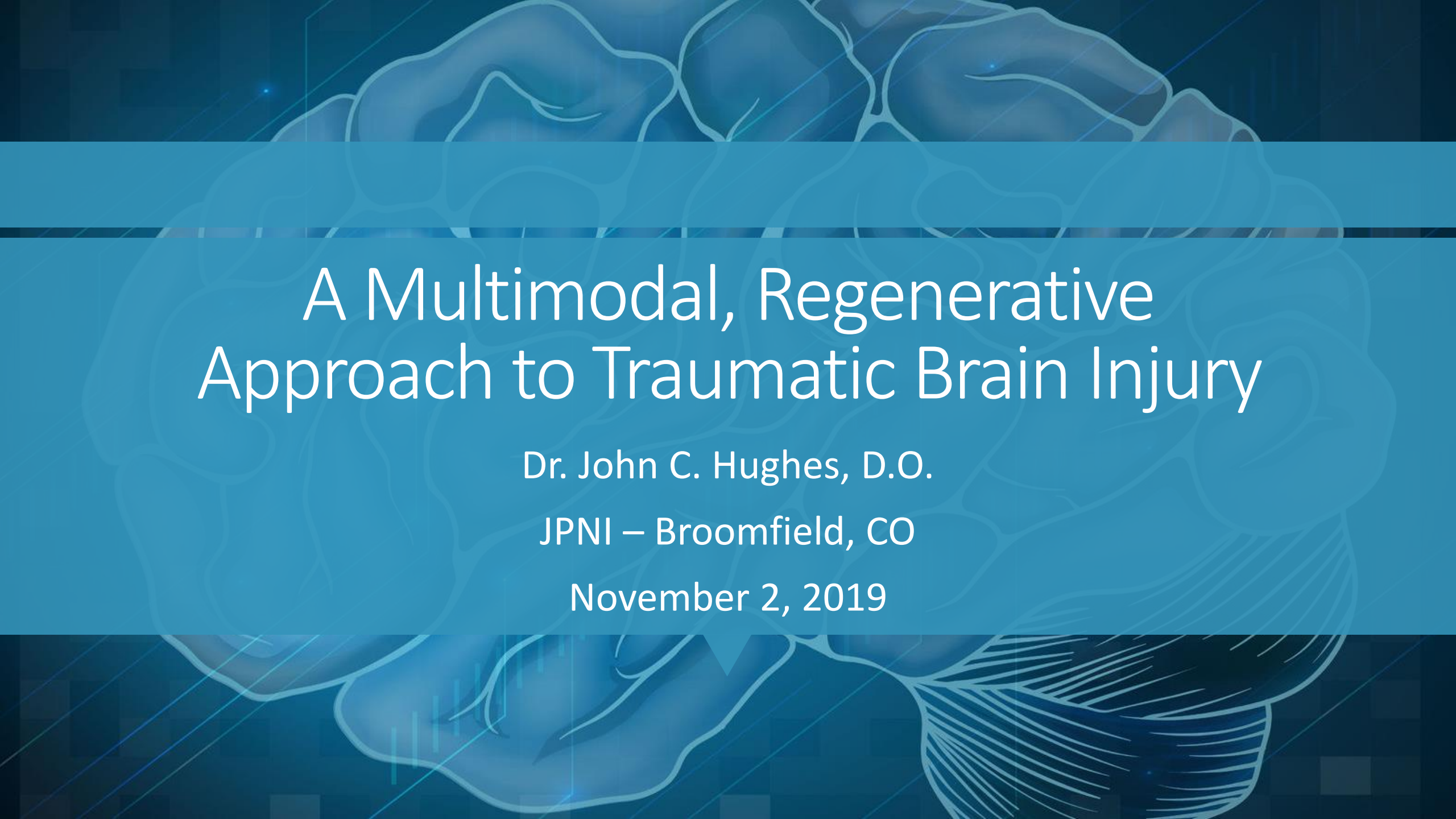


A Multimodal, Regenerative Approach to Traumatic Brain Injury

Dr. John C. Hughes, D.O.

JPNI – Broomfield, CO

November 2, 2019

Disclosure

The content of this presentation has been peer reviewed for fair balance and evidence based medicine.

Learning Objectives

Define

Define the clinical, biochemical and metabolic effects from TBI

Identify

Identify mainstream and alternative treatments for TBI

Understand

Understand the regenerative model of TBI treatment

Clinical Symptoms from TBI

Physical

Headache
Fatigue
Sleep disorders
Vertigo or dizziness
Tinnitus or hyperacusis
Photosensitivity
Anomia
Reduced tolerance to psychotropic medications
Disorientation
Loss of mobility
Seizures
Loss of smell

Cognitive

Memory decline / loss
Slow reaction time
Inability to pay attention
Executive dysfunction
Slow learning
Interrupted speech
Difficulty understanding
Unable to concentrate
Confusion
Difficulty communicating thoughts
Unable to plan, reason, problem-solve

Psychological

Irritability
Easy frustration
Tension
Anxiety
Affective lability
Personality changes
Disinhibition
Apathy
Suspiciousness
Suicidality
Depression
PTSD

Biochemical and Physiological Responses from TBI

- Disproportional proinflammatory cytokine production and release
- Increased counterregulatory hormones work against the action of insulin
- Hypermetabolic and catabolic states
- Severely impaired nitrogen homeostasis
- Oxidative Stress

Oxidative Stress From TBI

- Impairs cerebral vascular function
- Impairs circulation
- Impairs the energy metabolism
- Damages mitochondria and DNA

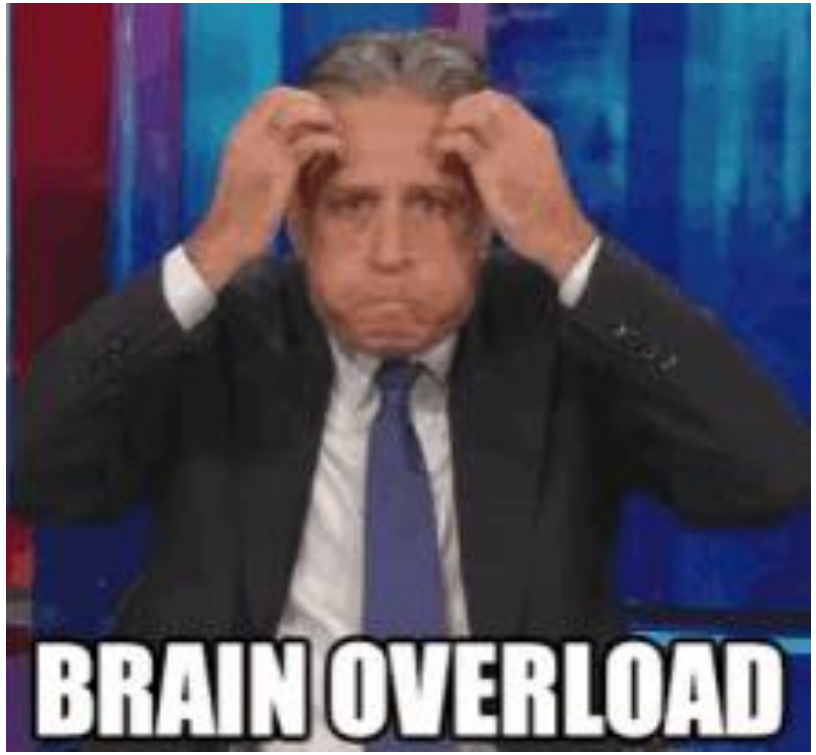
What Happens Metabolically with a TBI?

"The brain is in a metabolic crisis with concussion… potassium ion from inside the cell going extracellularly, calcium ions going intracellularly, neurotransmitters widely released in a chaotic manner.

It takes energy to pump that potassium back, put the neurotransmitters back on so the cell can function."

Dr Robert Cantu, MD, 2013

What Happens Metabolically with a TBI?

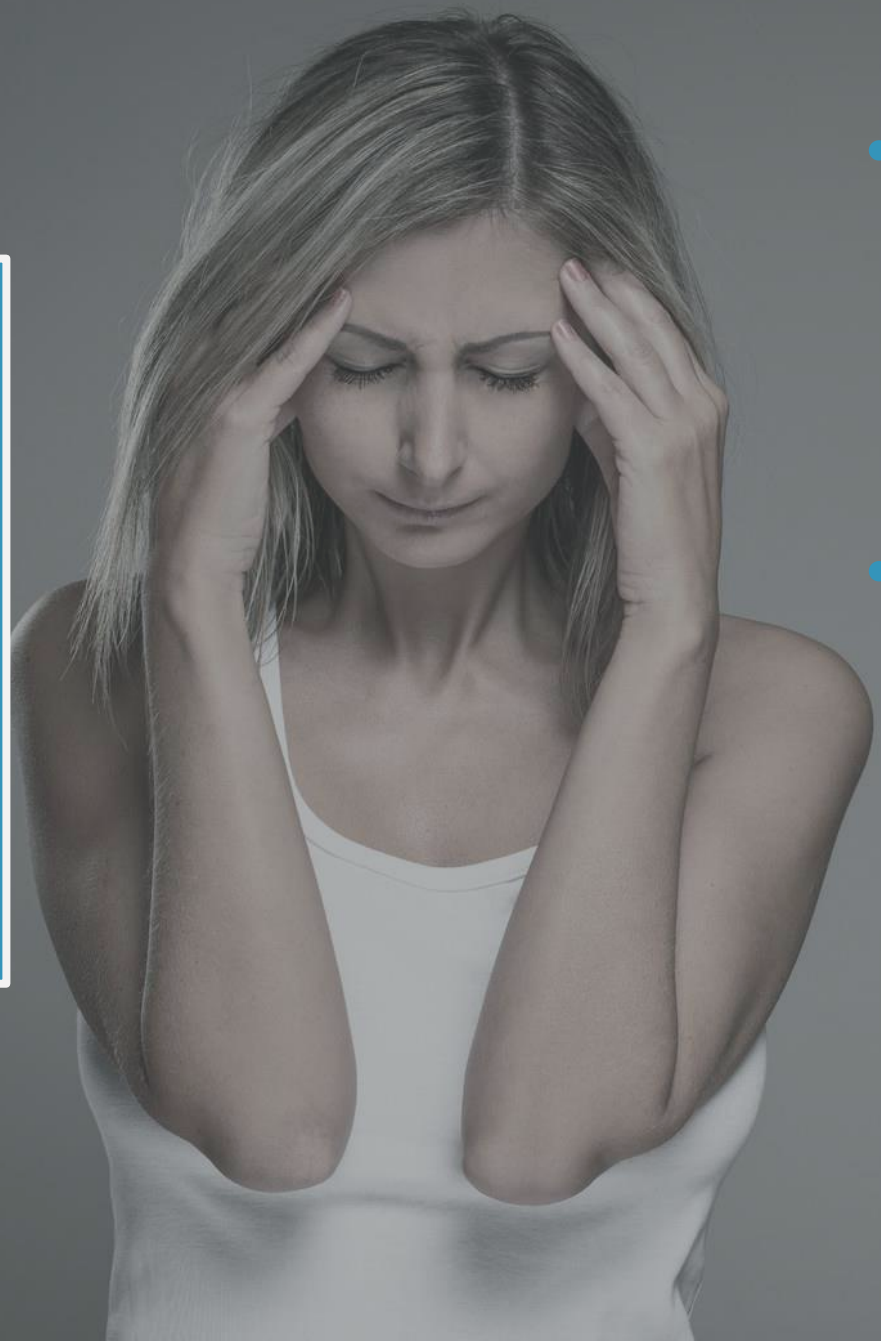


An Energy Crisis

Mainstream Treatments

- Occupational and physical rehabilitation
- Speech therapy
- Pharmaceutical drugs
- Cognitive maintenance exercises
- Patients simply cope with their condition

Alternative Treatments



- Do not seek to regenerate but rather simply treat symptoms
- Do not combine regenerative treatments in a multimodal manner in order to maximize patient benefit

Question 1

Which of the following are symptoms of a traumatic brain injury?

