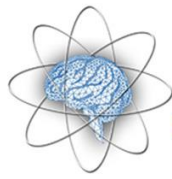


Laboratory Assessment

Basic Baseline Labs (Required for All Patients)

1. CBC with diff
 - If patients are anemic, these prospective subjects shall be treated with iron, liver, B12, folate, and/or vitamin C supplementation until CBC is normal
2. CMP with Ca, Mg and Phos
 - If significant imbalance = excluded
3. TSH
 - If greater than 2.0 or less than 0.2, patients must be treated first
4. Testosterone (Total and Free), SHBG, Estradiol for men (include E1 and E3 if female), DHEA-S
5. AM Cortisol
6. Mean Platelet Volume
 - Physicians should know that Mean Platelet Volume is not a specific biomarker for TBI but will help to show as a quantifiable prognostic data point
 - We know that high Mean Platelet Volume, along with lower resulting platelet count, is associated with increased anxiety and stress
 - Mean platelet volume level in patients with generalized anxiety disorder. Psychiatry and Clinical Psychopharmacology, 28(1), 43-47.
 - <https://www.tandfonline.com/doi/full/10.1080/24750573.2017.1385210>
 - <https://www.tandfonline.com/doi/figure/10.1080/24750573.2017.1385210?scroll=top&needAccess=true>
7. Serotonin blood levels
 - Serotonin levels in the blood—this is not a specific biomarker for TBI but will help to show as a quantifiable prognostic data point as well.
 - We know that serotonin is made in the gut from the amino acid tryptophan and carried by platelets to the brain. Lower platelets thus means less serotonin in the brain. We also know that serotonin whole blood levels increase with administration of inhaled oxygen. And we know that lower measurable serotonin levels are found in patients with anxiety, stress, depression, and PTSD.
 - Review the following studies:
 - Abe, K., Shimada, R., Okada, Y., & Kibayashi, K. (2016). Traumatic brain injury decreases serotonin transporter expression in the rat cerebrum. *Neurological research*, 38(4), 358-363.
 - Nishikawa, M., Kumakura, Y., Young, S. N., Fiset, P., Vogelzangs, N., Leyton, M., ... & Diksic, M. (2005). Increasing blood oxygen increases an index of 5-HT synthesis in human brain as measured using α -[11C] methyl-L-tryptophan and positron emission tomography. *Neurochemistry international*, 47(8), 556-564.



- Silliphant, D. (2017) How hyperbaric oxygen therapy works so well. Retrieved October 21, 2019 from <https://www.hyperbariccentral.com/hyperbaric-will-accomplish-health-needs/>
- Review this PowerPoint lecture on serotonin, oxygen, TBI, and PTSD <https://tbitherapy.com/neurobiochemical-cascade-in-tbi-ptsd-beneficial-effects-of-oxygen-and-serotonin/>

Optional Baseline Labs

1. Gut Biome studies: GI Maps makes a good one as a baseline. If the gut biome is off, the patient may not make enough serotonin
2. Urine Amino Acids: Without enough tryptophan, the serotonin levels will also not likely benefit from oxygen, including HBOT.
3. Catecholamines (dopamine, epinephrine, adrenaline, and norepinephrine) as well and expect a general downtrend.
 - Check out this research on altitude (lower O₂ in atmosphere) on serotonin levels and catecholamine levels—Colorado patients generally have 3x more likelihood of suicide over sea level patients. Altitude of where the patient is living should also be accounted for.
 - Kious, B. M., Bakian, A., Zhao, J., Mickey, B., Guille, C., Renshaw, P., & Sen, S. (2019). Altitude and risk of depression and anxiety: findings from the intern health study. *International Review of Psychiatry*, 1-9.
4. BDNF levels
 - <https://pubmed.ncbi.nlm.nih.gov/20679891/>
 - There's a lot of research on BDNF and TBI. "A body of research indicates that dysregulation of neural brain-derived neurotrophic factor (BDNF) is found in conditions of TBI and PTSD."

All of the above optional labs, with the exception of the urine amino acids, GI Biome, should be taken at baseline and every 2 months of the study for a total of one baseline and 3 post-treatment points.

Extra Labs

1. Patients with alcohol, drug abuse, tobacco use conditions so we may want a Utox level, BAC, and pay attention to LFTs on the CMP.
2. Order or review labs for patients with significant metabolic disorders or genetic disorders affecting heart, brain, metabolism (aka Diabetes, CAD, Lung disease, etc).