

CATEGORIES OF PUBLICATIONS

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CEREBROVASCULAR REACTIVITY (CVR)

1. Foundational CVR methods & clinical framework

- [Raghavan, V., et al. Assessment of Cerebrovascular Reactivity Using CO-BOLD MRI: A 15-Year, Single Center Experience. Journal of Magnetic Resonance Imaging 60, 954-961 \(2024\).](#)
- [Sobczyk, O., Duffin, J., Fisher, J.A. & Mikulis, D.J. The Physiological Basis of Cerebrovascular Reactivity Cerebrovascular reactivity \(CVR\) Measurements. in Cerebrovascular Reactivity: Methodological Advances and Clinical Applications \(eds. Chen, J. & Fierstra, J.\) 1-18 \(Springer US, New York, NY, 2022\).](#)
- [Sobczyk, O., et al. Measuring Cerebrovascular Reactivity: Sixteen Avoidable Pitfalls. Front Physiol 12, 665049 \(2021\).](#)
- [Fisher, J.A. & Mikulis, D.J. Cerebrovascular Reactivity: Purpose, Optimizing Methods, and Limitations to Interpretation - A Personal 20-Year Odyssey of \(Re\)searching. Frontiers in physiology 12, 629651-629651 \(2021\).](#)
- [McKetton, L., et al. The Effect of CO₂ on Resting-State Functional Connectivity: Isocapnia vs. Poikilocapnia. Frontiers in Physiology 12 \(2021\).](#)
- [Yao, J., Yang, H.C., Wang, J.H., Liang, Z., Talavage, T.M., Tamer Jr, G.G., et al. A novel method of quantifying hemodynamic delays to improve hemodynamic response and CVR estimates in CO₂ challenge fMRI. J Cereb Blood Flow Metab 41, 1886-1898 \(2021\).](#)
- [Sobczyk, O., et al. Cerebrovascular Reactivity Assays Collateral Function in Carotid Stenosis. Frontiers in Physiology 11\(2020\).](#)
- [Fisher, J.A., Venkatraghavan, L. & Mikulis, D.J. Magnetic Resonance Imaging–Based Cerebrovascular Reactivity and Hemodynamic Reserve. A Review of Method Optimization and Data Interpretation \(2018\).](#)
- [Fierstra, J., et al. Staging Hemodynamic Failure With Blood Oxygen-Level–Dependent Functional Magnetic Resonance Imaging Cerebrovascular Reactivity. Stroke \(2018\).](#)
- [Fisher, J.A. The CO₂ stimulus for cerebrovascular reactivity: Fixing inspired concentrations vs. targeting end-tidal partial pressures. Journal of Cerebral Blood Flow & Metabolism 36, 1004- 1011 \(2016\).](#)
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- [Fierstra, J., et al. Measuring cerebrovascular reactivity: what stimulus to use? J Physiol 591, 5809-5821 \(2013\).](#)
- [Spano, V.R., et al. CO₂ blood oxygen level-dependent MR mapping of cerebrovascular reserve in a clinical population: safety, tolerability, and technical feasibility. Radiology 266, 592-598 \(2013\).](#)
- [Mark, C.I., et al. Precise control of end-tidal carbon dioxide and oxygen improves BOLD and ASL cerebrovascular reactivity measures. Magn Reson Med 64, 749-756 \(2010\).](#)
- [Driver, I., Blockley, N., Fisher, J., Francis, S. & Gowland, P. The change in cerebrovascular reactivity between 3 T and 7 T measured using graded hypercapnia. NeuroImage 51, 274-279 \(2010\).](#)

CEREBROVASCULAR REACTIVITY (CVR)

1. Foundational CVR methods & clinical framework continued

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- [Mandell, D.M., et al. Mapping cerebrovascular reactivity using blood oxygen level-dependent MRI in Patients with arterial steno-occlusive disease: comparison with arterial spin labeling MRI. Stroke 39, 2021-2028 \(2008\).](#)

