

CLNEG054: Neuroimaging and Pathophysiology

View Online



[1]

J. C. Grotta et al., *Stroke: Pathophysiology, Diagnosis, and Management*, 6th ed. London: Elsevier Health Sciences, 2015. Available: <http://www.sciencedirect.com/science/book/9780323295444>

[2]

L. Pantoni and P. B. Gorelick, Eds, *Cerebral small vessel disease*, vol. Cambridge medicine. Cambridge: Cambridge University Press, 2014. Available: <http://dx.doi.org/10.1017/CBO9781139382694>

[3]

L. Pantoni, 'Cerebral small vessel disease: from pathogenesis and clinical characteristics to therapeutic challenges', *The Lancet Neurology*, vol. 9, no. 7, pp. 689–701, July 2010, doi: [10.1016/S1474-4422\(10\)70104-6](https://doi.org/10.1016/S1474-4422(10)70104-6)

[4]

A. A. Gouw et al., 'Heterogeneity of small vessel disease: a systematic review of MRI and histopathology correlations', *Journal of Neurology, Neurosurgery & Psychiatry*, vol. 82, no. 2, pp. 126–135, Feb. 2011, doi: [10.1136/jnnp.2009.204685](https://doi.org/10.1136/jnnp.2009.204685)

[5]

S. Homma, 'Patent Foramen Ovale and Stroke', *Circulation*, vol. 112, no. 7, pp. 1063–1072, Aug. 2005, doi: [10.1161/CIRCULATIONAHA.104.524371](https://doi.org/10.1161/CIRCULATIONAHA.104.524371)

[6]

R. G. Hart et al., 'Embolic strokes of undetermined source: the case for a new clinical construct', *The Lancet Neurology*, vol. 13, no. 4, pp. 429–438, Apr. 2014, doi: 10.1016/S1474-4422(13)70310-7

[7]

'Atrial fibrillation: the management of atrial fibrillation | Guidance and guidelines | NICE', Available: <https://www.nice.org.uk/guidance/cg180>

[8]

P. A. Wolf, R. D. Abbott, and W. B. Kannel, 'Atrial fibrillation as an independent risk factor for stroke: the Framingham Study', *Stroke*, vol. 22, no. 8, pp. 983–988, Aug. 1991, doi: 10.1161/01.STR.22.8.983

[9]

R. Wakili, N. Voigt, S. Křřřb, D. Dobrev, and S. Nattel, 'Recent advances in the molecular pathophysiology of atrial fibrillation', *Journal of Clinical Investigation*, vol. 121, no. 8, pp. 2955–2968, Aug. 2011, doi: 10.1172/JCI46315

[10]

L. A. Sposato, L. E. Cipriano, P. M. Riccio, V. Hachinski, and G. Saposnik, 'Very short paroxysms account for more than half of the cases of atrial fibrillation detected after stroke and TIA: a systematic review and meta-analysis', *International Journal of Stroke*, vol. 10, no. 6, pp. 801–807, Aug. 2015, doi: 10.1111/ijls.12555

[11]

J. M. Ferro, 'Cardioembolic stroke: an update', *The Lancet Neurology*, vol. 2, no. 3, pp. 177–188, Mar. 2003, doi: 10.1016/S1474-4422(03)00324-7

[12]

C. S. Anderson et al., 'Rapid Blood-Pressure Lowering in Patients with Acute Intracerebral Hemorrhage', *New England Journal of Medicine*, vol. 368, no. 25, pp. 2355–2365, June 2013, doi: 10.1056/NEJMoa1214609

[13]

L.-E. Bohman and J. M. Levine, 'Fever and therapeutic normothermia in severe brain injury', *Current Opinion in Critical Care*, vol. 20, no. 2, pp. 182–188, Apr. 2014, doi: 10.1097/MCC.0000000000000070

[14]

C. Delcourt and C. Anderson, 'Acute intracerebral haemorrhage: Grounds for optimism in management', *Journal of Clinical Neuroscience*, vol. 19, no. 12, pp. 1622–1626, Dec. 2012, doi: 10.1016/j.jocn.2012.05.018