A. Headache

B. Insomnia

C. Mood changes

D. Cognitive and memory impairment

E. Sound and light sensitivity

F. All of the above

Question 2

What is the most significant pathophysiologic reason why many TBI patients fail to recover?

A. Inflammation
B. Oxidative stress
C. Impaired nitrogen homeostasis
D. Impaired energy metabolism (“The brain is in a metabolic crisis.”)

A Multimodal, Regenerative Approach to TBI

It is hypothesized that the practical, effective combination of multiple regenerative TBI therapies can produce synergistic benefits to the patient that exceed the use of one particular TBI treatment.

A Multimodal, Regenerative Approach to TBI

I. Hyperbaric Oxygen Therapy

II. Intranasal Therapies

III. IV Nutrition

IV. Cranial Osteopathy

V. Ketogenic Diet and MCT Oil

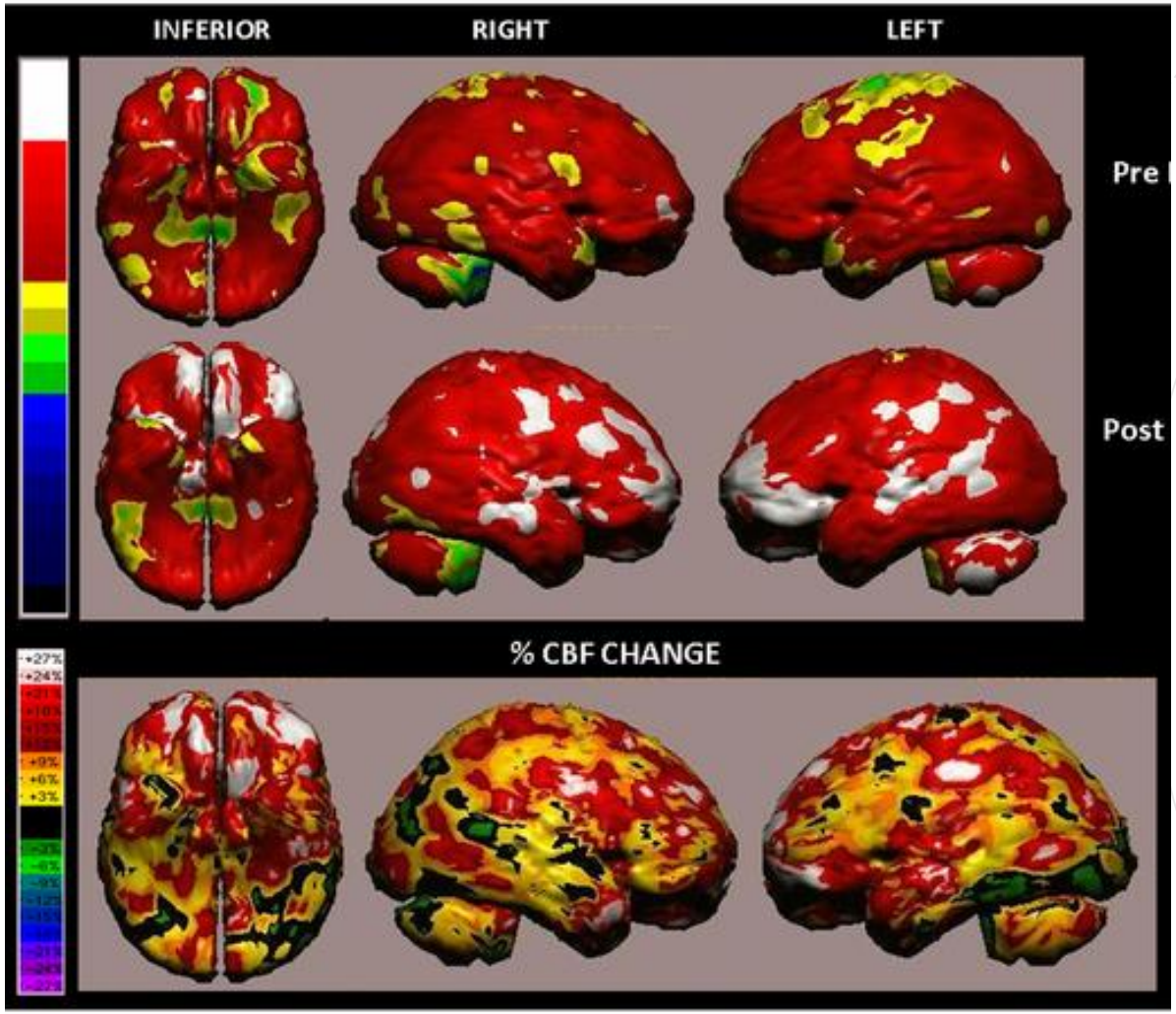
Part I

Hyperbaric Oxygen Therapy (HBOT) for TBI

Hyperbaric Oxygen Therapy (HBOT)

- Allows the body to absorb about 10-15 times its normal supply of oxygen
- Stimulates the growth of tissue, bone and blood vessels, and reduces inflammation

Thom, et al., 2006



Volume rendered Brain SPECT perfusion maps of a 51-year-old woman suffering from mTBI that had occurred 2 years prior to inclusion in the study

Boussi-Gross et al., 2013

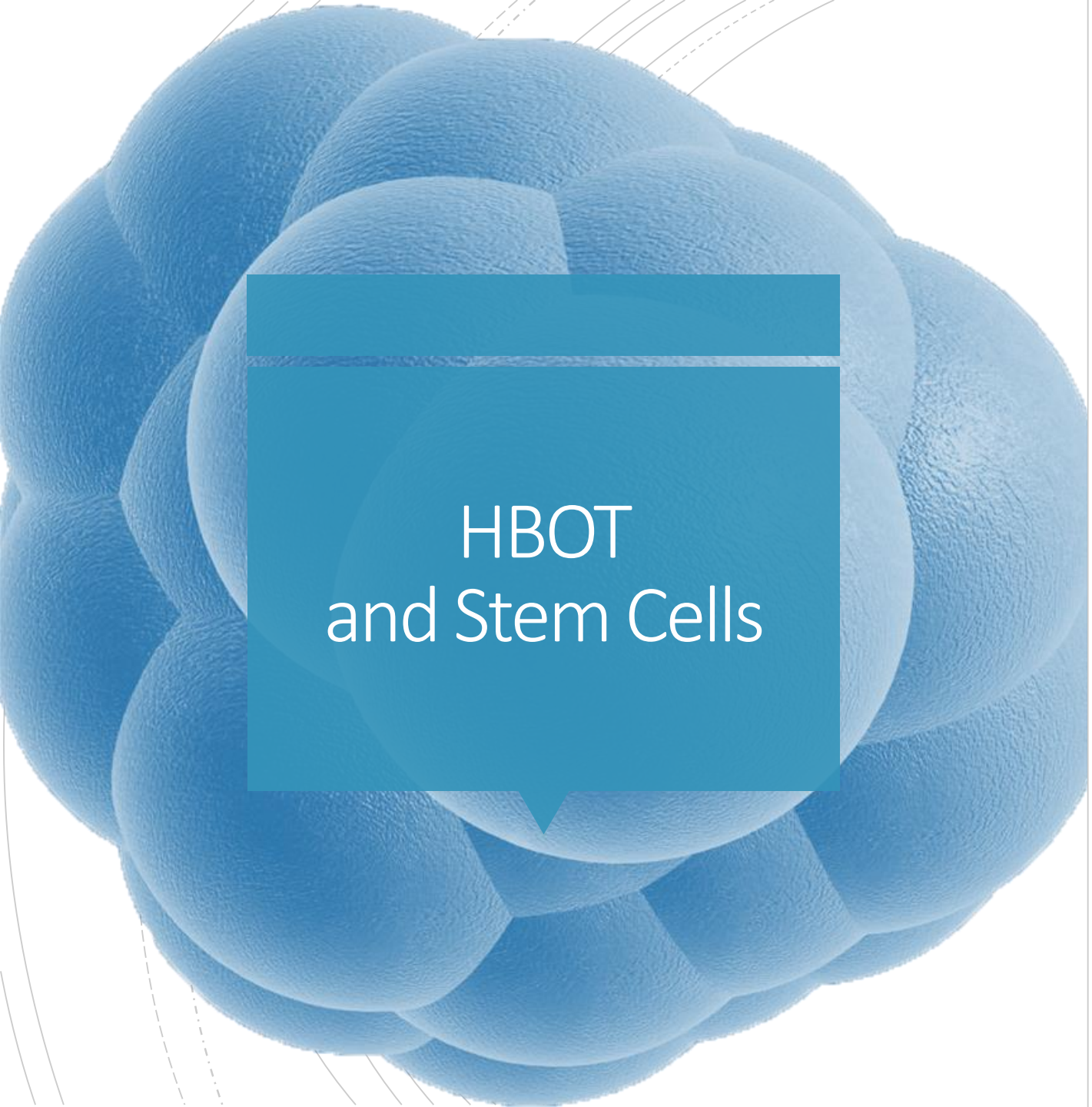
HBOT for TBI

- Induces neuroplasticity
- Increases tissue oxygenation
- Generates new capillary networks
- Restores blood supply
- Increases stem cells in the blood

Question 3

How does hyperbaric oxygen help TBI patients?

