



NEUROCRITICAL CARE:
FROM RESEARCH TO RECOVERY

18TH ANNUAL MEETING • SEPTEMBER 22-25, 2020
PHOENIX CONVENTION CENTER • PHOENIX, ARIZONA



NEUROCRITICAL
CARE SOCIETY



Multimodality Targets in Traumatic Brain Injury

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R2R **NEUROCRITICAL CARE:**
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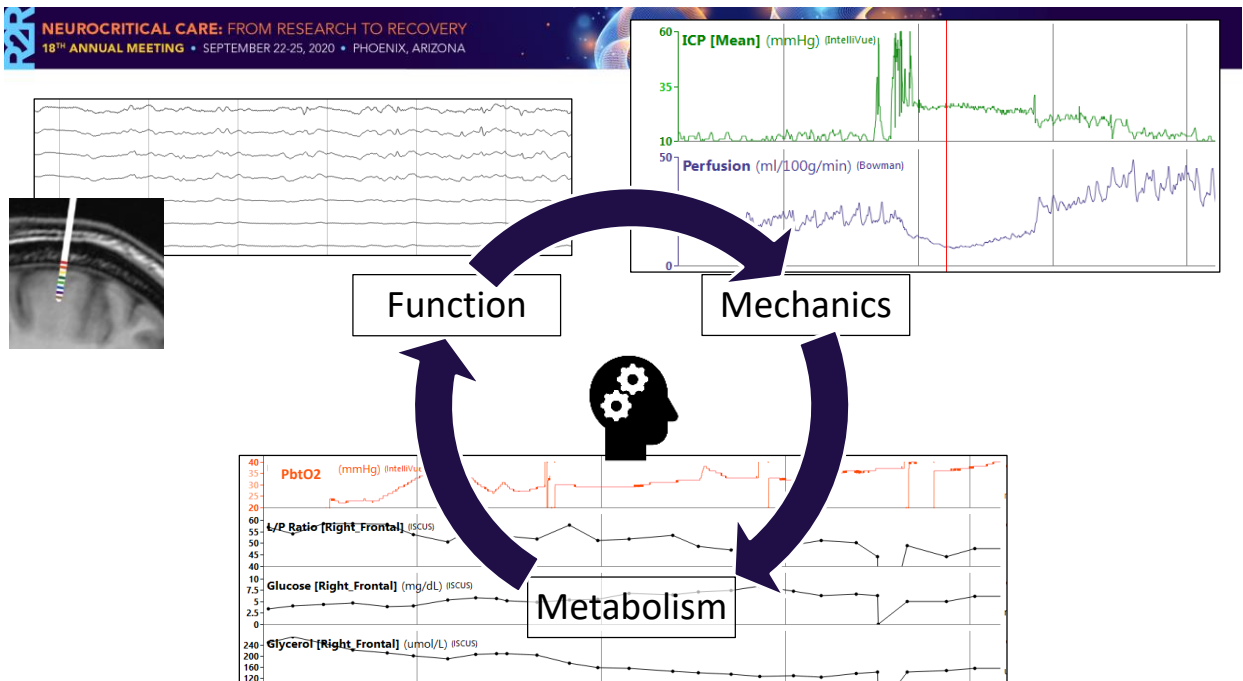
Disclosures

