Free-breathing dynamic contrast-enhanced MRI at 3.0 T using a 3D-radial-gradient echo sequence with K-space-weighted image contrast (KWIC): preliminary study

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Purpose:

Dynamic contrast-enhanced (DCE)-MRI has emerged as a important method for evaluating tumor blood vascularity. However, it is difficult to acquire high-qualited DCE-MRI of abdomen and thorax due to the respiratory motion. To overcome the respiratory motion artifact, DCE-MRI using a 3D-radial-gradient echo sequence with k-space weighted radial view-sharing scheme (KWIC) was proposed. Therefore, we aimed to evaluate the feasibility of free-breathing DCE-MRI of the abdomen and thorax at 3.0 T using radial k-space sampling and KWIC reconstruction.

Methods:

Sixteen patients with malignant tumors (hepatocellular carcinoma, n=5; liver metastasis, n=3; pancreas cancer, n=4; lung cancer, n=4) underwent DCE-MRI at 3.0T machine(Tim Trio, Siemens). Among them, 6 patients were scanned at two different time points before and after a vascular targeting agent (CKD-516). T1 map was generated from a triple flip-angle (α=2°, 8°, 15°) based free-breathing radial T1 mapping procedure. Free-breathing dynamic scan was conducted using a modified 3D-Radial-VIBE with KWIC sequence (TR/TE, 3.3/1.3 ms; flip angle, 11°; matrix size, 256x256) after Gd-DTPA bolus administration. The pixel-wise perfusion maps of the volume transfer coefficient (K-trans) and initial area under the concentration curve (iAUC) were generated using a software (4D Perfusion, Siemens). The overall image quality regarding the lesion conspicuity, artifact, and the sharpness of abdominal solid organ of the DCE-MRI were rated on a 4 point scale (1, poor, to 4, excellent quality) comparing the breath-hold T1-weighting gradient-echo sequence scanned immediately after the dynamic scan.

Results:

The proposed free-breathing DCE-MRI technique provided excellent motion-correction sum-up images with the reasonably high spatial resolution (1.48 x 1.48 mm) and temporal resolution (4.1 sec) that allowed for high frame-rate arterial input function sampling and excellent pixel-wise perfusion maps (Figure 1 and 2). Overall image quality score of DCE-MRI was 3.68±0.47 with negligible radial artifact and motion artifact.

Conclusions:

Free-breathing DCE-MRI with a 3D-radial-gradient echo sequence with KWIC reconstruction is feasible for perfusion analysis of tumor in the abdomen and thorax. It can overcome respiratory motion while providing high spatial and temporal resolution.

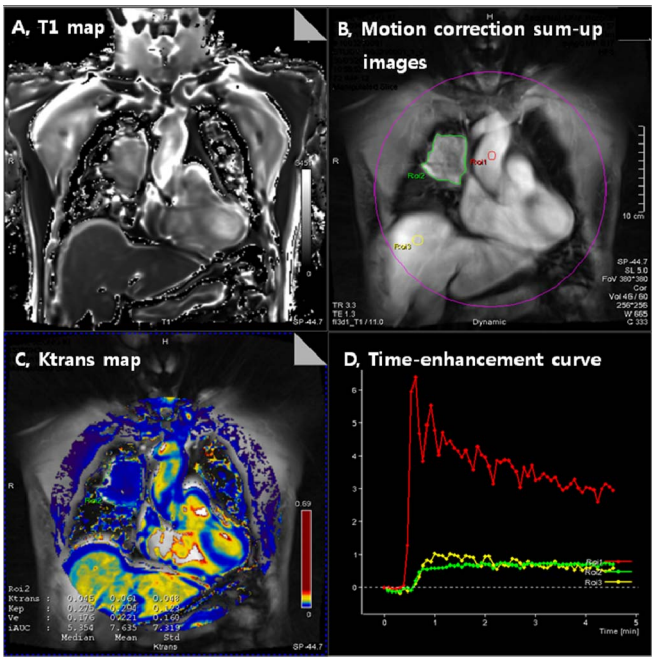

Figure 1. DCE-MRI of a patient with lung cancer

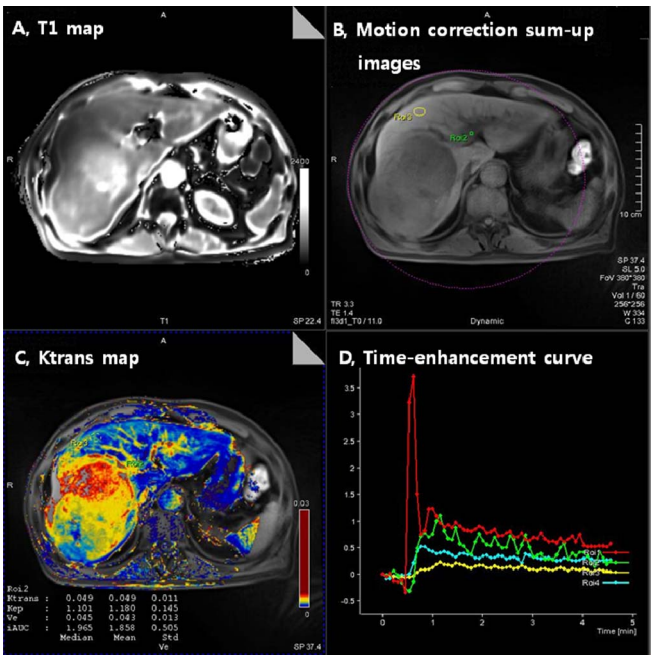

Figure 2. DCE-MRI of a patient with HCC

(A, T1 map; B, Motion correction sum-up image; C, Ktrans map; D, Time-enhancement curve)

Free-breathing DCE-MRI of thorax (Figure 1) and abdomen (Figure 2) showed high-qualited images and parametric perfusion maps that may enable the accurate analysis of tumor perfusion.