[15]

Grise, Erin M., 'Blood pressure control for acute ischemic and hemorrhagic stroke', *Current Opinion in Critical Care*, vol. 18, no. 2, Available: <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&AN=00075198-201204000-00005&LSLINK=80&D=ovft>

[16]

'Guidelines for Management of Ischaemic Stroke and Transient Ischaemic Attack 2008', *Cerebrovascular Diseases*, vol. 25, no. 5, pp. 457–507, 2008, doi: 10.1159/000131083

[17]

Flower, Oliver, 'The acute management of intracerebral hemorrhage', *Current Opinion in Critical Care*, vol. 17, no. 2, Available: <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&AN=00075198-201104000-00005&LSLINK=80&D=ovft>

[18]

Gioia, Laura C.a, 'Blood pressure management in acute intracerebral hemorrhage: current evidence and ongoing controversies', *Current Opinion in Critical Care*, vol. 21, no. 2, Available: <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&AN=00075198-201504000-00003&LSLINK=80&D=ovft>

[19]

J. C. Hemphill et al., 'Guidelines for the Management of Spontaneous Intracerebral Hemorrhage', *Stroke*, vol. 46, no. 7, pp. 2032–2060, July 2015, doi: 10.1161/STR.0000000000000069

[20]

E. C. Jauch et al., 'Guidelines for the Early Management of Patients With Acute Ischemic Stroke: A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association', *Stroke*, vol. 44, no. 3, pp. 870–947, Mar. 2013, doi: 10.1161/STR.0b013e318284056a

[21]

Kalanuria, Atul A.a , b, 'Early prognostication in acute brain damage: where is the evidence?', *Current Opinion in Critical Care*, vol. 19, no. 2, Available: <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&AN=00075198-201304000-00008&LSLINK=80&D=ovft>

[22]

M. A. Kirkman, G. Citerio, and M. Smith, 'The intensive care management of acute ischemic stroke: an overview', *Intensive Care Medicine*, vol. 40, no. 5, pp. 640–653, May 2014, doi: 10.1007/s00134-014-3266-z

[23]

Kirkman, Matthew A. MBBS*,†, 'Supratentorial Intracerebral Hemorrhage: A Review of the Underlying Pathophysiology and its Relevance for Multimodality Neuromonitoring in Neurointensive Care', *Journal of Neurosurgical Anesthesiology*, vol. 25, no. 3, pp. 228–239, Available: <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&AN=00008506-201307000-00002&LSLINK=80&D=ovft>

[24]

Smith, Martin MBBS, FRCA, 'Monitoring Intracranial Pressure in Traumatic Brain Injury', *Anesthesia & Analgesia*, vol. 106, no. 1, pp. 240–248, Available: <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&AN=00000539-200801000-00042&LSLINK=80&D=ovft>

[25]

Wartenberg, Katja E., 'Malignant middle cerebral artery infarction', *Current Opinion in Critical Care*, vol. 18, no. 2, Available: <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&AN=00075198-201204000-00008&LSLINK=80&D=ovft>

[26]

J. C. Rose and S. A. Mayer, 'Optimizing Blood Pressure in Neurological Emergencies', *Neurocritical Care*, vol. 1, no. 3, pp. 287–300, 2004, doi: 10.1385/NCC:1:3:287

[27]

M. Oeинck et al., 'Dynamic Cerebral Autoregulation in Acute Intracerebral Hemorrhage', *Stroke*, vol. 44, no. 10, pp. 2722–2728, Oct. 2013, doi: 10.1161/STROKEAHA.113.001913

[28]

J. A. Staessen, J. Wang, G. Bianchi, and W. H. Birkenhäger, 'Essential hypertension', *The Lancet*, vol. 361, no. 9369, pp. 1629–1641, May 2003, doi: 10.1016/S0140-6736(03)13302-8

[29]