Research

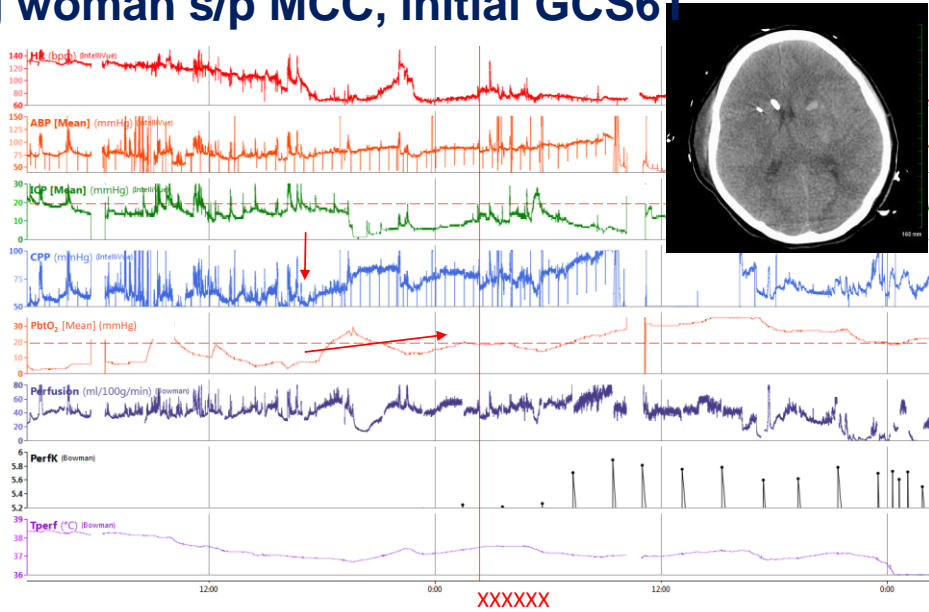
- NIH
 - ✓ K23NS101123 (PI: Foreman)
 - ✓ R03NS115011 (PI: Sunar)
 - ✓ EpiBioS4Rx U54 NS100064-01 (Site PI; PI: MacArthur)
- DOD
 - ✓ W81XWH-16-2-0020 (Co-I; PI: Hartings)
 - ✓ X81XWH-18-DMRDP-PTCRA (PI: Moberg)
- NSF
 - ✓ IIS-1838730 (Co-I; PI: Subbian)

Industry

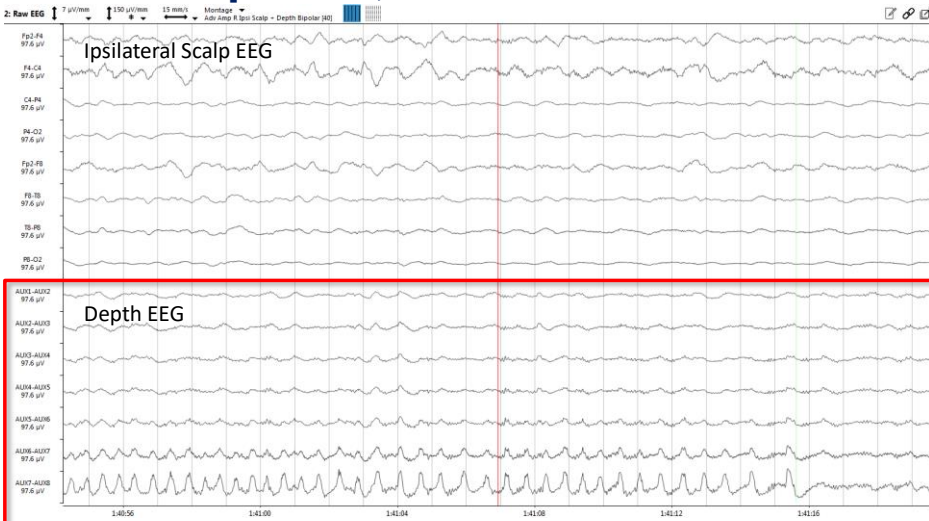
- UCB Pharma (speaking fees, consulting)
- Minnetronix, Inc (consulting)



