

New Approach to Brain Healing

Prof. Shai Efrati

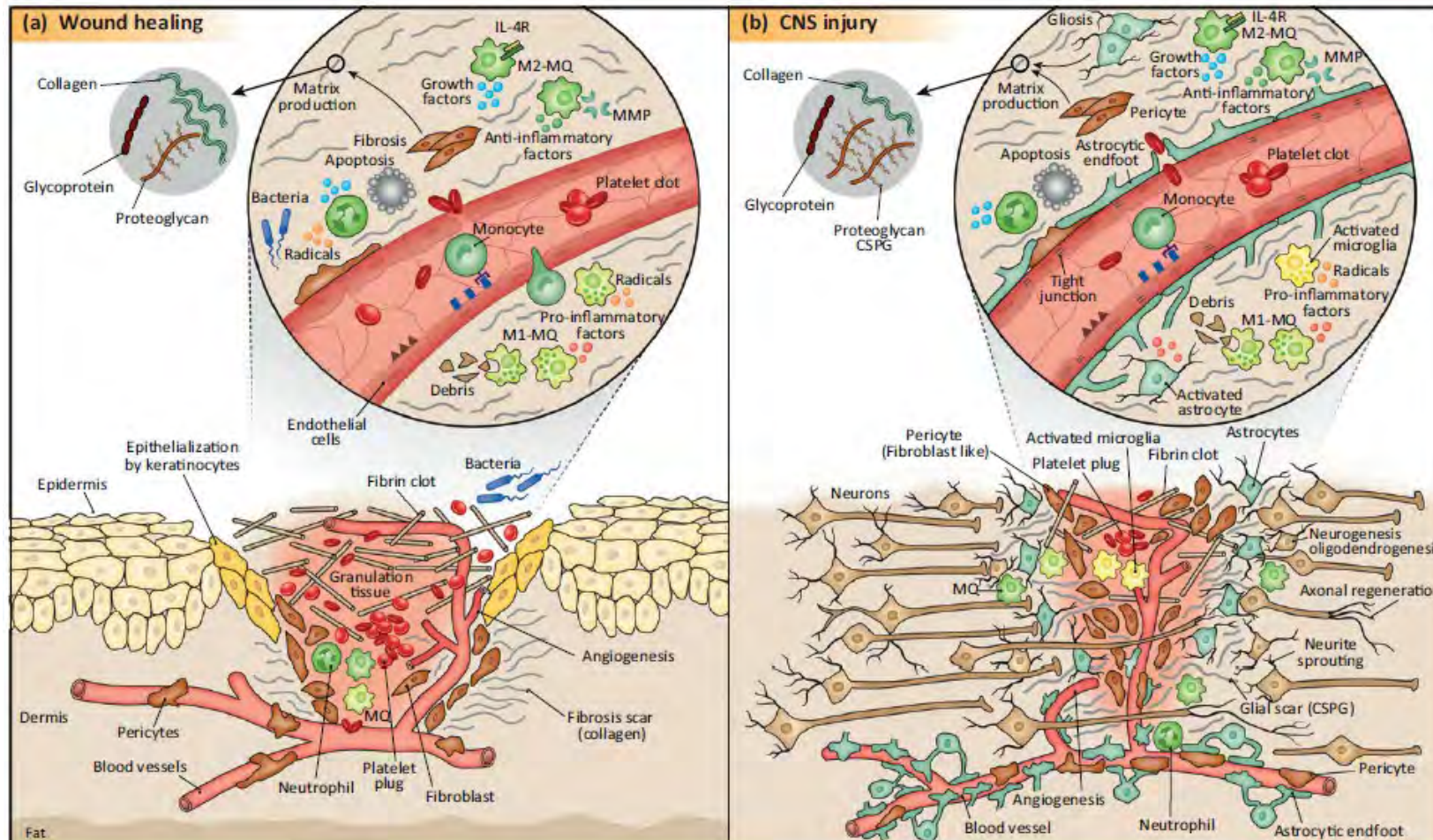


SHAMIR
MEDICAL
CENTER



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Tel Aviv University

May 2022

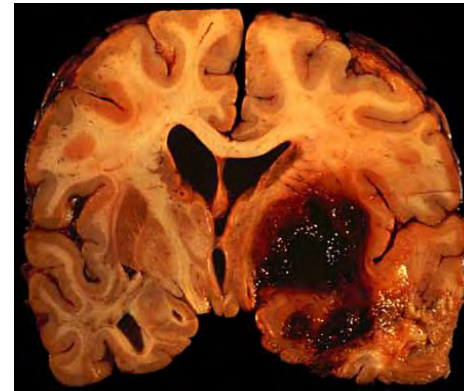


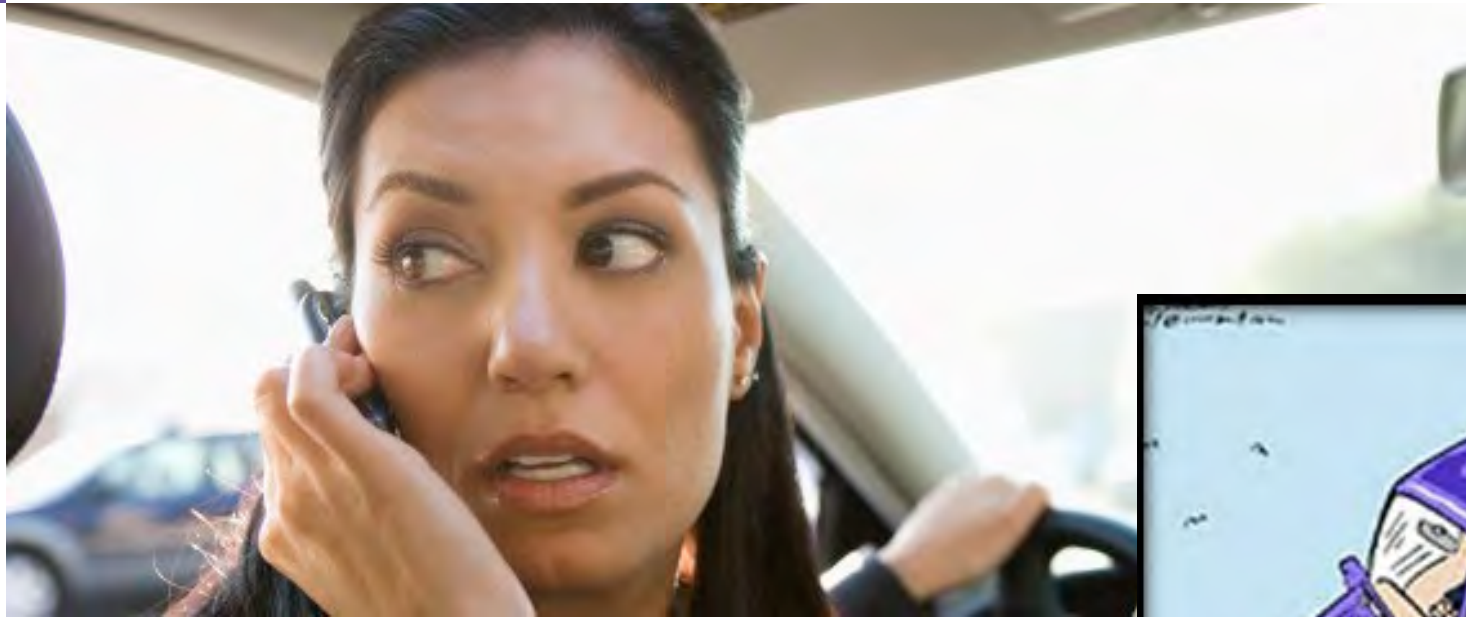
Michal Schwartz et al



What do we need for recovery of an injured non necrotic tissue?

- Energy (oxygen)
- Trigger
- Stem cells
- Angiogenesis





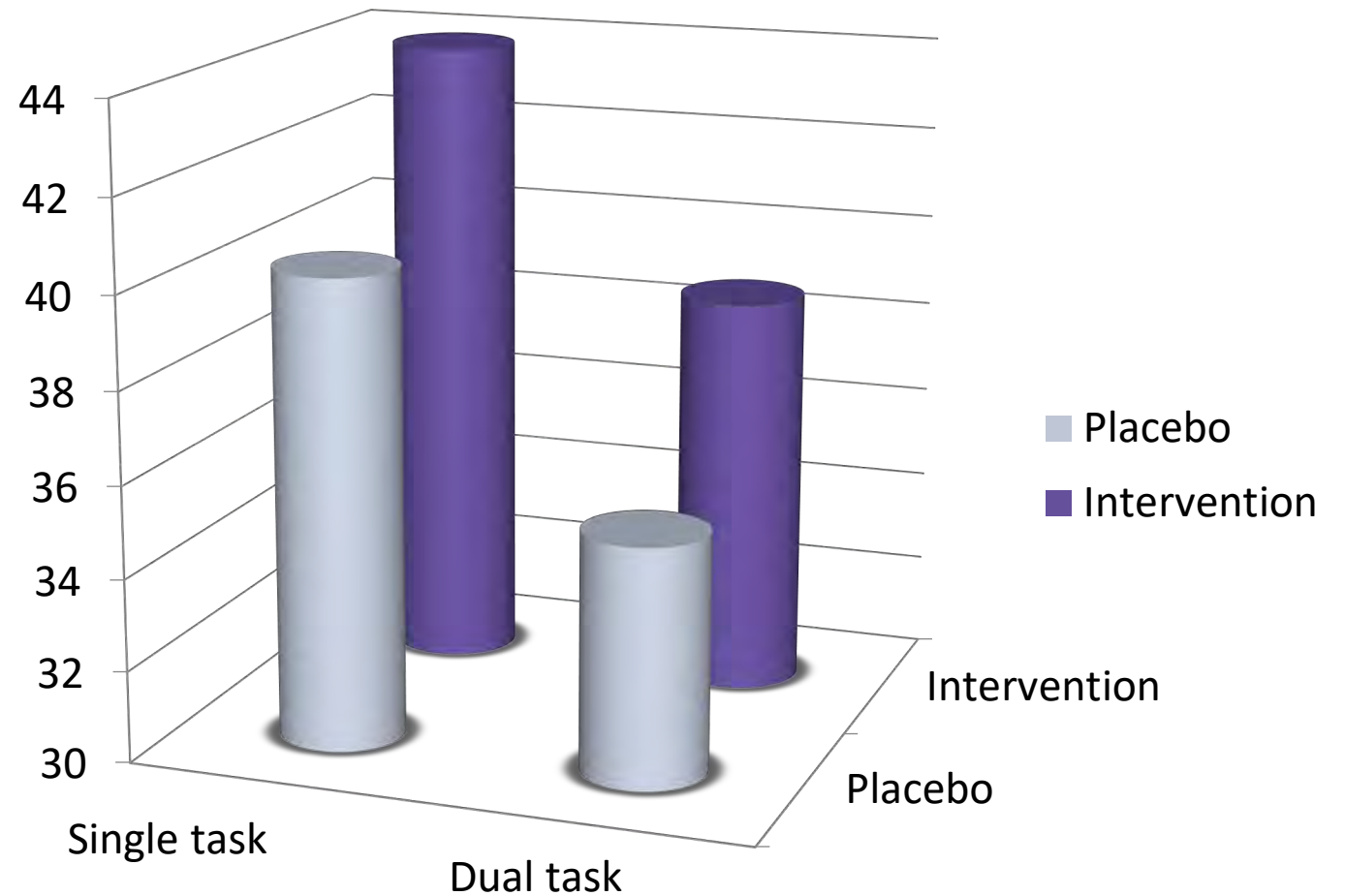
Oxygen – Limiting Factor for Brain Activity





Oxygen – Limiting factor for brain activity in healthy young individuals

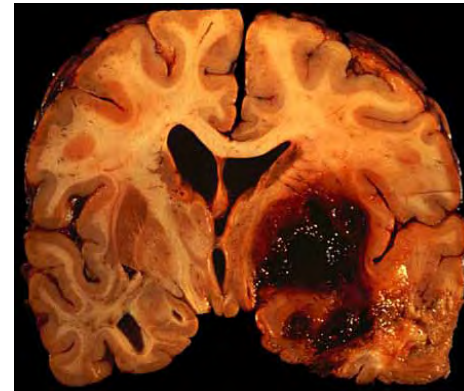
Cognitive function at dual tasking at normobaric (Placebo) and hyperbaric conditions (intervention)





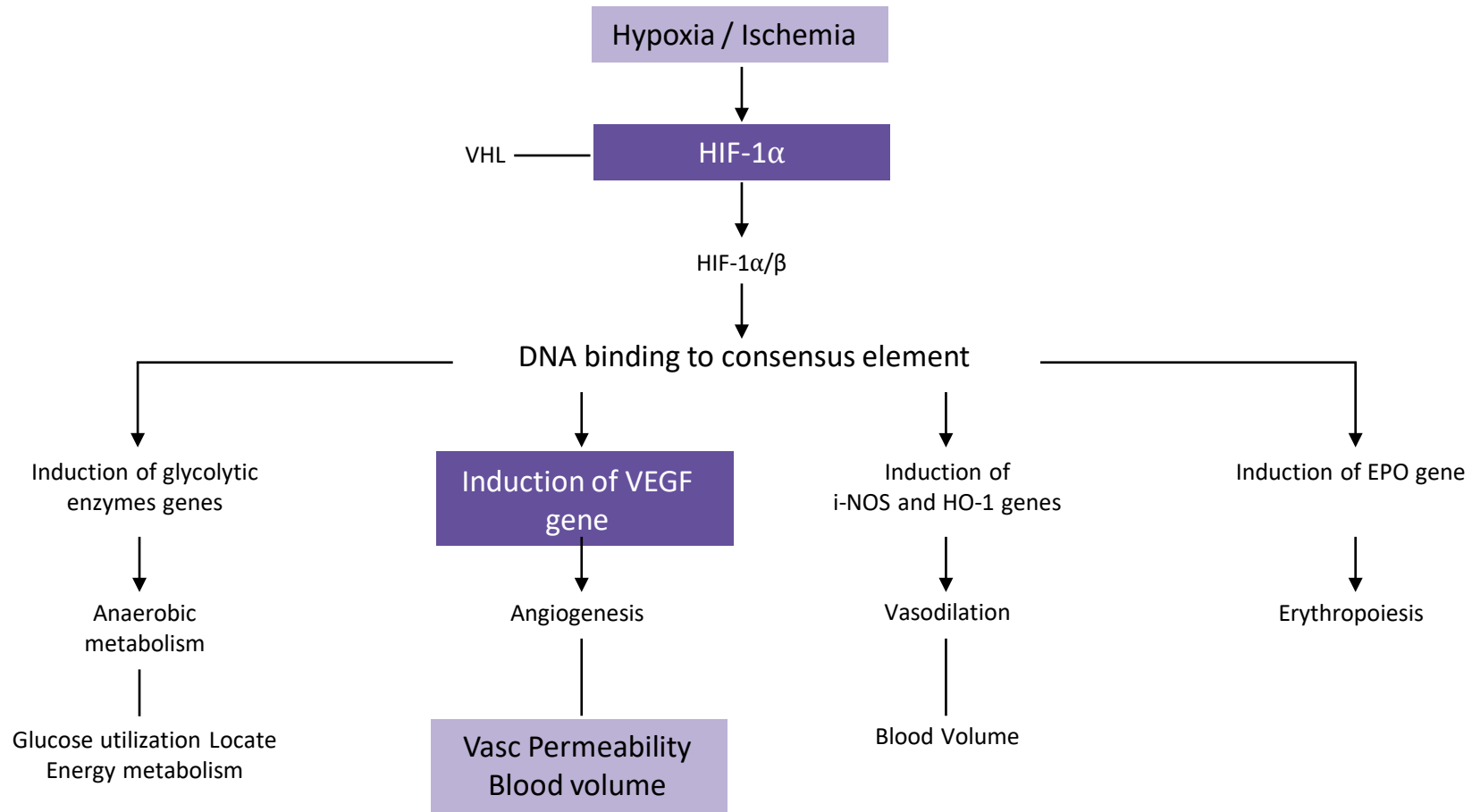
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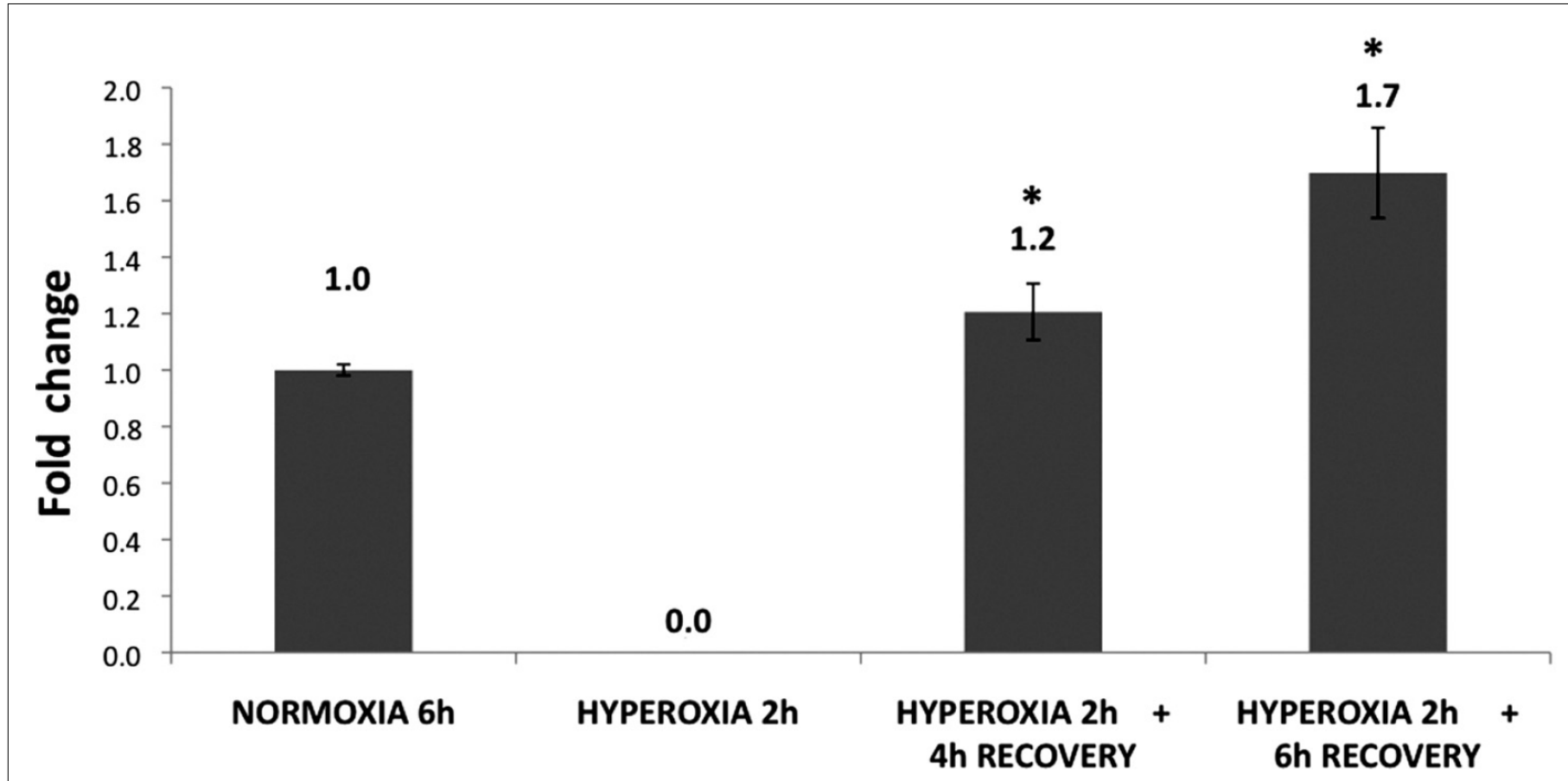


