

VNS Alters Brain Blood Flow

Brain Blood Flow Alterations Induced by Therapeutic Vagus Nerve Stimulation in Partial Epilepsy: I. Acute Effects at High and Low Levels of Stimulation

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Summary: *Purpose:* Left cervical vagus nerve stimulation (VNS) decreases complex partial seizures (CPS) by unknown mechanisms of action. We hypothesized that therapeutic VNS alters synaptic activities at vagal afferent terminations and in sites that receive polysynaptic projections from these medullary nuclei.

Methods: Ten patients with partial epilepsy underwent positron emission tomographic (PET) measurements of cerebral blood flow (BF) three times before and three times during VNS. Parameters for VNS were at high levels for 5 patients and at low levels for 5. Resting BF measurements were subtracted from measurements during VNS in each subject. Subtraction data were averaged in each of 2 groups of 5 patients. *t* Tests were applied to BF changes in brain regions that receive vagal afferents and projections (significant at $p < 0.05$, corrected for repeated measures).

Results: In both the low- and high-stimulation groups during VNS, **brain BF was (a) increased in the rostral, dorsal-central medulla; (b) increased in the right postcentral gyrus, (c) increased bilaterally in the hypothalami, thalami, and insular cortexes, and in cerebellar hemispheres inferiorly; and (d) decreased bilaterally in hippocampus, amygdala, and posterior cingulate gyri.** The high-stimulation group had greater volumes of activation and deactivation sites.

Conclusions: Our findings suggest that left cervical VNS acutely increases synaptic activity in structures directly innervated by central vagal structures and areas that process left-sided somatosensory information, but VNS also acutely alters synaptic activity in multiple limbic system structures bilaterally. These findings may reflect sites of therapeutic actions of VNS.