

# BEYOND THROMBOLYTICS: MEDICAL MANAGEMENT OF ACUTE STROKE AND ITS EARLY COMPLICATIONS

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- Supportive care for ischemic stroke has two main objectives: 1) to minimize injury to potentially ischemic brain tissue, and 2) to prevent and treat the many neurologic and medical complications that may occur in the immediate period following stroke
- Particular attention should be paid to the following parameters: respiration, blood pressure, skin care, dysphagia/aspiration, urinary dysfunction, hospital acquired infection, venous thromboembolism, seizures, spasticity, and depression
- Prevention of ischemic stroke entails control of modifiable risk factors (arterial hypertension, diabetes mellitus, dyslipidemia, cigarette smoking, obesity, excessive alcohol intake), pharmacologic therapy, and surgical intervention
- Antithrombotic agents (antiplatelet agents or anticoagulants) and thrombolytic agents are the mainstays of medical therapy for acute ischemic stroke
- Choosing an antithrombotic agent in the management of acute ischemic stroke: risks, benefits, indications, and timeliness of use/balancing risk of ischemic and hemorrhagic complications
- IV tPA initiated up to 4.5 hours of symptom onset is a first-line treatment for acute ischemic stroke in selected patients
- Endovascular mechanical thrombectomy should be pursued for patients with large artery occlusion of the ICA terminus or proximal MCA (M1) with groin puncture achieved within 6 hours of symptom onset.
- Patients deemed suitable for IV thrombolysis should still receive IV tPA even if endovascular treatment will be pursued
- Consideration of thrombolysis and endovascular therapy for acute stroke in patients exposed to anticoagulation and antiplatelets
- Acute complications of antithrombotic use: management and long-term risk assessment
- Early (<48 hours) decompressive surgery with hemicraniectomy and durotomy may be lifesaving in patients with malignant cerebral edema

## References

- Adams HP Jr, del Zoppo G, Alberts MJ, et al. Guidelines for the early management of adults with ischemic stroke: 2007 guidelines update a scientific statement from the stroke council of the American Heart Association/American Stroke Association. *Stroke* 2007;38(5):1655-711. [PMID 17431204](#)
- Anderson CS, Heeley E, Huang Y, et al. Rapid blood-pressure lowering in patients with acute intracerebral hemorrhage. *N Engl J Med* 2013;368(25):2355-65. [PMID 23713578](#)
- Anderson CS, Huang Y, Wang JG, et al. Intensive blood pressure reduction in acute cerebral haemorrhage trial (INTERACT): a randomised pilot trial. *Lancet Neurol* 2008;7(5): 391-9. [PMID 18396107](#)
- Berge E, Abdelnoor M, Nakstad PH, Sandset PM. Low molecular-weight heparin versus aspirin in patients with acute ischaemic stroke and atrial fibrillation: a double-blind randomised study. HAEST Study Group. Heparin in Acute Embolic Stroke Trial. *Lancet* 2000;355(9211):1205-10. [PMID 10770301](#)
- Berkhemer OA, Puck FSS, Beumer D, et al. MR CLEAN investigators. A randomized trial of intraarterial treatment of acute ischemic stroke. *NEJM*. 2015;372:11-20.
- Biffi A, Devan WJ, Anderson CD, et al. Statin treatment and functional outcome after ischemic stroke: case-control and meta-analysis. *Stroke* 2011;42(5):1314-9. [PMID 21415396](#)
- Bladin CF, Alexandrov AV, Bellavance A, et al. Seizures after stroke: a prospective multicenter study. *Arch Neurol* 2000;57(11):1617-22. [PMID 11074794](#)

