Brain Magnetic Resonance Imaging
CO_2 Stress Testing
in Adolescent Post-Concussion Syndrome

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CANADA NORTH
CONCUSSION NETWORK

panam

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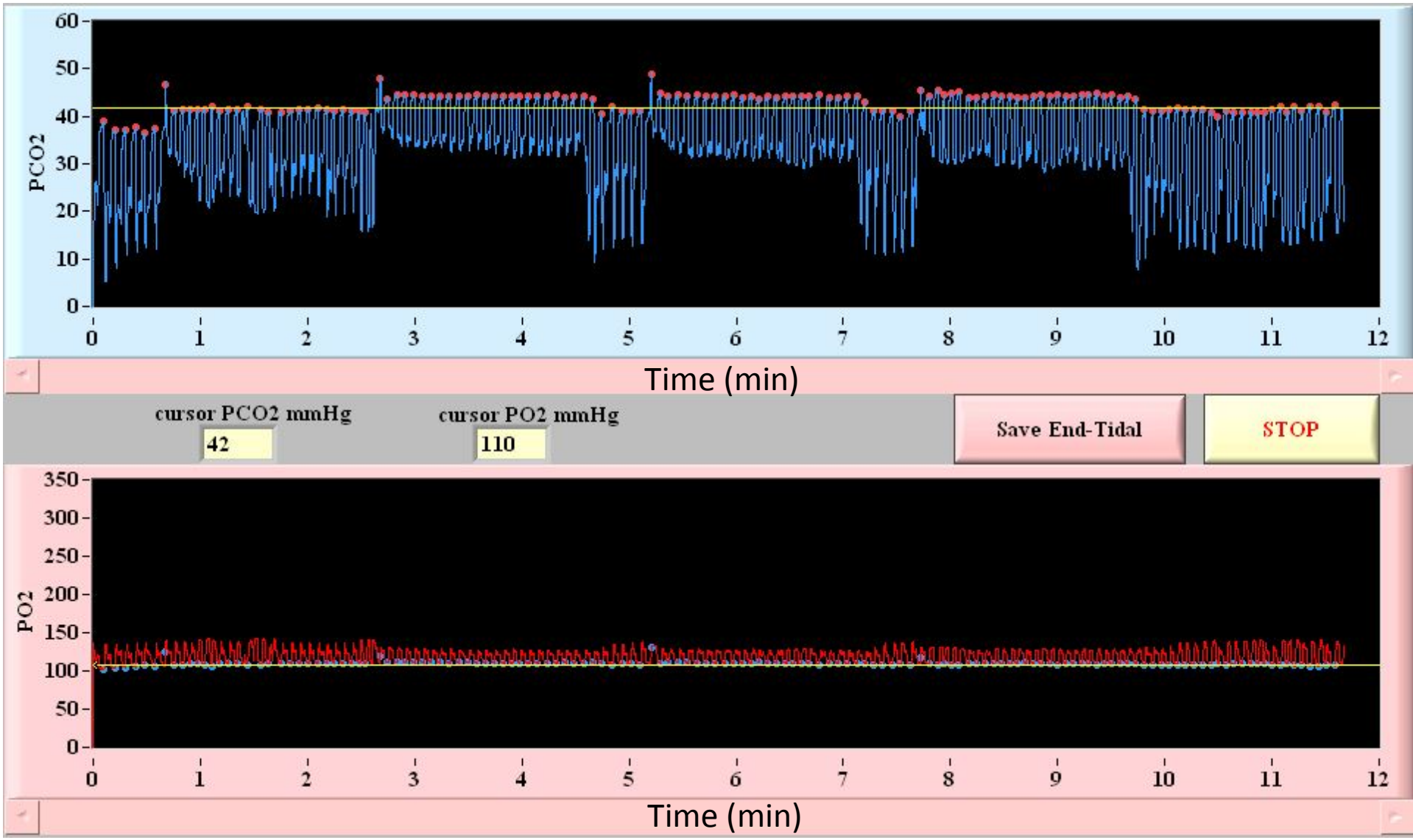
Health Sciences Centre Winnipeg
Celebrating children: 100 years of care

