Comparison of Free-Breathing Radial 3D T1 VIBE to Standard Breath-hold 3D T1 VIBE During Hepatobiliary Phase Imaging after Gadoxetic Acid Injection for Image Quality and HCC Detection

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Target audience: Radiologists, physicists and technologists with interest in liver disease.

Purpose: Breath-hold 3D T1 VIBE is a critical component of abdominal MRI [1]. It uses a Cartesian filling of k-space, thus is sensitive to motion related artifacts. A non-Cartesian 'stack-of-stars' scheme to acquire radial k-space data [2] has shown potential for improving image quality in patients with diminished breath-hold capacity [3, 4]. Gadoxetic-acid (Gd-EOB-DTPA, Primovist/Eovist, Bayer) MRI with hepatobiliary phase (HBP) has shown utility for imaging the cirrhotic liver with better lesion conspicuity and hepatocellular carcinoma (HCC) detection [5, 6]. In this study, we compared conventional VIBE (BH-VIBE) and free-breathing (FB) Radial-VIBE during HBP after gadoxetic acid injection in terms of image quality (IQ) and HCC detection in patients at risk of HCC.

Methods: Patients at risk of HCC who underwent Gadoxetic-acid liver MRI at 1.5T (Avanto, Siemens) including BH and Radial VIBE sequences during HBP were included in this retrospective HIPAA compliant IRB approved study. Sequence parameters were: TR/TE 3.2-6.2/1.1-1.9 ms, slices 96-104, flip angle 12-25°, slice thickness 2.5 mm, FOV Radial 379 x 379/BH 284 x350 mm, matrix Radial 288 x 28/ BH 256 x 125, voxel size Radial 1.3 x 1.3 x 2.5/ BH 1.1 x 1.1 x 2.5 mm, 1 average, GRAPPA 2 (for BH-VIBE) and acquisition times Radial 12 sec/ BH 4 min. Two sets of images were independently analyzed by two experienced radiologists: BH-VIBE set and Radial-VIBE set at HBP. For each data set, each reader scored the following IQ parameters using a five-point scale: overall IQ, respiratory motion artifact, liver edge sharpness and streak artifacts. Readers were also asked to detect hypointense lesions on HBP with a size > 1 cm suspicious for HCC and assign a lesion conspicuity (LC) score for each lesion detected (cysts and hemangiomas were excluded based on T2WI). Reference standard was provided by histopathologic findings and/or imaging evaluation by two separate readers. Wilcoxon paired test was used to test for differences in IQ and LC scores. Per-lesion sensitivity and PPV were calculated for both observers for each image set.

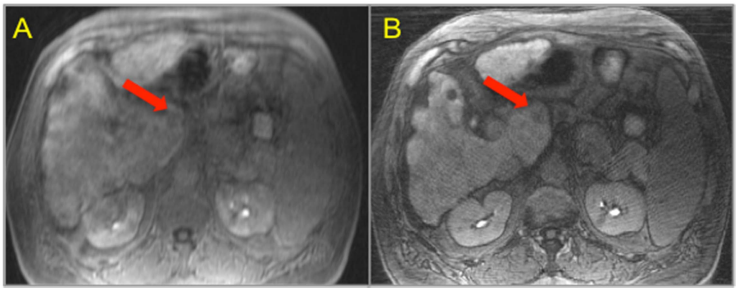
Results: Initial data for 40 patients (M/F 22/18, mean age 62 y) is presented. 30 patients with 46 HCCs (mean size 28.2 mm, range 11-70 mm) and 10 patients without HCC were evaluated. No differences in IQ scores were found between the two sequences (p=0.1). Radial-VIBE demonstrated improved IQ scores for liver edge sharpness (p <0.01) and respiratory artifacts (p <0.001), with significant degradation of IQ image quality due to increased streak artifacts (p <0.05) for both readers. High HCC detection rate was found for both data sets with sensitivities of 84% and 89% for BH-VIBE and Radial-VIBE for both readers respectively. Higher LC scores were observed with Radial-VIBE compared to BH-VIBE for one reader (3.5 versus 3.1, p <0.03) and a trend towards better LC for the second reader (3.3 versus 3, p =0.06).

	Reader 1			Reader 2		
	BH VIBE	Radial VIBE	p	BH VIBE	Radial VIBE	p
Overall image quality	3.6 ± 0.9	3.7 ± 0.4	0.19	3.3 ± 0.8	3.5 ± 0.5	0.23
Respiratory artifact	3.7 ± 0.9	4.7 ± 0.5	<0.0001	3.8 ± 0.9	4.2 ± 0.5	0.001
Liver edge sharpness	3.6 ± 0.9	4.0 ± 0.5	0.01	3.6 ± 0.6	4.1 ± 0.6	<0.0001
Streak artifacts	5.0 ± 0	3.1 ± 0.4	<0.0001	4.9 ± 0.1	3.3 ± 0.6	<0.0001

Table 1: Comparison of image quality scores for HBP BH-VIBE and HBP Radial-VIBE sequences.

Discussion: Our pilot data have shown the potential of free breathing Radial-VIBE post-gadoxetic acid at HBP for HCC detection compared to BH-VIBE, with similar sensitivity for HCC detection and better lesion conspicuity in comparison with BH-VIBE sequence for one reader. To our knowledge there are no prior studies comparing lesion detection and conspicuity between BH and Radial-VIBE sequences at HBP phase. Azevedo et al [4] showed higher liver lesion detection, confidence and conspicuity for non-contrast BH-VIBE in comparison with non-contrast Radial-VIBE. In our patient population, we found less respiratory motion artifacts and better definition of liver edge sharpness for Radial-VIBE. Chandarana et al [3] in a study comparing BH versus Radial VIBE acquired at equilibrium phase post-contrast administration of gadopentetate dimeglumine found no statistically significance between the two sequences regarding overall image quality, respiratory motion artifact and liver edge sharpness.

Conclusion: High-resolution free-breathing radial acquisition after administration of Gadoxetic acid has potential for HCC detection in patients that have difficulty breath-holding.



(A) BH and (B) Radial VIBE sequences in a cirrhotic patient with image degradation due to respiratory artifact. Better lesion conspicuity of a caudate lobe HCC (arrows) in noted on Radial VIBE acquisition.

References
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