HBOT - Hyperoxic – Hypoxic paradox





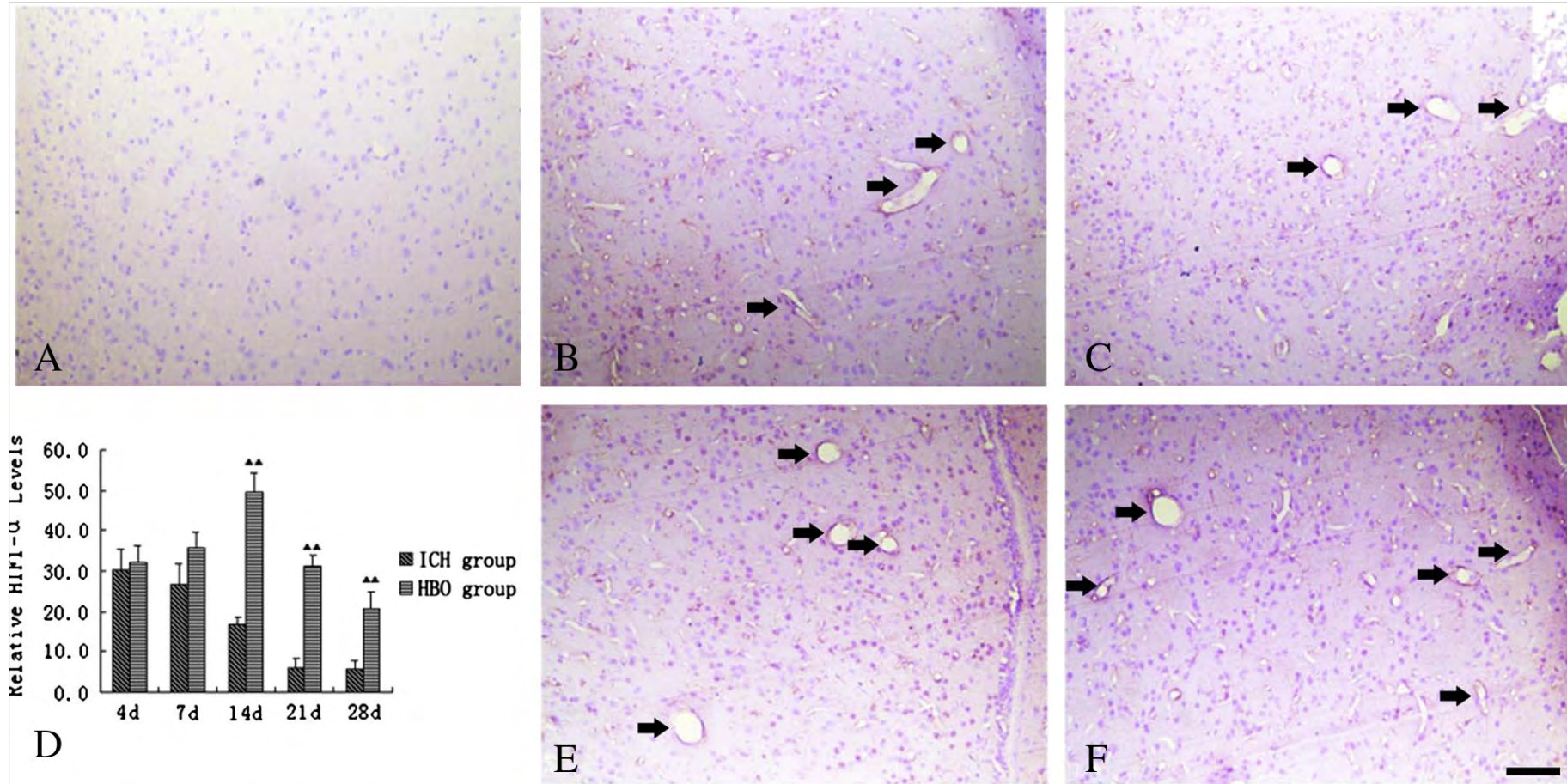
Hyperoxic - Hypoxic Paradox HIF 1 α in HUVEC



F. Cimino et al J Appl Physiol. 2012



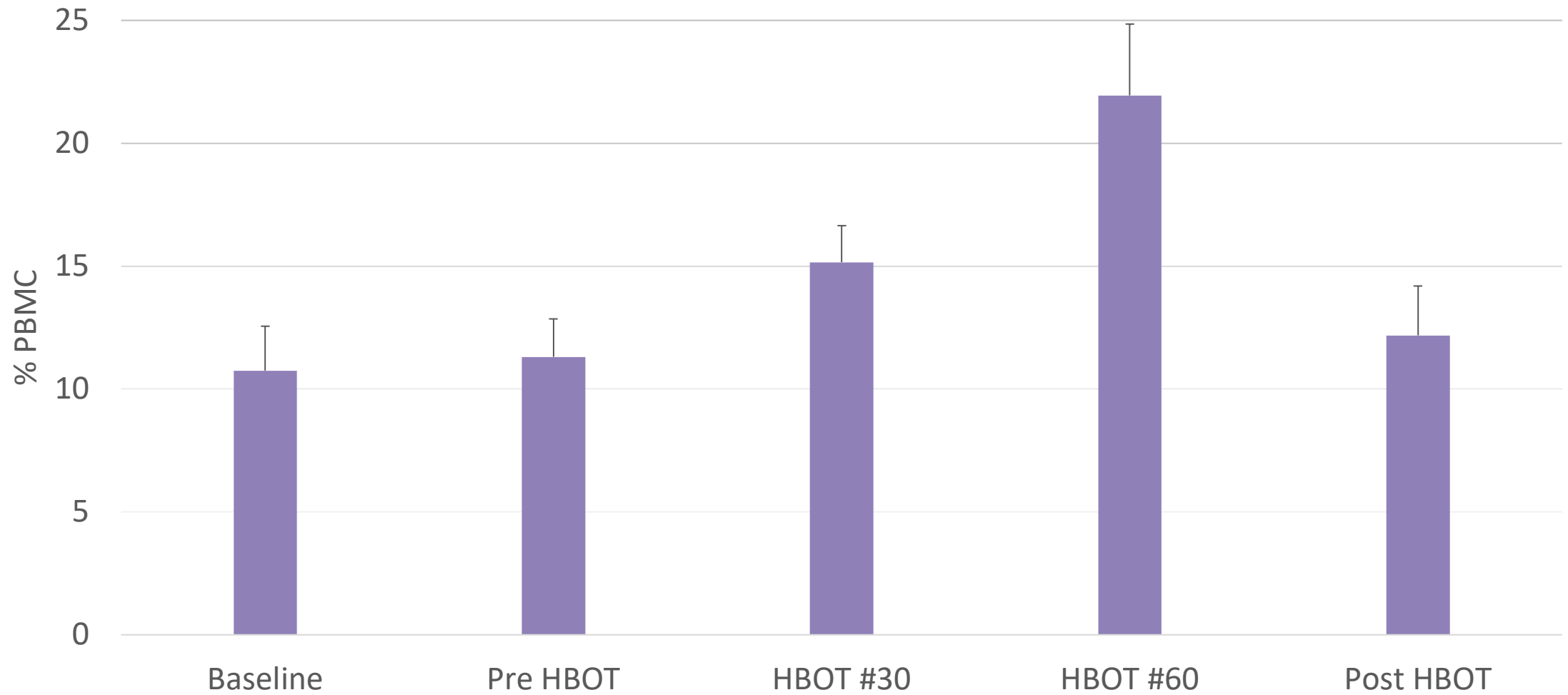
Hyperoxic - Hypoxic Paradox HIF in the Brain (animal model)



Peng et al. J Neurol Sci. 2014



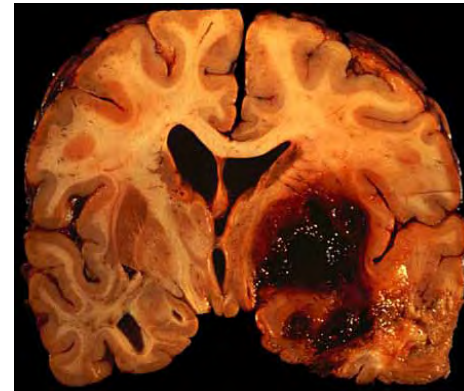
Hyperoxic - Hypoxic Paradox HIF 1 α in Humans PBMC





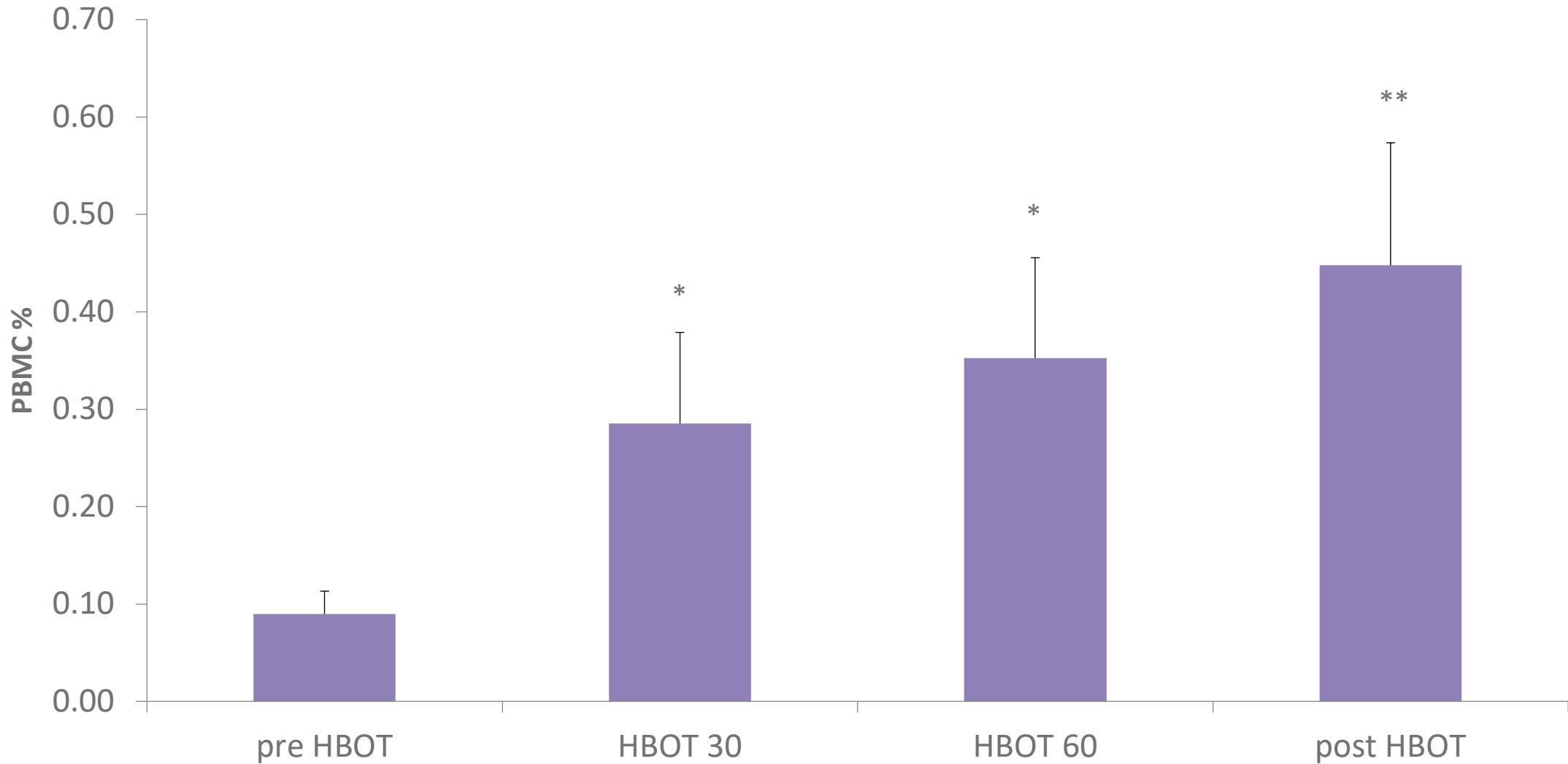
What do we need for recovery of an injured non necrotic tissue?

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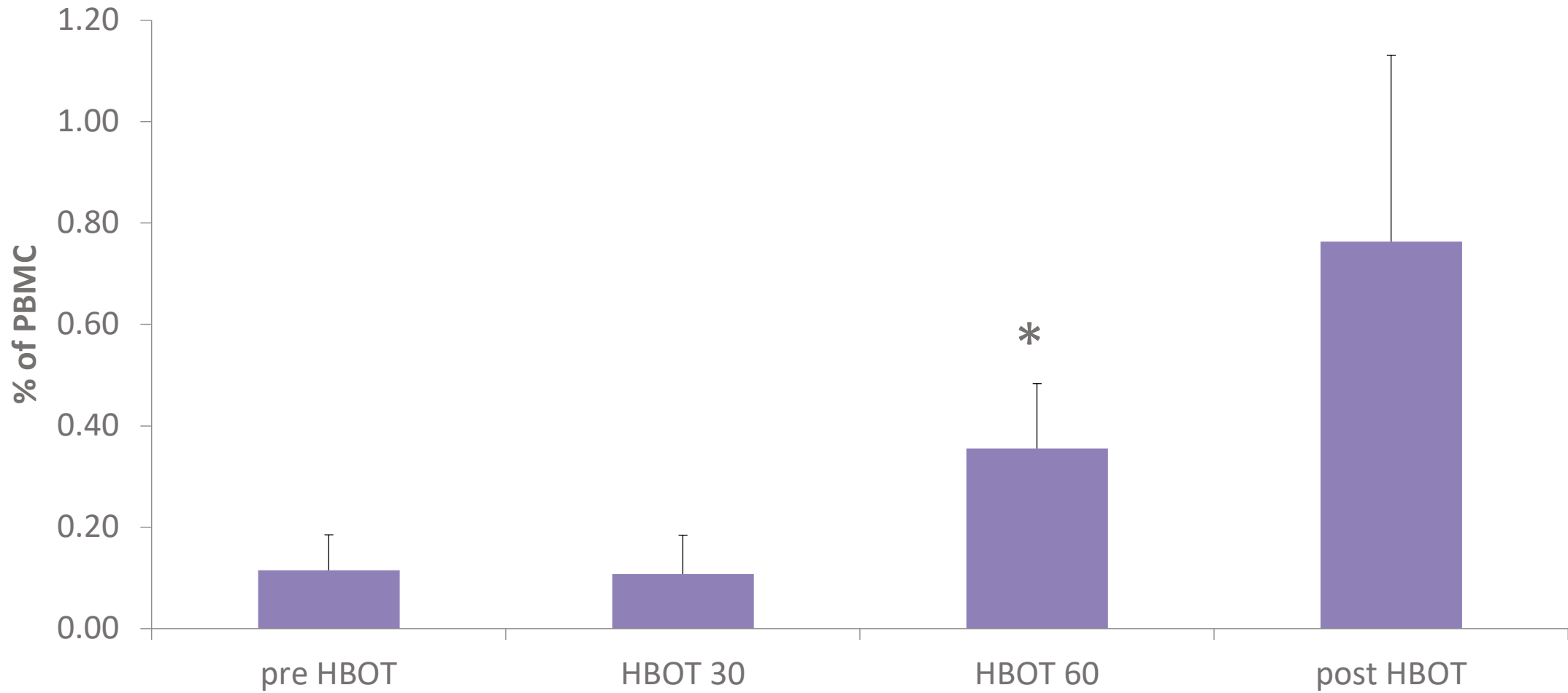


Hematopoietic Stem Cells (CD34+/CD90+)





Mesenchymal Stem Cells (CD34-/CD45-/CD73+/CD90+/CD105+)





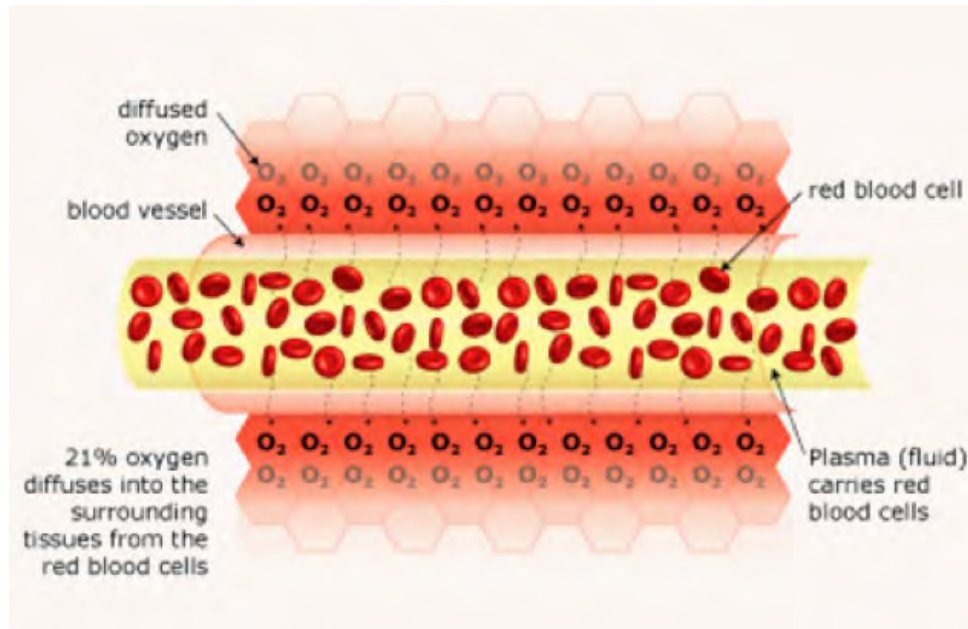
What do we need for regeneration?

