

The Synergistic Effect of Hyperbaric Oxygen and Virtual Reality Exposure Therapy on Mild Traumatic Brain Injury with PTSD

AP Research: STEM
Thousand Oaks High School

320,000

Number of American Soldiers
Returning from Iraq and Afghanistan
with Mild Traumatic Brain Injury

Mild Traumatic Brain Injury (mTBI)

- ❖ disruption to normal brain function caused by a bump or blow to the head
- ❖ disorientation/loss of consciousness for <30 minutes
- ❖ often missed at diagnosis
- ❖ fatigue, headaches, vision problems, memory loss

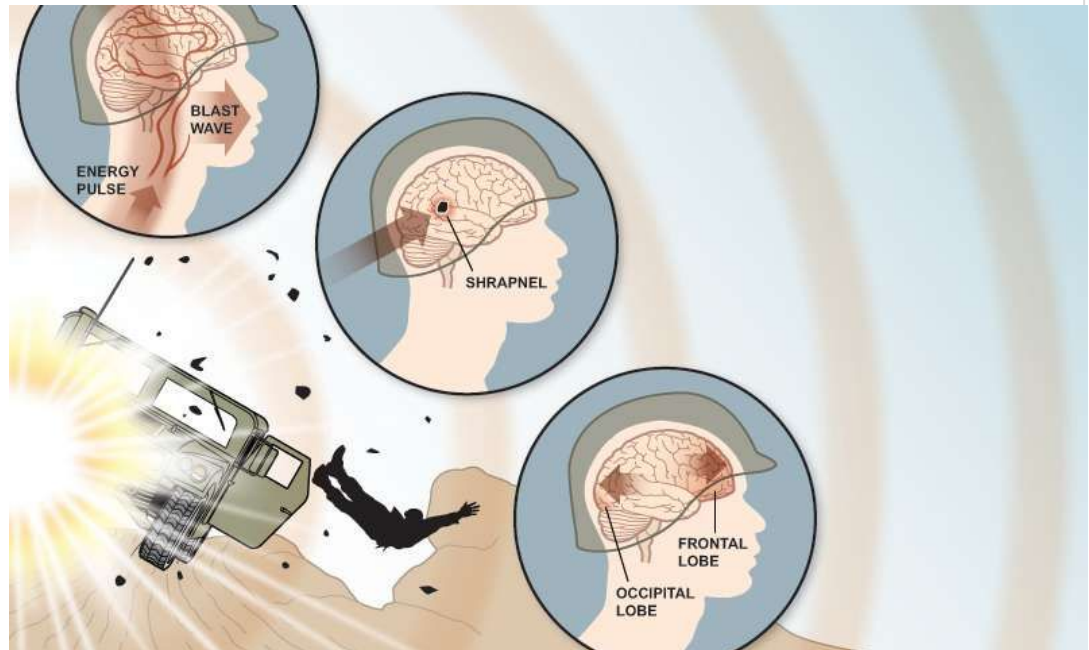


Figure 1. Graphic detailing brain injury from mild blast trauma

300,000

Soldiers have Post Traumatic Stress Disorder
(PTSD)

320,000

Soldiers Have Mild Traumatic Brain
Injury

82,000

Soldiers have PTSD and Mild
Traumatic Brain Injury

Post-Traumatic Stress Disorder (PTSD)