A. HBOT reduces neuroplasticity
B. HBOT causes vasodilation
C. HBOT increases tissue perfusion with new capillary growth
D. HBOT creates oxidative stress

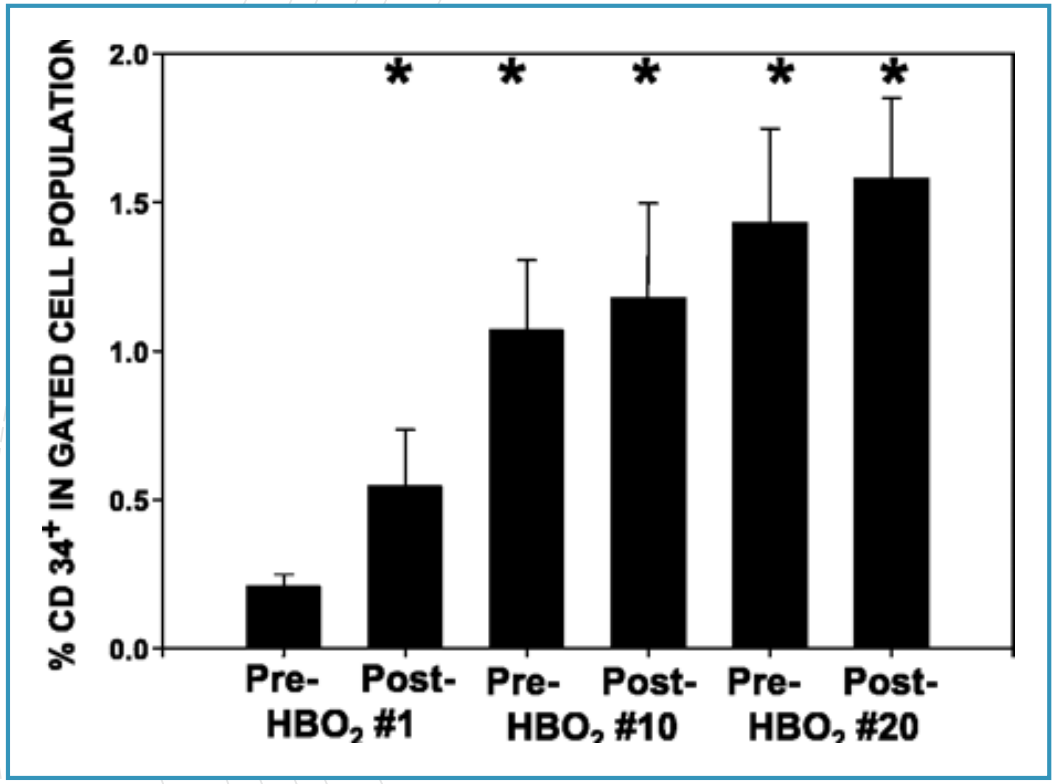


HBOT and Stem Cells

- 2 hours of HBOT triples the patients own circulating stem cells
- 20 sessions of HBOT increases circulating stem cells to 8 fold (800%)

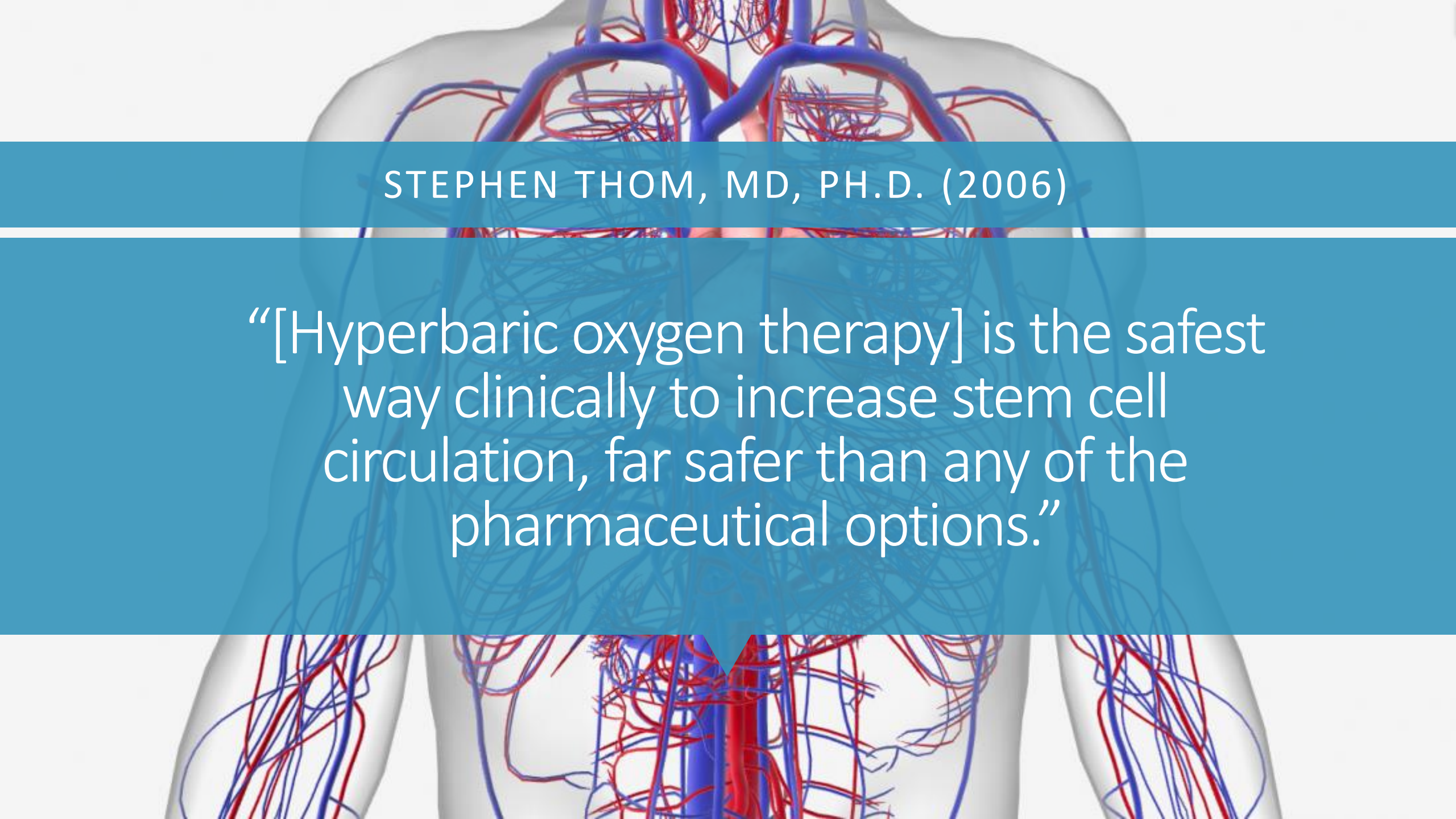
Thom, et al., 2006

Mean CD34+ population in blood of humans before and after HBOT treatments.



Data are the fraction of CD34+ cells within the gated population using leukocytes obtained from 26 patients before and after their 1st, 10th, and 20th HBO2 treatment.

Thom, et al., 2006



STEPHEN THOM, MD, PH.D. (2006)

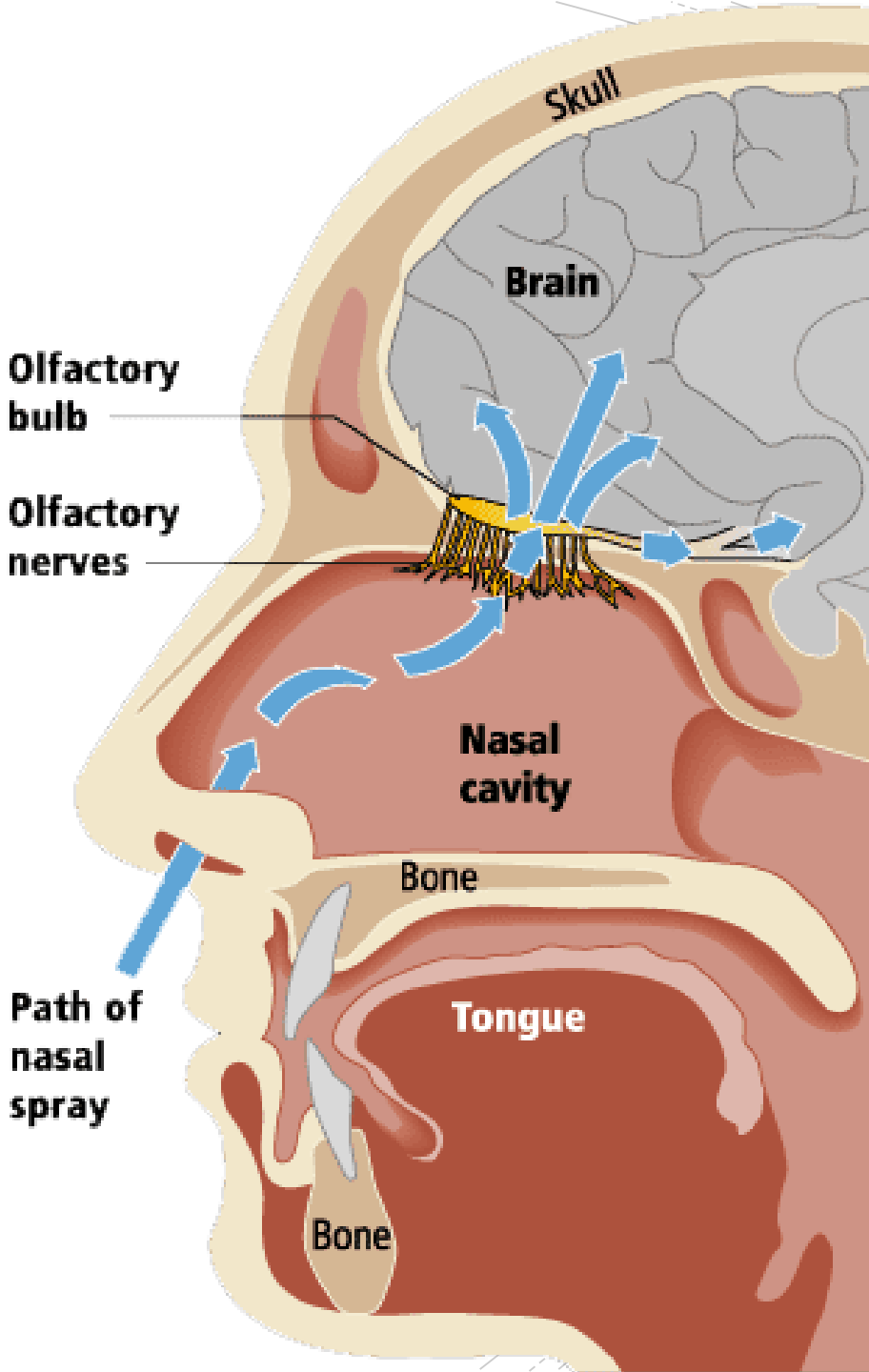
"[Hyperbaric oxygen therapy] is the safest way clinically to increase stem cell circulation, far safer than any of the pharmaceutical options."