A supporting environment

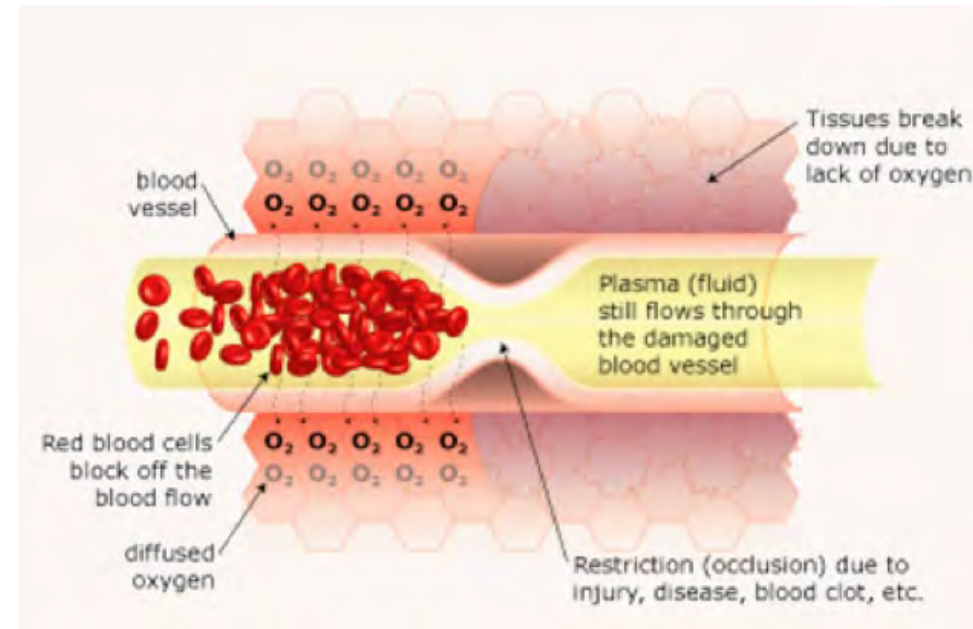


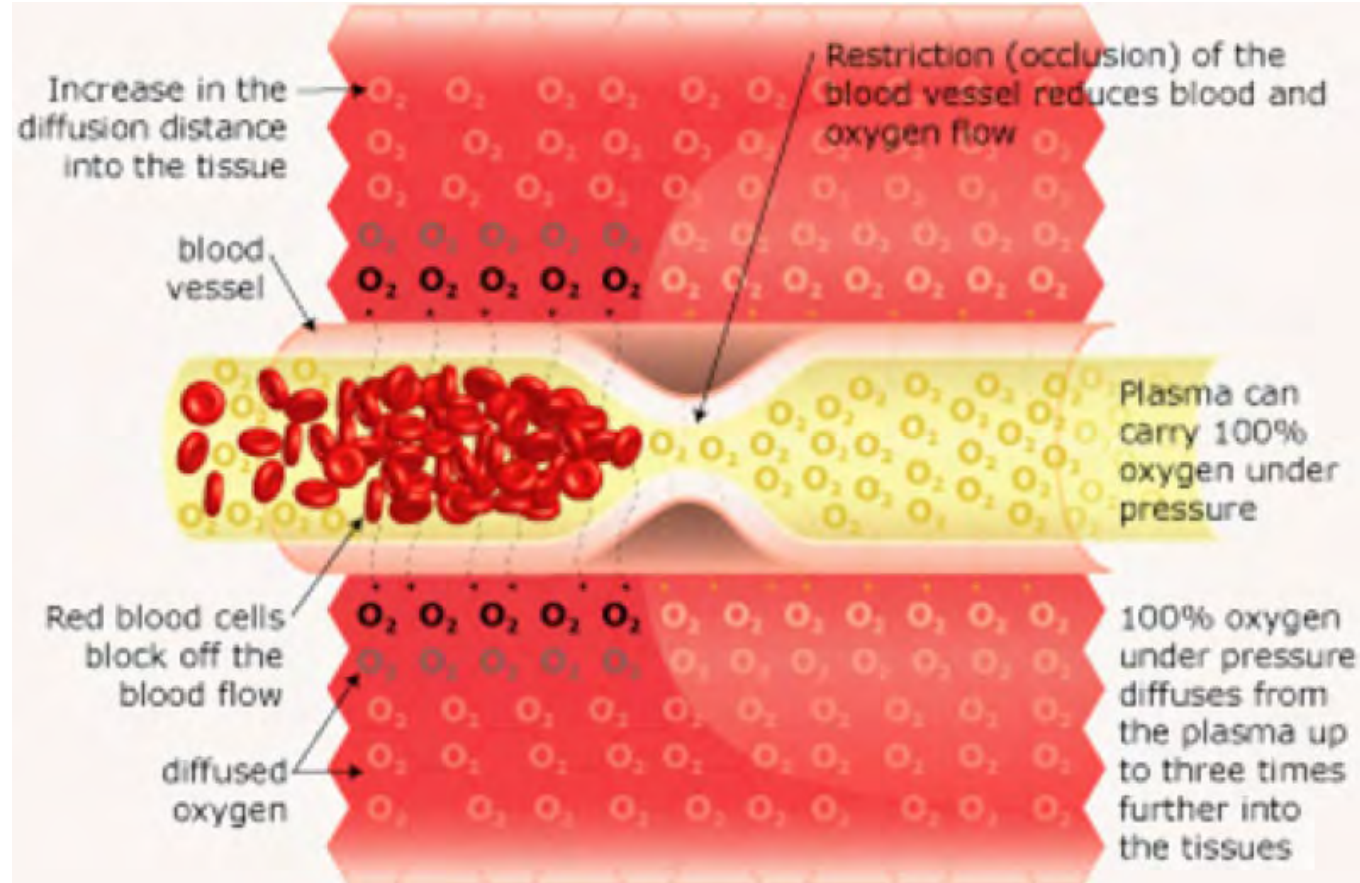


Normal Perfusion



Hypoperfusion





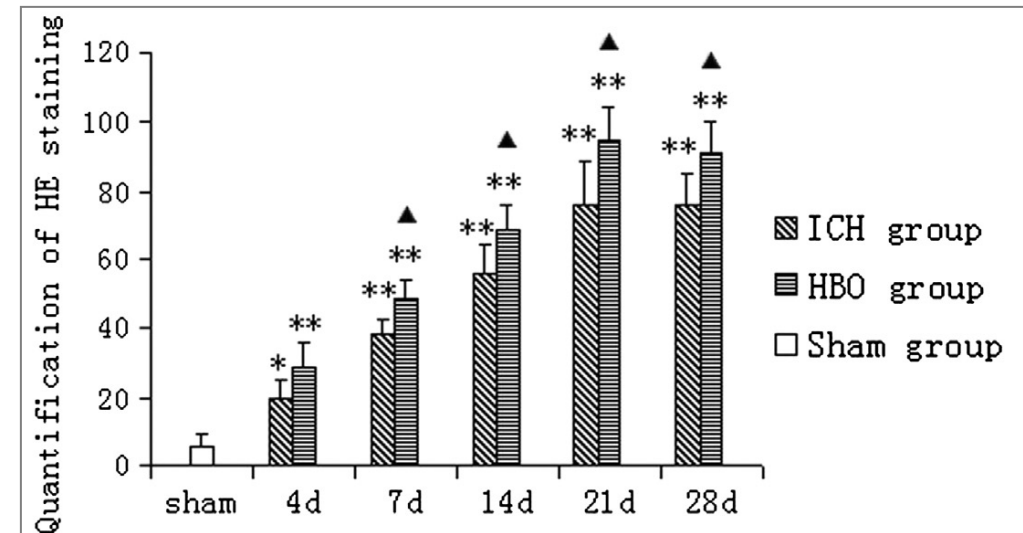
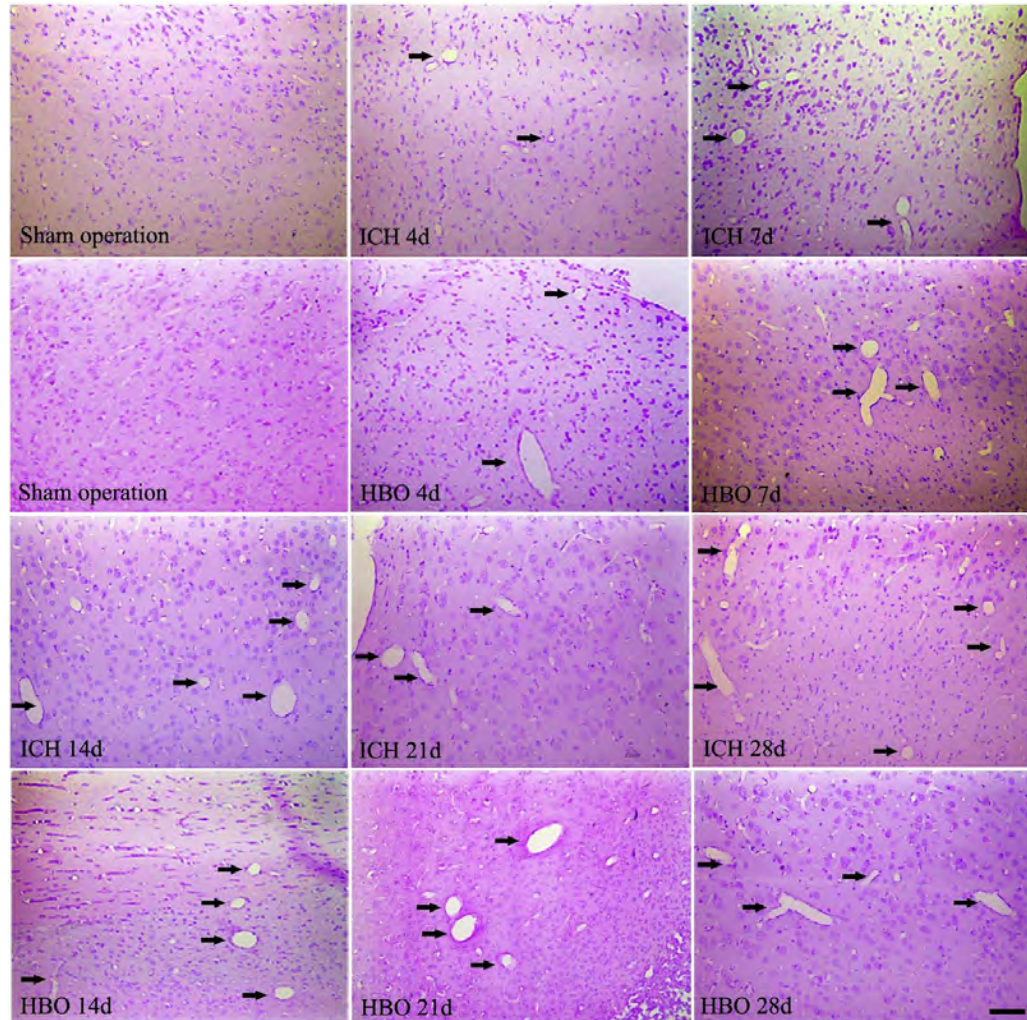


Angiogenesis





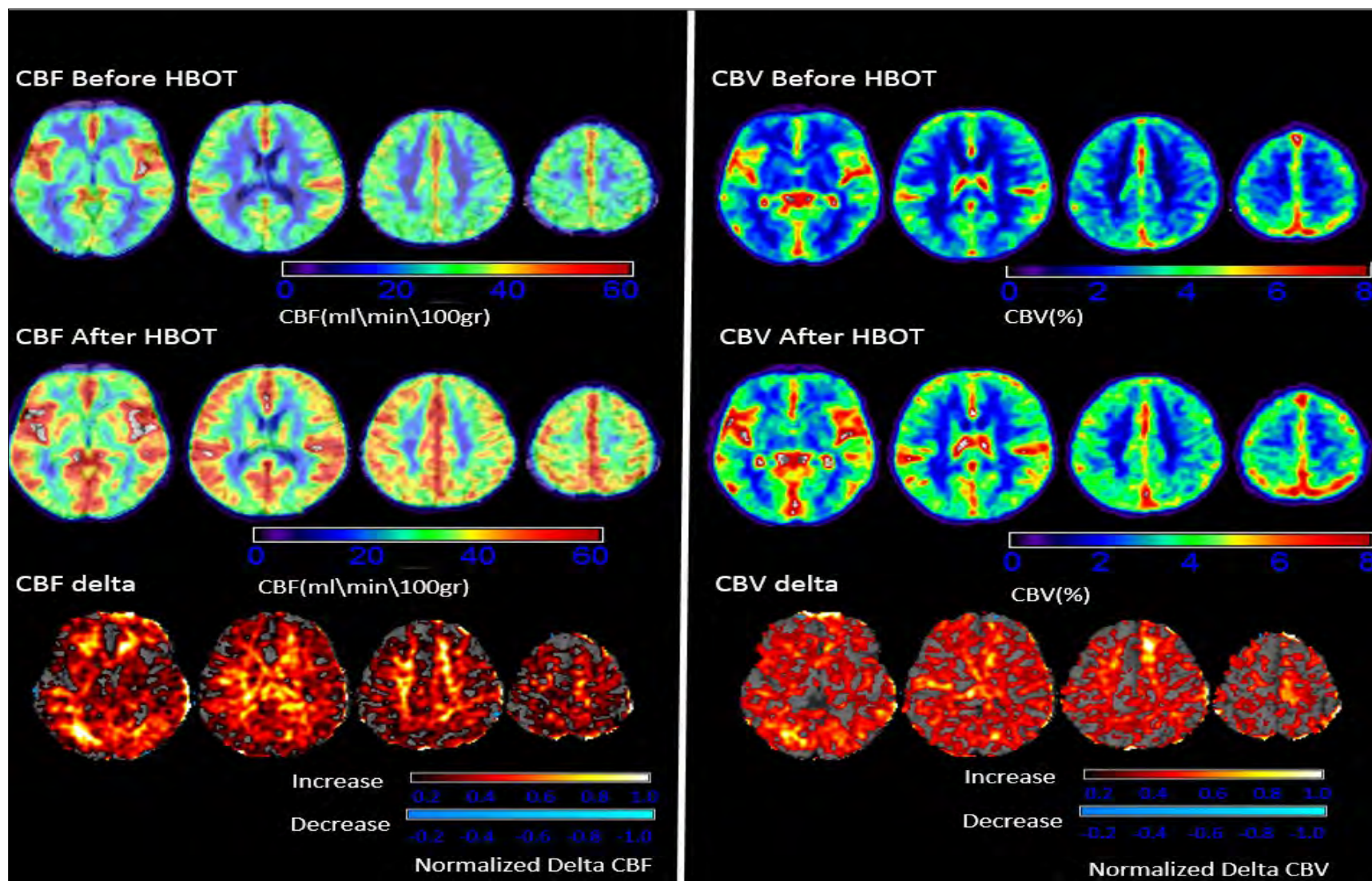
Hyperbaric Oxygen Therapy induce Brain Angiogenesis - Post Stroke rat



Peng et al. J Neurol Sci. 2014



Perfusion MRI of Post TBI Patients (10 ± 3 yrs after the acute event)





What do we need for recovery of an injured non necrotic tissue?

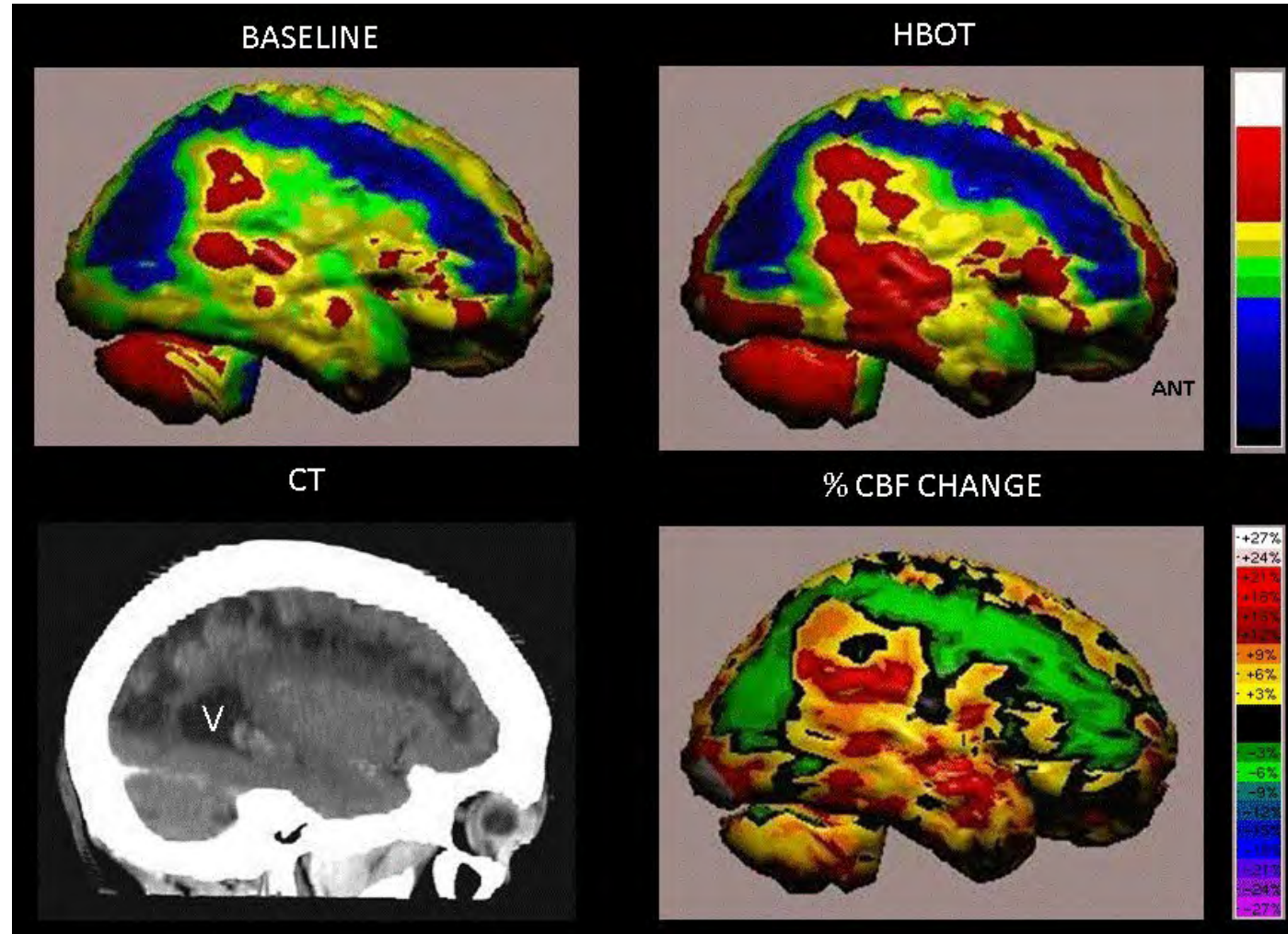
- ✓ Energy (oxygen)
- ✓ Trigger
- ✓ Stem cells
- ✓ Angiogenesis

What is the optimal wound for HBOT ?



Case Example

64-year-old woman, suffering from left hemiparesis due to ischemic stroke that occurred 26 months prior to inclusion in the study.

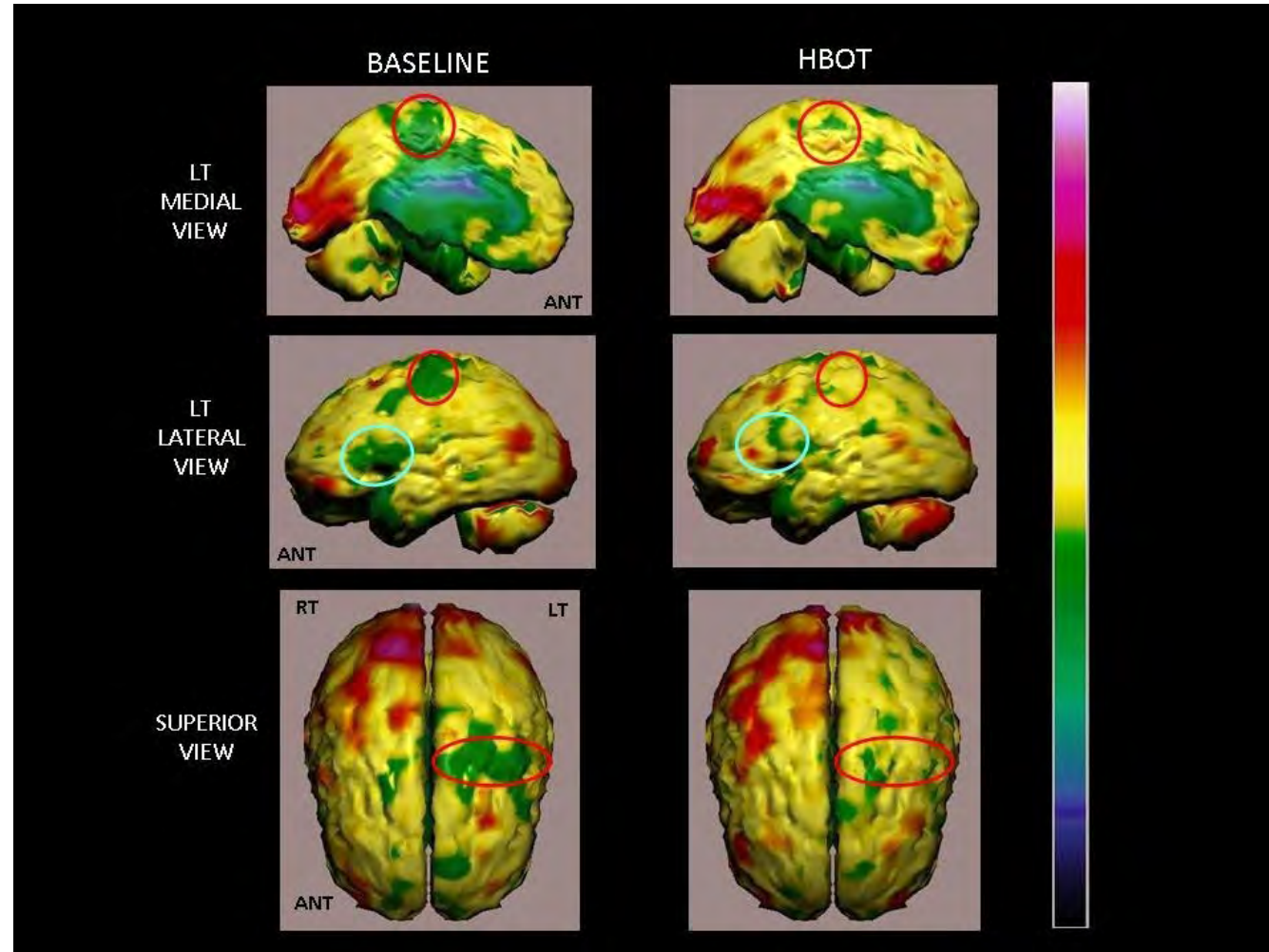


Efrati et al. Plos 2013



Case Example

62 years old woman suffering from right hemiparesis and aphasia due to ischemic stroke that occurred 14 months prior to her inclusion in the study.