A. W. Cowley, 'Long-term control of arterial blood pressure', *Physiological Reviews*, vol. 72, no. 1, pp. 231–300, Jan. 1992, Available: <http://physrev.physiology.org/content/72/1/231>

[30]

N. J. Abbott, A. A. K. Patabendige, D. E. M. Dolman, S. R. Yusof, and D. J. Begley, 'Structure and function of the blood-brain barrier', *Neurobiology of Disease*, vol. 37, no. 1, pp. 13–25, Jan. 2010, doi: 10.1016/j.nbd.2009.07.030

[31]

L. R. Bridges et al., 'Blood-Brain Barrier Dysfunction and Cerebral Small Vessel Disease (Arteriolosclerosis) in Brains of Older People', *Journal of Neuropathology & Experimental Neurology*, vol. 73, no. 11, pp. 1026–1033, Nov. 2014, doi: 10.1097/NEN.0000000000000124

[32]

J. Y. W. Liu et al., 'Neuropathology of the blood-brain barrier and pharmaco-resistance in human epilepsy', *Brain*, vol. 135, no. 10, pp. 3115–3133, Oct. 2012, doi: 10.1093/brain/aws147

[33]

S. Taheri et al., 'Blood-Brain Barrier Permeability Abnormalities in Vascular Cognitive Impairment', *Stroke*, vol. 42, no. 8, pp. 2158–2163, Aug. 2011, doi: 10.1161/STROKEAHA.110.611731

[34]

J. M. Wardlaw, P. A. G. Sandercock, M. S. Dennis, J. Starr, and H. Kalimo, 'Is Breakdown of the Blood-Brain Barrier Responsible for Lacunar Stroke, Leukoaraiosis, and Dementia?', *Stroke*, vol. 34, no. 3, pp. 806–812, Mar. 2003, doi: 10.1161/01.STR.0000058480.77236.B3

[35]

Z. Zhao et al., 'Central role for PICALM in amyloid- β blood-brain barrier transcytosis and clearance', *Nature Neuroscience*, vol. 18, no. 7, pp. 978–987, May 2015, doi: 10.1038/nn.4025

[36]

B. V. Zlokovic, 'The Blood-Brain Barrier in Health and Chronic Neurodegenerative Disorders', *Neuron*, vol. 57, no. 2, pp. 178–201, Jan. 2008, doi: 10.1016/j.neuron.2008.01.003

[37]

B. V. Zlokovic, 'Cerebrovascular Effects of Apolipoprotein E', *JAMA Neurology*, vol. 70, no. 4, Apr. 2013, doi: 10.1001/jamaneurol.2013.2152

[38]

K. D. Hougaard et al., 'Remote Ischemic Perconditioning as an Adjunct Therapy to Thrombolysis in Patients With Acute Ischemic Stroke: A Randomized Trial', *Stroke*, vol. 45, no. 1, pp. 159–167, Jan. 2014, doi: 10.1161/STROKEAHA.113.001346

[39]

S. Grupke, J. Hall, M. Dobbs, G. J. Bix, and J. F. Fraser, 'Understanding history, and not repeating it. Neuroprotection for acute ischemic stroke: From review to preview', *Clinical Neurology and Neurosurgery*, vol. 129, pp. 1–9, Feb. 2015, doi: 10.1016/j.clineuro.2014.11.013

[40]

K. R. Lees, 'Does neuroprotection improve stroke outcome?', *The Lancet*, vol. 351, no. 9114, pp. 1447–1448, May 1998, doi: 10.1016/S0140-6736(05)78865-6

[41]

Y. Wang, C. Reis, R. Applegate, G. Stier, R. Martin, and J. H. Zhang, 'Ischemic conditioning-induced endogenous brain protection: Applications pre-, per- or post-stroke', *Experimental Neurology*, Apr. 2015, doi: 10.1016/j.expneurol.2015.04.009

[42]