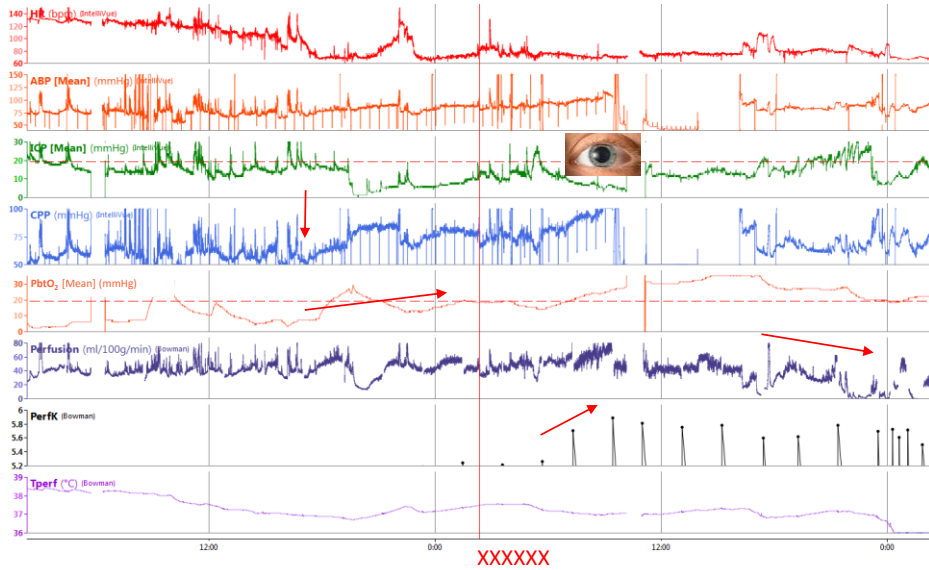
Young woman s/p MCC, initial GCS6T



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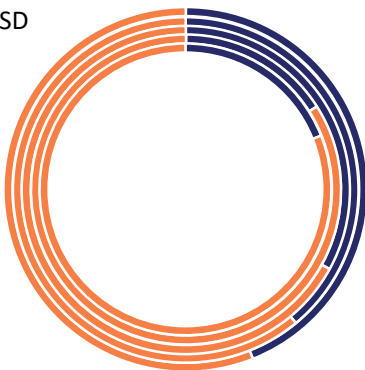
Young woman s/p MCC, initial GCS6T



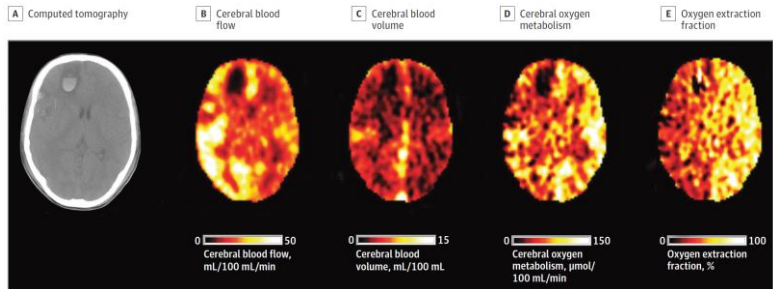
Secondary Brain Injury

Common patterns:

- Hypotension
- Elevated ICP
- Metabolic Crisis
- Sz/PD
- SD

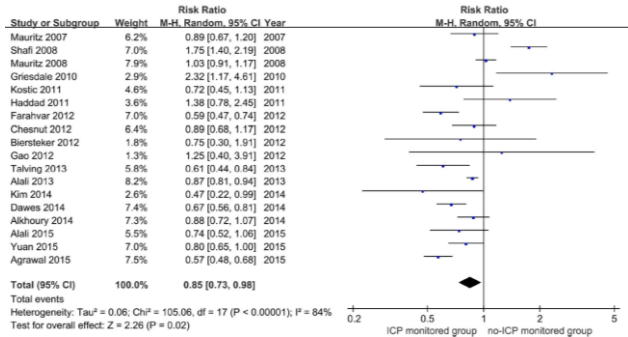
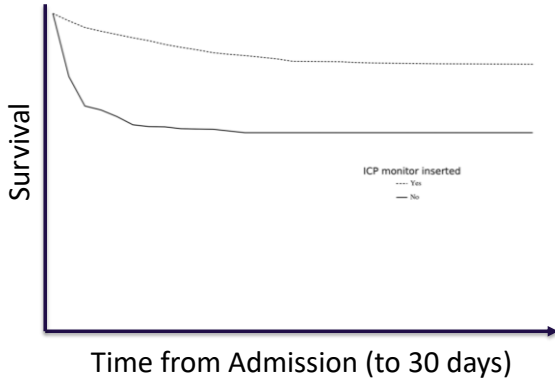