- Blanco M, Nombela F, Castellanos M, et al. Statin treatment withdrawal in ischemic stroke: a controlled randomized study. *Neurology* 2007;69(9):904-10. PMID 17724294
- Camilo O, Goldstein LB. Seizures and epilepsy after ischemic stroke. *Stroke* 2004;35(7):1769-75. PMID 15166395
- Campbell BC, Mitchell PJ, Kleinig TJ, et al. EXTEND-IA Investigators. Endovascular therapy for ischemic stroke with perfusion-imaging selection. *NEJM*. 2015;372:1009-1018
- Chamorro A, Horcajada JP, Obach V, et al. The Early Systemic Prophylaxis of Infection After Stroke study: a randomized clinical trial. *Stroke* 2005;36(7):1495-500. PMID 15961713
- Chen ZM, Sandercock P, Pan HC, et al. Indications for early aspirin use in acute ischemic stroke : a combined analysis of 40 000 randomized patients from the chinese acute stroke trial and the international stroke trial. On behalf of the CAST and IST collaborative groups. *Stroke* 2000;31(6):1240-9. PMID 10835439
- Coull BM, Williams LS, Goldstein LB, et al. Anticoagulants and antiplatelet agents in acute ischemic stroke: report of the Joint Stroke Guideline Development Committee of the American Academy of Neurology and the American Stroke Association (a division of the American Heart Association). *Stroke* 2002;33(7):1934-42. PMID 12105379
- Els T, Klisch J, Orszagh M, et al. Hyperglycemia in patients with focal cerebral ischemia after intravenous thrombolysis: influence on clinical outcome and infarct size. *Cerebrovasc Dis* 2002;13(2):89-94. PMID 11867881
- Evans A, Harraf F, Donaldson N, Kalra L. Randomized controlled study of stroke unit care versus stroke team care in different stroke subtypes. *Stroke* 2002;33(2):449-55. PMID 11823651
- Flaster M, Morales-Vidal S, Schneck M, Biller J. Stroke Supportive Care. *MedLink Neurology* 2014.
- Food Trial Collaboration. Poor nutritional status on admission predicts poor outcomes after stroke: observational data from the FOOD trial. *Stroke* 2003;34(6):1450-6.
- Goyal M, Demchuk AM, Menon BK, et al. ESCAPE Trial Investigators. Randomized assessment of rapid endovascular treatment of ischemic stroke. *NEJM*. 2015;372:1019-1030
- Gray CS, Hildreth AJ, Sandercock PA, et al. Glucose-potassium-insulin infusions in the management of post-stroke hyperglycaemia: the UK Glucose Insulin in Stroke Trial (GIST-UK). *Lancet Neurol* 2007;6(5):397-406. PMID 17434094
- Hacke W, Kaste M, Bluhmki E, et al. ECASS Investigators. Thrombolysis with alteplase 3 to 4.5 hours after acute ischemic stroke. *NEJM*. 2008;359:1317-1329
- He J, Zhang Y, Xu T, et al. Effects of immediate blood pressure reduction on death and major disability in patients with acute ischemic stroke: the CATIS randomized clinical trial. *JAMA* 2014;311(5):479-89. PMID 24240777
- Hillis AE, Ulatowski JA, Barker PB, et al. A pilot randomized trial of induced blood pressure elevation: effects on function and focal perfusion in acute and subacute stroke. *Cerebrovasc Dis*. 2003;16:236-46. PMID 12865611
- Johnston KC, Hall CE, Kissela BM, et al. Glucose Regulation in Acute Stroke Patients (GRASP) trial: a randomized pilot trial. *Stroke* 2009;40(12):3804-9. PMID 19834016
- Kelly J, Hunt BJ, Lewis RR, et al. Dehydration and venous thromboembolism after acute stroke. *QJM* 2004;97(5):293-6. PMID 15100423
- Kelly J, Rudd A, Lewis R, Hunt BJ. Venous thromboembolism after acute stroke. *Stroke* 2001;32(1):262-7. PMID 11136946
- Kidwell CS, Saver JL, Carneado J, et al. Predictors of hemorrhagic transformation in patients receiving intra-arterial thrombolysis. *Stroke* 2002;33(3):717-24. PMID 11872894
- Leonardi-Bee J, Bath PM, Phillips SJ, Sandercock PA; IST Collaborative Group. Blood pressure and clinical outcomes in the International Stroke Trial. *Stroke* 2002;33(5):1315-20. PMID 11988609
- McColl BW, Allan SM, Rothwell NJ. Systemic infection, inflammation and acute ischemic stroke. *Neuroscience* 2009;158(3):1049-61. PMID 18789376
- Mendelow AD, Gregson BA, Fernandes HM, et al. Early surgery versus initial conservative treatment in patients with spontaneous supratentorial intracerebral haematomas in the International Surgical Trial in Intracerebral Haemorrhage (STICH): a randomised trial. *Lancet* 2005 365(9457):387-97.
- Mistri AK, Thompson GR, Potter JF. Pressor Therapy in Acute Ischemic Stroke. *Stroke* 2006;37:1565-71. PMID 16675735
- NICE-SUGAR Study Investigators, Finfer S, Chittock DR, et al. Intensive versus conventional glucose control in critically ill patients. *N Eng J Med* 2009;360(13):1283-97.