the Manitoba Institute of Child Health

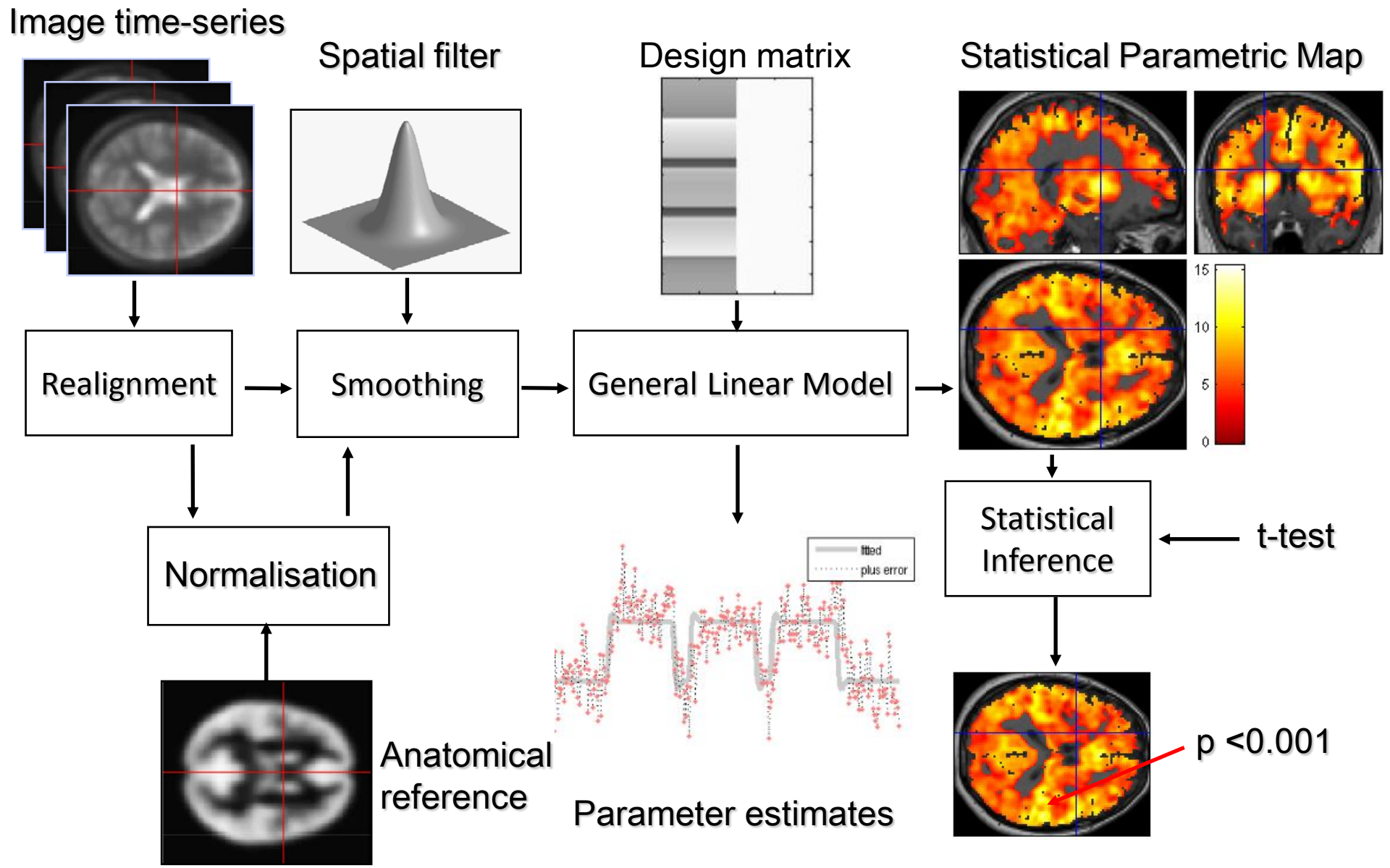
MRI Stress Testing Potential

- Can be quantified by voxel counts
- Comparisons between and within subjects by warping into MNI space
- Repeatable with Model-based Prospective End-Tidal Targeting (MPET) technology for gas control
- Permits longitudinal assessment
- Hard to ‘sandbag’ if test completed
- Comparison between centres with established atlases
- If established - a potential means to determine ‘return-to-play’