M. Habs et al., 'Age determination of vessel wall hematoma in spontaneous cervical artery dissection: A multi-sequence 3T Cardiovascular Magnetic resonance study', *Journal of Cardiovascular Magnetic Resonance*, vol. 13, no. 1, 2011, doi: 10.1186/1532-429X-13-76

[43]

A. Gupta et al., 'Carotid Plaque MRI and Stroke Risk: A Systematic Review and Meta-analysis', *Stroke*, vol. 44, no. 11, pp. 3071–3077, Nov. 2013, doi: 10.1161/STROKEAHA.113.002551

[44]

C. Yuan et al., 'MRI of atherosclerosis in clinical trials', *NMR in Biomedicine*, vol. 19, no. 6, pp. 636–654, Oct. 2006, doi: 10.1002/nbm.1065

[45]

N. Altaf, S. T. MacSweeney, J. Gladman, and D. P. Auer, 'Carotid Intraplaque Hemorrhage Predicts Recurrent Symptoms in Patients With High-Grade Carotid Stenosis', *Stroke*, vol. 38, no. 5, pp. 1633–1635, May 2007, doi: 10.1161/STROKEAHA.106.473066

[46]

N. Altaf et al., 'Plaque Hemorrhage Is a Marker of Thromboembolic Activity in Patients with Symptomatic Carotid Disease', *Radiology*, vol. 258, no. 2, pp. 538–545, Feb. 2011, doi: 10.1148/radiol.10100198

[47]

D. K. Jones, *Diffusion MRI: theory, methods, and applications*. New York: Oxford University Press, 2011.

[48]

P. B. Barker, X. Golay, and G. Zaharchuk, *Clinical perfusion MRI techniques and applications*. Cambridge: Cambridge University Press, 2013.

[49]

D. Wilson, M. E. Adams, F. Robertson, M. Murphy, and D. J. Werring, 'Investigating intracerebral haemorrhage', *BMJ*, vol. 350, no. may20 10, pp. h2484–h2484, May 2015, doi: 10.1136/bmj.h2484

[50]

D. Wilson, A. Charidimou, and D. J. Werring, 'Advances in understanding spontaneous intracerebral hemorrhage: insights from neuroimaging', *Expert Review of Neurotherapeutics*, vol. 14, no. 6, pp. 661–678, June 2014, doi: 10.1586/14737175.2014.918506

[51]

J. C. Hemphill et al., 'Guidelines for the Management of Spontaneous Intracerebral Hemorrhage', *Stroke*, vol. 46, no. 7, pp. 2032–2060, July 2015, doi: 10.1161/STR.0000000000000069

[52]

T. H. Murphy and D. Corbett, 'Plasticity during stroke recovery: from synapse to behaviour', *Nature Reviews Neuroscience*, vol. 10, no. 12, pp. 861–872, Dec. 2009, doi: 10.1038/nrn2735

[53]

S. R. Zeiler and J. W. Krakauer, 'The interaction between training and plasticity in the poststroke brain', *Current Opinion in Neurology*, vol. 26, no. 6, pp. 609–616, Dec. 2013, doi: 10.1097/WCO.0000000000000025

[54]

J. W. Krakauer, S. T. Carmichael, D. Corbett, and G. F. Wittenberg, 'Getting Neurorehabilitation Right: What Can Be Learned From Animal Models?', *Neurorehabilitation and Neural Repair*, vol. 26, no. 8, pp. 923–931, Oct. 2012, doi: 10.1177/1545968312440745

[55]

N. S. Ward, 'Does neuroimaging help to deliver better recovery of movement after stroke?', *Current Opinion in Neurology*, vol. 28, no. 4, pp. 323–329, Aug. 2015, doi: 10.1097/WCO.0000000000000223

[56]

N. S. Ward, 'Using oscillations to understand recovery after stroke', *Brain*, vol. 138, no. 10, pp. 2811–2813, Oct. 2015, doi: 10.1093/brain/awv265

[57]

J. Krakauer and R. Marshall, 'The proportional recovery rule for stroke revisited', *Annals of Neurology*, p. n/a-n/a, Oct. 2015, doi: 10.1002/ana.24537