Jones 1994, Vespa 2005, Vespa 2016, Hartings 2020



Spatial variation in regional physiology (Launey 2020)

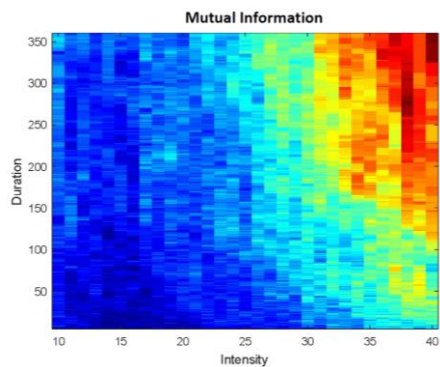
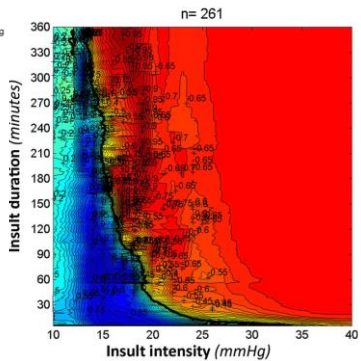
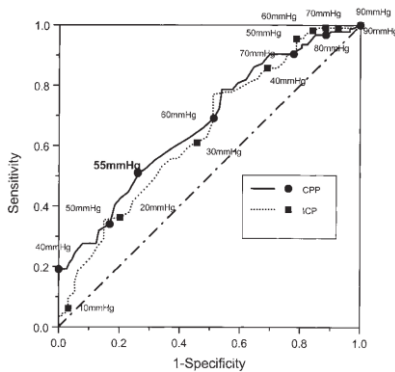
Intracranial Pressure



Propensity-matched analysis of 1327 sTBI patients (OR 0.22; 95%CI 0.15-0.35) (Ronning 2019)

Meta-analysis of studies of ICP monitoring and mortality (RR 0.85; 95%CI 0.73-0.98) (Shen 2016)

Intracranial Pressure

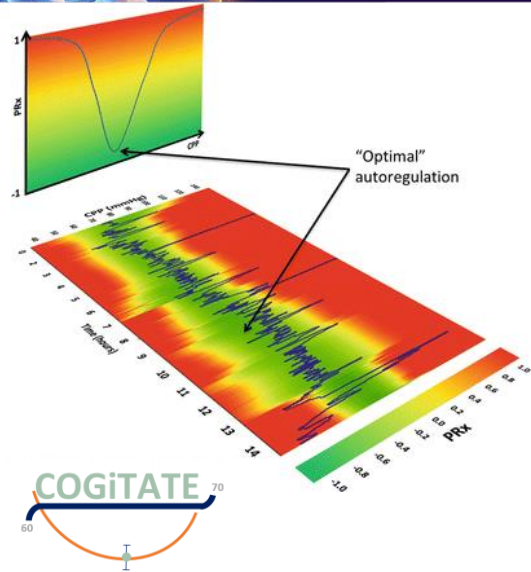
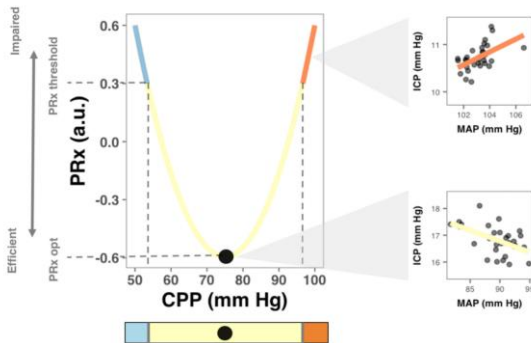