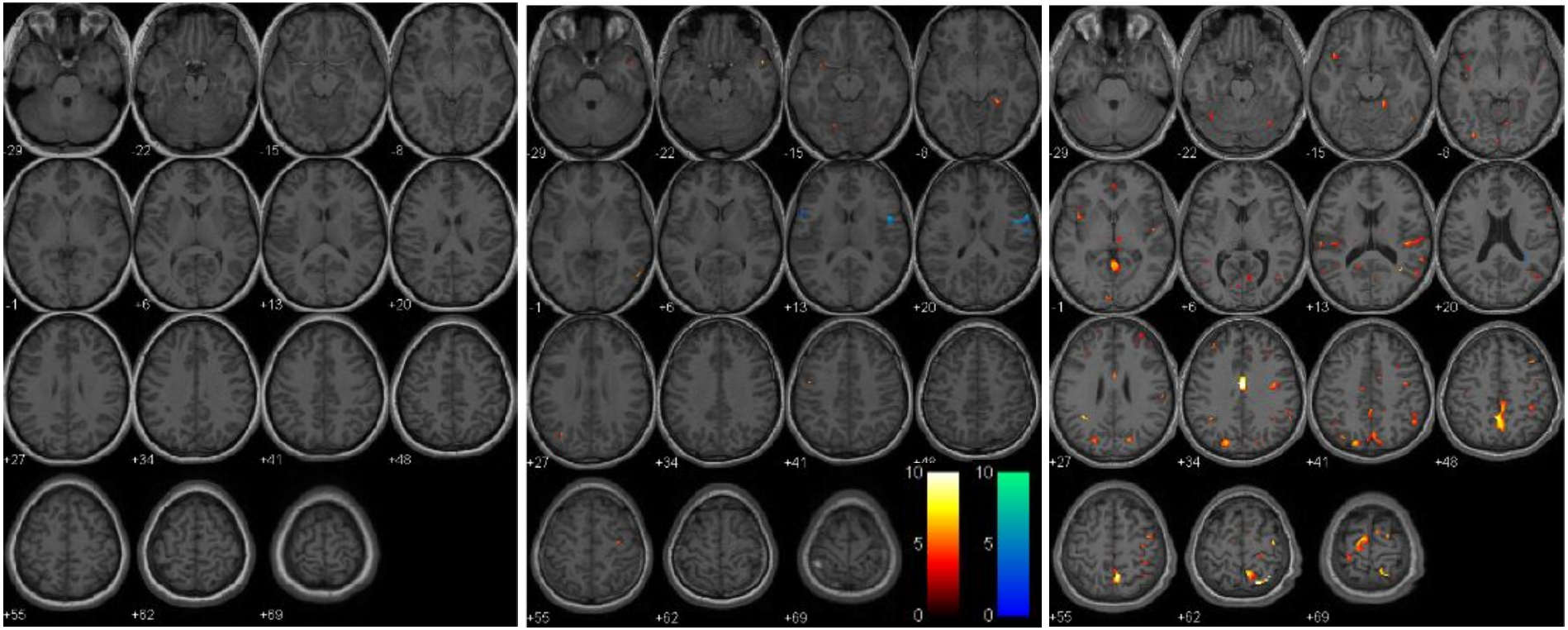
RespirAct™ Breathing Sequence



SPM Preprocessing and Analysis



2nd Level Comparisons to Control Atlas p = 0.005



A

PCSS=0
>Voxels=0
<Voxels=0

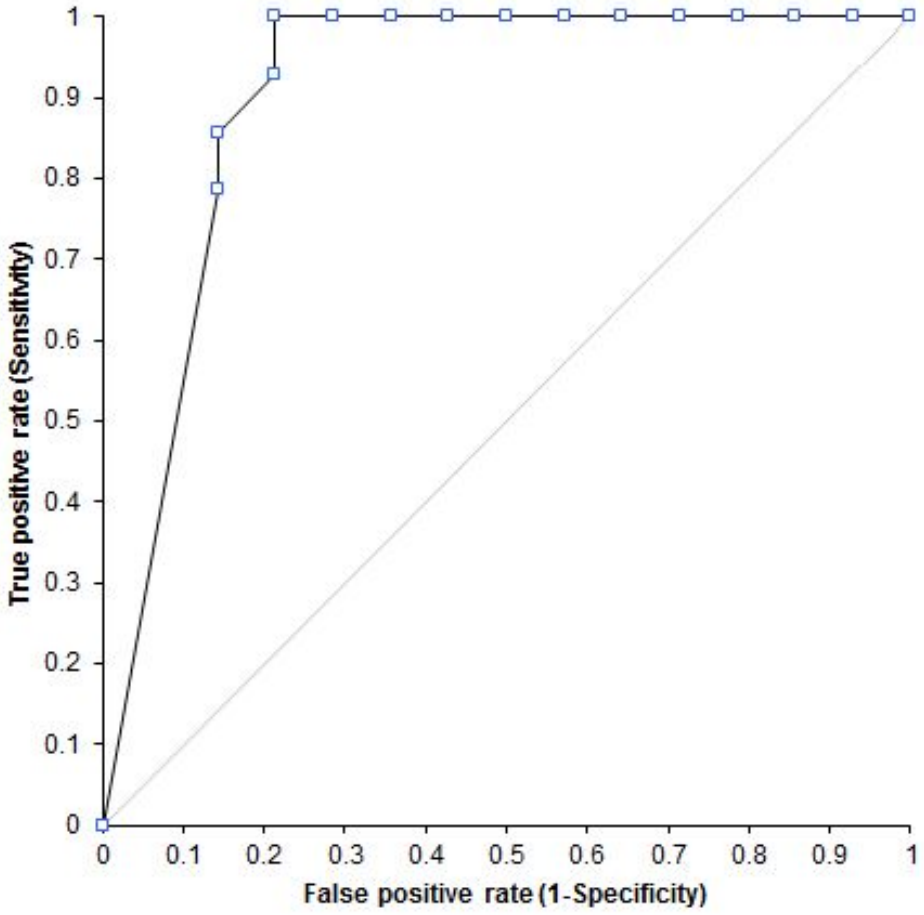
B

PCSS=73
>Voxels=349
<Voxels=868

C

