



WHAT IS BRAIN FOG?

For patients and physicians

by Julian Stewart, MD, PhD

“Brain Fog” is a common complaint in patients with POTS. Patients often use the term to describe symptoms of lightheadedness, impaired awareness, mental fatigue, and cognitive deficits.¹ Although the constellation of symptoms is imprecise, and has until recently lacked clear physiological correlates, there is evidence that brain fog is closely associated with upright posture in POTS and is related to specific abnormalities found in cerebral blood flow (CBF).

At first it was hypothesized that orthostatic reduction in mean CBF was the culprit. While on average CBF does decrease excessively in POTS,² later scrutiny showed important decreases in mean CBF only occurred during rapid orthostasis in some patients. While brain fog symptoms are consistently reported with increasing orthostatic stress, decreased average CBF does not consistently occur and cannot fully account for brain fog in patients with POTS.

Oscillatory Cerebral Blood Flow (OCBF) occurs in POTS and progressively increases during incremental tilt. The blood flow in cerebral arteries is not constant but fluctuates (oscillates) about its mean value. When upright, these oscillations are largely produced by fluctuations in arterial blood pressure at low frequency which capture or “entrain” cerebral blood flow oscillations. Moreover, oscillations in cerebral blood flow and blood pressure are increased, especially in upright POTS patients.

If differences in mean CBF couldn’t account for brain fog, perhaps time-dependent changes in CBF could. We reviewed prior upright tilt data and observed prominent oscillatory arterial pressure (OAP) when upright in POTS, which is closely synchronized to OCBF (Figure 1). Oscillations were present in all patients.

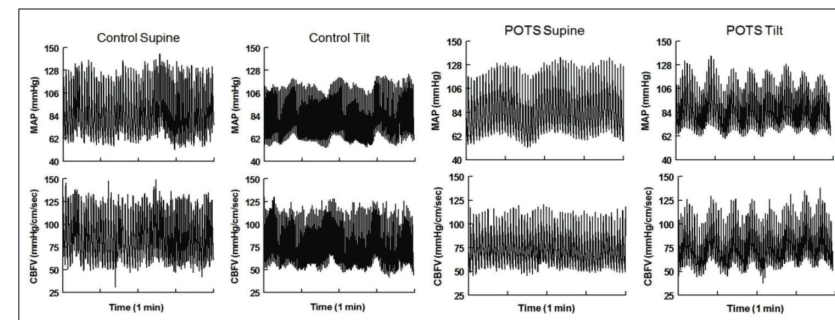


Figure 1: Phasic oscillatory BP (upper panels) and CBF (lower panels) in control (left 4 panels) and POTS patients (right 4 panels) when supine and upright. When upright both BP and CBF became highly oscillatory and synchronous in POTS and to a much lesser degree in control.

We revisited incremental tilt and found monotonically increasing OCBF in POTS patients, but not in controls (Figure 2). Supine, there were predominant slow irregular oscillations of CBF in control and POTS alike, with a frequency range of 0.01 – 0.10 Hz. Oscillatory power was mostly at very low frequencies of 0.01 – 0.03 Hz. When upright, OCBF was concentrated in the 0.07 – 0.12Hz range for POTS. Cerebral blood flow oscillations depend on both blood pressure oscillations and impaired cerebral autoregulation.

This data suggests increased oscillatory cerebral blood flow contributes to postural cognitive deficits in POTS.

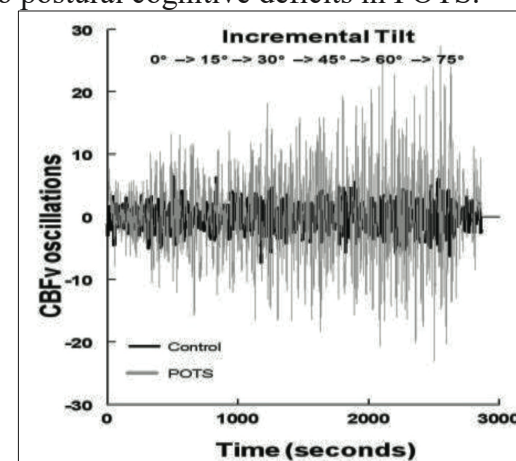


Figure 2 shows increasing OCBF in POTS (gray), compared to control (black) during incremental tilt.

In a recent study¹ of 138 POTS patients (88% female), ranging in age from 14 to 29 years, 132 subjects reported brain fog. Subjects were

asked to complete a 38-item questionnaire designed to better understand several factors, including triggers and treatments. The most frequently reported brain fog triggers were:

- fatigue (91 %)
- lack of sleep (90 %)
- prolonged standing (87 %)
- dehydration (86 %)
- feeling faint (85 %)

Although aggravated by upright posture, brain fog was reported to persist after assuming a recumbent posture. The most frequently reported interventions for the treatment of brain fog were:

- intravenous saline (77 %)
- stimulant medications (67 %)
- salt tablets (54 %)
- intra-muscular vitamin B-12 injections (48 %)
- midodrine (45 %).

Descriptors for "brain fog" are most consistent with it being a cognitive complaint. Factors other than upright posture may play a role in the persistence of this symptom.

-
1. Ross AJ, Medow MS, Rowe PC, Stewart JM. What is brain fog? An evaluation of the symptom in postural tachycardia syndrome. Clin Auton Res. 2013;23:305-311.
 2. Ocon AJ, Medow MS, Taneja I, Clarke D, Stewart JM. Decreased upright cerebral blood flow and cerebral autoregulation in normocapnic postural tachycardia syndrome. Am J Physiol Heart Circ Physiol. 2009;297:H664-H673.
-

Dr. Stewart obtained his MD and PhD degrees at the University of Chicago. His internship and residency was in pediatrics at NYU with a fellowship in Pediatric Cardiology at Cornell-New York Hospital. His laboratory funded by the National Institutes of Health for more than 15 years focuses on the study of acute and chronic orthostatic intolerance (OI). He has published widely in the field of autonomic dysfunction and most recently obtained cerebral blood flow correlates of "brain fog" which points towards mechanisms and effective treatment of this disability.