2. Small vessel disease

- [Atwi, S., et al. BOLD-based cerebrovascular reactivity vascular transfer function isolates amplitude and timing responses to better characterize cerebral small vessel disease. NMR in Biomedicine 32, e4064 \(2019\).](#)
- [De Vis, J.B., Bhogal, A.A., Hendrikse, J., Petersen, E.T. & Siero, J.C.W. Effect sizes of BOLD CVR, resting-state signal fluctuations and time delay measures for the assessment of hemodynamic impairment in carotid occlusion patients. NeuroImage 179, 530-539 \(2018\).](#)
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- [Sam, K., et al. Development of White Matter Hyperintensity is Preceded by Reduced Cerebrovascular Reactivity. Annals of Neurology, n/a-n/a \(2016\).](#)
- [Gauthier CJ, Lefort M, Mekary S, Desjardins-Crépeau L, Skimminge A, Iversen P, Madjar C, Desjardins M, Lesage F, Garde E, Frouin F. Hearts and minds: linking vascular rigidity and aerobic fitness with cognitive aging. Neurobiology of aging. 2015 Jan 1;36\(1\):304-14.](#)
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- [Sam, K., et al. Impaired dynamic cerebrovascular response to hypercapnia predicts development of white matter hyperintensities. NeuroImage: Clinical 11, 796-801 \(2016\).](#)
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- [Mandell, D.M., et al. Selective reduction of blood flow to white matter during hypercapnia corresponds with leukoaraiosis. Stroke 39, 1993-1998 \(2008\).](#)

CEREBROVASCULAR REACTIVITY (CVR)

3. Large vessel disease

- [Shi, R.B., Poubanc, J., Sayin, E.S., Sobczyk, O., Fisher, J.A., Mikulis, D.J. & Para, A.E. Persistent Steal Physiology during a Ramp Cerebrovascular Reactivity Assessment Correlates with Severe Cortical Thinning in Steno-Occlusive Disease. AJNR Am J Neuroradiol 47, 1367-1372 \(2026\).](#)
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- [van Niftrik, C.H.B., et al. Increased Risk of Recurrent Stroke in Symptomatic Large Vessel Disease With Impaired BOLD Cerebrovascular Reactivity. Stroke \(2024\).](#)
- [Bellomo, J., et al. The volume of steal phenomenon is associated with neurological deterioration in patients with large-vessel occlusion minor stroke not eligible for thrombectomy. European Stroke Journal, 23969873241251718 \(2024\).](#)
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- [van Niftrik, C.H.B., et al. A dual-center validation of the PIRAMD scoring system for assessing the severity of ischemic Moyamoya disease. Quant Imaging Med Surg 13, 4618-4632 \(2023\).](#)
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CEREBROVASCULAR REACTIVITY (CVR)

3. Large vessel disease continued

- [Bellomo, J., et al. Blood Oxygenation Level-Dependent Cerebrovascular Reactivity-Derived Steal Phenomenon May Indicate Tissue Reperfusion Failure After Successful Endovascular Thrombectomy. Transl Stroke Res \(2023\).](#)
- [Sebök, M., et al. Flow augmentation STA-MCA bypass evaluation for patients with acute stroke and unilateral large vessel occlusion: a proposal for an urgent bypass flowchart. J Neurosurg, 1-9 \(2022\).](#)
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CEREBROVASCULAR REACTIVITY (CVR)

4. Pediatrics

- [Smith, A.E., Lewis, J.B., Zhang, J., et al. Unsedated cerebrovascular reactivity imaging is well-tolerated in children. *Pediatr Radiol* 55, 2127-2137 \(2025\).](#)
- [Alhadid, K., et al. Quantitative Cerebrovascular Reactivity Atlas In Children \(P14-5.003\). *Neurology* 98, 3097 \(2022\).](#)
- [Kosinski, P.D., et al. The severity of anaemia depletes cerebrovascular dilatory reserve in children with sickle cell disease: a quantitative magnetic resonance imaging study. *Br J Haematol* 176, 280-287 \(2017\).](#)
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- [Han, J.S., et al. Measurement of cerebrovascular reactivity in pediatric patients with cerebral vasculopathy using blood oxygen level-dependent MRI. *Stroke* 42, 1261-1269 \(2011\).](#)