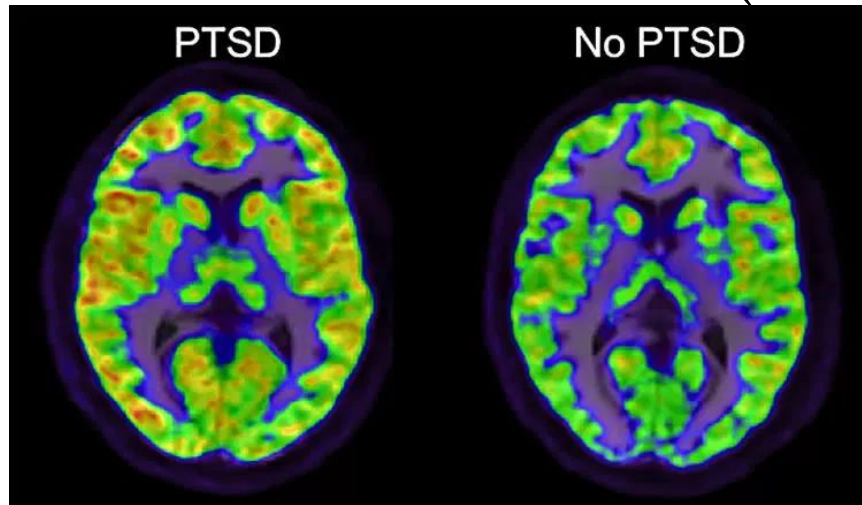


Figure 2. PET images indicating higher mGluR5 receptor availability in an individual with PTSD vs. a healthy comparison participant.

- ❖ mental disorder caused by experiencing a traumatic event
- ❖ characterized by avoidance, nightmares, anxiety, and/or tormenting memories
- ❖ 30% of all American soldiers experience PTSD

Correlation Between mTBI and PTSD in Soldiers

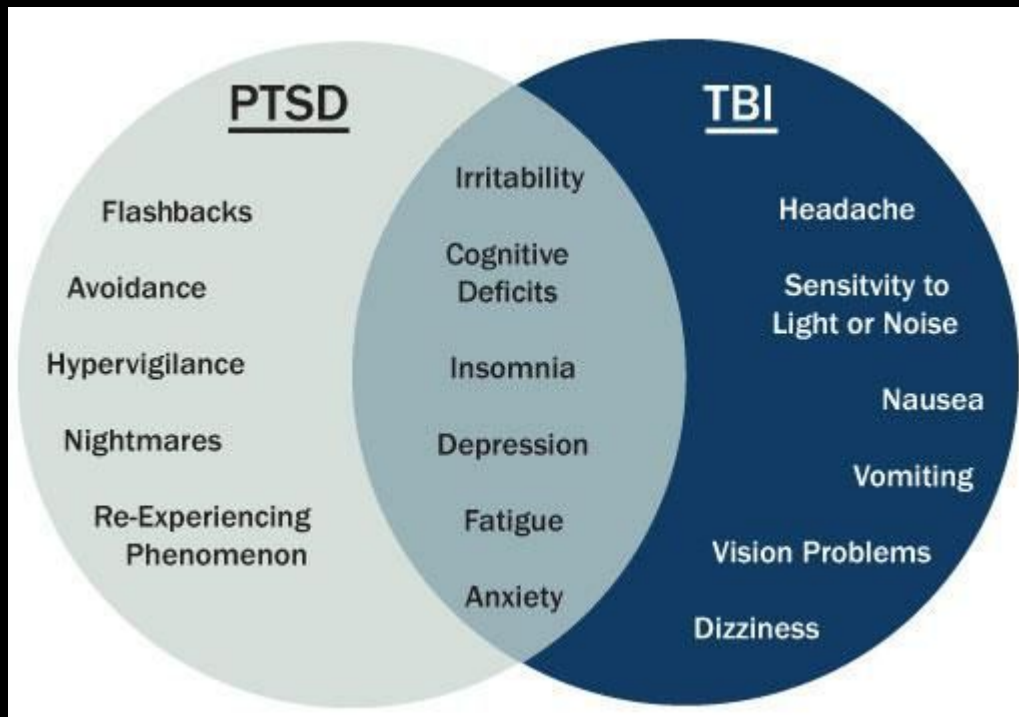


Figure 3. Venn diagram comparing similar symptoms of PTSD and TBI

- ❖ PTSD and mTBI have similar symptoms
- ❖ mTBI is a traumatic experience
- ❖ mTBI damage emotion-regulation areas in the brain

Current Treatment

- ❖ mTBI
 - physical rest, cognitive rest, rehabilitative therapies, and medication
 - successful but time-extensive and does not treat psychological symptoms
- ❖ PTSD
 - psychotherapy and antidepressants
 - $\frac{2}{3}$ of soldiers receiving treatment still had PTSD after treatment
- ❖ No current treatment for combined diagnosis of mTBI and PTSD