Part II

Intranasal Therapies (Insulin, PRP, and Stem Cells) for TBI

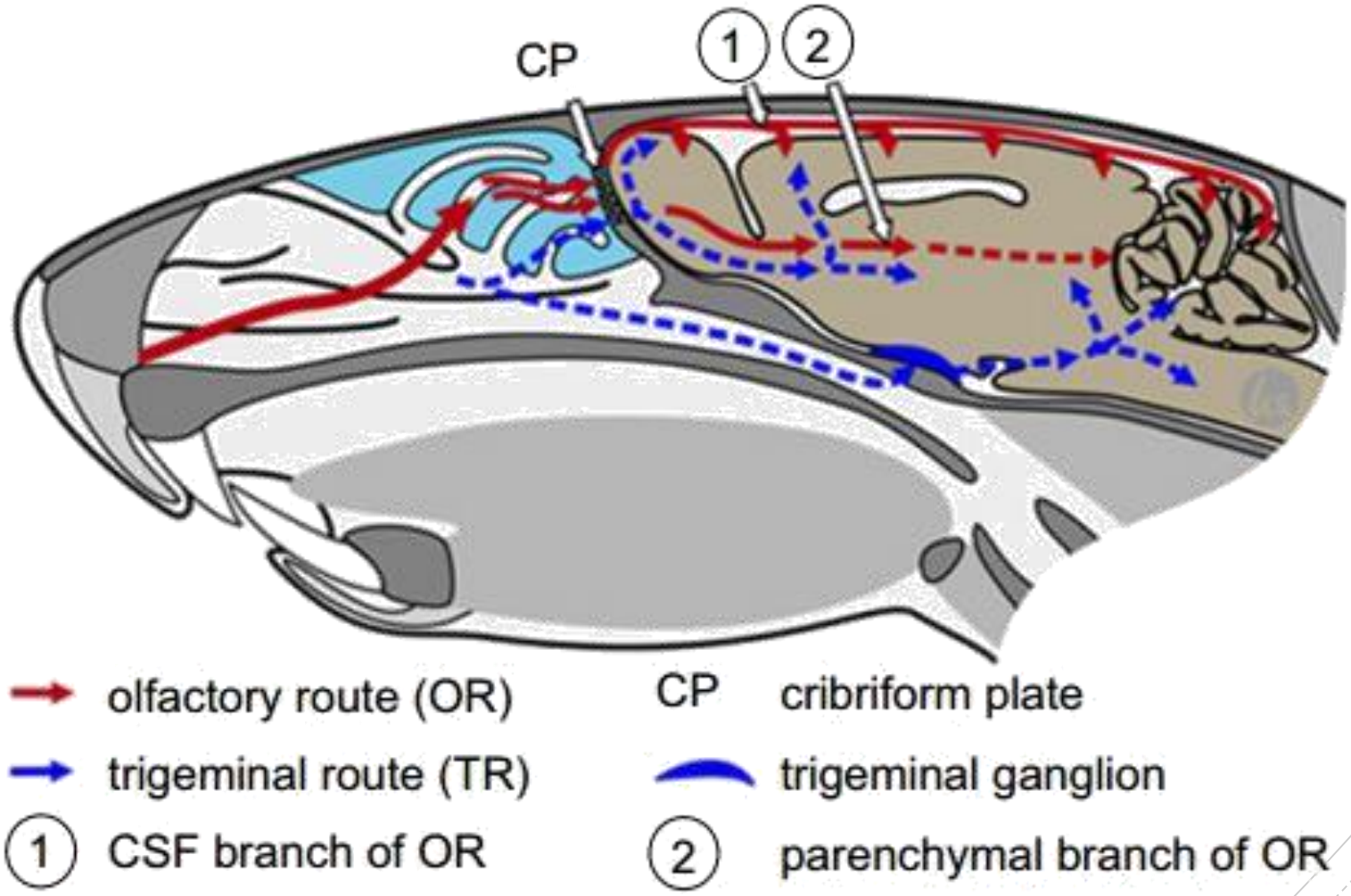
Journey Through the Nose

- Through the olfactory nerves
- Bypasses the blood-brain barrier
- Into the CSF within 10 minutes



Mouse Brain

Solid arrows represent the paths of migration of cells into the brain, dashed arrows reflect possible hypothetical routes of cell delivery

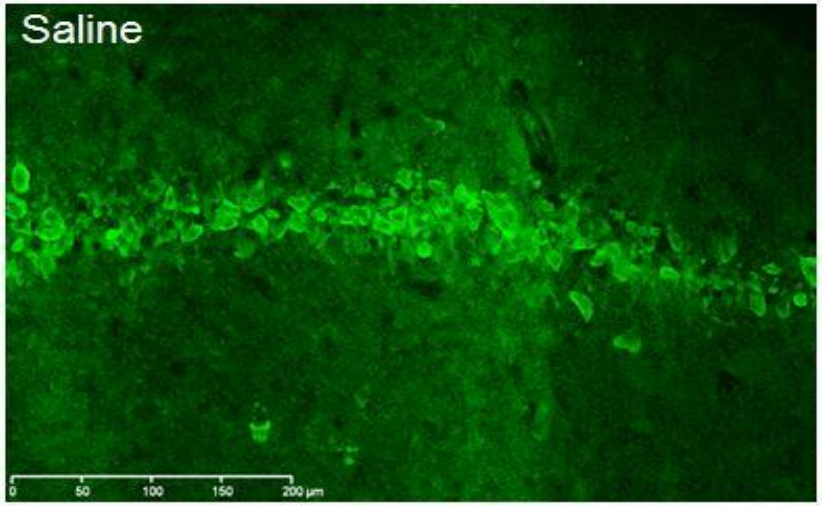


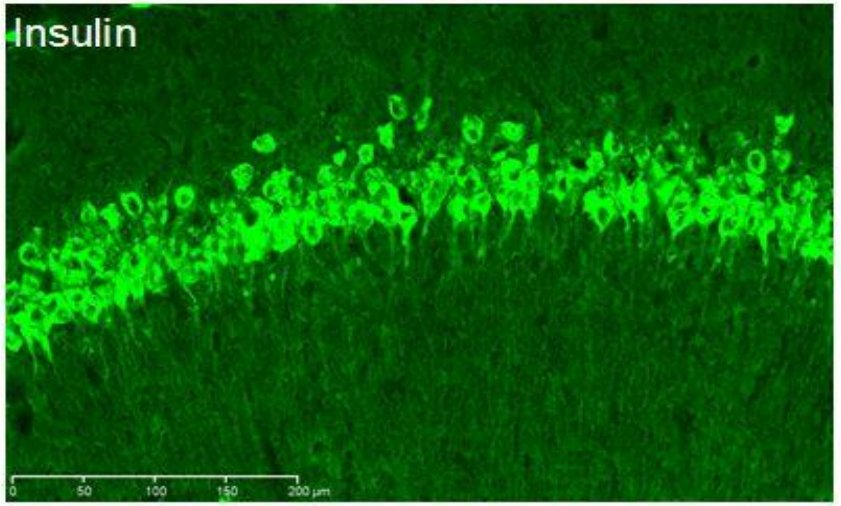
Danielyan, et al., 2014

Intranasal Insulin for TBI

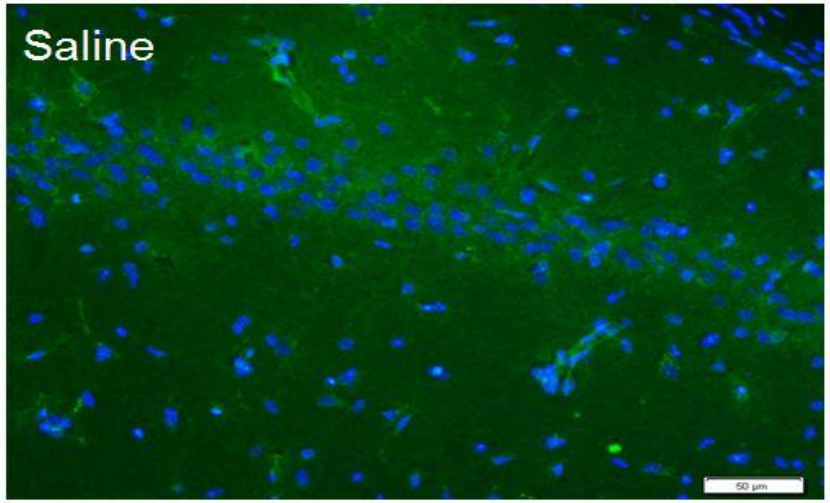
- Improves brain ATP production
- Decreases CSF cortisol
- Improves neuronal viability in the hippocampus
- Increases the expression of anti-inflammatory microglia
- Reduces beta-amyloid and tau protein deposition

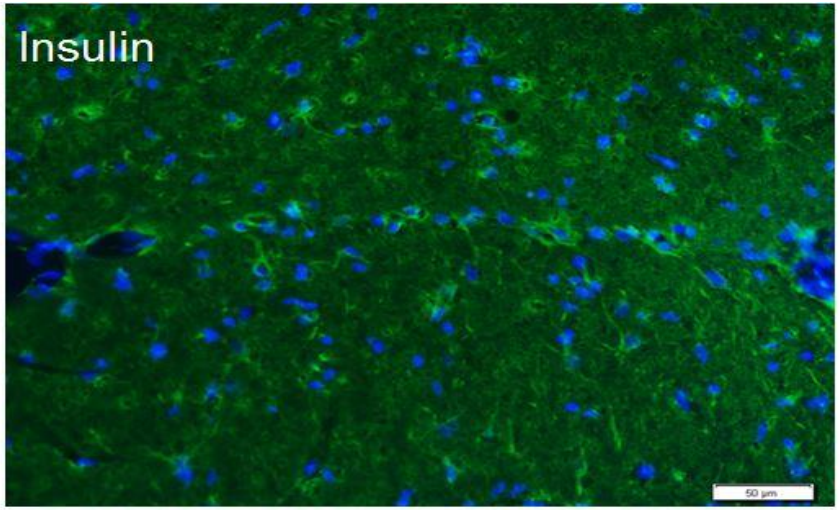
Improved neuronal viability in the hippocampus of the insulin treated rats.





Intranasal insulin increases the expression of anti-inflammatory microglia in the hippocampus





Brabazon, Khayrullina, Frey, & Byrnes, 2014

Question 4

Intranasal insulin has the following effects:

A. Increases ATP production and utilization

B. Decreases gliosis

C. Decreases cortisol

D. Reduces amyloid and tau protein deposition

E. All of the above

Platelet Rich Plasma (PRP)

- Autologous plasma contains growth factors and cytokines to aid the injured brain:
  - VEGF, EGF increases angiogenesis
  - PDGF, TGF-p enhance collagen growth
  - IGF-1 stimulates protein synthesis

Platelet Rich Plasma (PRP)

The infusion of concentrated platelets results in an exponential increase in numerous growth factors at the sight of infusion

Plasma cytokines control inflammatory mediators cox1, cox2 and guide stem cells to areas of injury

Intranasal Platelet Rich Plasma (PRP) for TBI

- "Basic fibroblast growth factor infusion enhances injury-induced cell proliferation in the dentate gyrus and improves cognitive function in rats following fluid percussive injury."

- "Other studies have found that infusion of S100β or VEGF can also enhance neurogenesis in the hippocampus and improve the functional recovery of animals following TBI."

