Your Brain Without Oxygen

Insights into the Cerebral Response to Hypoxia from functional MRI

David Dubowitz MD PhD
Center for Functional MRI
Regional hypoxic vulnerability

Challenges:
• Can’t study normal physiological response once brain is already damaged
• Need a “safe” model of global cerebral hypoxia

Selective hypoxic vulnerability


Luigetti et al. Acta Neurol Belg 2011
Sustained Hypoxia at High Altitude Barcroft Lab

• Advanced fMRI techniques developed at CFMRI to quantify:
  • Cerebral blood flow
  • Cerebral O₂ metabolism
  • Tissue oxygenation
  • Parenchymal swelling
  • Diffusion
Brain Changes at “recreational” altitudes

- CO₂ is an important modulator of blood flow
- CO₂ is also an important modulator of O₂ metabolism

Smith JAP 2013;114:11-18
Hypoxic for 6 hrs (85% SaO$_2$)

Does +5% CO$_2$ (as in ischemia) cause regional differences in $\Delta$CMRO$_2$?

**Insular Cortex**
-8%

**Basal Ganglia**
+4%

**Occipital Cortex**
-20%

**Post. Cingulate Cortex**
-14%

CO$_2$ sensitivity appears to be important in regional hypoxia vulnerability.
Global hypoperfusion and hypometabolism during migraine headache
Reversed by sumatriptan therapy (5-HT agonist)

Current Grants:
• Regional CBF / CMRO$_2$ sensitivity to CO$_2$ in hypoxic vulnerability
• Hemodynamic and Metabolic Coupling in Migraine

CBF / CMRO$_2$ / PtiO$_2$ in Migraine

• Global hypoperfusion and hypometabolism during migraine headache
• Reversed by sumatriptan therapy (5-HT agonist)