Hyperbaric Oxygen Therapy (HBOT)

- ❖ patient is exposed to 100% oxygen in contained environment
- ❖ clinically proven for 15 ailments
- ❖ increases oxygen concentration within blood
- ❖ reduces cerebral edema, increasing blood flow



Figure 4. Image of a hyperbaric oxygen chamber

Virtual Reality Exposure Therapy (VRET)



- ❖ vividly re-experience the event in a safe setting
 - hard to replicate in real world
- ❖ work with therapists to develop anxiety-reducing techniques
- ❖ six to twelve sessions

Figure 5: Image of a typical VRET session

Purpose

To find out if HBOT and VRET have
a significant effect on mTBI with
PTSD

Research Question

Does the combination of HBOT
and VRET have a statistically
significant effect on mTBI with
PTSD?

Hypotheses

Alternative

HBOT+VRET=
significant
effect on mTBI
with PTSD

Null

HBOT+VRET \neq
significant effect
on mTBI with
PTSD

Methods

- ❖ Systematic Review
 - Google Scholar, EBSCOhost, PubMed
- ❖ Data Collection
 - Included 11 studies
 - Excluded 19 studies
- ❖ Data Analysis
 - paired T-test

Quantifying mTBI

- ❖ not a single quantifiable way to test for mTBI
- ❖ studies use combination of many tests
- ❖ self-reported patient symptom questionnaires

Quantifying PTSD

- ❖ Clinician Administered PTSD Scale (CAPS)
 - 30 questions
 - meet Criterion B-G
 - 0-10: asymptomatic
 - 11-22: mild PTSD
 - 23-34: moderate PTSD
 - 35-46: severe PTSD
 - 47+: extreme PTSD

HBOT Results

- ❖ Self-reported symptom questionnaires
 - 12 symptoms tested
 - majority of symptoms improved post-HBOT
- ❖ CAPS score
 - 84.7 pre-treatment to 80.1 post-treatment
 - Standard Deviation: 14.5 pre-treatment and 26.2 post-treatment

Table 1. The effect of HBOT on specific symptoms of mTBI as self-reported by patients

Symptom	Better (%)	No Change(%)	Worse(%)
Headache	87 (13/15)	13 (2/15)	0
Sleep disruption	75 (9/12)	25 (3/12)	0
Memory	92 (11/12)	8 (1/12)	0
Cognition	87 (13/15)	13 (2/15)	0
Energy level	93 (14/15)	7 (1/15)	0
PTSD stress	40 (2/5)	60 (3/5)	0
Irritability	82 (9/11)	18 (2/11)	0
Mood swings	87 (13/15)	13 (2/15)	0
Imbalance	55 (6/11)	45 (5/11)	0
Incoordination	75 (3/4)	25 (1/4)	0
Depression	93 (13/14)	7 (1/14)	0
Photophobia	56 (5/9)	44(4/9)	0

VRET Results

- ❖ Average CAPS score: 83.5
pre-treatment to 48.1
post-treatment
 - Standard Deviation: 18.1
pre-treatment and 36.9
post-treatment