Sun, 2014

Peripheral Blood Based Adult Stem Cells

Recently discovered in peripheral blood

PLURIPOTENT adult stem cells

Behave like embryonic stem cells

Give rise to all the cell types

Long lifespan

Work in combination with PRP

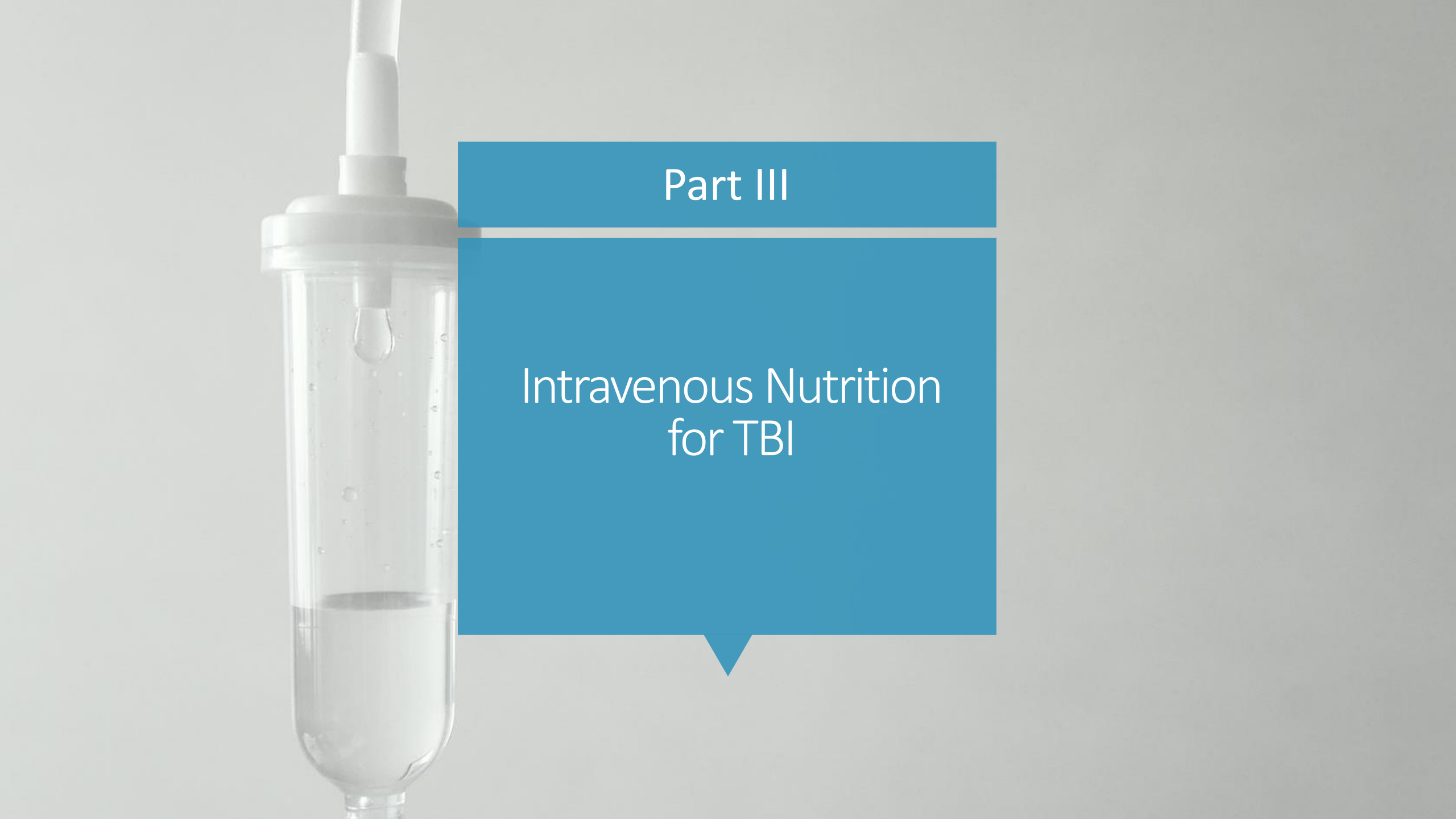
Intranasal Peripheral Blood Stem Cells for TBI

- Have regenerative and reparative properties
- Adult stem cells from BMA have been used to treat ischemic brain damage by reducing gray and white matter loss (Danielyan, et al., 2014).
- Downregulate neuroinflammatory cytokines

Intranasal Nutrients for TBI

- IN glutathione has been used to reduce oxidative stress and enhance cellular detoxification in Parkinson's disease patients (Mischley, et al., 2016).

- IN methylcobalamin has been shown to improve QEEG Theta activity in ADHD and autism patients (Kurtz, 2008).



Part III

Intravenous Nutrition for TBI

IV Nutrition for TBI

- PRP
- Adult peripheral blood stem cells
- NAD+
- Myer's cocktail with potassium, magnesium, calcium, B-complex, B5, B6, and B12, ascorbate, and glutathione

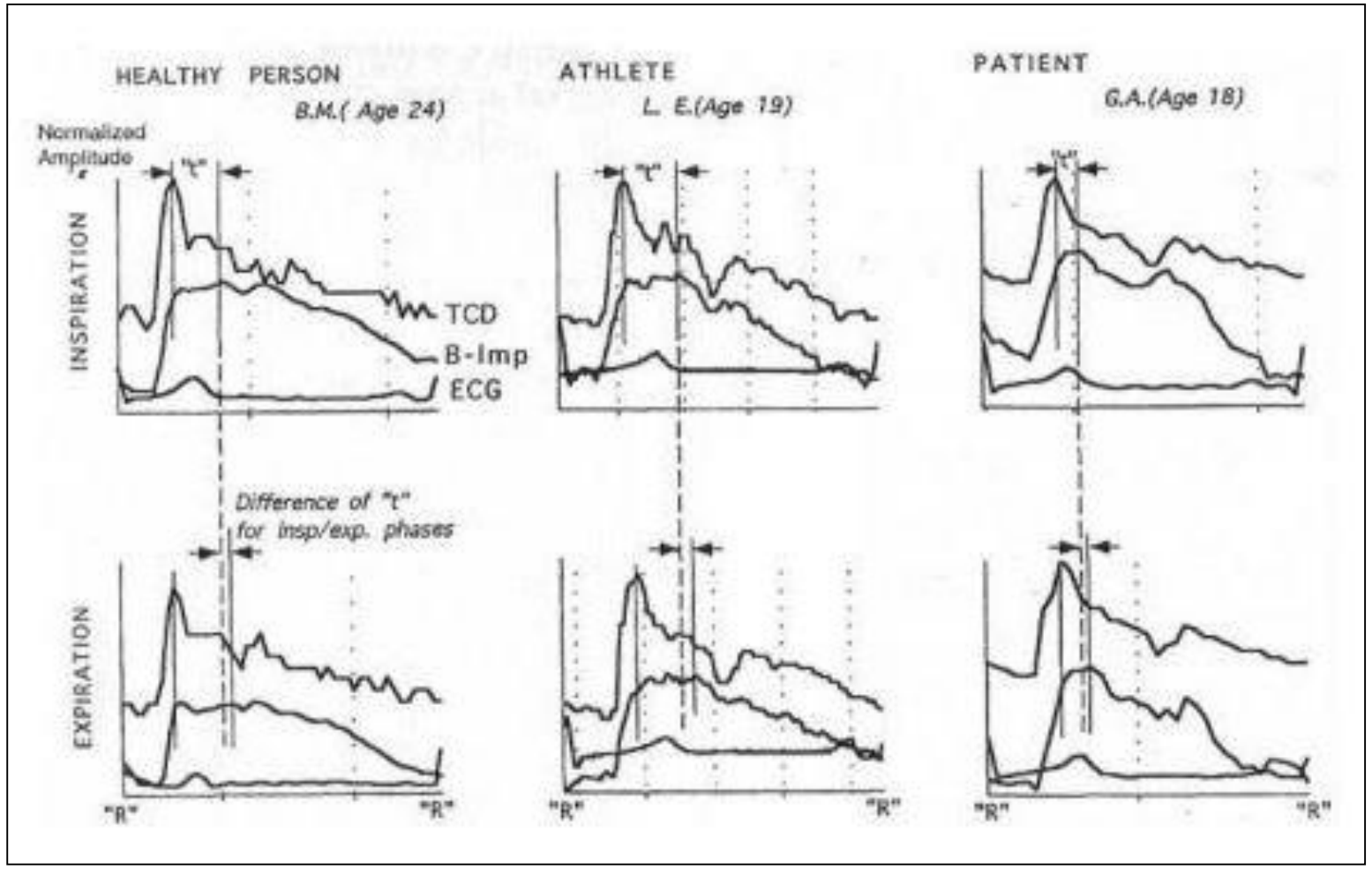
Part IV
Cranial Osteopathy for TBI

Cranial Osteopathy for TBI

- Manual manipulation of the cranial bones and membranes to allow the cerebral spinal fluid to flow properly
- The central nervous system, including the brain and spinal cord, has a subtle, rhythmic pulsation

Cranial Osteopathy for TBI

- This rhythmic pulsation can be blocked in brain injuries - impedes CSF and blood flow
- Effective at treating vertigo and headaches associated with TBIs



- Time shift between peaks of TCD and B-Imp is determined by the replacement of some portion of CSF out from (or into) zone of B-Imp electrodes.
- This time interval represents the mobility of CSF inside the cranium during the pulse cycle.

Moskalenko, Frymann, Kravchenko, & Weinstein, 2003

Question 5

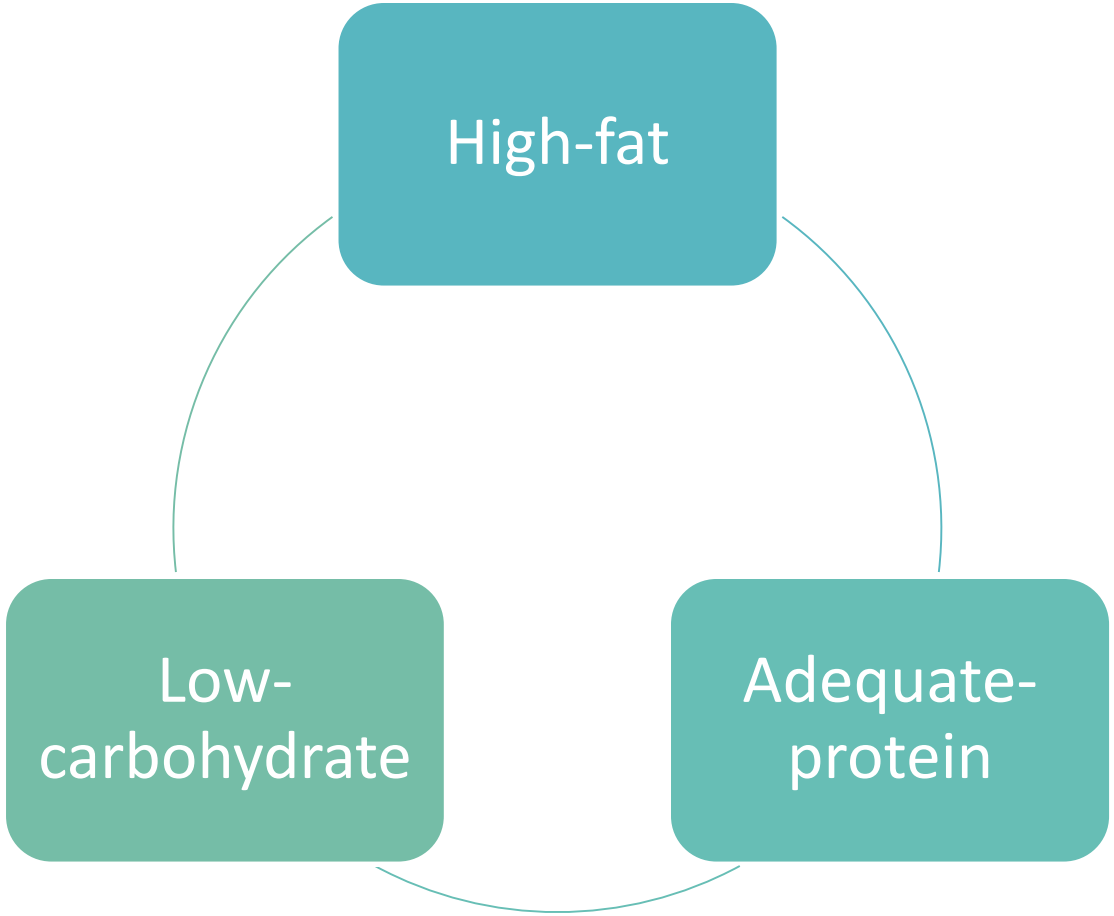
TBI patients have:

A. Reduced mobility of the CSF
B. Increased mobility of the CSF
C. Complete loss of CSF
D. No change in mobility of the CSF

Part V

MCT Oils and the Ketogenic Diet for TBI

Ketogenic Diet for TBI



Ketogenic Diet for TBI

DO NOT EAT

- Grains – wheat, corn, rice, cereal, etc.
- Sugar – honey, agave, maple syrup, etc.
- Fruit – apples, bananas, oranges, etc.
- Tubers – potato, yams, etc.

