

Susceptibility Weighted Imaging based approach to Δ OEF quantification using Propofol and Midazolam as potential OEF modulators

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Target audience: Clinicians, Dentists, MRI researchers.

Purpose: Oxygen extraction fraction (OEF) represents a critical relationship between blood supply and tissue oxygen consumption in the brain. Disruption in this relationship is known to occur in a range of cerebrovascular disorders, and is therefore considered to be an important indicator of cerebrovascular health. Traditionally, the gold standard approach to OEF measurement is Positron emission tomography (PET); however in this work aim to demonstrate the use of susceptibility-weighted imaging (SWI) in the assessment of OEF in healthy sedated and non-sedated individuals.

Methods: SWI was performed using repeated phase imaging (7T GE, 3D SPGR, 512*512, 18 x 2mm slices TE 15ms, TR 22ms, scan time 2.31 min) in three subject groups: control (n=5), sedation group 1 (Propofol, n=5) and sedation group 2 (Midazolam, n=5), from which Δ OEF maps¹ were calculated between baseline and sedation, and two periods of sedation recovery (10mins and 30 mins post injection). Group ROI's were averaged for each slice and between groups to measure global differences in Δ OEF due to anesthesia (Fig. 1).

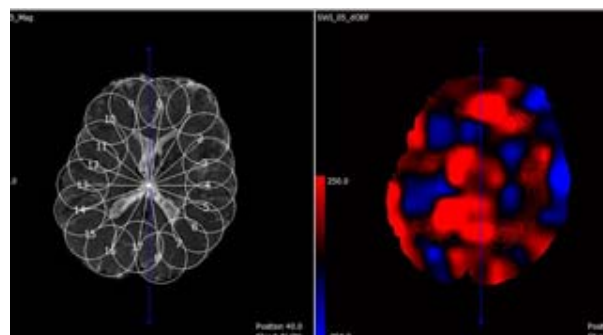


Figure 1. Example image slice with ROIs (left) and corresponding Δ OEF map (right).

Results: Repeated one-way ANOVA tests showed significant main effect between groups in Δ OEF (sedation) ($p < 0.018$) where multi-comparison tests revealed *significant difference* exists between *control and Midazolam* group means during sedation*(Table.1, Fig. 2)

Table 1. Group average % Δ OEF values

	% Δ OEF (Sedation)	% Δ OEF (10min)	% Δ OEF (30/40min)
Control	3.029*	1.5916	-0.3472
Midazolam	-9.0419*	-6.6684	-6.4387
Propofol	-3.4521	-3.3816	-0.5627

Discussion: No-significant change in Δ OEF during Propofol sedation, *significant reduction* in Δ OEF during Midazolam sedation, and the short-term nature of cortical suppression during Midazolam sedation is in agreement with previous literature^{2,3,4}.

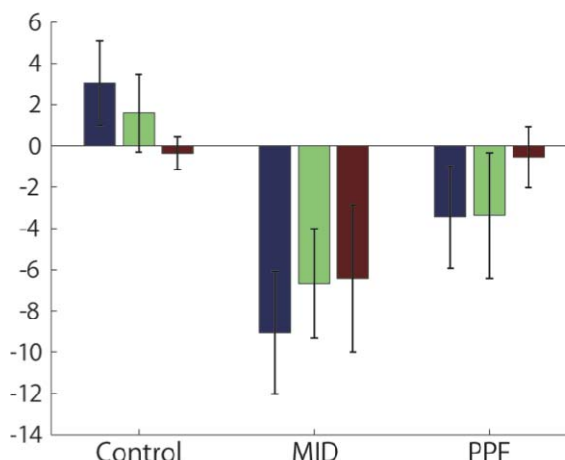


Figure 2. % Δ OEF average group values during sedation (blue), 10mins (green) and 30mins (brown) post sedation vs. non-sedated control group with equivalent scan times.

Conclusion: Preliminary results assessing differences in OEF between anesthesia and control groups suggest that this method may be a useful tool for measuring altered OEF in the human brain. Currently we are developing a method of *quantitative* SWI for region specific, resting state OEF mapping, for application in clinical cases such as hemodynamic ischemia.

References: [1]. Zaitzu, Y. et al, Radiology: Volume 261: Number 3—December 2011, [2]. Kaisti, K. et al.- Anesthesiology, V 99, No 3, Sep 2003; Oshima, T et al.- Acta Anaesthesiol Scand 2002; 46: 831–835, [3] Hoffman, WE. et al.-Anesth Analg 730 1986;65:729-33, [4] Van Gorder, P. – Anesth Analg 1985; 64:129-35.