The Effect of Virtual Reality Exposure Therapy on CAPS Scores

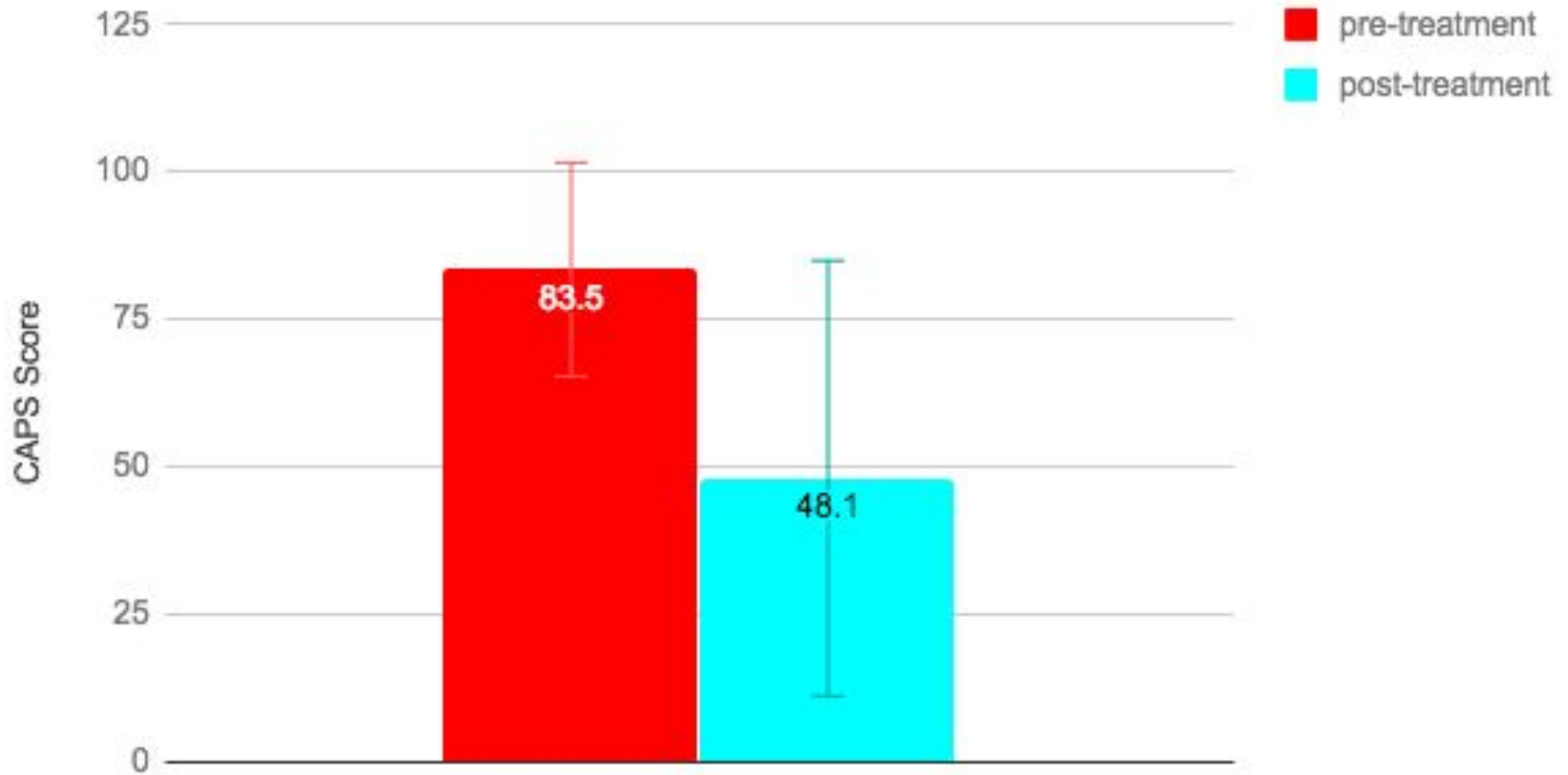


Figure 6. Graphical comparison of the effect of VRET on CAPS scores

$p \approx 0.0007$

for HBOT (symptoms)

$p = 0.6330$

for HBOT (CAPS)

$p = 0.0014$

for VRET (CAPS)

Discussion

- ❖ HBOT alone is not adequate for treatment of mTBI with PTSD
 - lacks PTSD treatment
- ❖ VRET fulfills gap HBOT leaves
- ❖ the combination of both should be looked at as a possible treatment method

Conclusion

- ❖ HBOT and VRET have a significant effect on mTBI with PTSD
 - Should be considered as a treatment option for soldiers with mTBI with PTSD
- ❖ Limitations
 - Small sample size
 - Only American soldiers returning from tours in Iraq and Afghanistan

Further Work

- ❖ HBOT and VRET need to be tested concurrently
- ❖ Universal objective rating for mTBI
- ❖ More research on the correlation between mTBI and PTSD in soldiers

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