

# Signal Changes of the Brain in Susceptibility-Weighted Imaging under Low Cerebral Blood Flow

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**Introduction:** Susceptibility-weighted imaging (SWI) is a novel imaging method that maximizes the sensitivity to susceptibility effects of each voxel [1]. SWI is dependent on BOLD effect, however, the relationship between SWI and CBF reduction has not been well studied.

**Materials and Methods:** A prospective study was performed with six normal healthy volunteers (5 males, 1 female, 24-33 years, mean 29 years) All the subjects underwent SWI and PASL under normal ventilation (NV) and hyperventilation (HV) at 3.0 T (Magnetom Trio, Siemens).

Imaging parameters for SWI (Figure 1): TR 27 msec, TE 20 msec, flip angle 15 °, FOV 230 mm × 186 mm, matrix of 512 × 416, slice thickness 0.9 mm. Imaging parameters for quantitative PASL (modified FAIR technique) [2]: TR 2930 msec, TE 27 msec, FOV 200 mm × 200 mm, matrix of 64 × 64, slice thickness 8mm, slice selective inversion slab of 10cm, TI1 700 msec, TI2 1500 msec, 80 repetitions. HV is known to induce CBF reduction and the respiratory rate was kept around 20 – 30 per minute by monitoring for HV state. ROIs were placed at basal ganglia, genu, gray matter and white matter of frontal and occipital lobes without including veins and the differences between NV and HV were evaluated. Contrast of veins and the adjacent brain parenchyma were evaluated in the perpendicular plane against the long axis of veins by using 3D-ROI.

**Results:** CBF<sub>HV</sub> decreased compared with CBF<sub>NV</sub> (29.1 ± 4.6%) (Table 1). Decrease rate of ROIs are shown in Table 2. FL-GM<sub>HV</sub> (frontal lobe-gray matter) and OL-GM<sub>HV</sub> (occipital lobe-gray matter) showed significant decrease compared with FL-GM<sub>NV</sub> and OL-GM<sub>NV</sub>, respectively (*p* = 0.018, 0.017). Venous Contrast<sub>HV</sub> increased compared with Venous Contrast<sub>NV</sub> (164.1 ± 29.9%) (*p* = 0.0027) (Figure 2).

**Discussion and Conclusion:** Hypocapnia caused by HV induces respiratory alkalosis, which increases perivascular pH. Increased perivascular pH causes vasoconstriction and CBF decrease. On BOLD imaging, hypocapnia decreases BOLD signals due to lower venous oxygenation. SWI under HV showed signal decrease in brain parenchyma, however, large signal loss was shown in venous structures, and the contrast between veins and brain parenchyma became conspicuous under HV. It is important to consider CBF changes in interpreting the signals of SWI.

**References:** [1] Haacke, MRM 2004;52:(612-618), [2] Wang, JMRI 2003;18:(404-413)

	CBF <sub>NV</sub>	CBF <sub>HV</sub>	CBF Decrease Rate <sub>HV-NV</sub>
	52.8 ± 8.0 ml/100g/min	37.6 ± 7.3 ml/100g/min	29.1 ± 4.6 %

Note: Values derived from ASL

ROI	BG	Genu	FL-GM	FL-WM	OL-GM
Decrease Rate (%)	5.1 ± 5.4	4.8 ± 7.9	4.6 ± 6.1*	3.4 ± 5.7	5.3 ± 5.7*

BG: basal ganglia, FL: frontal lobe, OL: occipital lobe, GM: gray matter, WM: white matter

\* *p* < 0.05