DO EAT

- Meats (organic, pasture-raised, sustainable)
- Above ground vegetables and leafy greens
- High fat dairy
- Nuts and seeds
- Avocado and berries
- Other fats – avocado oil, coconut oil, grass-fed ghee, high-fat salad dressing, saturated fats, etc.

Which burns more even?

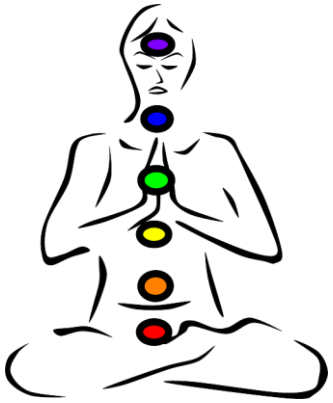
Glucose/Carbohydrates = Kindling

Ketones/Fats = Logs

Ketones are like diesel fuel (Glucose is like gasoline)

- Diesel fuel has a higher flash point than gasoline
- Harder to oxidize – Less flammable (excitable)
- The brain works like a diesel engine
- Burns more efficiently – lasts longer

Increases Neuroprotection



Increases GABA

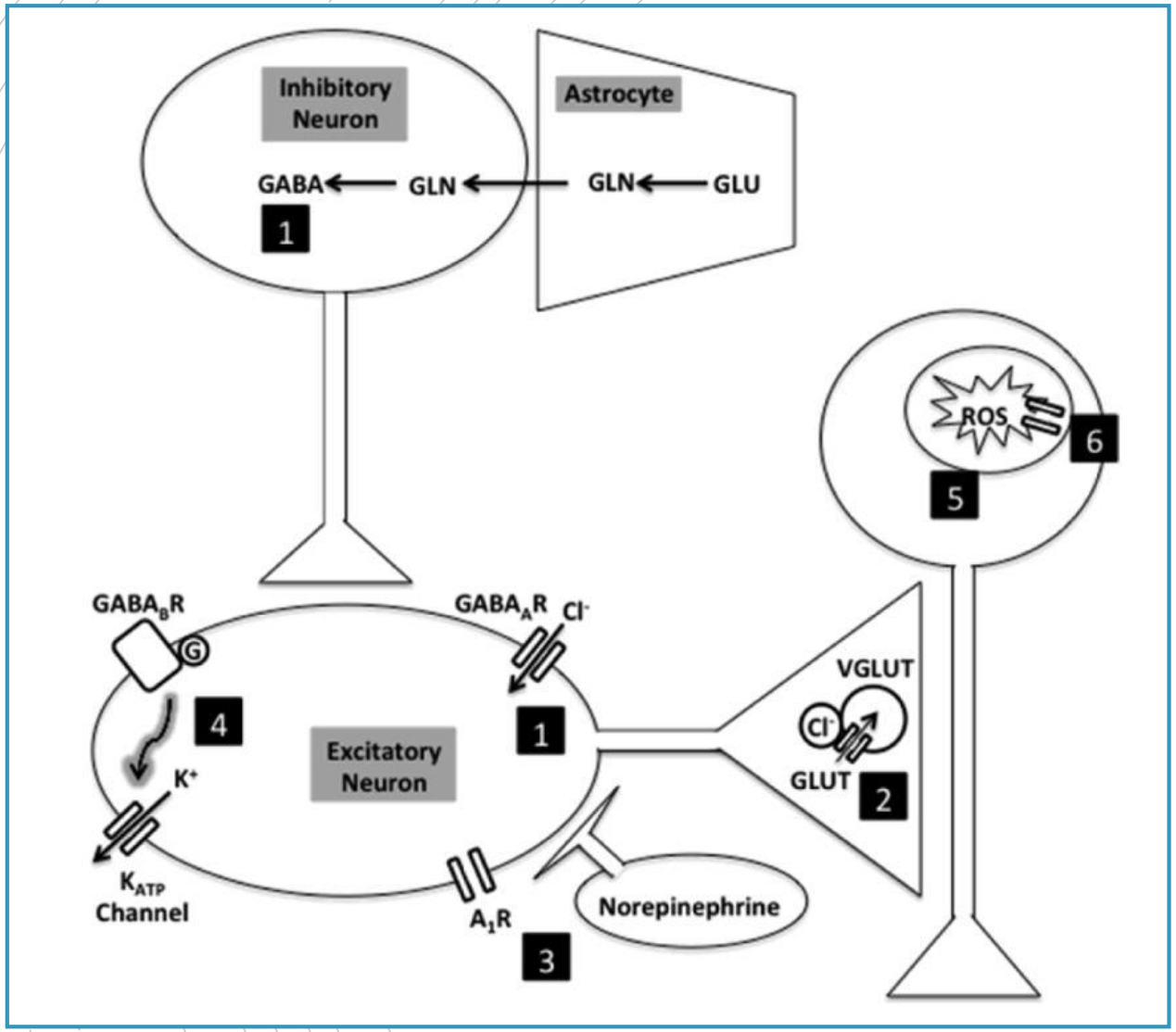
Increases Calming

What else do ketones do?

Decreases Glutamate

Decreases Depression,
Fear, Anxiety

Decreases Oxidative Stress

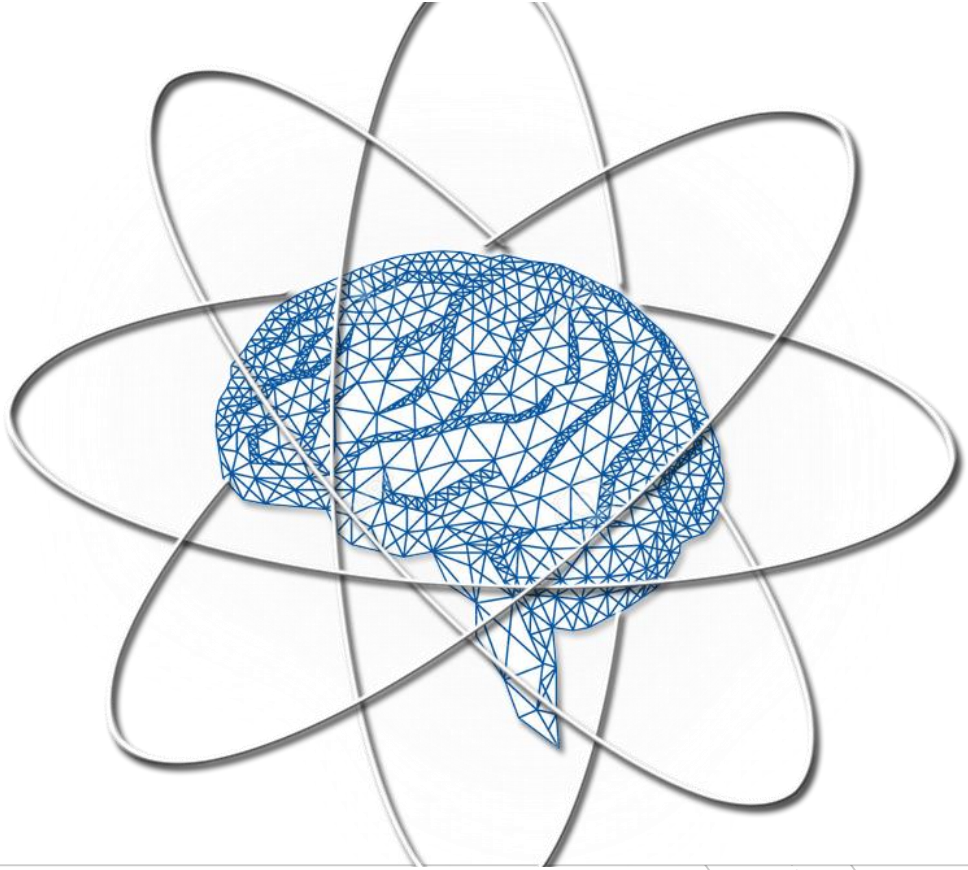


- Increased GABA synthesis
- Decreased glutamate release by competitive inhibition of vesicular glutamate transporters.
- Decreased reactive oxygen species production from glutamate exposure

McNally & Hartman, 2012

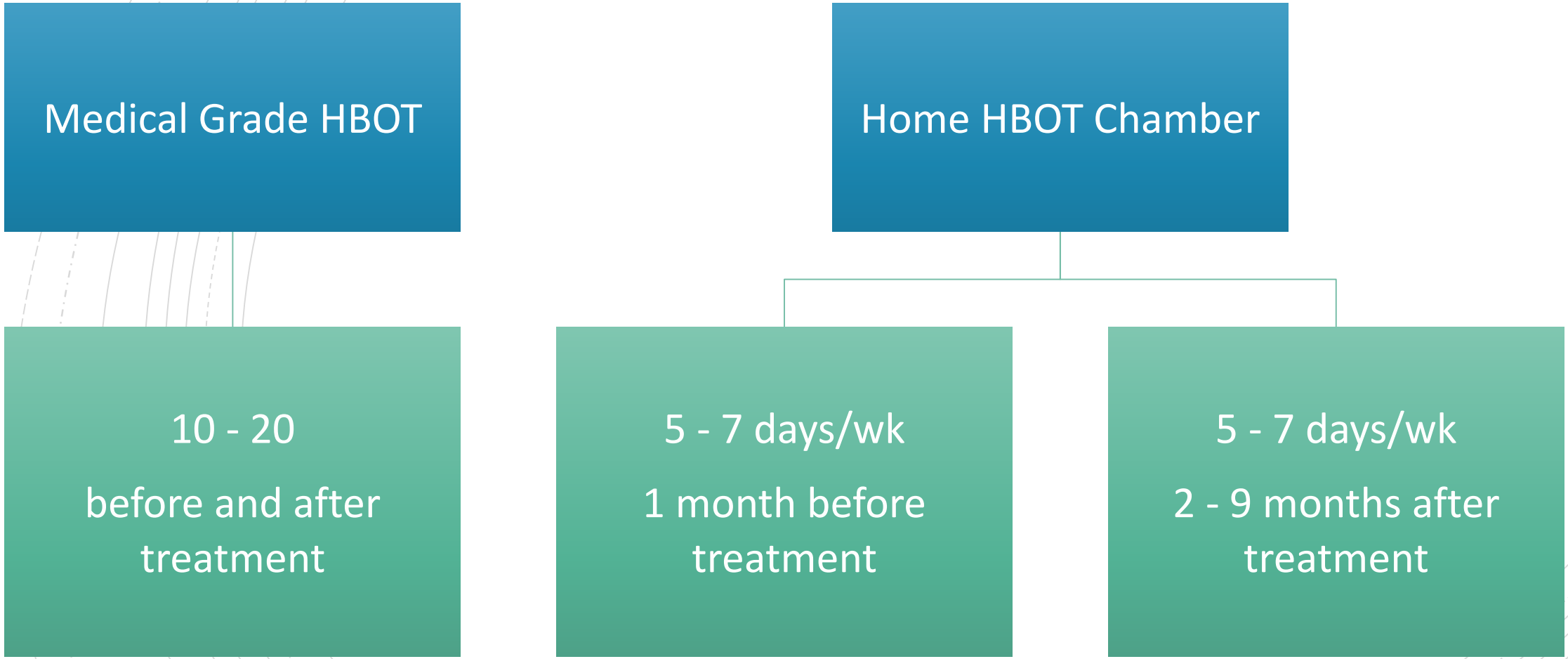
Neuroprotective Actions of the Ketogenic Diet