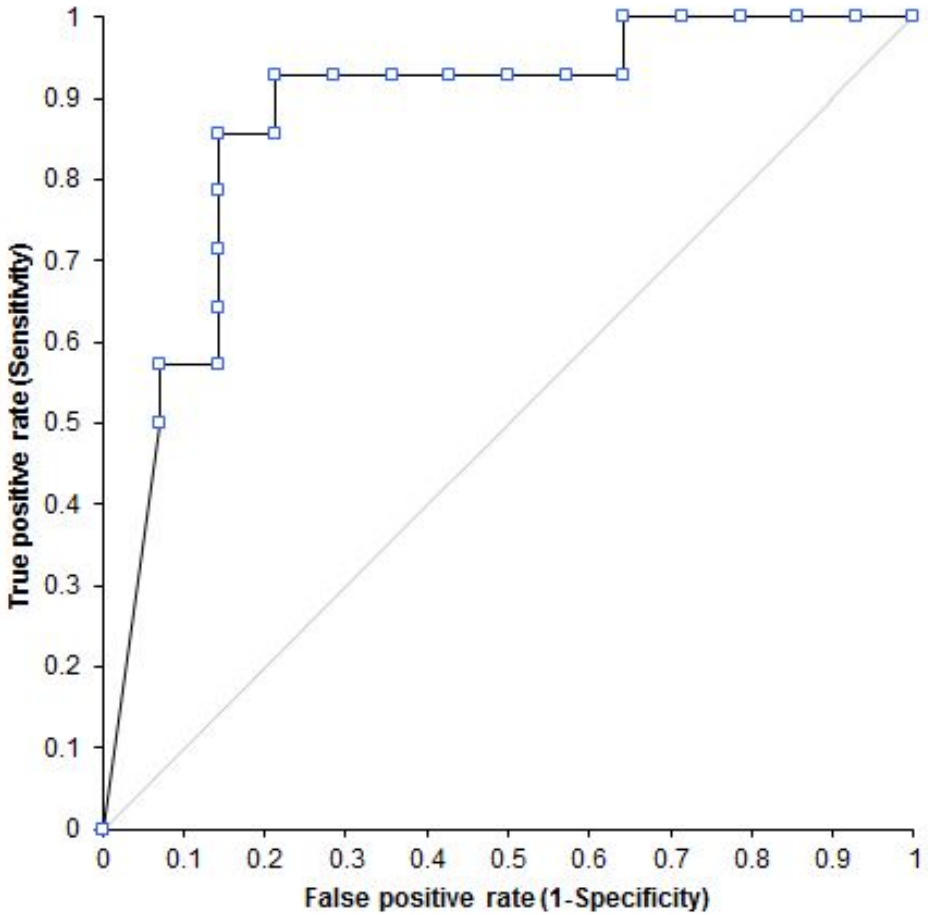
PCSS=42
>Voxels=6109
<Voxels=134

BOLD 2nd Level at p = 0. 001 ROC Curve



A

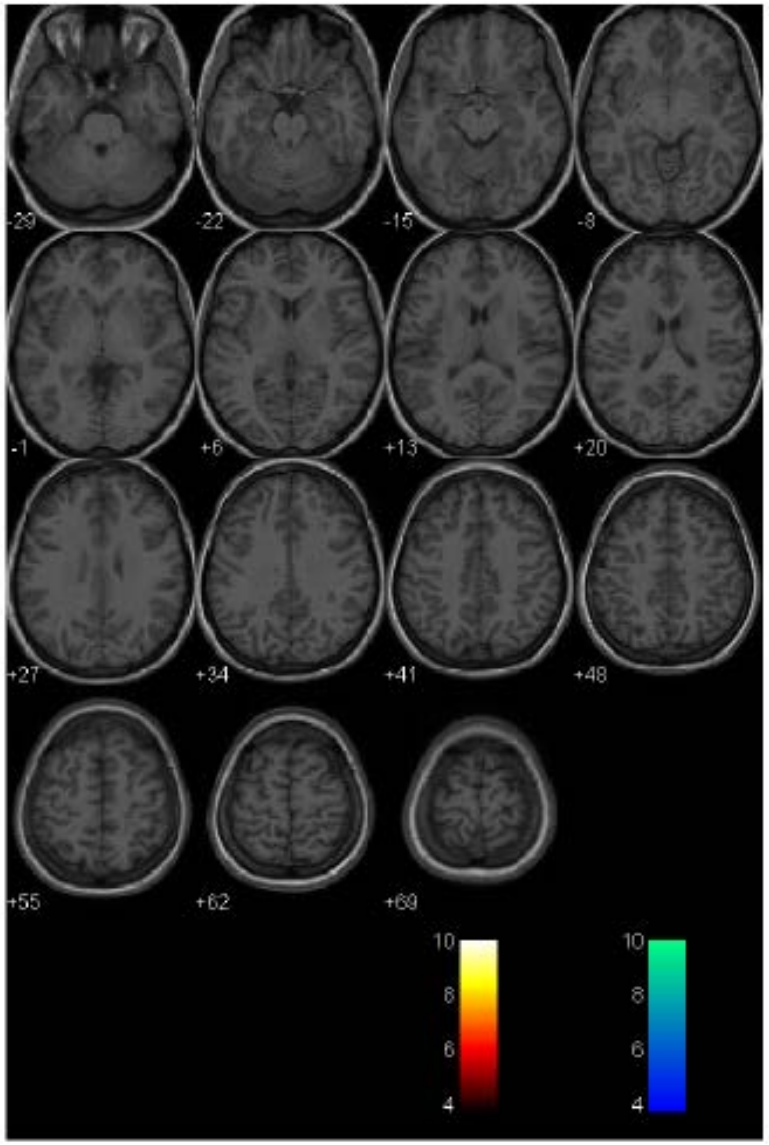
Voxel Counts > Control Group

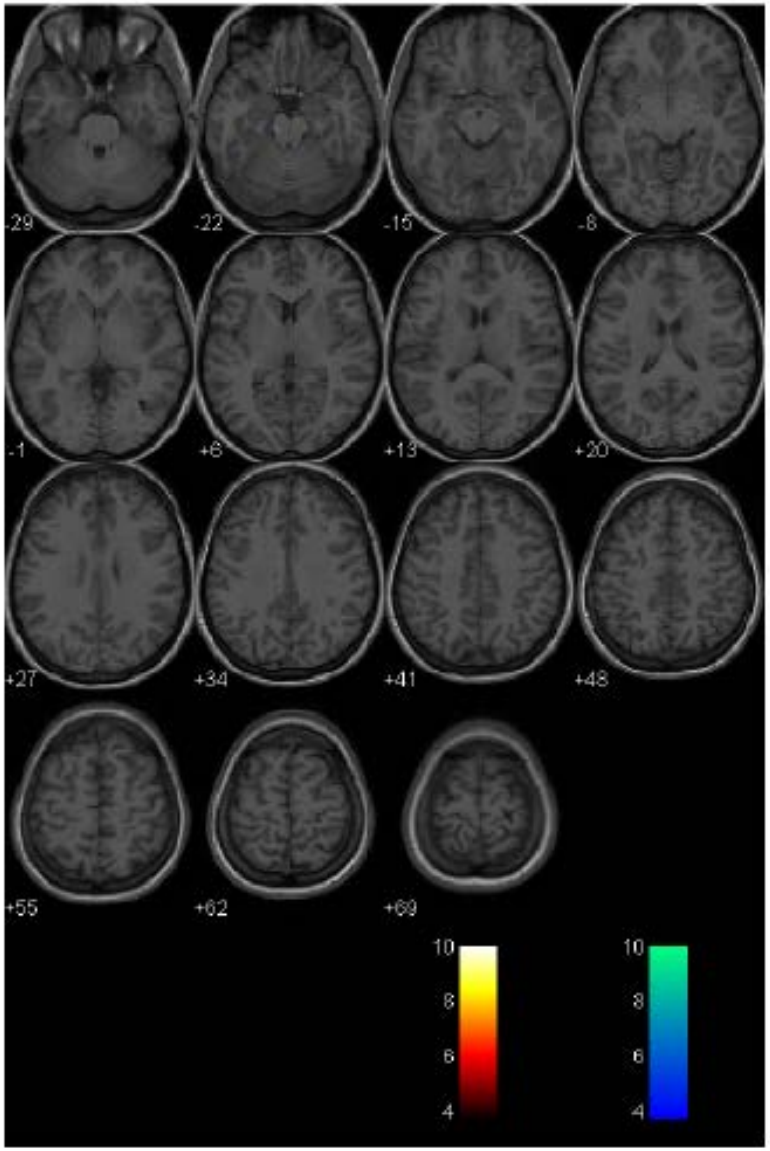


B

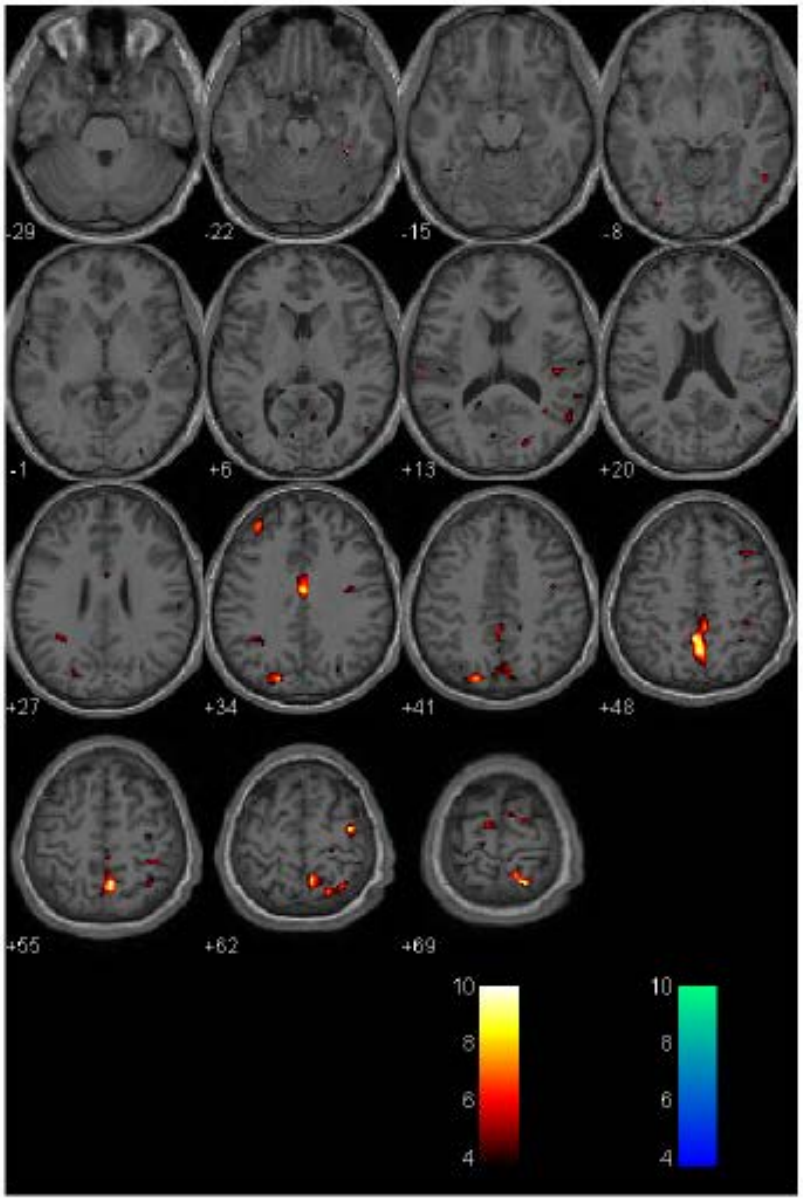
