COMPARISON OF CAIPIRINHA-VIBE, RADIAL-VIBE, AND CONVENTIONAL VIBE FOR FREE-BREATHING DYNAMIC CONTRAST-ENHANCED MRI (DCE-MRI): A PRELIMINARY STUDY

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Purpose

It is difficult to acquire good dynamic contrast-enhanced MRI (DCE-MRI) images of the body due to respiratory motion.[1] To overcome the respiratory motion artifact, motion-resistant T1-weighted gradient echo sequences have been developed, including CAIPIRINHA-VIBE and Radial-VIBE with KWIC reconstruction.[2,3] Therefore, we aimed to compare the quality of free-breathing DCE-MRI using CAIPIRINHA-VIBE, Radial-VIBE, and conventional VIBE.

Methods

Fifteen patients with malignant tumors underwent DCE-MRI at 3.0T machine (Skyra, Siemens). Free-breathing dynamic scans were conducted using a CAIPIRINHA-VIBE in 9 patients (TR/TE, 3.8/1.6 ms; flip angle, 25°; matrix size, 256x256), a Radial-VIBE in 3 patients (TR/TE, 3.7/1.4 ms; flip angle, 25°; matrix size, 256x256; 6 subframes), and conventional VIBE in 3 patients (TR/TE, 3.2/1.1 ms; flip angle, 25°; matrix size, 256x256), after Dotarem 0.1 mmol/kg bolus administration at an injection rate of 2 mL/s. The perfusion maps of initial area under the concentration curve (iAUC) were generated using a software (Tissue 4D, Siemens). The goodness of fit (GOF) of the time-intensity curve was evaluated for aorta and liver by Pearson's Chi-squared test. The overall image quality regarding the lesion conspicuity, sharpness of abdominal solid organ, fat suppression, and artifacts of the DCE-MRI were rated on a 5 point scale (1, poor, to 5, excellent quality) and compared using ANOVA test. The signal-to-noise ratio (SNR) of the liver was also calculated.

Results

In all three tested sequences, we can obtain DCE-MRI with high temporal resolution (5 seconds) and spatial resolution (1.48 x 1.48 mm) and reasonably good voxel-wise perfusion maps. Image quality of perfusion maps was higher in Radial-VIBE (4.78±0.44) than CAIPIRINHA-VIBE (3.15±1) and conventional VIBE (3.22±0.67) (p<0.001) (Fig. 1, 2). The GOF of time-intensity curve for aorta was better in CAIPIRINHA-VIBE (2.1±1.58) and Radial-VIBE (2.76±1.64) than that of conventional VIBE (6.96±6.71) (p=0.001). GOF for liver was similar between three sequences. Regarding the image quality of raw MRI images, the CAPIRINHA-VIBE (3.47±1.6) and Radial-VIBE (3.52±0.53) showed the higher overall quality than conventional VIBE (2.78±1) (p=0.001). The artifacts of CAIPIRINHA-VIBE were lower (3.46±1.8) than those of Radial-VIBE (3.22±0.87) and conventional VIBE (3±1.12) although statistically not significant (p=0.069). The SNR of the liver was highest in Radial-VIBE (24.69 ±1.21), followed by conventional VIBE (18.8±3.93) and CAIPIRINHA-VIBE (15.12±3.87) (p=0.049).
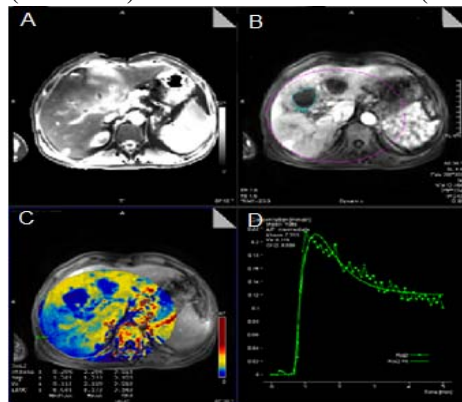

Figure 1. DCE-MRI: CAIPIRINHA-VIBE   **Figure 2. DCE-MRI : Radial-VIBE**
(A, T1 map; B, Motion correction sum-up image; C, iAUC map; D, Time-enhancement curve)
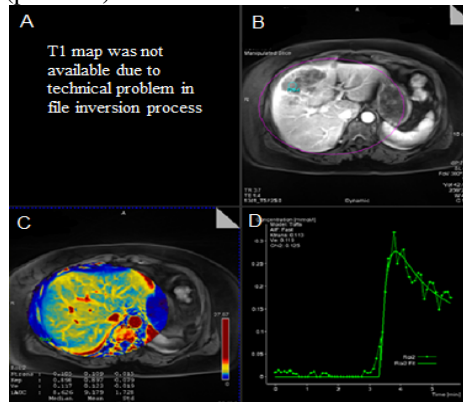
Discussion and Conclusion

The CAIPIRINHA-VIBE and Radial-VIBE showed similarly higher image quality than conventional VIBE for free-breathing DCE-MRI. Radial-VIBE showed higher performance in perfusion map quality and SNR than CAIPIRINHA-VIBE. However, Radial-VIBE is a research-purpose protocol (i.e, work-in-progress product) and may not be readily available to use in clinical practice, while CAIPIRINHA-VIBE is an established sequence and commercially available. In conclusion, the CAIPIRINHA-VIBE is feasible and readily available for the free-breathing DCE-MRI with comparable performance with Radial-VIBE.

References

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