Situational Intracranial Pressure Management: An Argument Against a Fixed Treatment Threshold

Randall M. Chesnut, MD, FCCM, FACS, FAANS¹; Walter Videtta, MD²

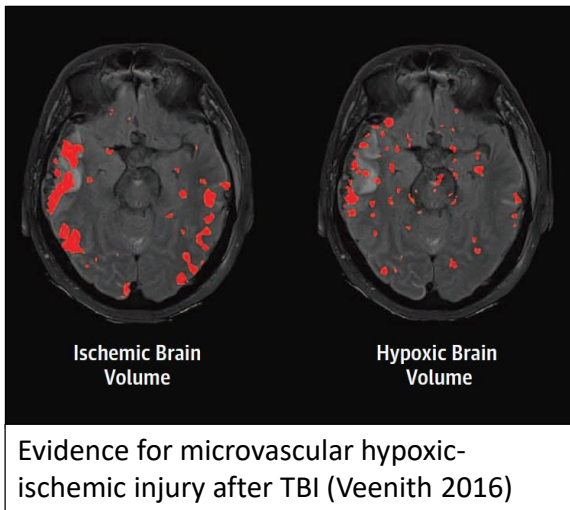
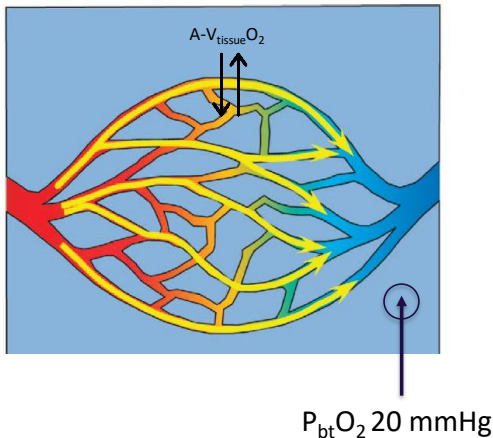
Optimal Perfusion Pressure

Each % CPP less than the lower limit of autoregulation increases odds for unfavorable outcome by 4% (95%CI 2-6%; Donnelly 2017, Ercole 2018)



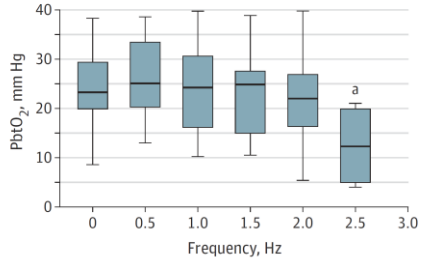
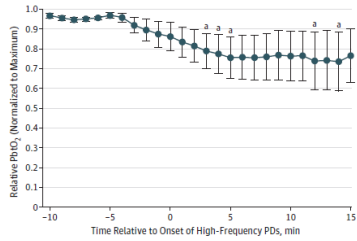
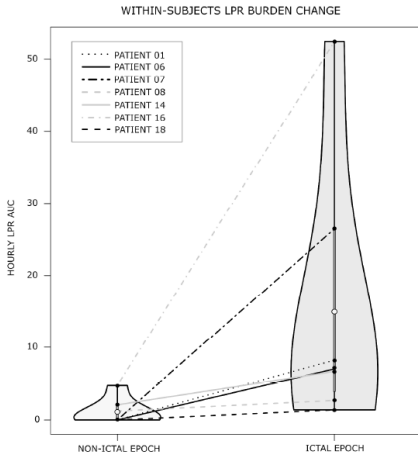
Optimizing Brain Oxygen