Voxel Counts < Control Group

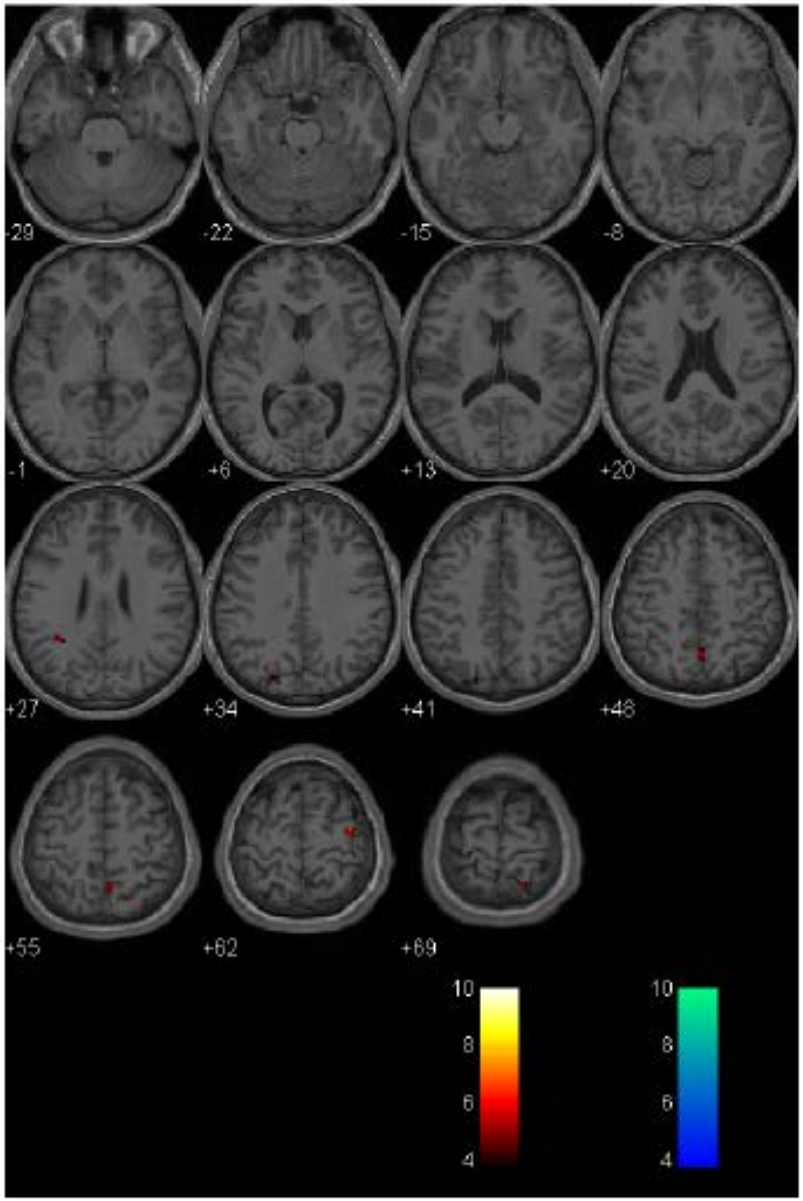
Control subject vs Atlas – 18 months apart





PCS Patient – Before and After Exercise Test





Conclusions

- MRI CVR provides usable biomarkers to indicate altered brain CV physiology in PCS patients
