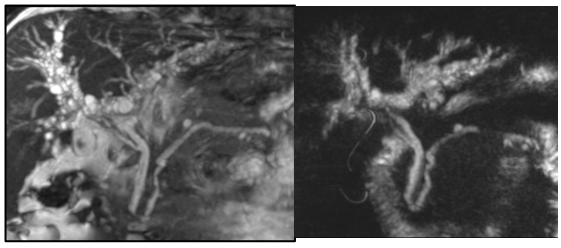

Fig 2. Subvolume MIP images from 3D SSFP MRCP (left) and 3D FRFSE MRCP (right) in a patient with Caroli disease variant. Note blurring of innumerable biliary cysts on the 3D FRFSE image due to respiratory motion artifact.

Discussion: SSFP pulse sequences are useful additions to standard respiratory-triggered 3D FRFSE MRCP sequences particularly in patients with irregular breathing and difficulties with breath-holding. SSFP sequences also allow visualization of the hepatic vessels and parenchyma without the use of contrast. The major limitation of this technique is the relatively poor background suppression relative to FRFSE pulse sequences, which makes 3D reconstructions more difficult; however, visualization of hepatic parenchyma and vasculature is sometimes useful in staging biliary tumors.