- Upregulates energy metabolism genes
- Stimulates of mitochondrial biogenesis
- Promotes synthesis of ATP
- Limits glutamate toxicity
- Anticonvulsant effects of ketone bodies on the brain



The TBI Therapy Protocol

TBI Therapy HBOT Protocol



TBI Therapy 3-Day Program

Day 1:	Consultation IV therapy Cranial osteopathy HBOT
Day 2:	HBOT IV PRP + Nutrition IN PRP + Insulin
Day 3:	IV pluripotent stem cells (VESLs) from the blood + NAD IN pluripotent stem cells (VESLs) from the blood HBOT

Case Report 1: 46 year-old male, severe TBI from MVA

Before Treatment:	After Treatment:
• Memory loss • Depression and anxiety • Emotionally unstable • Headaches daily • Inability to carry on conversation • Inability to do math or read • Light and sound sensitivity • Could not drive • Insomnia	• “Memory download” • “An awakening” • Mood and personality improvements • Improvements intellectually, physiologically, and psychologically • Improved ability to read • Able to turn on lights /electronics • Able to drive • Sleep normalized

TBI Therapy: Case Report 1

"It was like a stream of information had been let loose... I felt for the first time in a year that I had some clarity. I was excited and able to read more than 2-3 sentences without triggering a migraine... The ability to think and plan returned."

Case Report 2: 30 year-old female, mild TBI from fall

Before Treatment:

- Insomnia
- Mood swings
- Depression
- Unable to work
- Head pressure
- Sound and light sensitivity

After Treatment:

- Able to travel and work
- Light and sound sensitivity decreased
- Improved mood
- Less fatigued
- Relief from anxiety

TBI Therapy: Case Report 2

"I felt well enough that I started saying yes again. TBI Therapy has turned me into a TBI THRIVER, not just a survivor. I'm happy. I enjoy life again, can travel and am doing work in the world that's more aligned with myself than ever."

Case Report 3: 48 year-old female, mild TBI from multiple concussions

Before Treatment:	After Treatment:
• Anger • Depression • Suicidal ideation • Anosmia • Extreme mental fatigue • PTSD	• Calm • No longer “reactive” and irritable • Confident • No thoughts of suicide • Feeling of less inflammation • Improved memory • Improved sense of smell

TBI Therapy: Case Report 3

"The results for me have been are nothing short of MIRACULOUS! Popeye may have his spinach but I have stem cells and PRP! Yes, my brain is strong!"

Boone Report

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Session Number (Created Date)	Patient Age	Original Title	Reason for Visit	Followup	Change	Hrs. Sleep | Since Meal
Session 1 (5/20/2019)	49 yrs	Routine	Performance Cognitive Evaluation	No	N/A	7-9 | 1-3

Target Ranges: Calculated for ages 50–54 yrs.

See Appendix for explanations of metrics and symbols shown on this page.

Performance Assessments	Session 1 (5/20/2019)	Target Range
Physical Reaction Time	236 (±32) ms	332–402 ms
Trail Making Test A	N/A	35–51 sec
Trail Making Test B	N/A	59–103 sec
Evoked Potentials		
Audio P300 Delay	260 ms	288–336 ms
Test/Retest Change	-	±12%
Audio P300 Voltage	16.7 µV	9–19 µV
Test/Retest Change	-	±24%
Boone Brain Age	23 yrs	-
State (Power)		
CZ Eyes Closed Theta/Beta	0.7	0.1–1.6
F3/F4 Eyes Closed Alpha	1.2	0.9–1.1
Front-Back (F-P) Coherence in Theta and Alpha Bands		
Left (Theta | Alpha)	0.31 | 0.15	≥ 0.35 | ≥ 0.4
Mid (Theta | Alpha)	0.28 | 0.18	≥ 0.35 | ≥ 0.4
Right (Theta | Alpha)	0.20 | 0.08	≥ 0.35 | ≥ 0.4

Maximum P300 Test Depth (µV) — Range: 240–500 ms

Boone Report

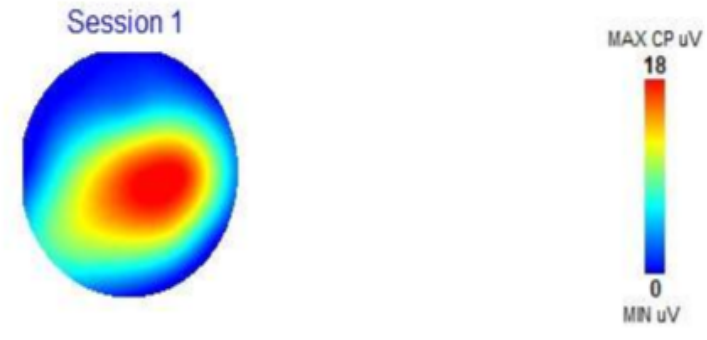
[redacted] — ID: — Generated: 6/27/2019 11:23 AM

Session Number (Created Date)	Patient Age	Original Title	Reason for Visit	Followup	Change	Hrs. Sleep | Since Meal
Session 1 (6/27/2019)	49 yrs	Baseline	Performance Cognitive Evaluation	N/A	N/A	4-6 | < 1

See Appendix for explanations of metrics and symbols shown on this page.

Performance Assessments	Session 1 (6/27/2019)	Target Range
Physical Reaction Time	237 (±59) ms	251–362 ms
Trail Making Test A	N/A	45–77 sec
Trail Making Test B	N/A	46–89 sec
Evoked Potentials		
Audio P300 Delay	272 ms	264–343 ms
Test/Retest Change	-	±12%
Audio P300 Voltage	18.0 µV	7–18 µV
Test/Retest Change	-	±24%
Boone Brain Age	20 yrs	-
State (Power)		
CZ Eyes Closed Theta/Beta	0.7	0.8–1.8
F3/F4 Eyes Closed Alpha	1.0	0.9–1.1
Front-Back (F-P) Coherence in Theta and Alpha Bands		
Left (Theta | Alpha)	0.32 | 0.16	≥ 0.35 | ≥ 0.4
Mid (Theta | Alpha)	0.39 | 0.25	≥ 0.35 | ≥ 0.4
Right (Theta | Alpha)	0.20 | 0.11	≥ 0.35 | ≥ 0.4

Maximum P300 Test Depth (µV) — Range: 240–500 ms



Boone Report

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P300 Common/Rare Comparison - Session 1 (5/20/2019)

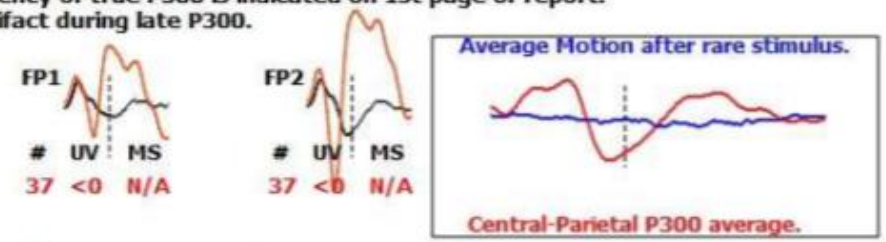
For only one session, the common responses are compared to the rare responses.

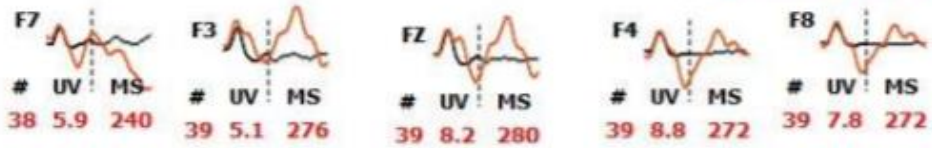
Color Key

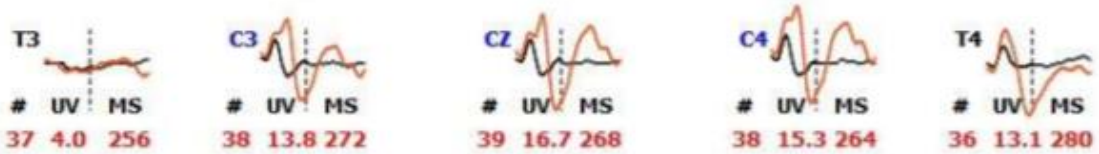
Common Rare

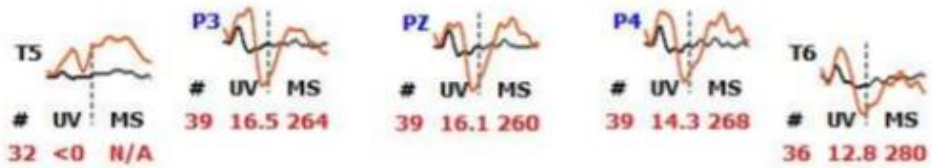
Yield Display Threshold: 20

Largest depths between 240-500 msec are reported. P300s typically occur between 240 and 450 msec.
Probable depth and latency of true P300 is indicated on 1st page of report.
***Indicates possible artifact during late P300.**









Black dotted lines at 300 msec post stimulus.

Boone Report

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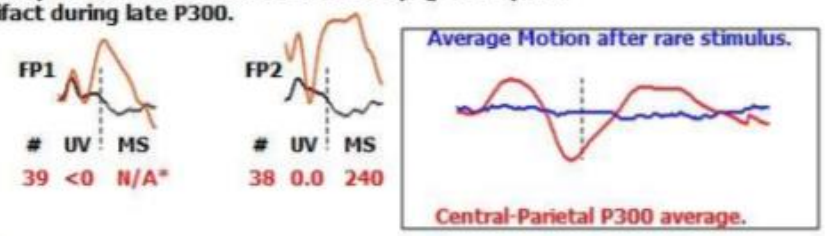
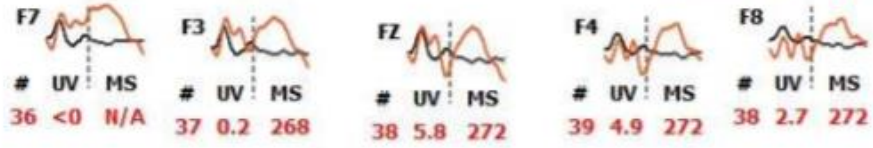
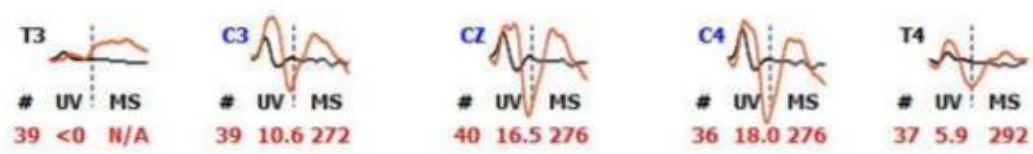
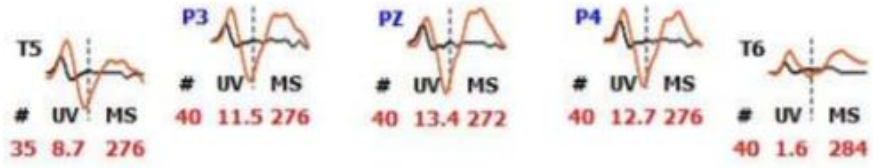








Black dotted lines at 300 msec post stimulus.