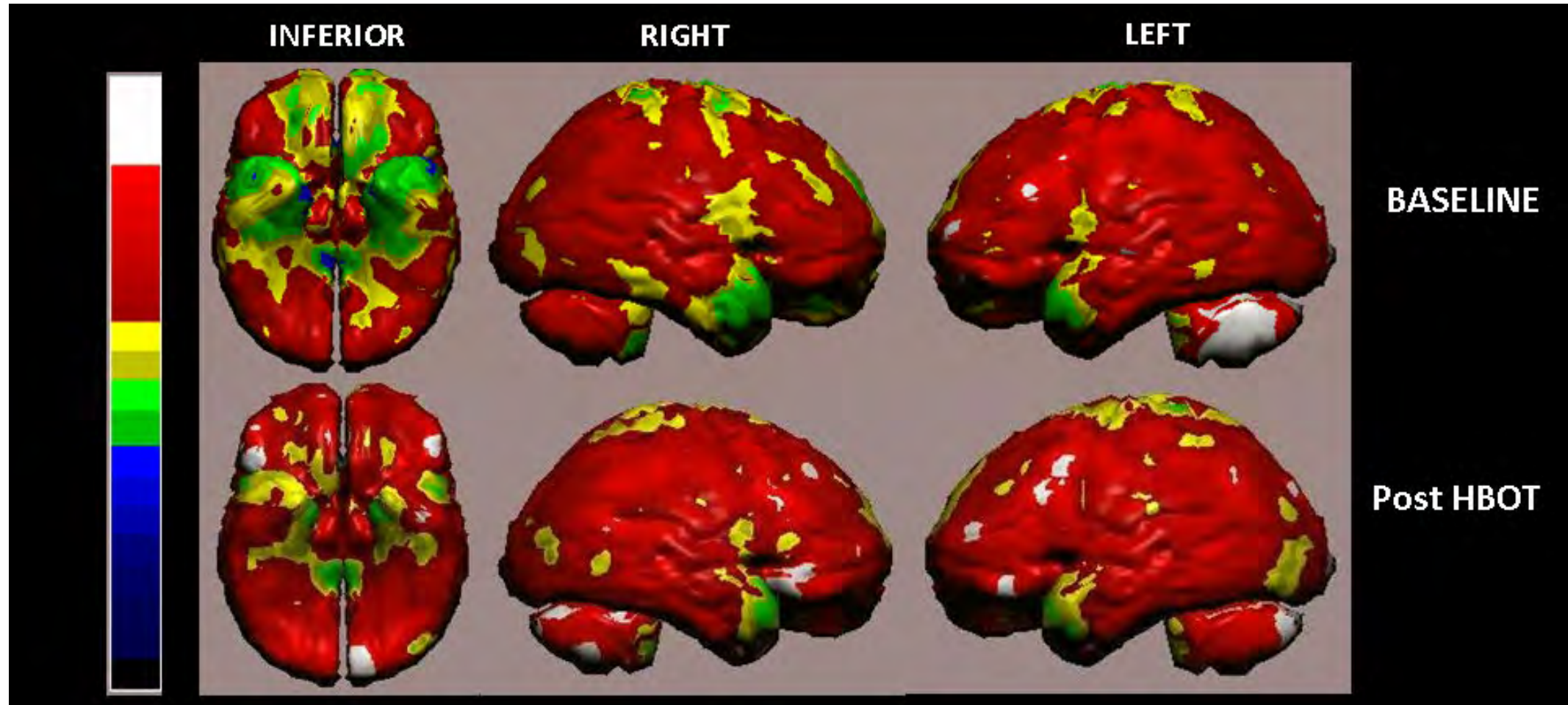


Efrati et al. Plos 2013



Case Example

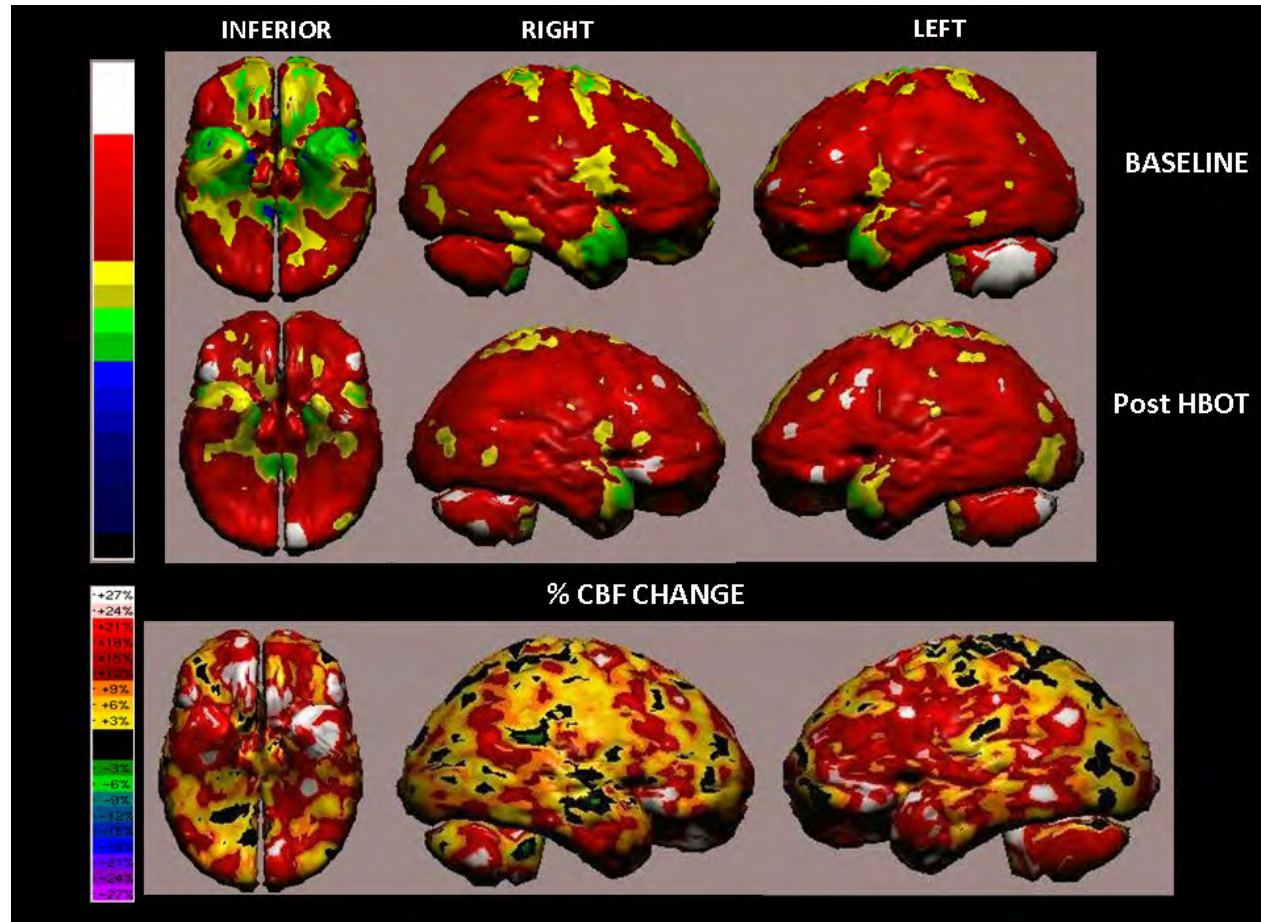
51-year-old woman that had mTBI (fall from a bus)
2 years prior to her inclusion





Case Example

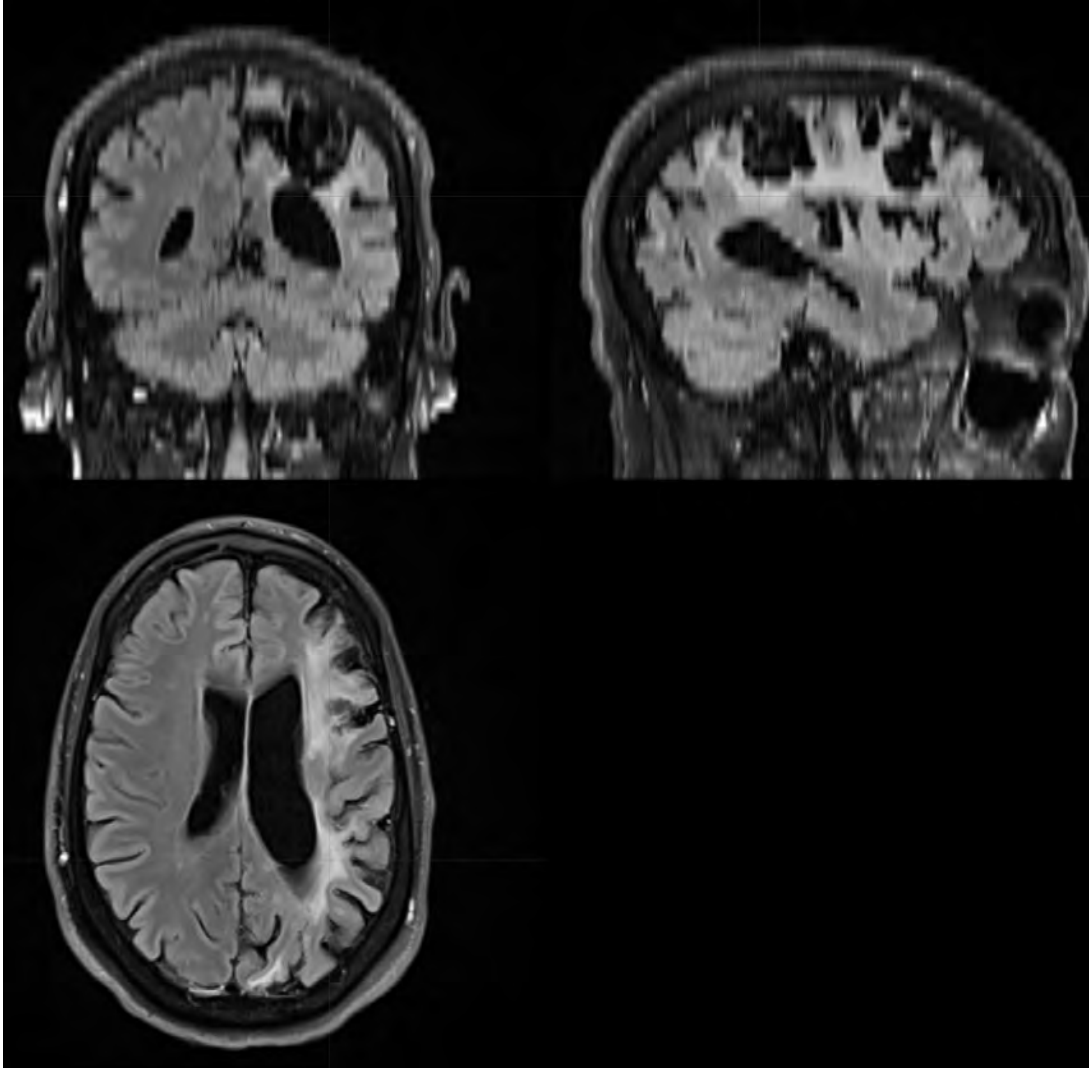
51-year-old woman that had mTBI (fall from a bus)
2 years prior to her inclusion



	Baseline	Post HBOT
Memory	56	108
Attention	47	81
Executive Function	65	85
Information processing speed	85	95



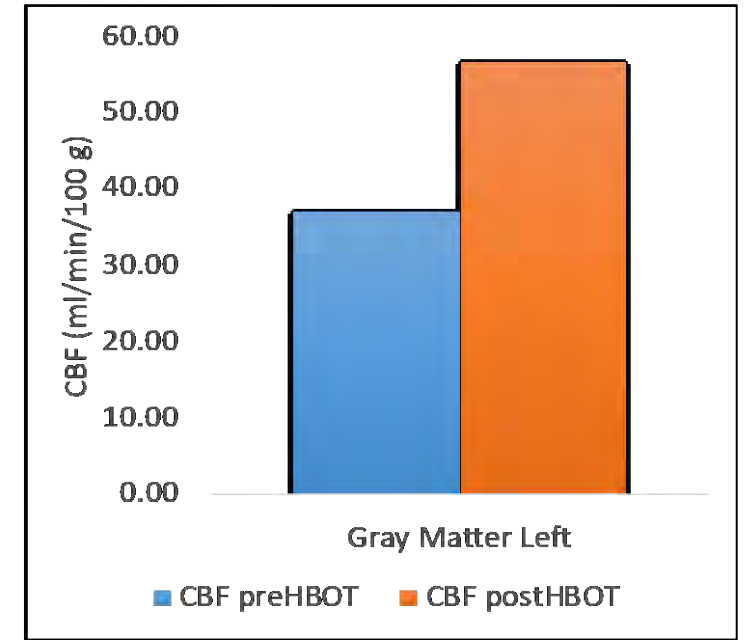
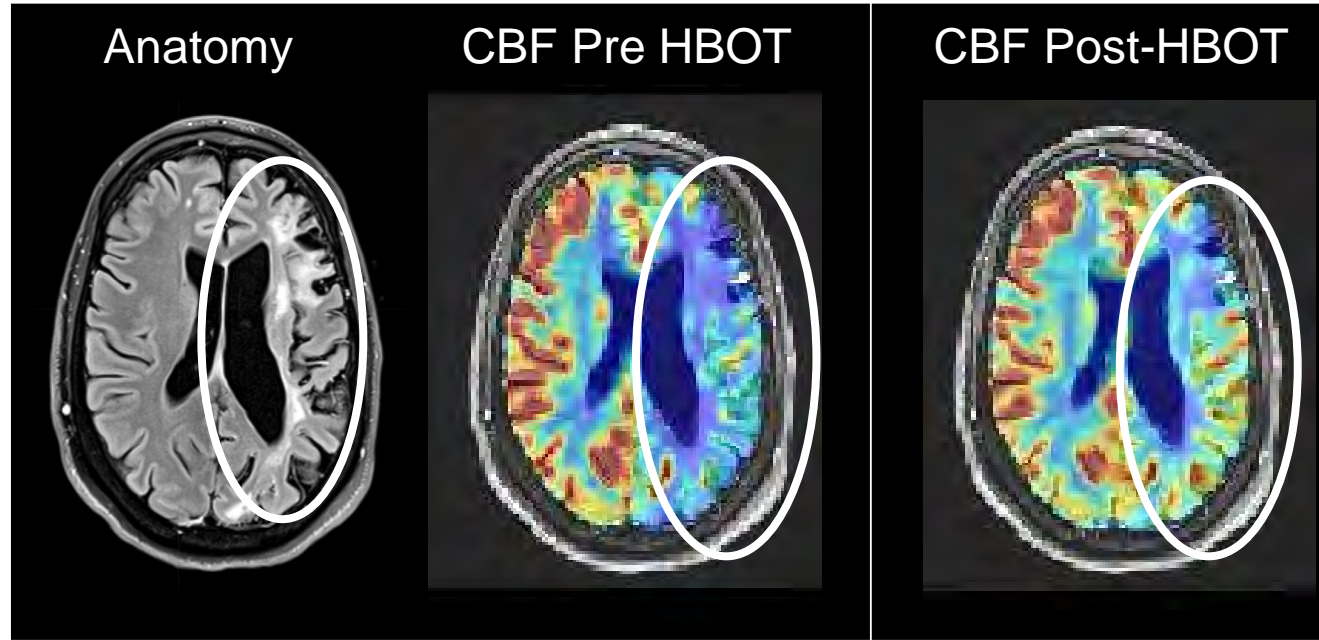
Perfusion MRI in Stroke Following HBOT



- 47y male
- CVA at age 43y
- HBOT 4y after CVA
- Mild weakness -right side
- memory difficulties, speech impairment and aphasia
- FLAIR MRI image – Lesion in right hemisphere in parietal and frontal lobes



Perfusion MRI in Stroke Following HBOT

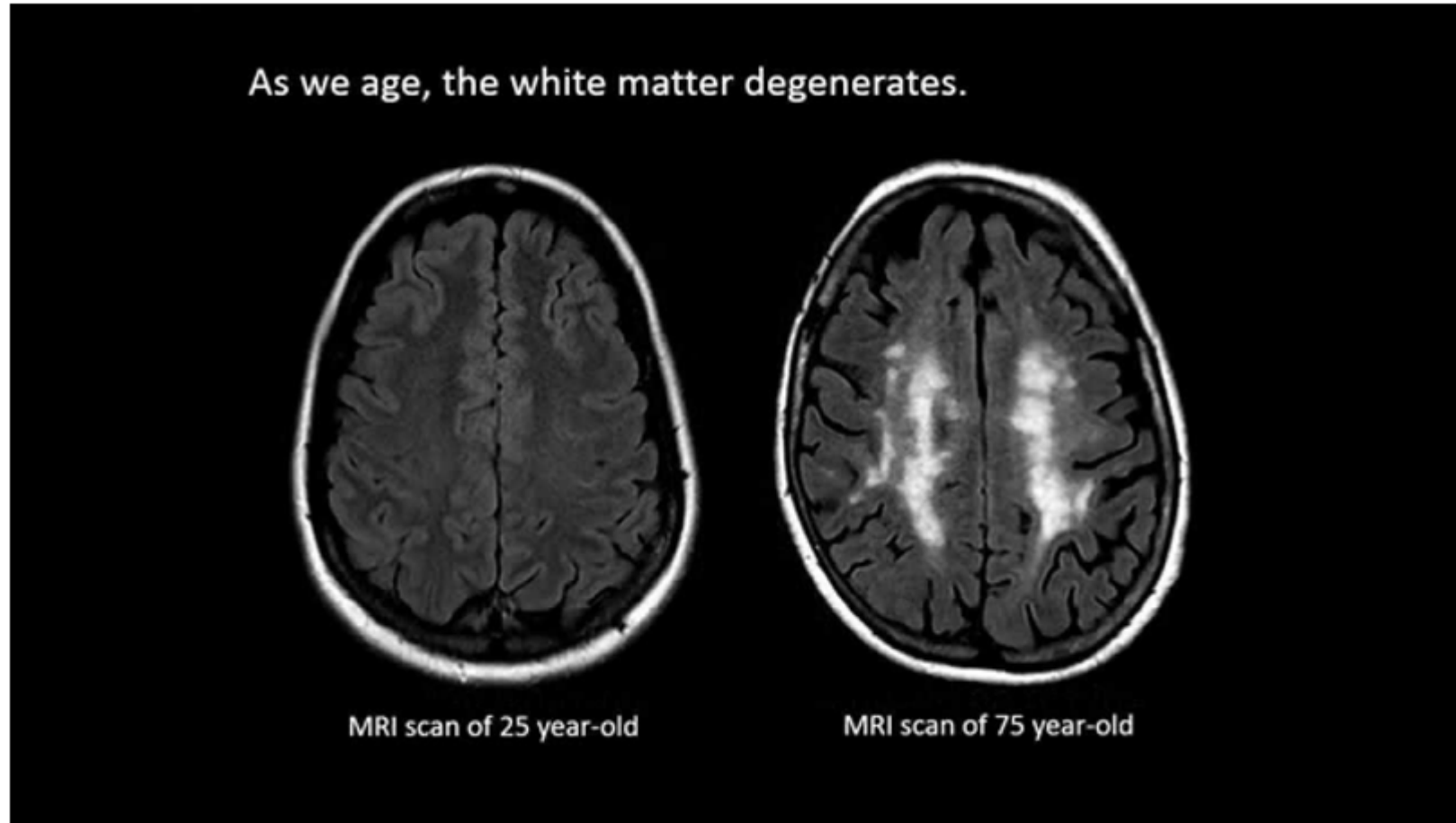


Brain region	Brain function	% change
Superior/inferior temporal gyrus	Face recognition, word meaning (reading)	49.60%
Supramarginal gyrus	Language perception and processing	46.77%
Medial temporal gyrus	Visual memory	41.77%
Anterior cingulate cortex	Working memory	36.92%

Post HBOT clinical improvements:

- Memory
- Speech improvement
- Started to use his right hand

THE AGING BRAIN



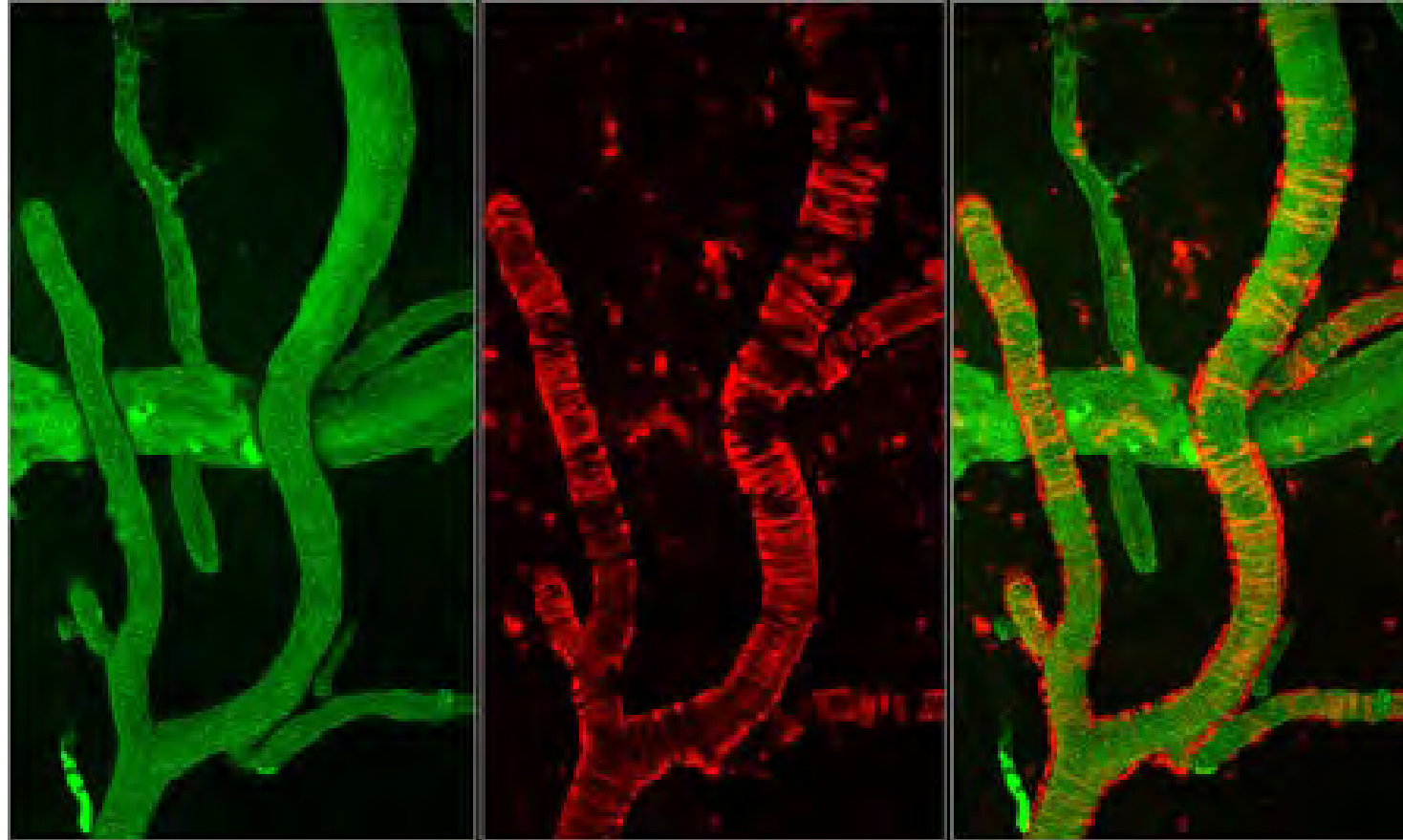


____ THE AGING BRAIN





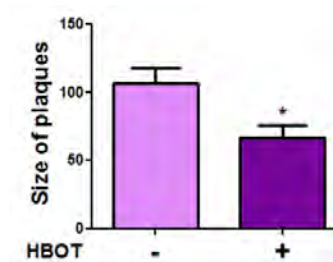
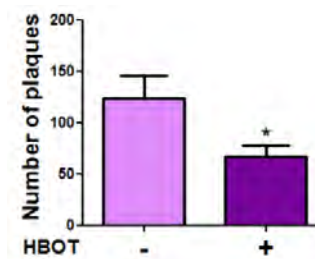
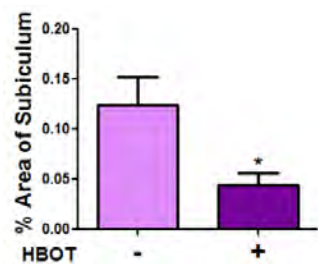
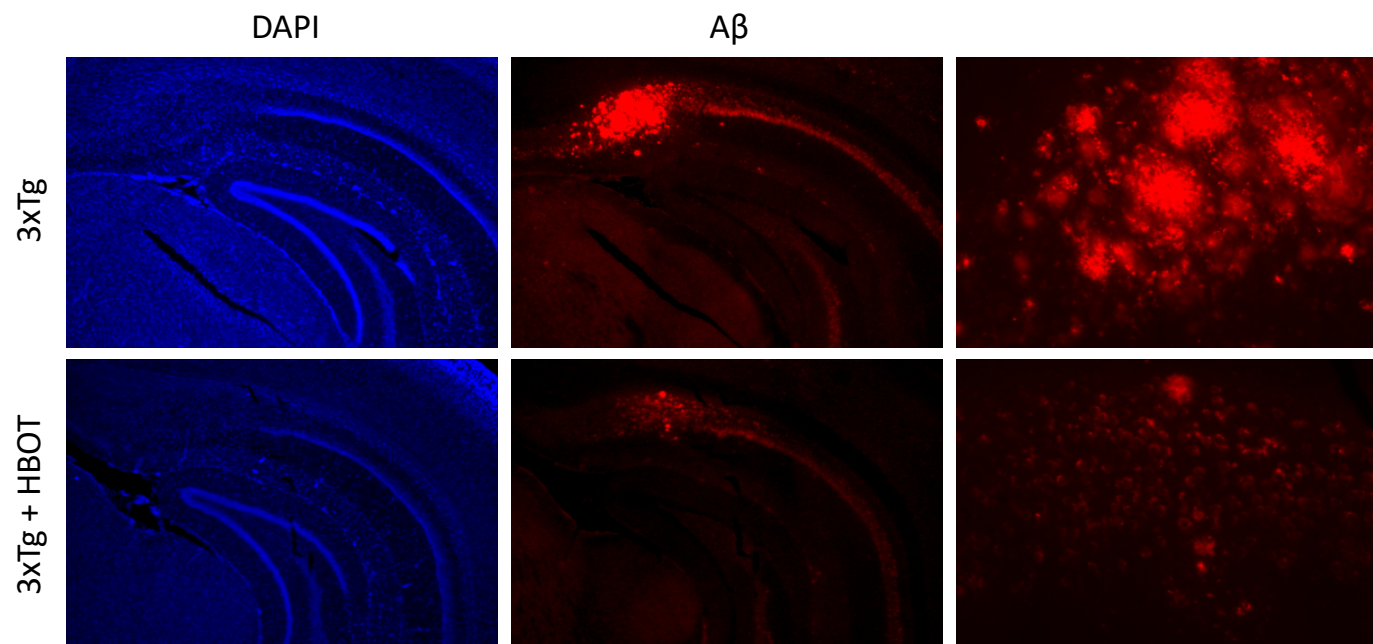
AMYLOID & BLOOD FLOW IN ALZHEIMER DISEASE MICE



The images were taken using a multiphoton microscope and illustrate the vasculature of an Alzheimer's disease mouse. Green shows blood flow and red amyloid deposition. The ring-like structures surrounding the blood vessels represent cerebral amyloid angiopathy.

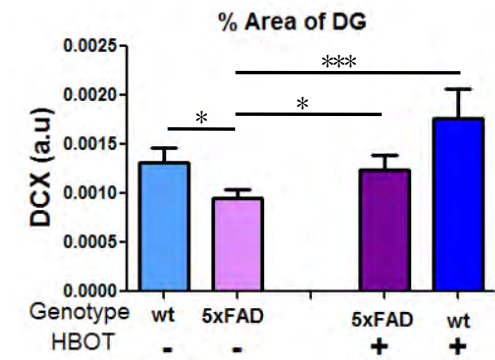
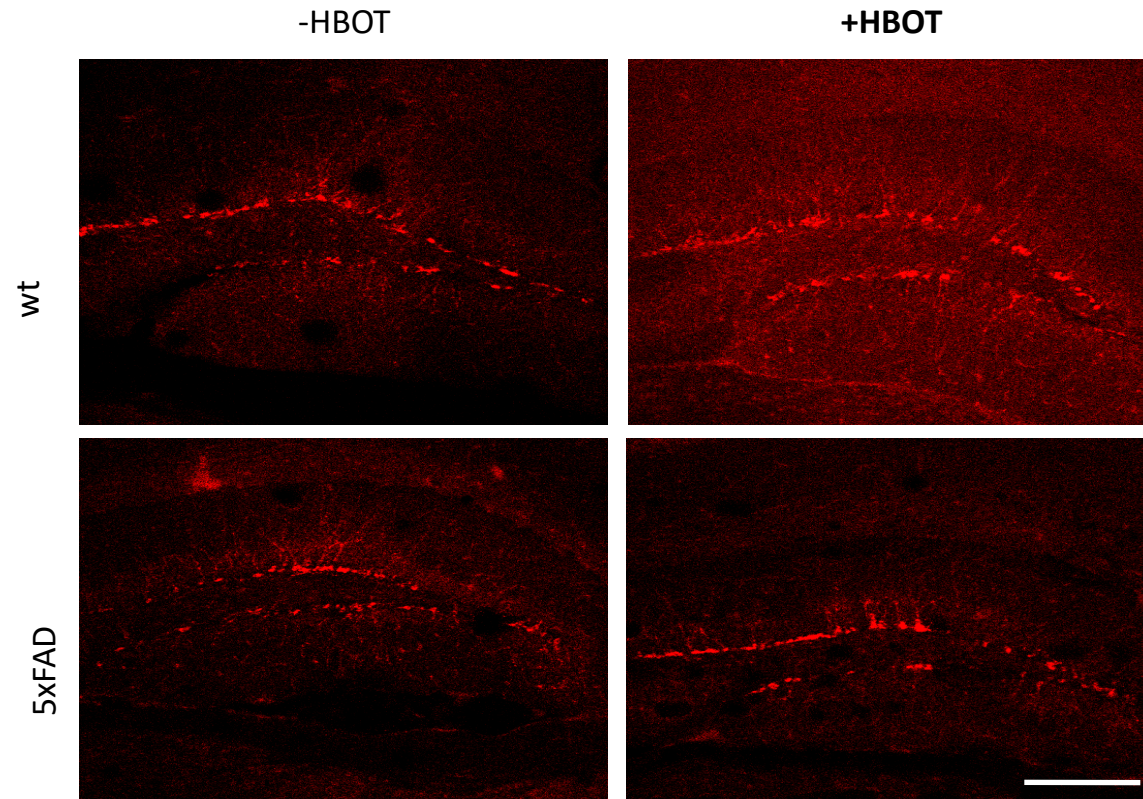


HBOT REDUCES AMYLOID LOAD IN THE OLD 3XTG MICE



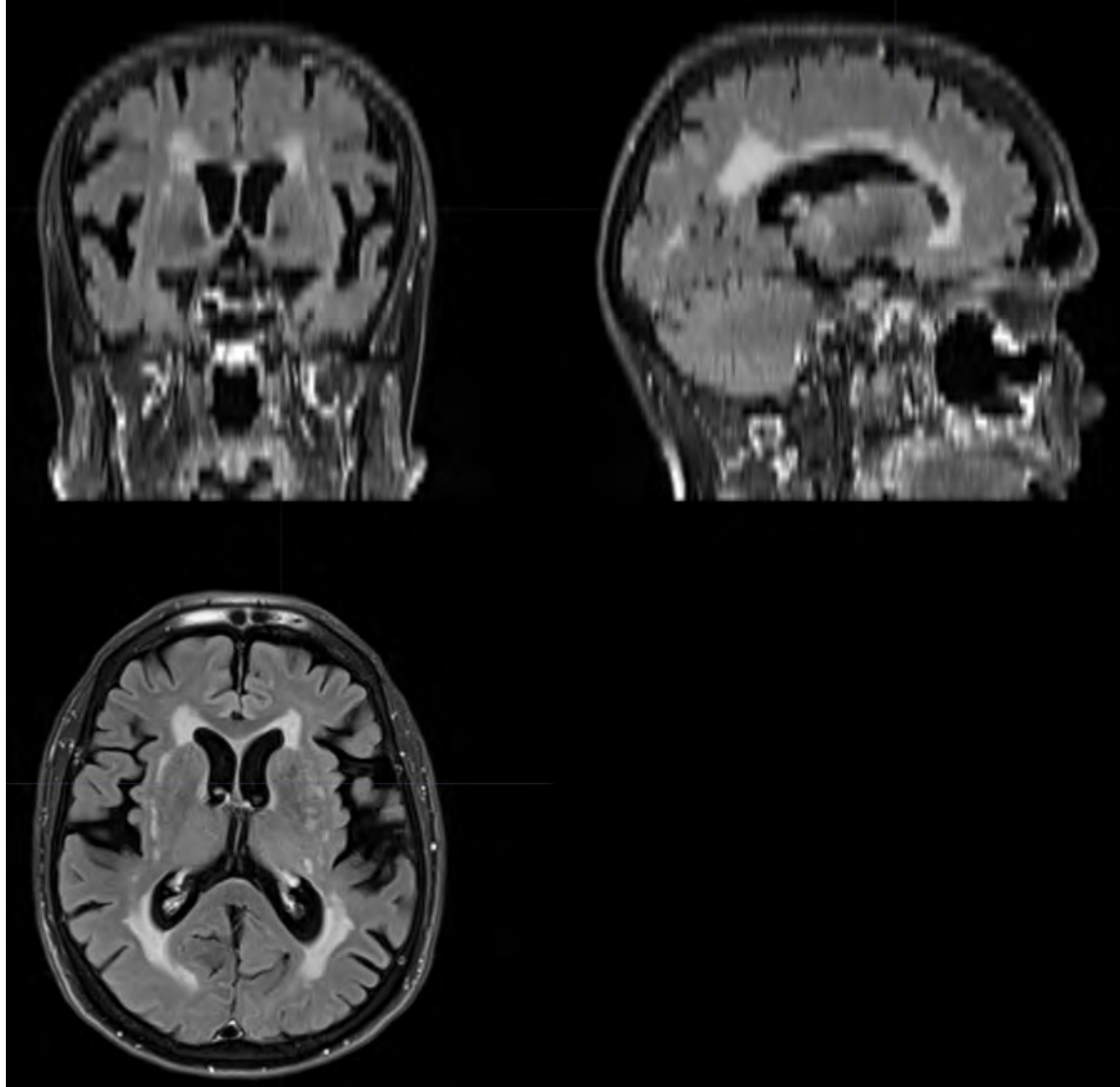


HBOT INCREASE SURVIVAL OF NEW-BORN NEURONS IN CONTROL AND 5XFAD MICE

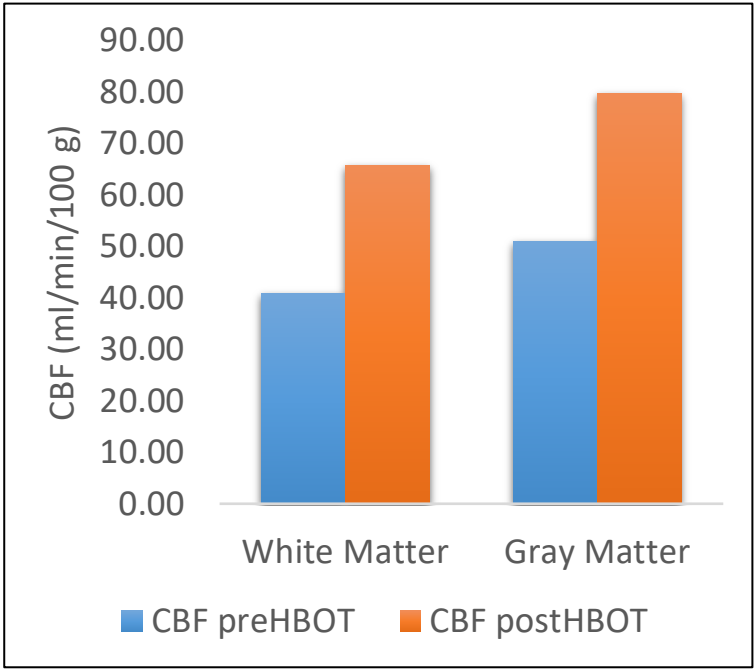
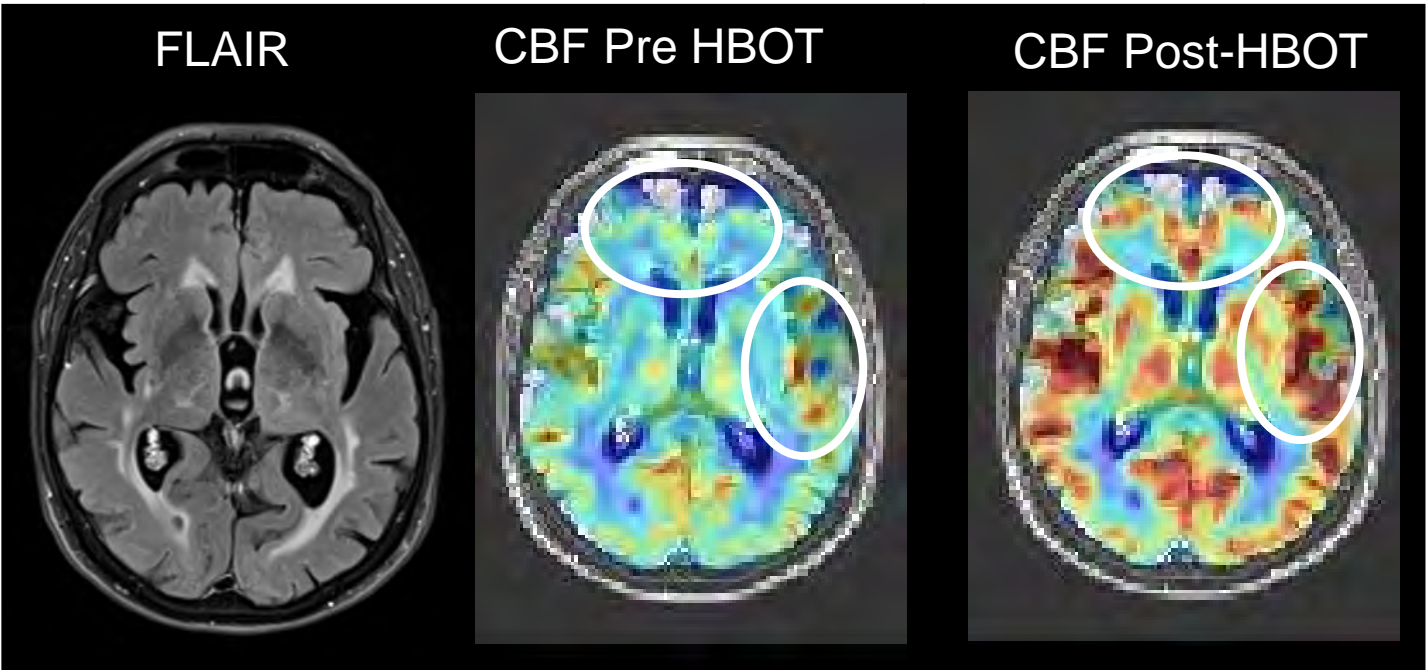




Age Related Mild Cognitive Impairment



84 yr female, with MCI
(memory loss, shortness of attention span)



Brain region	Brain function	% change
Anterior cingulate cortex	Attention	67.40%
Hippocampus	Long term memory, Spatial memory	65.53%

Post HBOT cognitive assessments show significant improvement in:

- Attention
- Memory
- Overall cognitive function

Reverse Aging Program Target Population

Age 65 years or older

Medically stable population

Fully function in their daily life activity

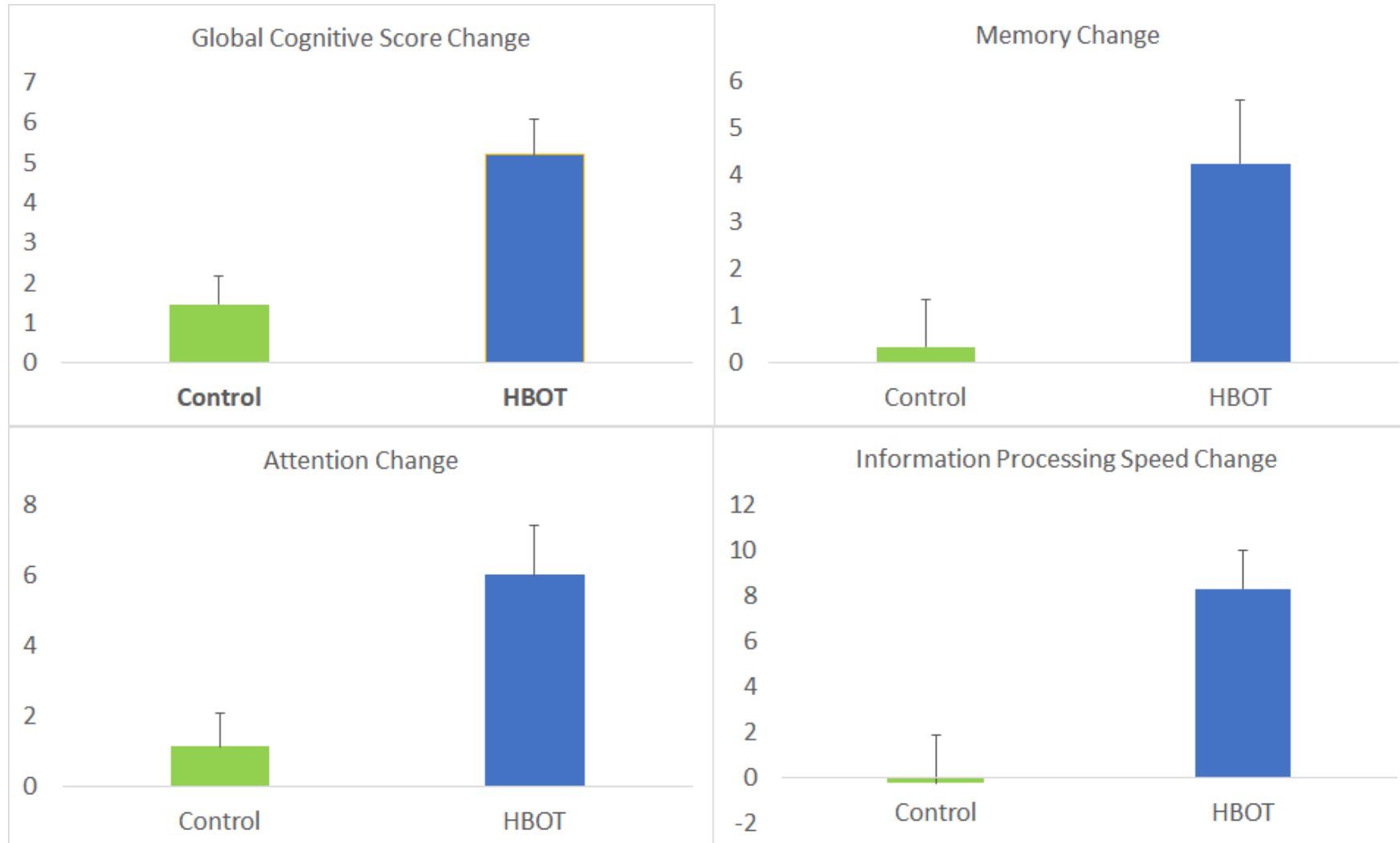
Non- obese

Nonsmokers

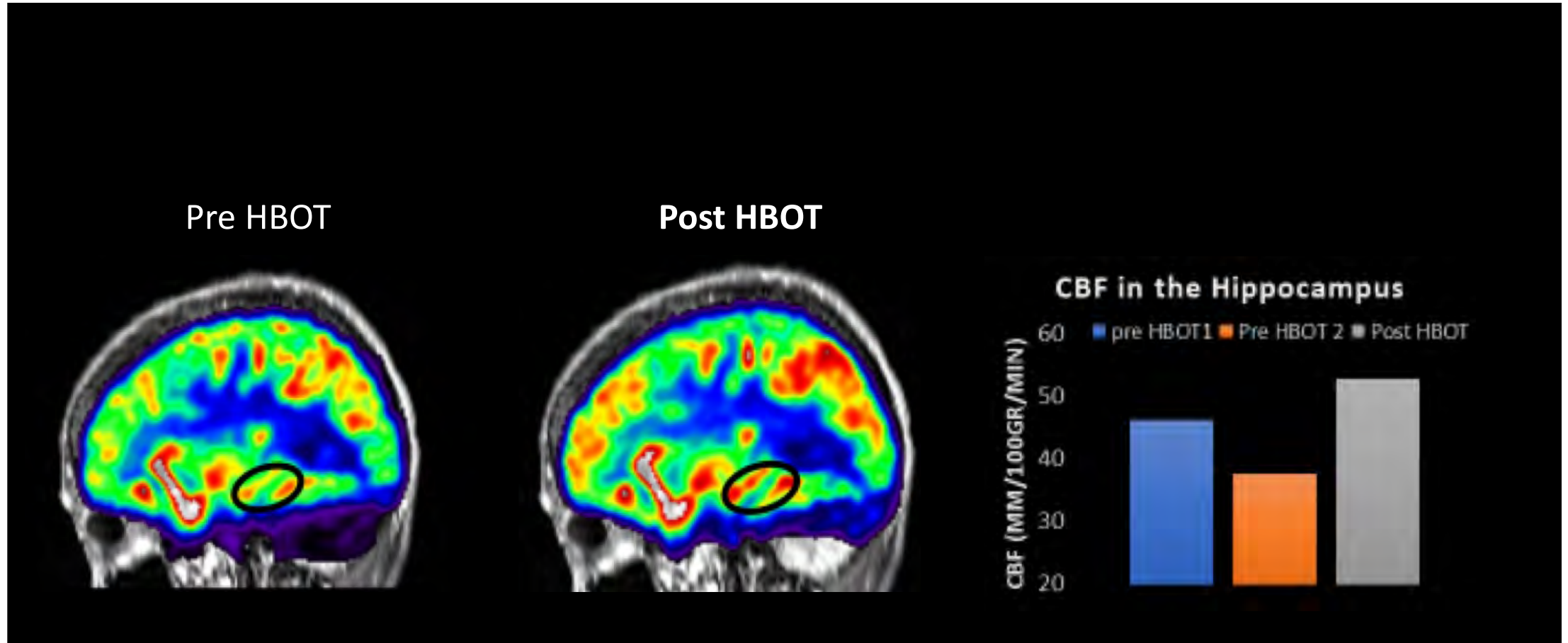




Cognitive Functions - Reverse Ageing Population

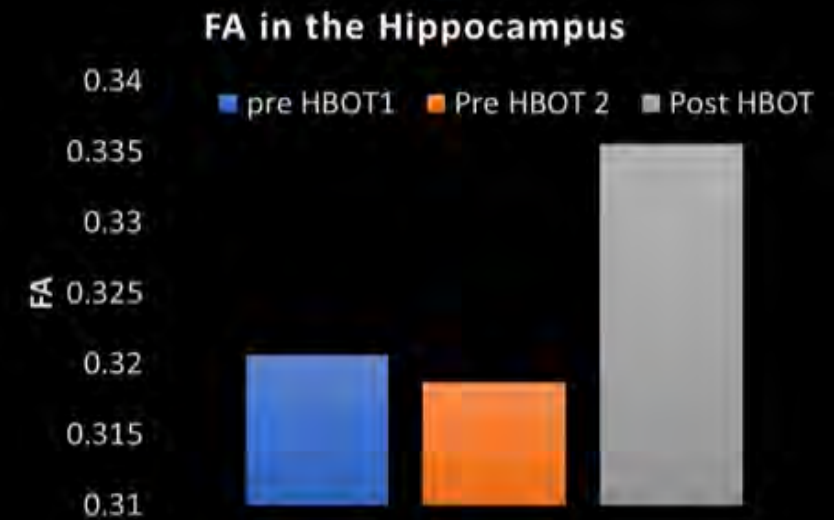
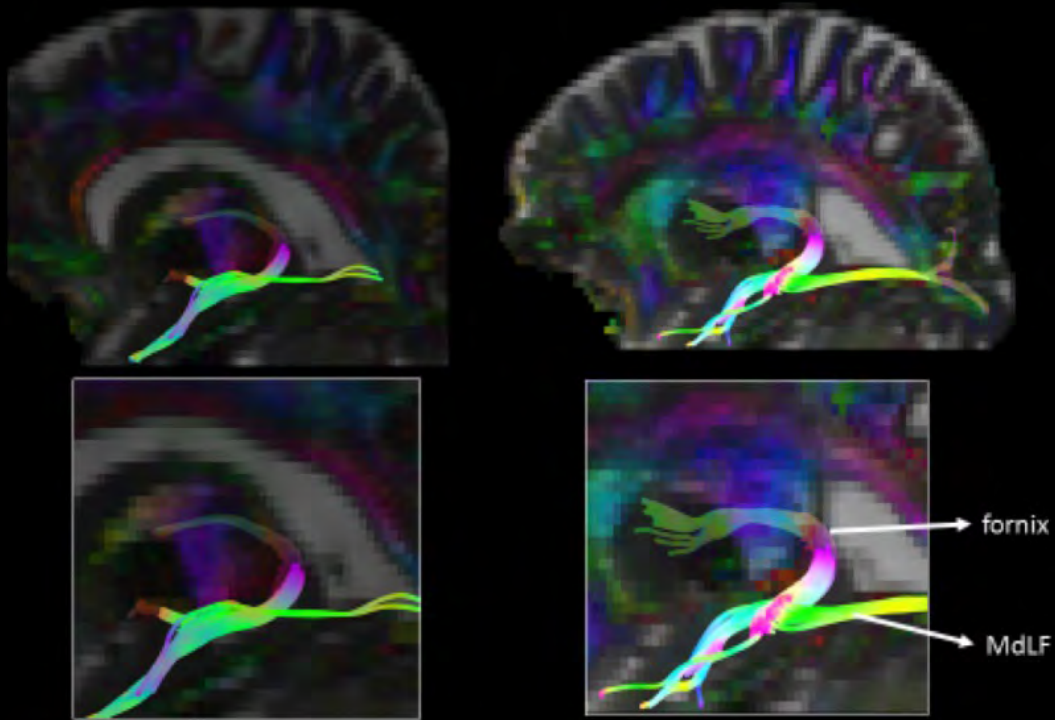






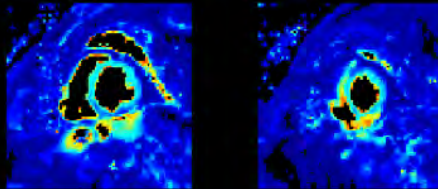


Hippocampal Fiber Tracts

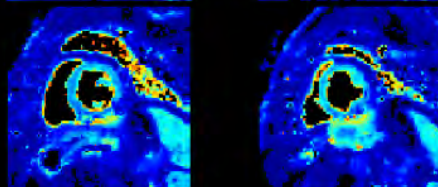


CARDIAC MRI MYOCARDIAL BLOOD FLOW

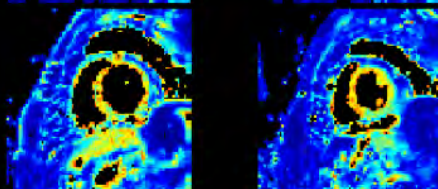
Pre HBOT 1



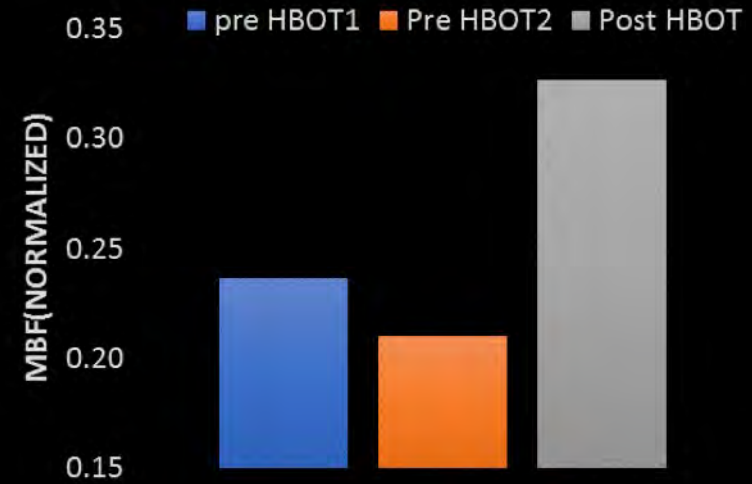
Pre HBOT 2



Pre HBOT 3



Myocardial Blood Flow



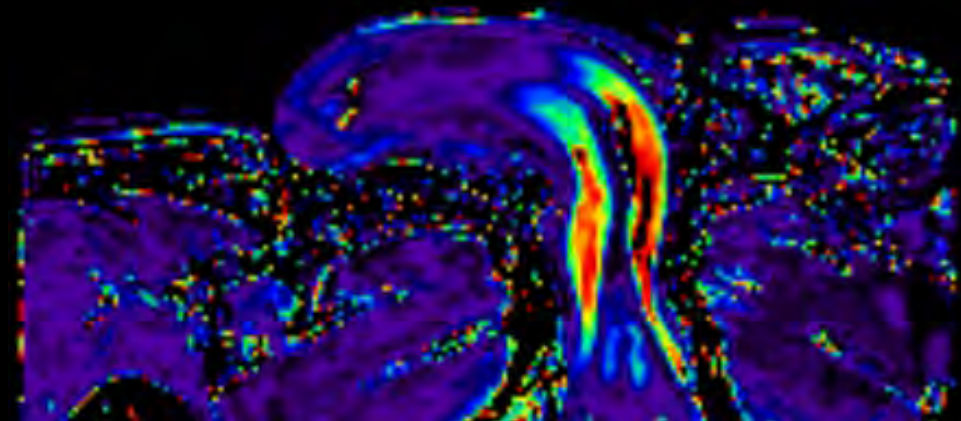
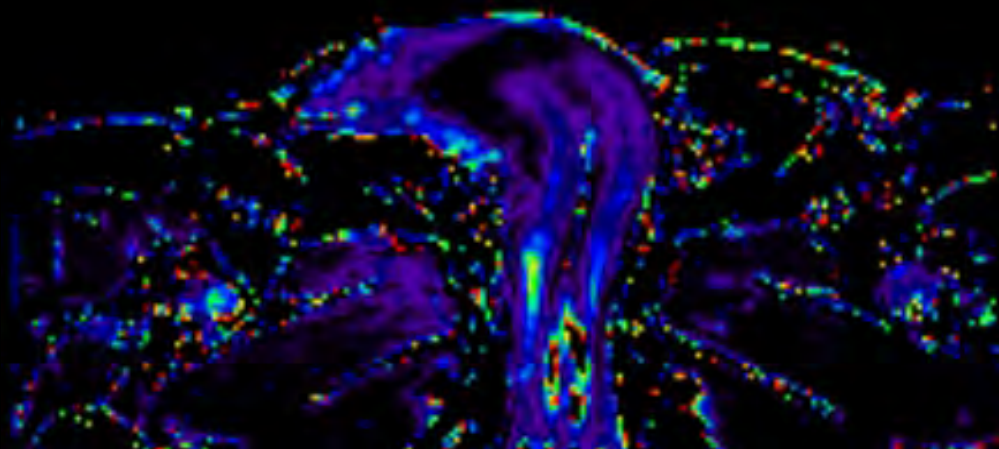
Cardio-Pulmonary Exercise Test (VO₂ max test)

15% improvement in the
Anaerobic Threshold (AT)



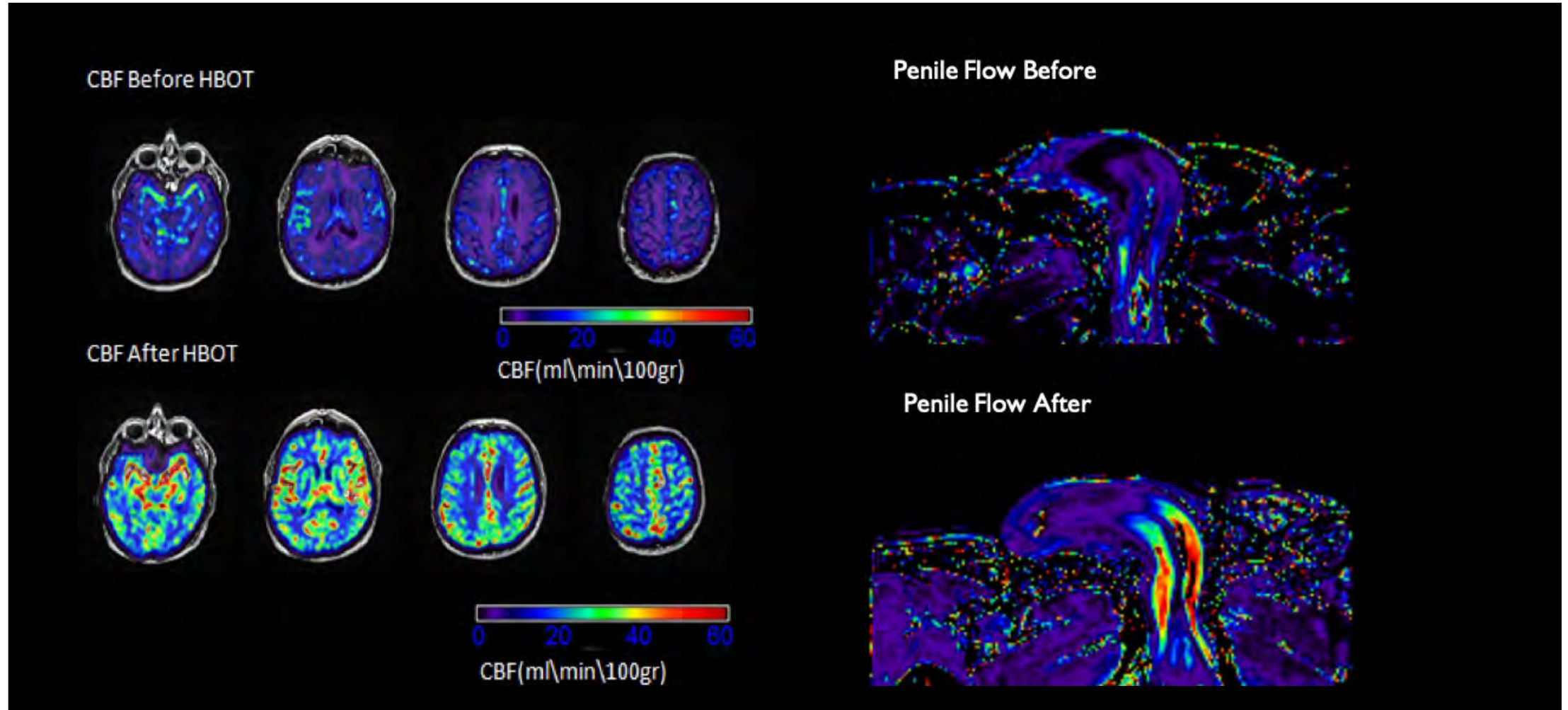
Pre HBOT

Post HBOT

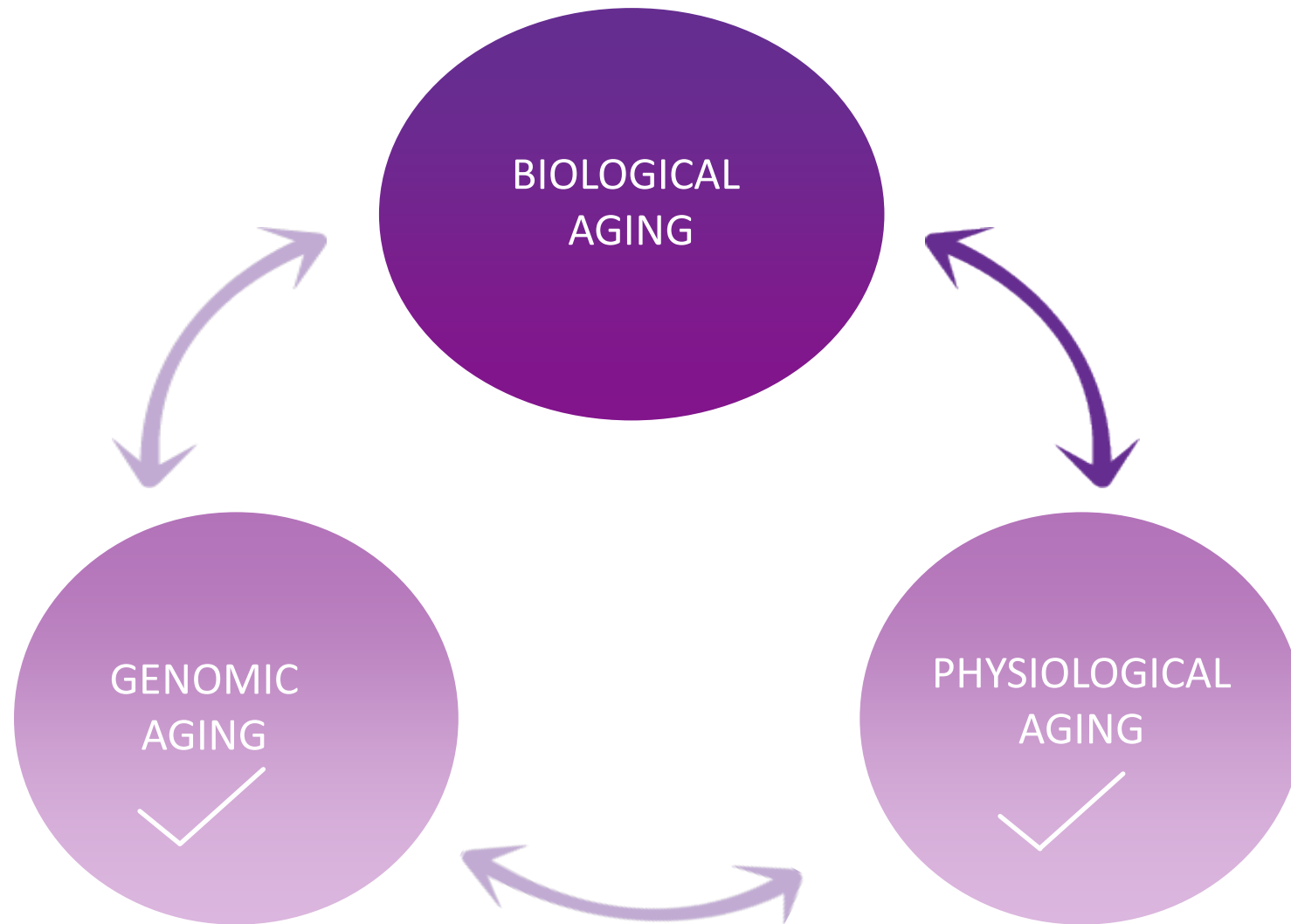


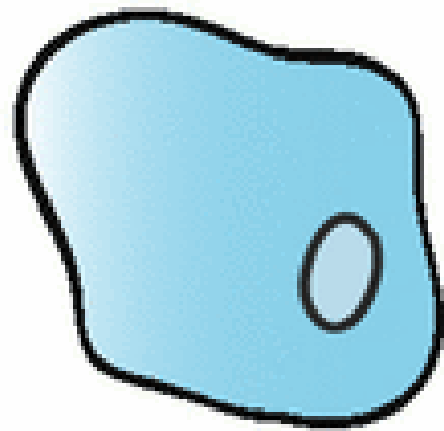
Ktrans (min⁻¹)