5. Non-invasive measurement of arterial PCO₂

- [Plitman, E., et al. Variability of Resting Carbon Dioxide Tension in Patients with Intracranial Steno-occlusive Disease. *Asian J Neurosurg* 19, 235-241 \(2024\).](#)
- [Fisher, J.A., Iscoe, S. & Duffin, J. Sequential gas delivery provides precise control of alveolar gas exchange. *Respir Physiol Neurobiol* 225, 60-69 \(2016\).](#)
- [Fierstra, J., et al. Non-invasive accurate measurement of arterial PCO₂ in a pediatric animal model. *J Clin Monit Comput* 27, 147-155 \(2013\).](#)
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- [Ito, S., et al. Non-invasive prospective targeting of arterial PCO₂ in subjects at rest. *J Physiol* 586, 3675-3682 \(2008\).](#)
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CEREBROVASCULAR REACTIVITY (CVR)

6. Generating physiological & clinically information

- [Baker, J.R., Incognito, A.V., Ranada, S.I., et al. Reduced Stroke Volume and Brain Perfusion Drive Postural Hyperventilation in Postural Orthostatic Tachycardia Syndrome. JACC Basic Transl Sci 9, 939-953 \(2024\).](#)
- [Milej, D., Shoemaker, L. N., Samaei, S., Deller, G., & St, K. Non-invasive blood flow calibration using a hybrid time-resolved NIRS/DCS system. \(2024\)](#)
- [Hoiland, R.L., MacLeod, D.B., Stacey, B.S., Caldwell, H.G., Howe, C.A., Nowak-Flück, D., et al. Hemoglobin and cerebral hypoxic vasodilation in humans: Evidence for nitric oxide-dependent and S-nitrosothiol mediated signal transduction. J Cereb Blood Flow Metab 43, 1519-1531 \(2023\).](#)
- [Vu, C., et al. Sinusoidal CO\(2\) respiratory challenge for concurrent perfusion and cerebrovascular reactivity MRI. Front Physiol 14, 1102983 \(2023\).](#)
- [Xu, B., et al. Improved cerebrovascular reactivity mapping using coherence weighted general linear model in the frequency domain. Neurolmage 284, 120448 \(2023\).](#)
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- [Milej, D., Abdalmalak, A., Rajaram, A., Jhaji, A., Owen, A.M. & St. Lawrence, K. Incorporating early and late-arriving photons to improve the reconstruction of cerebral hemodynamic responses acquired by time-resolved near-infrared spectroscopy. J Biomed Opt 26, 056003 \(2021\).](#)
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 CEREBROVASCULAR REACTIVITY (CVR)

6. Generating physiological & clinically information continued

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- [Duffin, J., et al. The dynamics of cerebrovascular reactivity shown with transfer function analysis. NeuroImage 114, 207-216 \(2015\).](#)
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7. Compatibility across time, subjects & institutions

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8. Understanding the physiological basis of CVR

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CVR IN OTHER CLINICAL CONDITIONS

1. Cognitive decline and revascularization

- [Kim, D., et al. Relationship Between Cerebrovascular Reactivity and Cognition Among People With Risk of Cognitive Decline. Front Physiol 12, 645342 \(2021\).](#)
- [McKetton, L., et al. Cerebrovascular Resistance in Healthy Aging and Mild Cognitive Impairment. Frontiers in Aging Neuroscience 11 \(2019\).](#)
- [Fierstra, J., et al. Surgical revascularization reverses cerebral cortical thinning in patients with severe cerebrovascular steno-occlusive disease. Stroke 42, 1631-1637 \(2011\).](#)
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2. Arteriovenous malformations and seizure risk

- [Sebök, M., et al. More pronounced hemodynamic alterations in patients with brain arteriovenous malformation-associated epilepsy. Neurosurgical Focus 53, E4 \(2022\).](#)
- [Fierstra, J., et al. Impaired peri-nidal cerebrovascular reserve in seizure patients with brain arteriovenous malformations. Brain 134, 100-109 \(2011\).](#)
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3. MELAS

- [Rodan, L.H., et al. L-arginine effects on cerebrovascular reactivity, perfusion and neurovascular coupling in MELAS \(mitochondrial encephalomyopathy with lactic acidosis and stroke-like episodes\) syndrome. PLoS One 15, e0238224 \(2020\).](#)
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4. Traumatic brain injury

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CVR IN OTHER CLINICAL CONDITIONS