$P_{iO_2} = 120 \text{ mmHg}$ (dissolved = 0.36 mmHg) $P_{iO_2} = 30 \text{ mmHg}$ (dissolved = 0.12 mmHg)



Figures from Ostergaard 2013

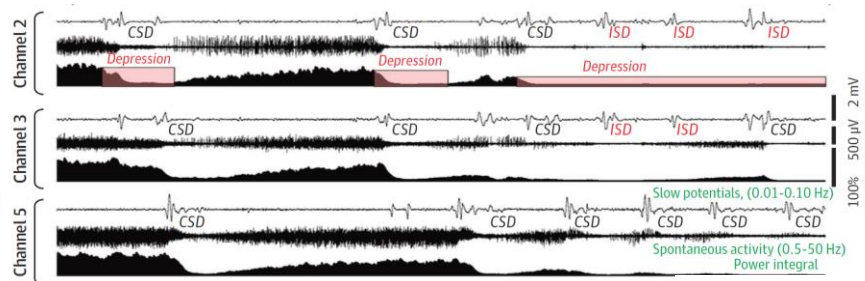
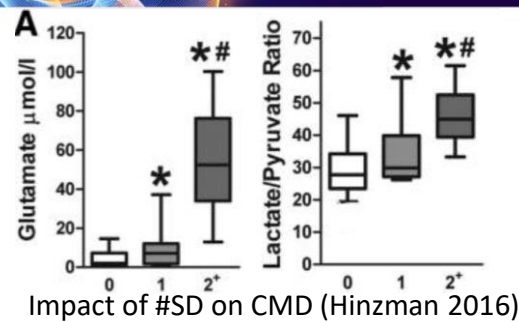
Seizures and Periodic Discharges



- Cortical Sz/PD are detected in 61% and associated with an increase in metabolic stress (Vespa 2016)
- Increasing PD burden is associated with brain tissue hypoxia (Witsch 2017)

Spreading Depolarizations

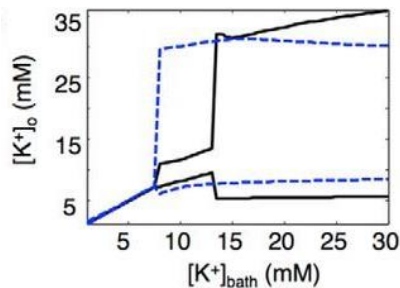
- Depolarization of brain tissue occurs in 60% of those with surgical sTBI
- Clusters of SD lead to electrical silence of tissue associated with impaired motor recovery and unfavorable outcome (OR 2.29, 95%CI 1.13-4.65; Hartings 2020)



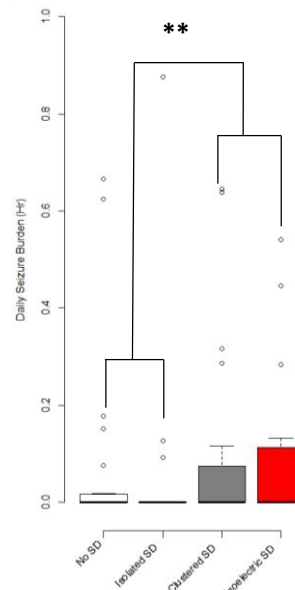
(Hartings 2020)

Sz/SD Reflect Tissue *At-Risk*

- Both may co-occur but with variable temporal association (Fabricius 2008)
- Both result from and mediate metabolic vulnerability: ischemia, hypoxia, mitochondrial dysfunction



Bifurcation diagram showing unification of Sz/SD dynamics in biophysical model; hypoxic conditions shown in blue (Wei 2014)



(SDI; Foreman unpublished)

Summary

- Multimodality monitoring reflects the mismatch between supply-demand that characterizes **secondary brain injury**
- Targets for management should be *individualized* based on careful interpretation of integrated multimodal data