[58]

F. Coupar, A. Pollock, P. Rowe, C. Weir, and P. Langhorne, 'Predictors of upper limb recovery after stroke: a systematic review and meta-analysis', *Clinical Rehabilitation*, vol. 26, no. 4, pp. 291–313, Apr. 2012, doi: 10.1177/0269215511420305

[59]

C. M. Stinear, P. A. Barber, M. Petoe, S. Anwar, and W. D. Byblow, 'The PREP algorithm predicts potential for upper limb recovery after stroke', *Brain*, vol. 135, no. 8, pp. 2527–2535, Aug. 2012, doi: 10.1093/brain/aws146

[60]

T. M. H. Hope, M. L. Seghier, A. P. Leff, and C. J. Price, 'Predicting outcome and recovery after stroke with lesions extracted from MRI images', *NeuroImage: Clinical*, vol. 2, pp. 424–433, 2013, doi: 10.1016/j.nicl.2013.03.005

[61]

A. N. Clarkson, B. S. Huang, S. E. MacIsaac, I. Mody, and S. T. Carmichael, 'Reducing excessive GABA-mediated tonic inhibition promotes functional recovery after stroke', *Nature*, vol. 468, no. 7321, pp. 305–309, Nov. 2010, doi: 10.1038/nature09511

[62]

S. D. Hall et al., 'The role of GABAergic modulation in motor function related neuronal network activity', *NeuroImage*, vol. 56, no. 3, pp. 1506–1510, June 2011, doi: 10.1016/j.neuroimage.2011.02.025

[63]

H. C. Stary et al., 'A Definition of Advanced Types of Atherosclerotic Lesions and a Histological Classification of Atherosclerosis : A Report From the Committee on Vascular Lesions of the Council on Arteriosclerosis, American Heart Association', *Circulation*, vol. 92, no. 5, pp. 1355–1374, Sept. 1995, doi: 10.1161/01.CIR.92.5.1355

[64]

R. Virmani, F. D. Kolodgie, A. P. Burke, A. Farb, and S. M. Schwartz, 'Lessons From Sudden Coronary Death : A Comprehensive Morphological Classification Scheme for Atherosclerotic Lesions', *Arteriosclerosis, Thrombosis, and Vascular Biology*, vol. 20, no. 5, pp. 1262–1275, May 2000, doi: 10.1161/01.ATV.20.5.1262

[65]

A. M. Malek, 'Hemodynamic Shear Stress and Its Role in Atherosclerosis', *JAMA*, vol. 282, no. 21, Dec. 1999, doi: 10.1001/jama.282.21.2035

[66]

Y. S. Chatzizisis, A. U. Coskun, M. Jonas, E. R. Edelman, C. L. Feldman, and P. H. Stone, 'Role of Endothelial Shear Stress in the Natural History of Coronary Atherosclerosis and Vascular Remodeling', *Journal of the American College of Cardiology*, vol. 49, no. 25, pp. 2379–2393, June 2007, doi: 10.1016/j.jacc.2007.02.059

[67]

P. Libby, 'Inflammation in atherosclerosis', *Nature*, vol. 420, no. 6917, pp. 868–874, Dec. 2002, doi: 10.1038/nature01323

[68]

J. Astrup, L. Symon, N. M. Branston, and N. A. Lassen, 'Cortical evoked potential and extracellular K⁺ and H⁺ at critical levels of brain ischemia', *Stroke*, vol. 8, no. 1, pp. 51–57, Jan. 1977, doi: 10.1161/01.STR.8.1.51

[69]

F. R. Sharp, A. Lu, Y. Tang, and D. E. Millhorn, 'Multiple Molecular Penumbra After Focal Cerebral Ischemia', *Journal of Cerebral Blood Flow and Metabolism*, pp. 1011–1032, July 2000, doi: 10.1097/00004647-200007000-00001

[70]