4. Traumatic brain injury continued

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- [Mutch, W.A.C., et al. Patient-Specific Alterations in CO₂ Cerebrovascular Responsiveness in Acute and Sub-Acute Sports-Related Concussion. Frontiers in Neurology 9 \(2018\).](#)
- [Mutch, W.A.C., et al. Brain magnetic resonance imaging CO₂ stress testing in adolescent postconcussion syndrome. Journal of Neurosurgery JNS 125, 648-660 \(2016\).](#)
- [da Costa, L., van Niftrik, C.B., Crane, D., Fierstra, J. & Bethune, A. Temporal profile of cerebrovascular reactivity impairment, grey matter volumes and persistent symptoms after mild traumatic head injury. Frontiers in Neurology 7 \(2016\).](#)
- [Mutch, W.A., et al. Brain MRI CO₂ stress testing: a pilot study in patients with concussion. PLoS One 9, e102181 \(2014\).](#)

5. Alzheimer's disease

- [Kim, D., et al. Regional cerebrovascular reactivity and cognitive performance among people with risk of cognitive decline. Alzheimer's & Dementia 17, e053331 \(2021\).](#)
- [Holmes, K.R., et al. Slowed Temporal and Parietal Cerebrovascular Response in Patients with Alzheimer's Disease. Canadian Journal of Neurological Sciences / Journal Canadien des Sciences Neurologiques 47, 366-373 \(2020\).](#)

6. Intracerebral bleeding

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7. Spinal cord vascular reactivity

- [Cohen-Adad, J., et al. BOLD signal responses to controlled hypercapnia in human spinal cord. Neuroimage 50, 1074-1084 \(2010\).](#)

CVR IN OTHER CLINICAL CONDITIONS

8. Obstructive sleep apnea

- [Ryan, C.M., Battisti-Charbonney, A., Sobczyk, O., Duffin, J. & Fisher, J. Normal hypercapnic cerebrovascular conductance in obstructive sleep apnea. Respiratory Physiology & Neurobiology 190, 47-53 \(2014\).](#)

9. Cocaine vasculitis

- [Han, J.S., et al. BOLD-MRI cerebrovascular reactivity findings in cocaine-induced cerebral vasculitis. Nat Clin Pract Neurol 4, 628-632 \(2008\).](#)

10. Brain cancer

- [van der Voort, E.C., et al. CO\(2\) as an engine for neurofluid flow: Exploring the coupling between vascular reactivity, brain clearance, and changes in tissue properties. NMR Biomed, e5126 \(2024\).](#)
- [van Grinsven, E.E., Guichelaar, J., Philippens, M.E.P., Siero, J.C.W. & Bhogal, A.A. Hemodynamic imaging parameters in brain metastases patients – Agreement between multi- delay ASL and hypercapnic BOLD. Journal of Cerebral Blood Flow & Metabolism 43, 2072-2084 \(2023\).](#)
- [Guida, L., et al. Hemodynamic Imaging in Cerebral Diffuse Glioma-Part A: Concept, Differential Diagnosis and Tumor Grading. Cancers \(Basel\) 14 \(2022\).](#)
- [Stumpo, V., et al. Feasibility of glioblastoma tissue response mapping with physiologic BOLD imaging using precise oxygen and carbon dioxide challenge. Magma 35, 29-44 \(2022\).](#)
- [Muscas, G., et al. Distinct Cerebrovascular Reactivity Patterns for Brain Radiation Necrosis. Cancers 13, 1840 \(2021\).](#)
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- [Muscas, G., et al. Hemodynamic investigation of peritumoral impaired blood oxygenation- level dependent cerebrovascular reactivity in patients with diffuse glioma. Magn Reson Imaging 70, 50-56 \(2020\).](#)
- [Para, A.E., et al. Invalidation of fMRI experiments secondary to neurovascular uncoupling in patients with cerebrovascular disease. Journal of Magnetic Resonance Imaging, n/a-n/a \(2017\).](#)

11. CSF-hemoglobin toxicity

- [Thomson, B.R., et al. Blood oxygenation-level dependent cerebrovascular reactivity imaging as strategy to monitor CSF-hemoglobin toxicity. J Stroke Cerebrovasc Dis 32, 106985 \(2023\).](#)

CVR IN OTHER CLINICAL CONDITIONS

12. Sickle cell disease

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