

Dynamic oxygen-enhanced MRI of cerebrospinal fluid: IR FASE vs. FASE

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Target audience: Those who have interest in CSF analysis and contrast media.

Purpose: To compare the ability to dynamically track oxygen enhancement (OE) of cerebrospinal fluid (CSF) between 3-T MRI fast advanced spin echo (FASE) and FASE with inversion recovery (IR-FASE). FASE

Methods: Fifteen volunteers were scanned using both IR-FASE and FASE to track OE of CSF using the following dynamic imaging protocol: 1) Pre-O₂: 21% O₂ for 5min; 2) O₂: 15L/min 100% O₂ for 5min; 3) Post-O₂: 21% O₂ for 8min. Sulcal CSF (CSFs) and ventricular CSF (CSFv) mask images were created (Fig. 1). Maximum signal intensity (maxSI) and maximum signal intensity slope (maxSI_{slope}) of CSF were calculated. Mean SI of CSFs and CSFv were calculated.

Results:

Time intensity curve of CSFs and CSFv: Shown in Fig 2.

Subtraction images: O₂ minus Pre-O₂ shows a positive SI difference (warm color), while Post-O₂ minus O₂ shows a negative SI difference (cold color) in both IR-FASE and FASE images (Fig. 3).

IR-FASE vs. FASE: CSFs: Values of maxSI and maxSI_{slope} were significantly higher for

IR-FASE than for FASE (p=0.001 and p< 0.0001, respectively). CSFv: Values of maxSI and maxSI_{slope} were significantly higher for IR-FASE than for FASE (p=0.034, and p=0.0001, respectively).

Discussion: This study demonstrated dynamic tracking OE of CSF on both IR-FASE and FASE, since both methods showed positive signal increases during O₂ administration and maxSI data supported these findings. Rapid OE after O₂ administration displayed by SI_{slope} was also demonstrated and represented by maxSI_{slope}. In addition, OE of CSFs was visualized better than OE of CSFv on both IR-FASE and FASE. IR-FASE showed more OE of CSFs than FASE. Our results support previous reports of differences between OE of CSFs and OE of CSFv, but with higher temporal resolution than previously described [1]. CSF is traditionally thought to mainly form from the choroid plexus in the ventricles and is absorbed at the arachnoid villi [2]. Oxygen diffuses into the CSF through the blood-CSF barrier, and this exchange occurs more in CSFs than in CSFv, probably due to the abundance of pial vessels on the surface of the brain compared to intra-ventricular vessels. The larger amount of intra-ventricular CSF might also cause more dilution of oxygen.

Conclusion: Rapid oxygen enhancement of CSF can be dynamically tracked with both IR-FASE and FASE, and is observed more in CSFs than in CSFv.

References: [1] Anzai Y et al. AJNR 2004, [2] Oreskovic D, et al. Brain Res Rev 2010.

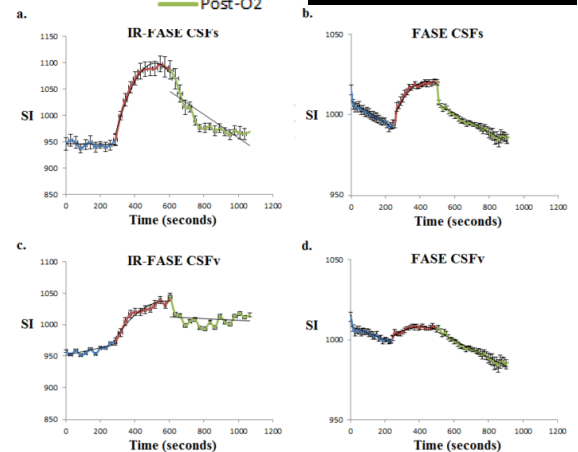
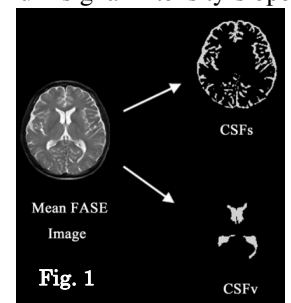


Fig. 2 Time intensity curve of CSFs and CSFv

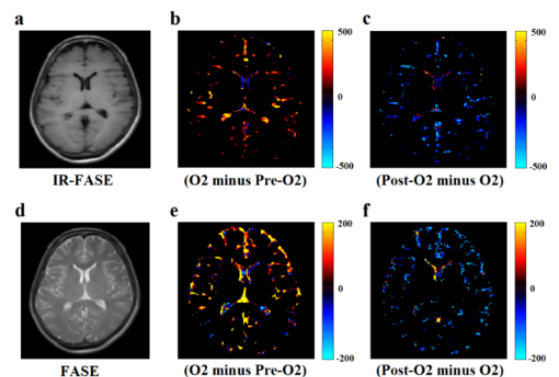


Fig. 3 [a, b, c] IR-FASE, [d, e, f] FASE, [a, d] original images, [b, e] O₂ minus Pre-O₂, [c, f] Post-O₂ minus O₂.