78 YEARS OLD MALE PRE AND POST HYPERBARIC OXYGEN THERAPY

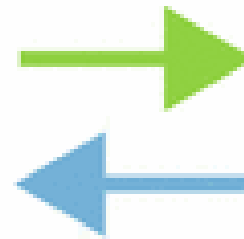


Aging

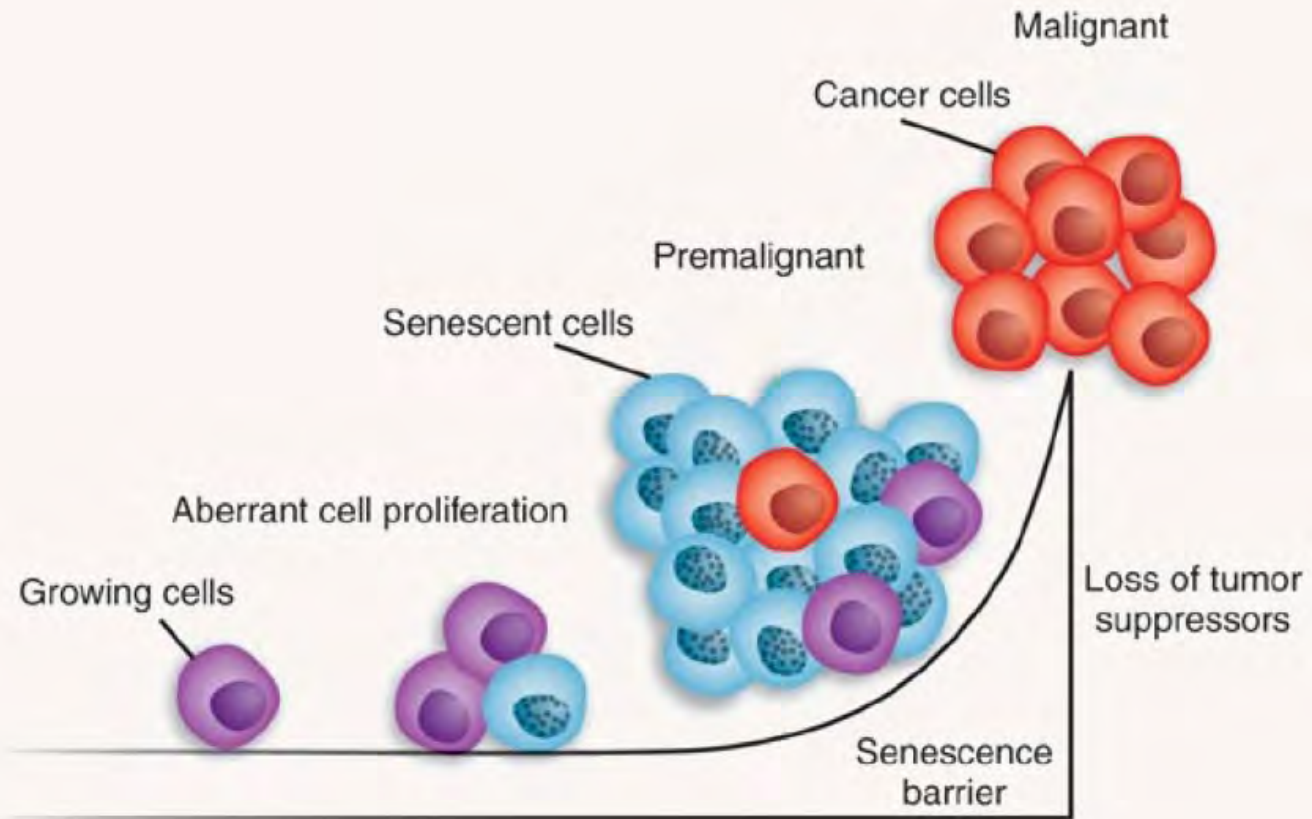


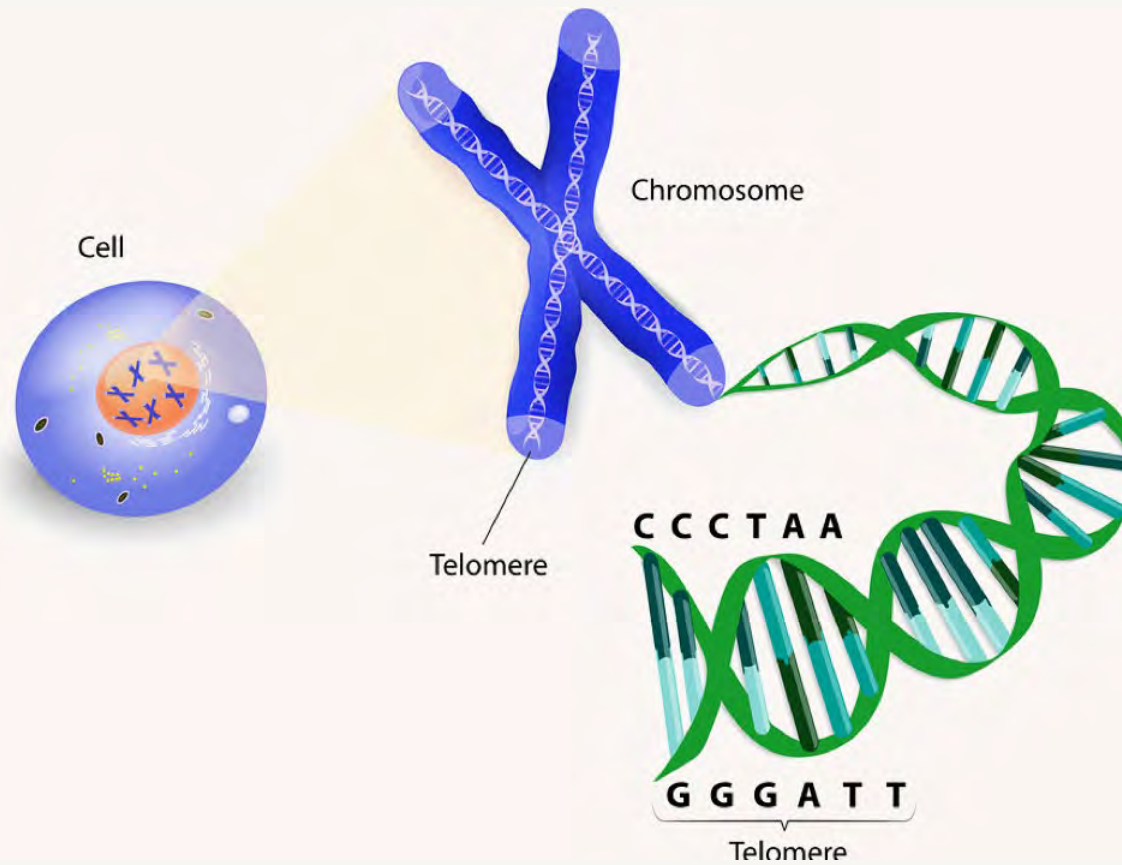


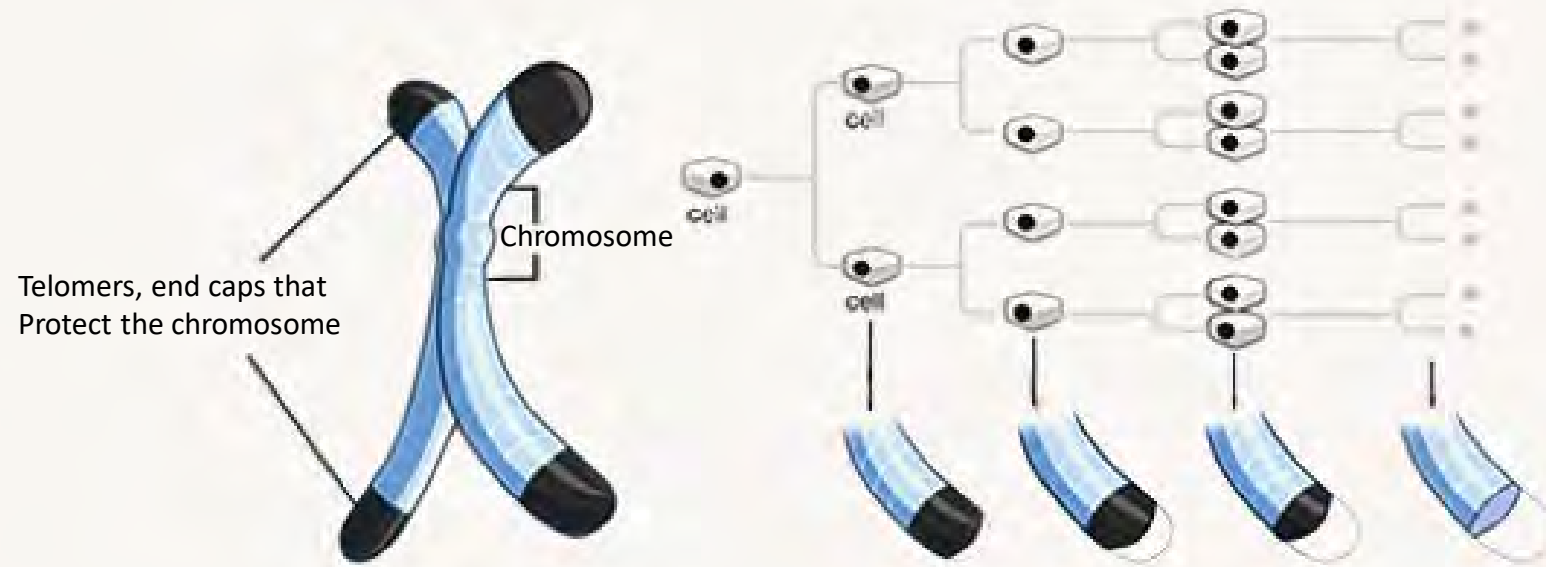
Senescence



Aging





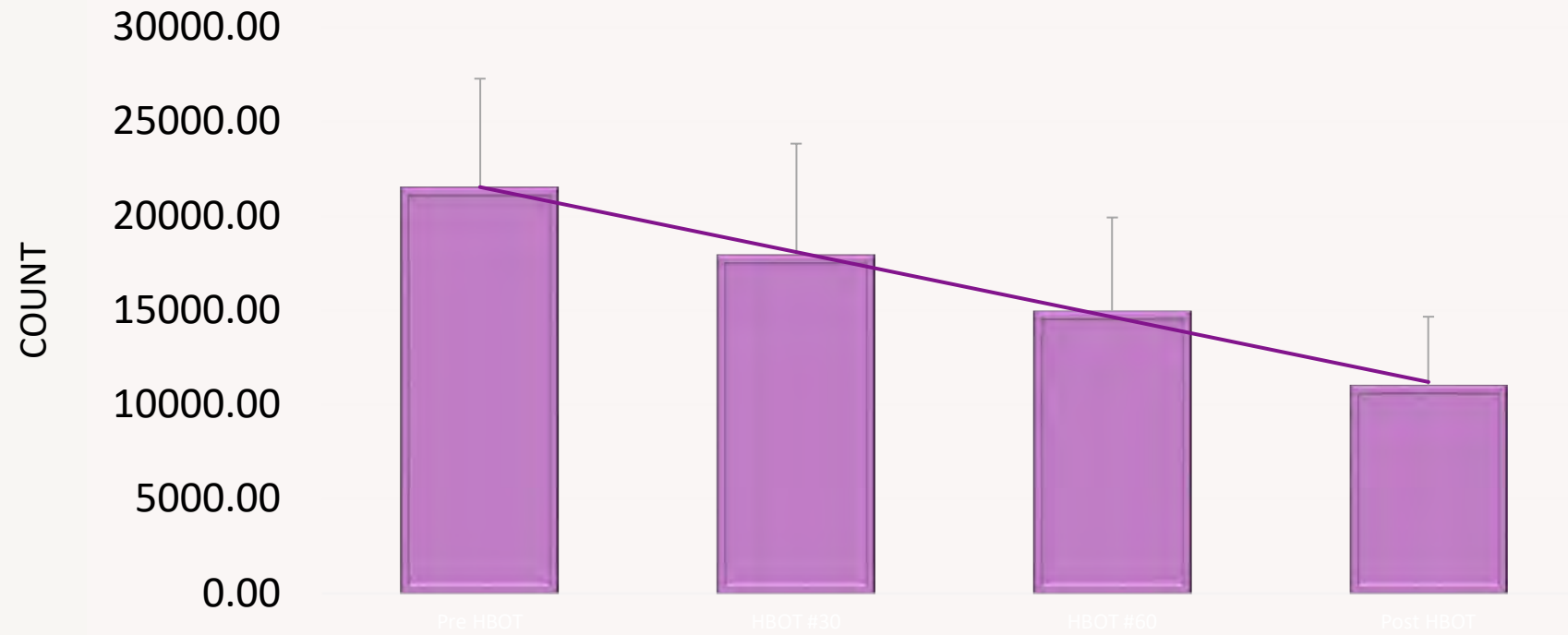


As Cells divide over time... telomeres shorten, and eventually cell division stops.

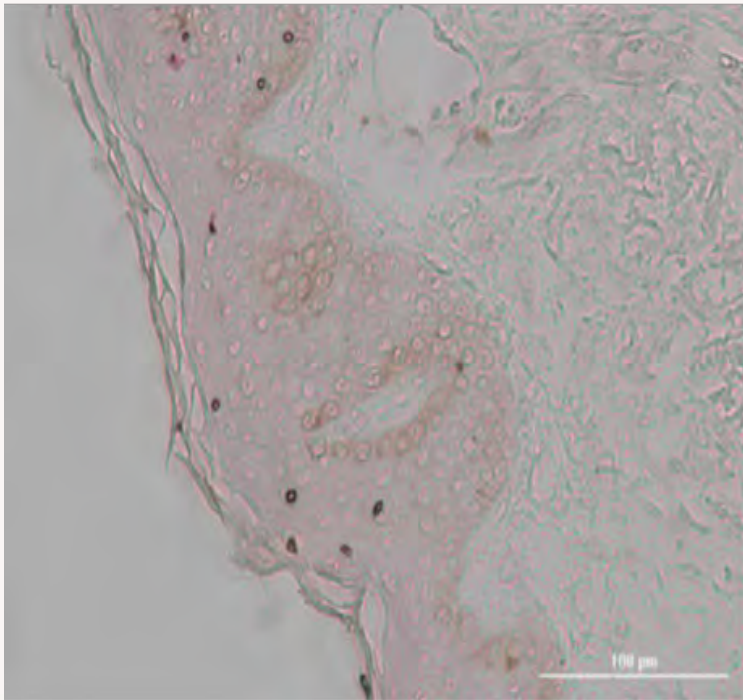


T_{60} / T_0 Ratio ~ 1.37
B Cells

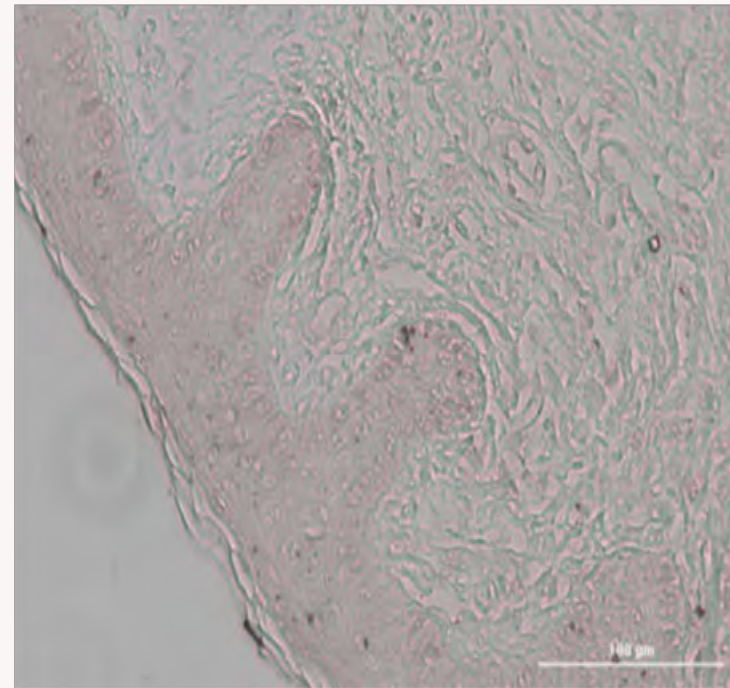
Senescent Cells & HBOT in our Reverse Aging Population (CD4 + SENESCENT CELLS)