M. D. Ginsberg, 'Adventures in the Pathophysiology of Brain Ischemia: Penumbra, Gene Expression, Neuroprotection: The 2002 Thomas Willis Lecture', *Stroke*, vol. 34, no. 1, pp. 214–223, Jan. 2003, doi: 10.1161/01.STR.0000048846.09677.62

[71]

M. Furlan, G. Marchal, J.-M. Derlon, J.-C. Baron, and F. Viader, 'Spontaneous neurological recovery after stroke and the fate of the ischemic penumbra', *Annals of Neurology*, vol. 40, no. 2, pp. 216–226, Aug. 1996, doi: 10.1002/ana.410400213

[72]

P. Ramos-Cabrer, F. Campos, T. Sobrino, and J. Castillo, 'Targeting the Ischemic Penumbra', *Stroke*, vol. 42, no. 1, Supplement 1, pp. S7–S11, Jan. 2011, doi: 10.1161/STROKEAHA.110.596684

[73]

E. H. Lo, 'A new penumbra: transitioning from injury into repair after stroke', *Nature Medicine*, vol. 14, no. 5, pp. 497–500, May 2008, doi: 10.1038/nm1735

[74]

F. R. Sharp, A. Lu, Y. Tang, and D. E. Millhorn, 'Multiple Molecular Penumbras After Focal Cerebral Ischemia', *Journal of Cerebral Blood Flow and Metabolism*, pp. 1011–1032, July 2000, doi: 10.1097/00004647-200007000-00001

[75]

J. Lok et al., 'Cell-cell Signaling in the Neurovascular Unit', *Neurochemical Research*, vol. 32, no. 12, pp. 2032–2045, Dec. 2007, doi: 10.1007/s11064-007-9342-9

[76]

G. J. del Zoppo and J. M. Hallenbeck, 'Advances in the Vascular Pathophysiology of Ischemic Stroke', *Thrombosis Research*, vol. 98, no. 3, pp. 73–81, May 2000, doi: 10.1016/S0049-3848(00)00218-8

[77]

T P Obrenovitch, 'The ischaemic penumbra: Twenty years on', *Cerebrovascular and brain metabolism reviews*, vol. 7, no. 4, 1995.

[78]

J. J. Harris, R. Jolivet, and D. Attwell, 'Synaptic Energy Use and Supply', *Neuron*, vol. 75, no. 5, pp. 762–777, Sept. 2012, doi: 10.1016/j.neuron.2012.08.019

[79]

D. Attwell, A. M. Buchan, S. Charpak, M. Lauritzen, B. A. MacVicar, and E. A. Newman, 'Glial and neuronal control of brain blood flow', *Nature*, vol. 468, no. 7321, pp. 232–243, Nov. 2010, doi: 10.1038/nature09613

[80]

E. H. Lo, T. Dalkara, and M. A. Moskowitz, 'Neurological diseases: Mechanisms, challenges and opportunities in stroke', *Nature Reviews Neuroscience*, vol. 4, no. 5, pp. 399–414, May 2003, doi: 10.1038/nrn1106

[81]

C. Culmsee and J. Krieglstein, 'Ischaemic brain damage after stroke: new insights into efficient therapeutic strategies. International Symposium on Neurodegeneration and Neuroprotection', *EMBO reports*, vol. 8, no. 2, pp. 129–133, Feb. 2007, doi: 10.1038/sj.embor.7400892

[82]

C. N. Hall et al., 'Capillary pericytes regulate cerebral blood flow in health and disease', *Nature*, vol. 508, no. 7494, pp. 55–60, Mar. 2014, doi: 10.1038/nature13165

[83]

A. Fisch, *Neuroanatomy: draw it to know it*, 2nd ed. New York: Oxford University Press, 2012. Available: <http://dx.doi.org/10.1093/med/9780199845712.001.0001>

[84]

T A Yousry, 'Localization of the motor hand area to a knob on the precentral gyrus. A new landmark.', *Brain*, vol. 120, no. 1, pp. 141–157, 1997, Available:

<http://brain.oxfordjournals.org/content/120/1/141>