Case Report 4: 36 year-old male vet – bomb tech

Before Treatment:	After Treatment:
• Headache • Insomnia • Suicide ideation • PTSD • Depression • Fatigue • Chronic pain	• No headaches • Improved sleep • No suicidal thoughts • More energy • Able to exercise • Less pain

WAVi Wellness Basic Report

[redacted] — ID: N/A — Generated: 8/26/2019 2:30 PM

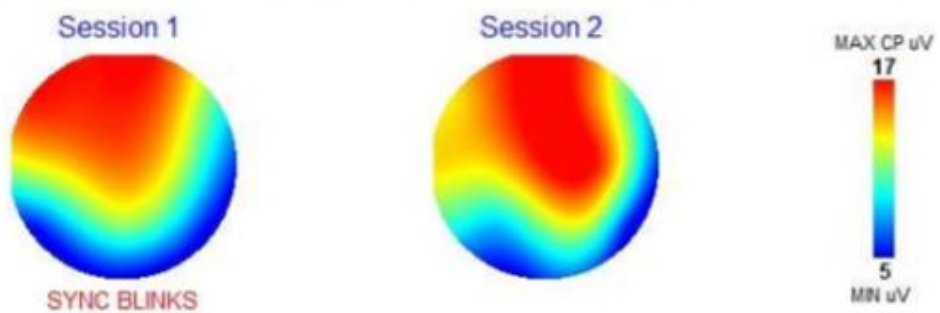
Session Number (Created Date)	Patient Age	Original Title	Change	Hrs. Sleep | Since Meal
Session 1 (7/1/2019)	36 yrs	Baseline	N/A	4-6 | 10+
Session 2 (8/26/2019)	36 yrs	Baseline	N/A	7-9 | 10+

See Appendix for explanations of metrics and symbols shown on this page.
Symbol Key: ▽ = Sync Blinks, **?** = Questionable Value

Screening Scores	Session 1 (7/1/2019)	Session 2 (8/26/2019)	Target Range
Hamilton Anxiety Rating Scale (HAM-A)	N/A	N/A	≤ 17
Patient Health Questionnaire-9 (PHQ-9)	N/A	N/A	< 5
Performance Assessments			
Physical Reaction Time	249 (±42) ms	247 (±27) ms	252–363 ms
Trail Making Test A	N/A	52 sec	38–64 sec
Trail Making Test B	N/A	57 sec	43–83 sec
Evoked Potentials			
Audio P300 Delay	288 ms	292 ms	250–324 ms
Test/Retest Change	-	4 ms	±11 ms
Audio P300 Voltage	▽ 15.2 µV	17.0 µV	8–21 µV
Test/Retest Change	-	2 µV	±2 µV
State			
CZ Eyes Closed Theta/Beta (Power)	5.0	4.0	0.9–2.1
F3/F4 Eyes Closed Alpha (Magnitude)	1.2	1.2	0.9–1.1
Peak Frequency (7.0–13.0 Hz)			
Frontal	? 7.0 Hz	7.0 Hz	9.0–11.0 Hz
Central-Parietal	? 7.0 Hz	? 7.0 Hz	9.0–11.0 Hz
Occipital	? 7.0 Hz	? 9.5 Hz	9.0–11.0 Hz

Maximum P300 Test Depth (µV) — Range: 240–500 ms — Topo scale referenced to Session 2

SYNC BLINKS REPORTED IF MAXIMUM DEPTH OF FP1 or FP2 > 20 uV. SYNC BLINKS AFFECT FRONTAL DEPTH VALUES.



WAVi Wellness Basic Report

[redacted] — ID: N/A — Generated: 8/26/2019 2:30 PM

P300 Rare Comparison

For multiple sessions, the rare responses are compared across sessions.

Yield Display Threshold: 20

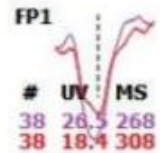
Color Key

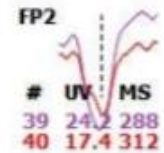
Session 1 (7/1/2019) Session 2 (8/26/2019)

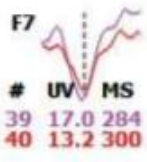
Largest depths between 240-500 msec are reported. P300s typically occur between 240 and 450 msec.
Probable depth and latency of true P300 is indicated on 1st page of report.
***Indicates possible artifact during late P300.**

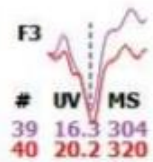
(See Appendix)

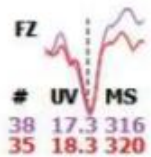
SYNC BLINKS

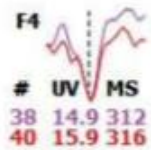


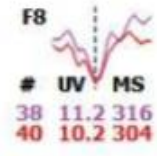


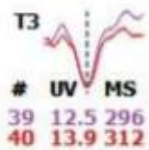


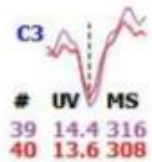


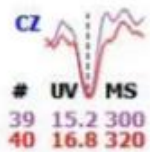


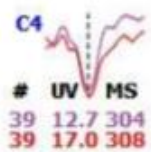


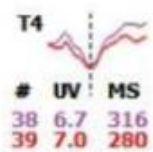


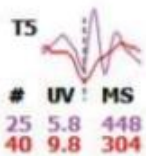


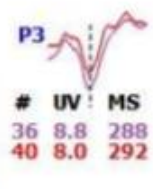


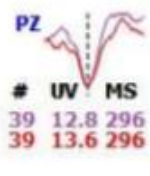


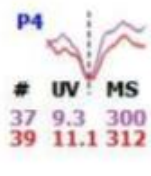


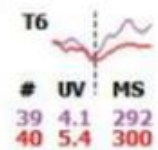


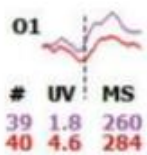


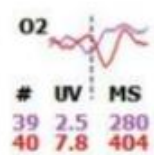


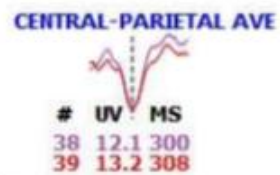












Black dotted lines at 300 msec post stimulus.

Out of 100 patients treated, nearly every patient reports:

More mental clarity

Improved memory

Improved executive function/decision making

More stable emotions and less stress

Better ability to cope with pain

More physical and mental energy

Out of 100 patients treated, some patients report:

Less sound and light sensitivity

Improved eyesight

Improved sleep and libido

Improved motor function

(ability to open a clenched fist, ability to walk)

Less muscle spasticity

Conclusion: The Multimodal, Regenerative Approach is a Superior Way to Treat TBI

- The practical, effective combination of multiple regenerative TBI therapies can produce synergistic benefits to the patient superior to mainstream TBI or single modality TBI treatments.

Pilot Study with Invictus Project and TBI Therapy

- 10 veterans
- Tested with WAVi and DTI at baseline
- 20 Pre-treatment HBOT
- TBI Therapy intranasal and IV PRP-PBSC (Platelet rich plasma-peripheral blood stem cell) and IV nutrient/cranial therapy/light therapy protocol in 24 h period
- 20 Post-treatment HBOT with 10 days intranasal insulin
- Functional qEEG with WAVI post TBI Therapy protocol at 1, 2 months, 4 months, 6 months
- DTI at 6 months
- Quality of Life testing at baseline, 2 months, 4 months, 6 months

Contact invictusproject.org for more information

Sam Peterson, Co-Founder & CEO of Invictus

"Right now, there are a countless number of combat veterans struggling not to take the loaded gun sitting on their nightstand and put it into their mouth. I know this because on Christmas Day 2014, after returning from my second tour in Afghanistan, I was that guy. If it weren't for the people closest to me who wouldn't allow me to quit on myself I wouldn't be here."

Jeffrey Haugland, COO of Invictus

"After tours to Iraq and Afghanistan, I was exposed to blasts that ultimately lead to multiple TBIs. Easy, everyday tasks became a challenge through the migraines, and I found myself not being able to recall what I was doing or where I was going while driving.

I was told this was the quality of life I should get used to. I was prescribed medication after medication with no improvement…. The quickest way to remove the threat was to put a gun in my mouth and make all the pain go away. I credit my son with saving my life, because had he not cried at that very moment, I may not be here to share my story and serve others like us."

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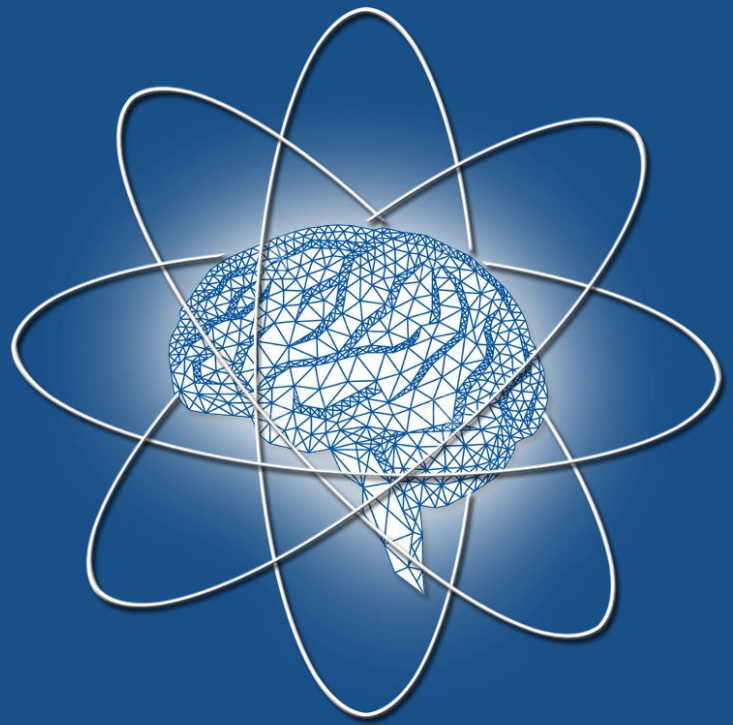

TBI Therapy

Treats TBI patients by combining regenerative therapies: HBOT, stem cells, PRP, and nutritional therapies.

tbitherapy.com

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