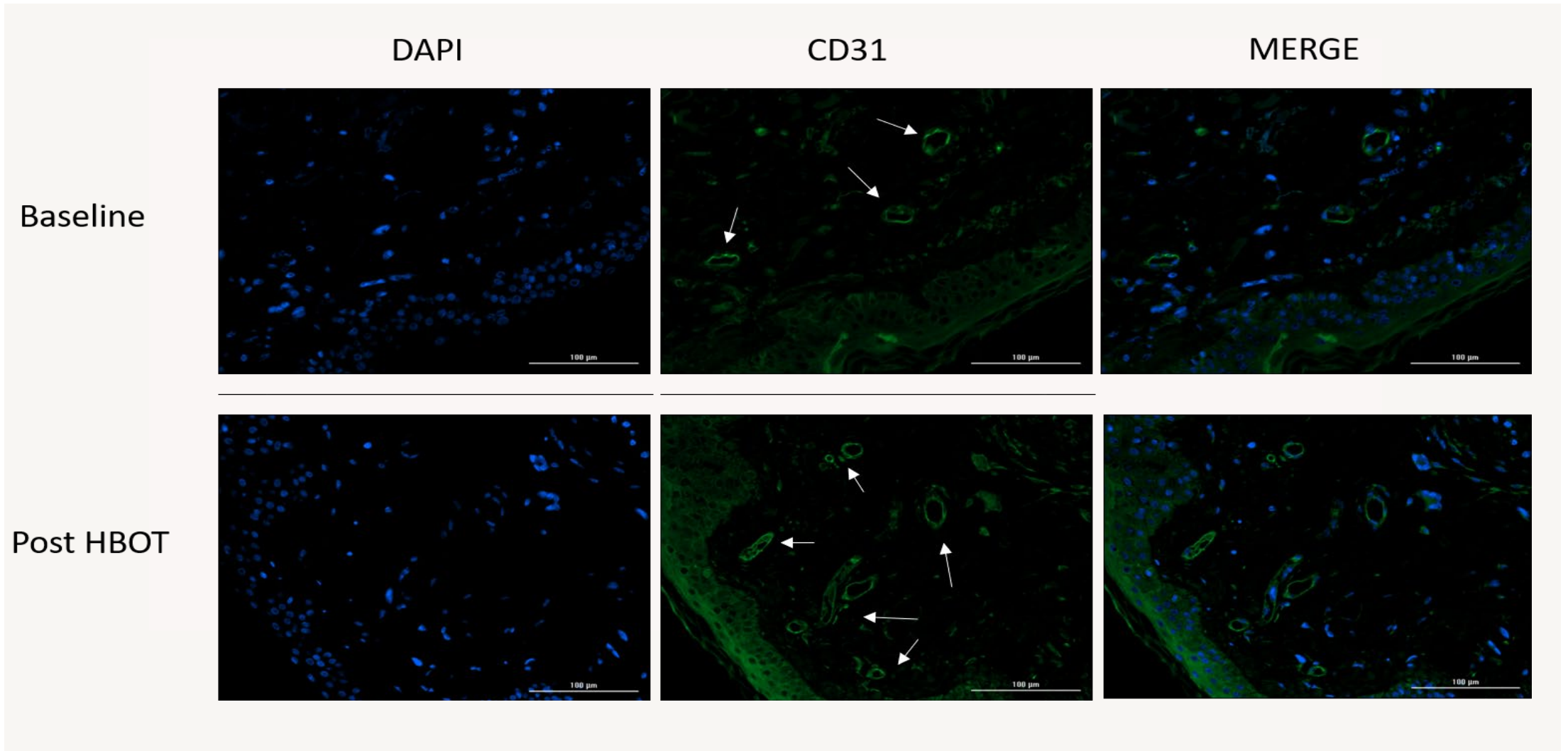


Baseline

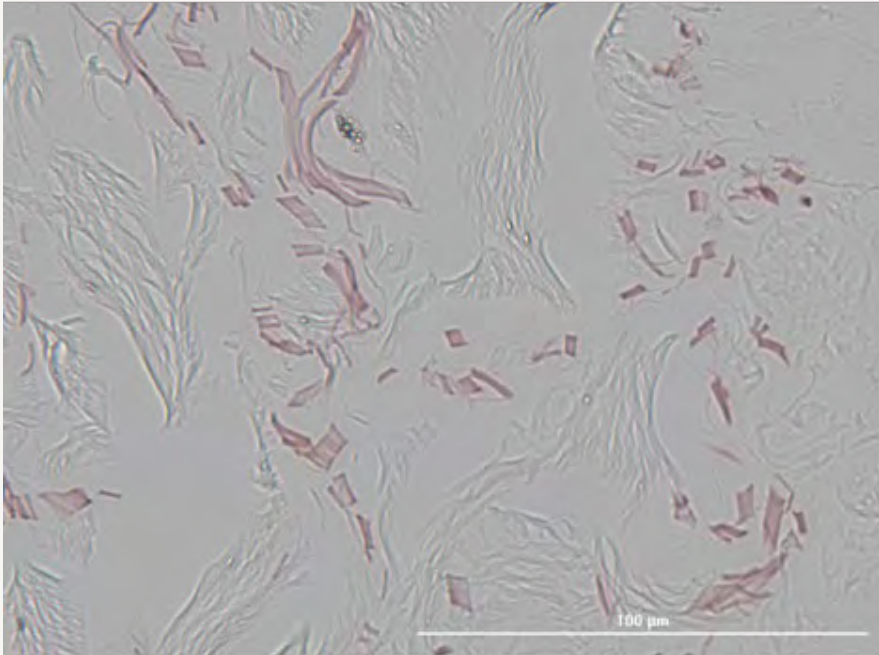


Post HBOT

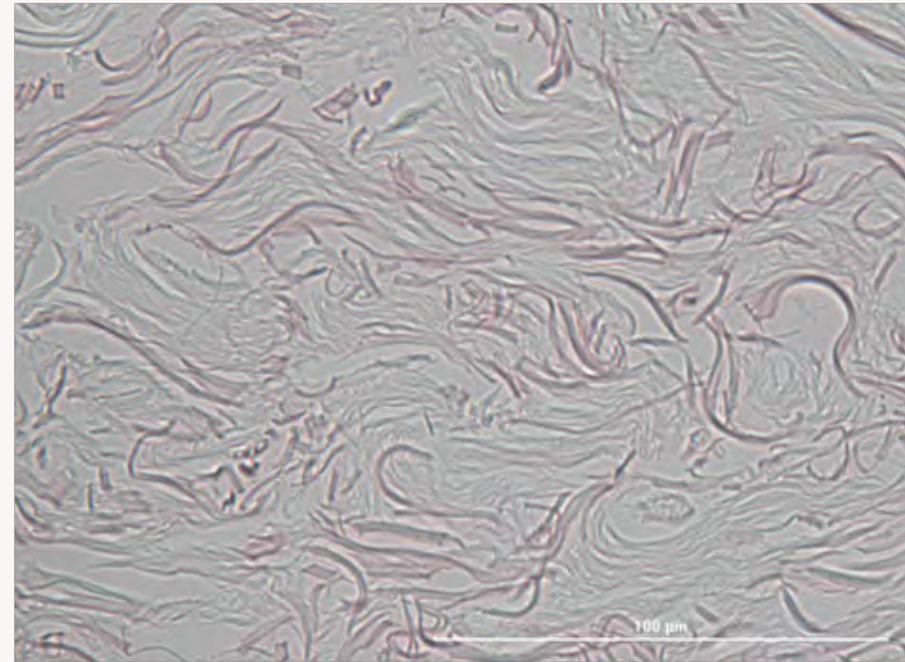




Baseline

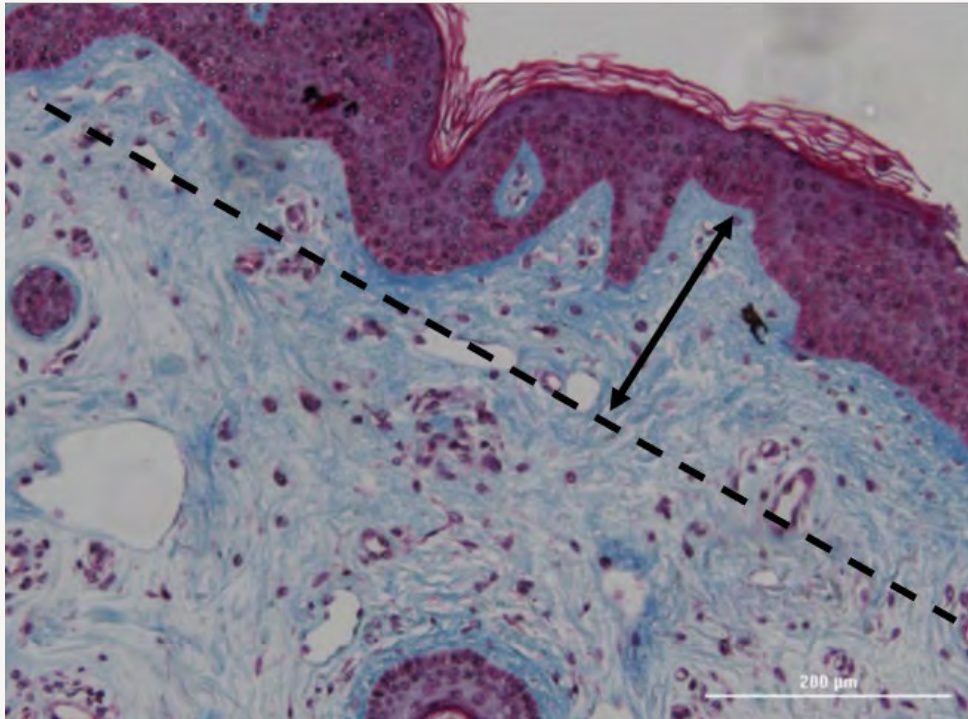


Post HBOT

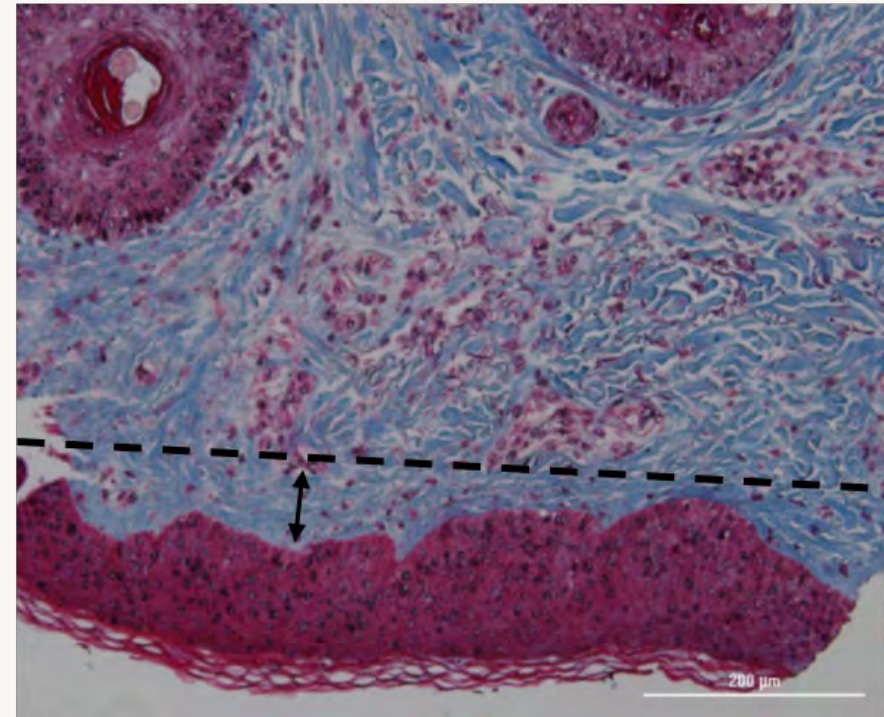


Skin: Papillary layer thickness changes

Baseline

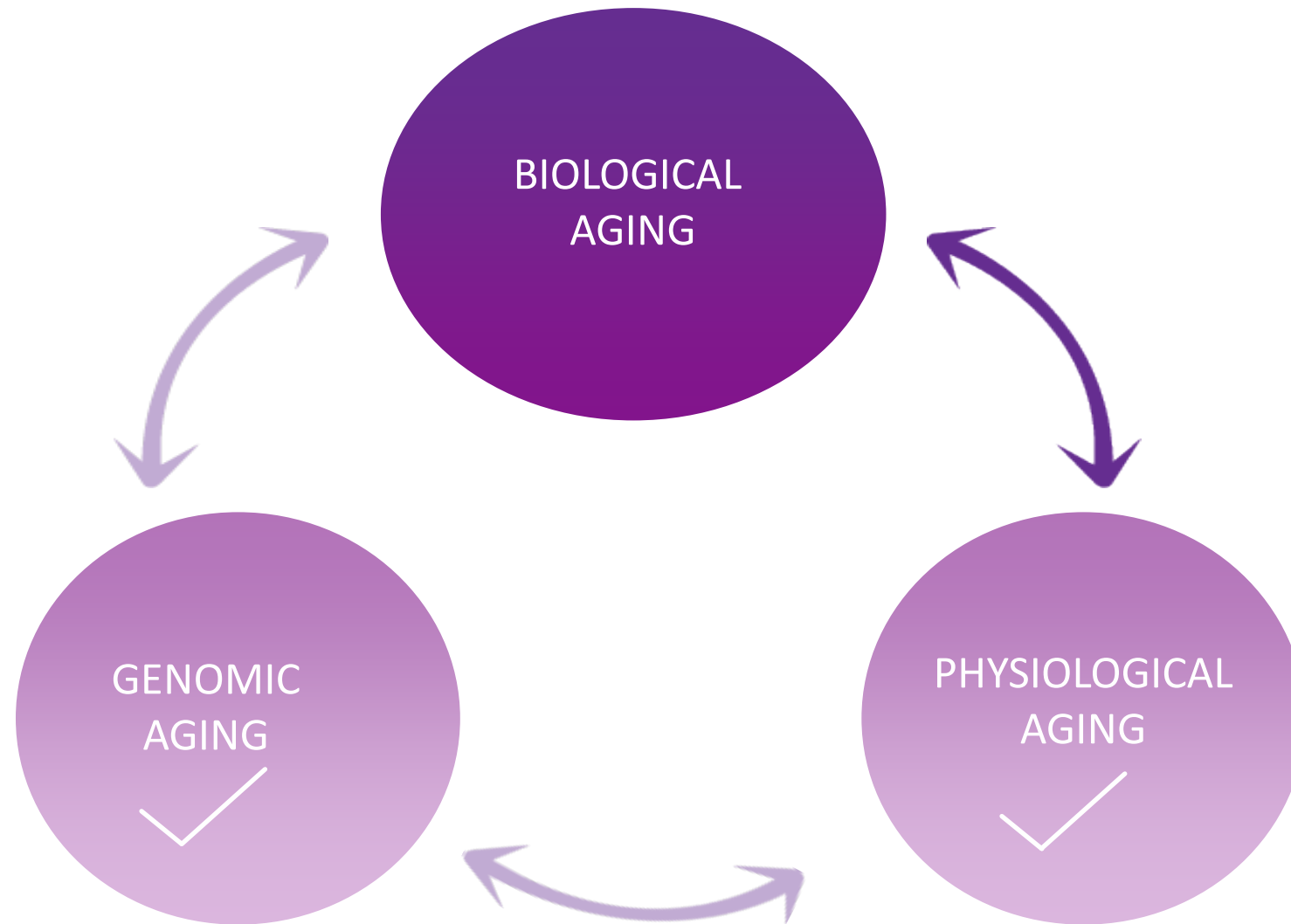


Post HBOT





Reverse Aging



The Living Brain

My brain

My Brain



Post Stroke

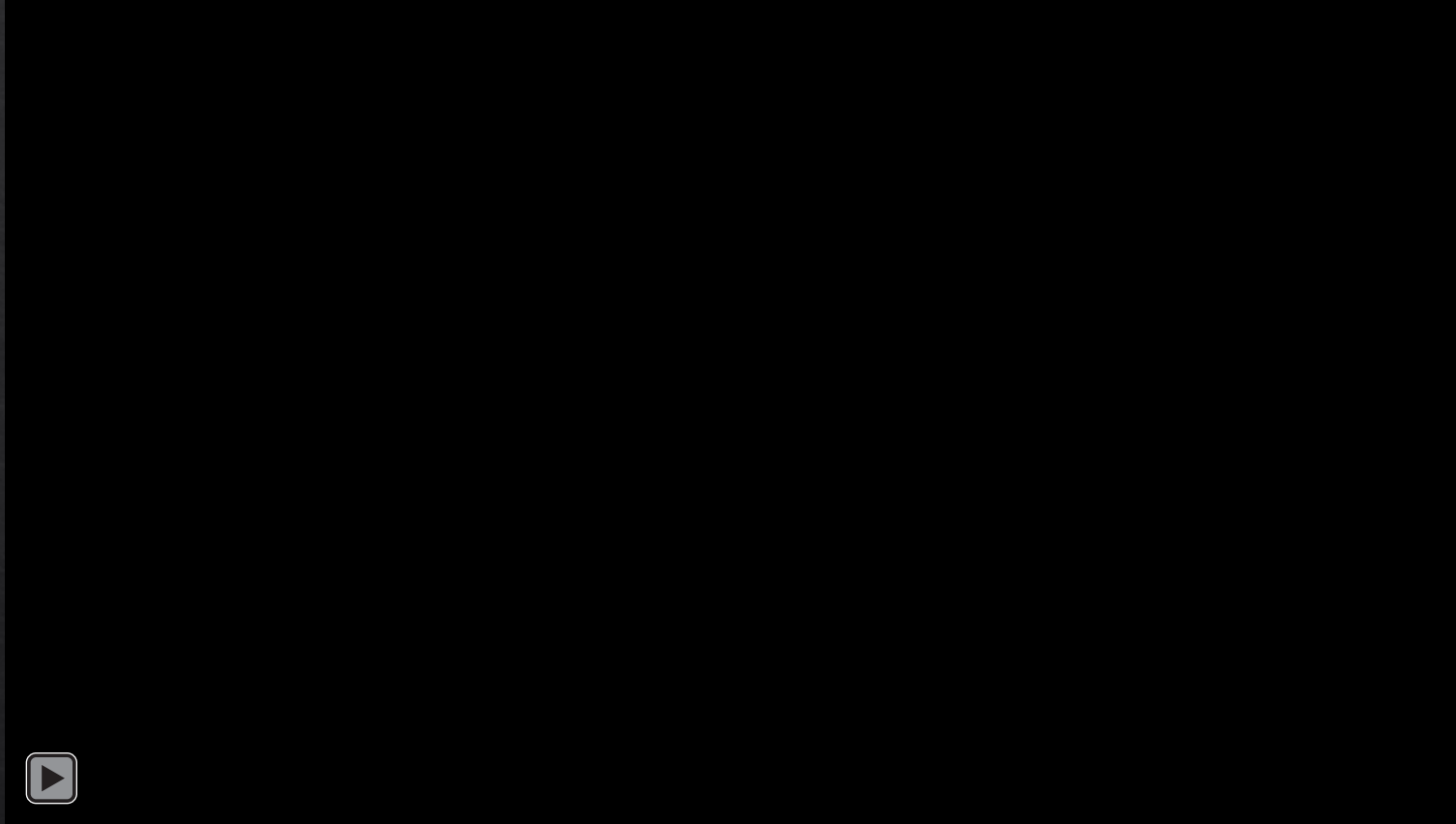
Post stroke



Before and After HBOT

Post stroke

Before and After HBOT Post Stroke Patient

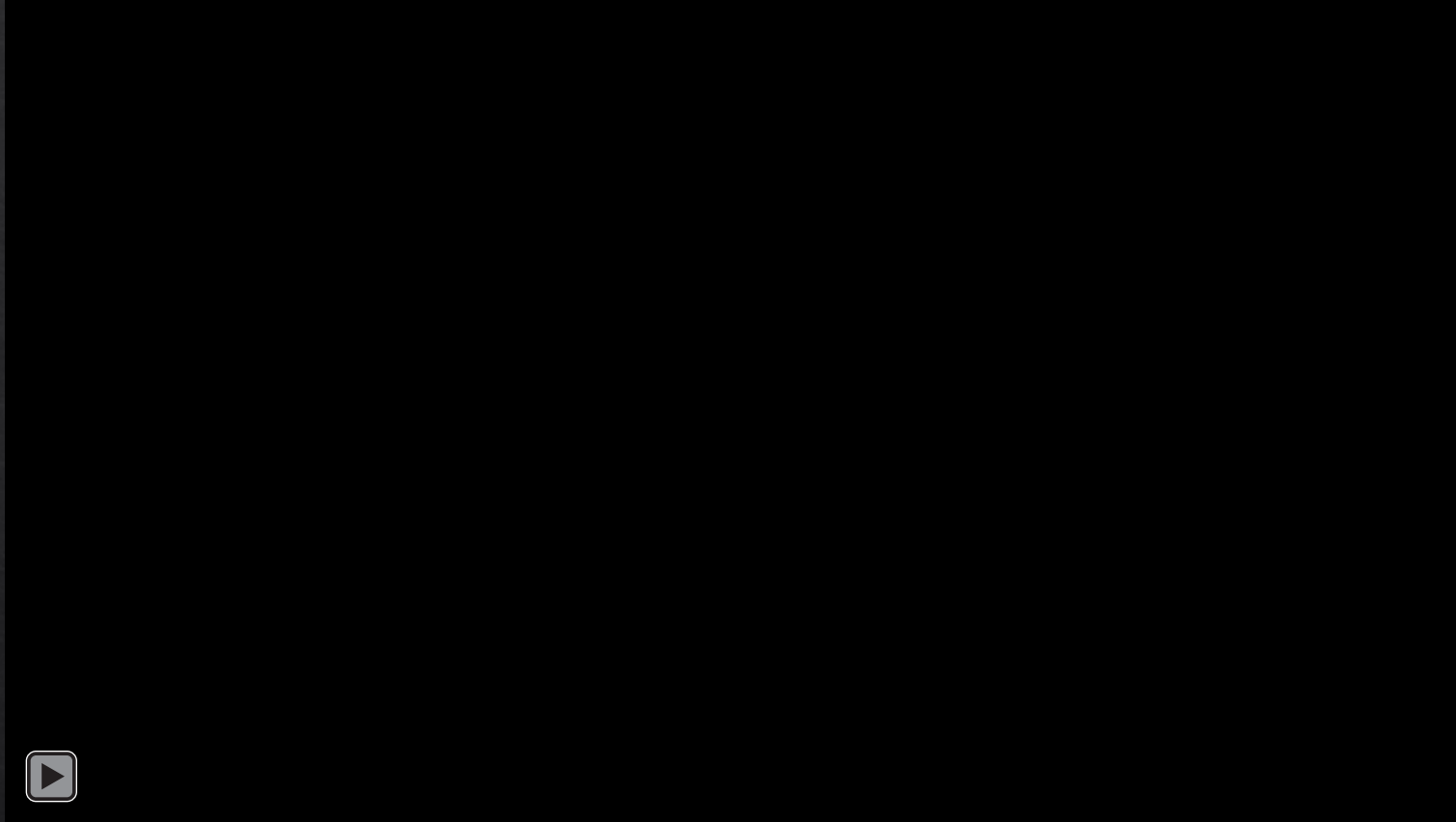


Aging Brain

Mild Cognitive Impairment

Aging Brain

Mild Cognitive Impairment



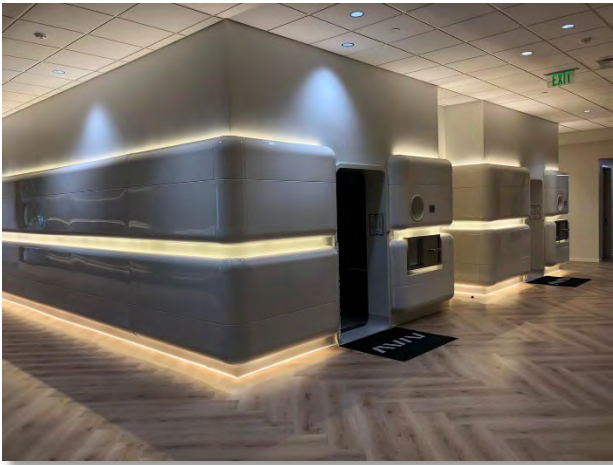
Before and After HBOT
Aging Brain
Mild Cognitive Impairment

Aging with Mild cognitive Impairment Before & After HBOT



The non-healing wounds...





Vs.