- Potential for diagnosis with the acute syndrome and aid in prognosis
- Repeatability permits longitudinal assessment
- No reason to assume same approach cannot be used to assess TBI patients – potentially across the full spectrum of condition

Acknowledgements

- Kleysen Institute for Advanced Medicine
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- Department of Anesthesia, Research Office, Dean's Office
- Most importantly our patients

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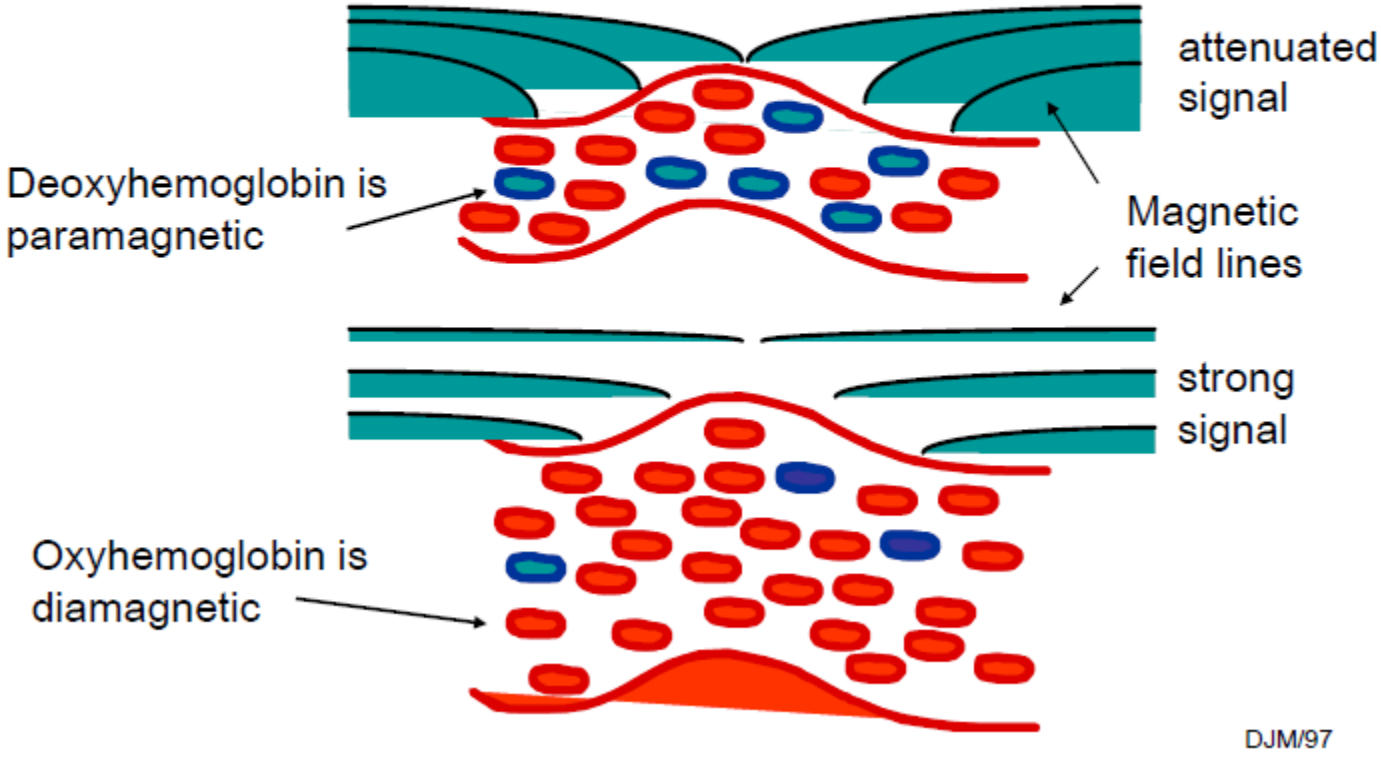
Limitations

