Contrast Enhanced T1W FLAIR PROPELLER MRI: Improvement in Flow-Related Phase Artifacts Compared to Conventional Cartesian Techniques

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PURPOSE

Conventional Cartesian methods for T1W contrast-enhanced magnetic resonance imaging (CE-MRI) produce flow-related phase artifacts which both obscure and simulate true pathologic lesions. These artifacts occur as a consequence of phase misregistration of Gadolinium-brightened protons moving through large blood vessels. Non-pulsatile flow within large venous sinuses causes diffuse spread of coherent noise along the phase-encode direction, whereas repetitive, periodic arterial pulsations result in focal ghosting artifacts. The radial scanning nature of PROPELLER MRI minimizes the perceptibility of phase artifacts by dispersing them in all directions (1). Ghosting and coherent motion artifacts caused by moving blood are avoided, thereby improving overall image quality. We set out to formally compare image quality and both the presence and severity of phase artifacts by subjective analysis of a series of T1W CE-MRI cases scanned with both conventional Cartesian and PROPELLER techniques.

METHODS

Approval has been granted by the Institutional Review Board. Conventional Cartesian Spin-Echo T1W (CONV-T1) and PROPELLER FLAIR T1W (T1-PF) CE-MRI are performed following administration of 0.1 mmol/kg gadolinium-DTPA during routine clinical imaging. The order of sequence acquisition is alternated from subject to subject. T1-PF imaging parameters (TR = ~2700 ms, TI = 800 ms, BW = ±250 kHz, Freq Resolution = 340, 5 gradient echoes per SE period, ETL = 5) are similar to those on CONV-T1 sequences (auto TR, TE = 17 ms, BW = ±15.6 kHz, matrix size = 352×256, FOV = 24×18 cm^2, and NEX = 1). The following parameters are identical for both sequences: 5 mm slice thickness, skip 2.5 mm, FOV = 24x24 cm. All images are visually assessed for the presence of flow related phase artifacts by three trained neuroradiologists. A first score ranging from 1 through 5 is assigned for each pair of images based on the presence and/or severity of image phase artifact. A score of 1 or 2 is assigned if T1-PF shows marked or mild improvement in perceptible phase artifacts, respectively, when compared to CONV-T1. A score of 3 denotes that phase artifacts are equal between both techniques. A score of 4 or 5 is assigned if CONV-T1 images show mild or marked improvement in perceptible phase artifacts, respectively, when compared to T1-PF images. A second score, also ranging from 1 through 5 is assigned to each pair based on the conspicuity of any existing contrast enhancing parenchymal lesions. All three readers must agree on the presence of each enhancing lesion in order for it to qualify. A score of 1 or 2 is assigned to the pair of images if T1-PF shows marked or mild increase in conspicuity of enhancing lesions, respectively, when compared to CONV-T1. A score of 3 denotes that the enhancing lesions are equal in degree of conspicuity between both techniques. A score of 4 or 5 is assigned if CONV-T1 images show mild or marked increase in conspicuity of enhancing lesions, respectively, when compared to T1-PF images. All readers are blinded to the type of technique.

RESULTS

To date, twenty-five subjects have been scanned with CE-MRI using both CONV-T1 and T1-PF techniques. 25 out of 25 pairs were successfully scored by all three readers for the presence and severity of phase artifact. Out of the three readers, the average score ranking artifacts for these image pairs was 1.05, confirming that T1-PF showed significant improvement in perceived phase artifacts. In 10 out of 25 cases, all three readers agreed on the presence of enhancing parenchymal lesions, and the average score on lesion conspicuity for all readers for the 10 pairs was 3.2.

CONCLUSION

PROPELLER MRI scanning techniques substantially diminish the perceptibility of flow-related phase artifacts on T1W CE-MRI (Figure 1). The technical improvement in image quality can potentially strengthen the confidence of the neuroradiologist in diagnosing the presence or absence of abnormally enhancing lesions. The average reader scored slightly favored conventional spin-echo technique for conspicuity of enhancing lesions (Figure 2), which may be related to differences between spin-echo and FLAIR T1W techniques (2). Further work is necessary in a larger patient population to determine if these differences result in significant changes in accuracy of lesion detection.

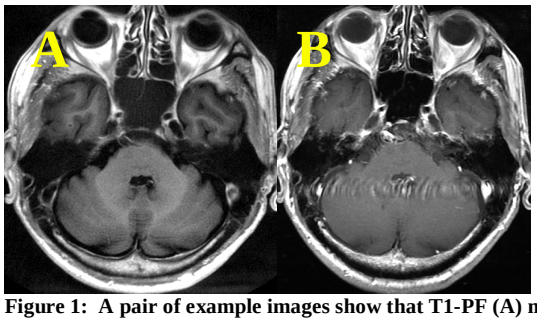

Figure 1: A pair of example images show that T1-PF (A) markedly improves the appearance of phase artifacts from flow within the transverse sinus compared to CONV-T1 (B) technique.

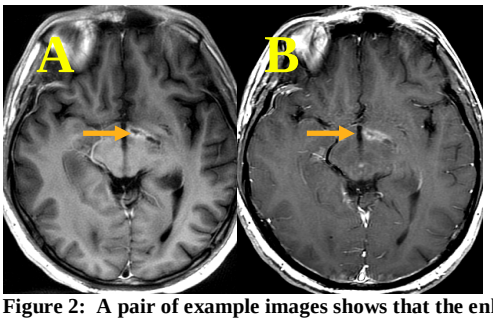

Figure 2: A pair of example images shows that the enhancing lesion is slightly less conspicuous on T1-PF (A) compared to CONV-T1 (B) technique.

REFERENCES

1) MRM 42:963-969; 1999. 2) AJR 171:803-807; 1998.