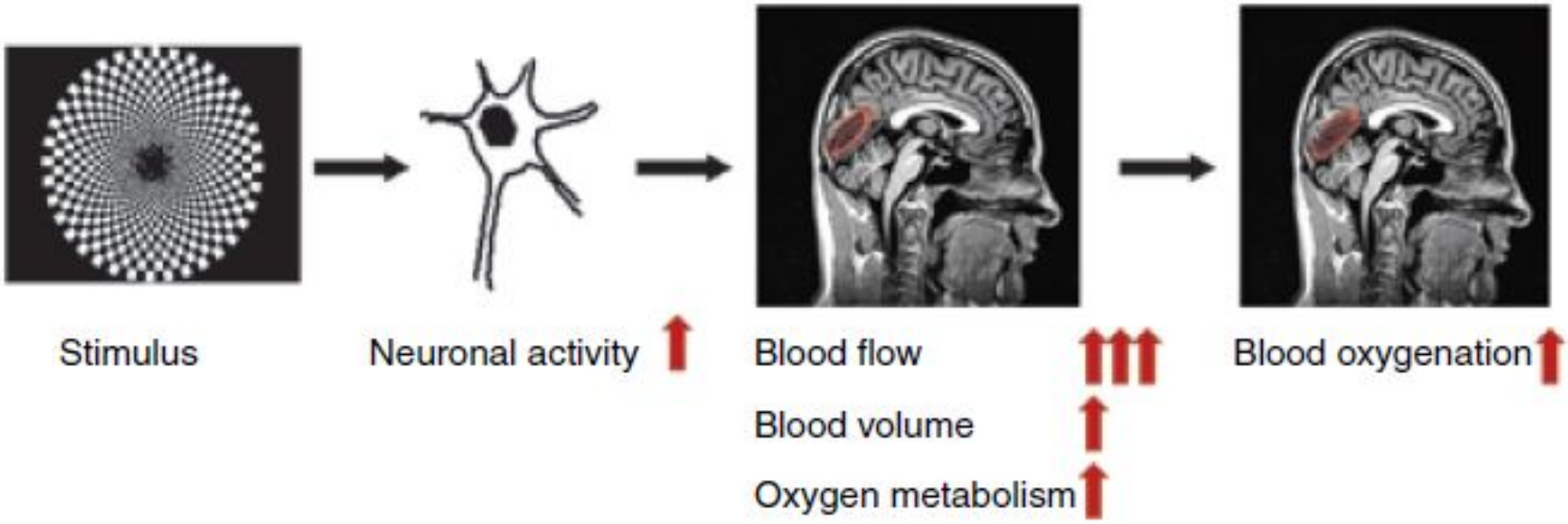
- Cost and Availability
- MRI contra-indications
- Available expertize to utilize MPET technology
- Need to establish atlas of control subjects

Blood oxygen level-dependent (BOLD) MRI signal



Assuming constant O_2 extraction by tissues, BOLD signal varies with CBF

BOLD imaging Influences



Influences on BOLD signal output

*** neuronal activation not a requirement for CO_2 stress testing**