- Ni Chroinin D, Callaly EL, Duggan J, et al. Association between acute statin therapy, survival and improved functional outcome after ischemic stroke: the North Dublin Population Stroke Study. *Stroke* 2011;42(4):1021-9. [PMID 21372311](#)
- Novak V, Chowdhary A, Farrar B, et al. Altered cerebral vasoregulation in hypertension and stroke. *Neurology* 2003;60(10):1657-63. [PMID 12771258](#)
- Ovbiagele B, Schwamm LH, Smith EE, et al. Recent nationwide trends in discharge statin treatment of hospitalized patients with stroke. *Stroke* 2010;41(10):2271-7. [PMID 20724709](#)
- Parsons MW, Barber PA, Desmond PM, et al. Acute hyperglycemia adversely affects stroke outcome: a magnetic resonance imaging and spectroscopy study. *Ann Neurol* 2002;52(1):20-8. [PMID 12112043](#)
- Perron AD, Brady WJ. Electrocardiographic manifestations of CNS events. *Am J Emerg Med* 2000;18(6):715-20. [PMID 11043629](#)
- Potter, JF, Robinson, TG, Ford GA, et al. Controlling hypertension and hypotension immediately post-stroke (CHHIPS): a randomised, placebo-controlled, double-blind pilot trial. *Lancet Neurol* 2009;8(1):48-56. [PMID 19058760](#)
- Powers WJ, Derdeyn CP, Biller J, et al. 2015 AHA/ASA focused update of the 2013 guidelines for the early treatment of patients with acute ischemic stroke regarding endovascular treatment. *Stroke*. 2015;46:1-47
- Qaseem A, Chou R, Humphrey LL, Starkey M, Shekelle P; Clinical Guidelines Committee of the American College of Physicians. Venous thromboembolism prophylaxis in hospitalized patients: a clinical practice guideline from the American College of Physicians. *Ann Intern Med* 2011;155(9):625-32. [PMID 22041951](#)
- Sacco RL, Adams R, Albers G, et al. Guidelines for prevention of stroke in patients with ischemic stroke or transient ischemic attack: a statement for healthcare professionals from the American Heart Association/American Stroke Association Council on Stroke: co-sponsored by the Council on Cardiovascular Radiology and Intervention: the American Academy of Neurology affirms the value of this guideline. *Stroke* 2006;37(2):577-617. [PMID 16534023](#)
- Sanossian N, Saver JL, Liebeskind DS, Kim D, Razinia T, Ovbiagele B. Achieving target cholesterol goals after stroke: is in-hospital statin initiation the key. *Arch Neurol* 2006;63(8):1081-3. [PMID 16908732](#)
- Saver J, Goyal M, Bonafe A, et al. SWIFT PRIME Investigators. Solitaire with the intention for thrombectomy as primary endovascular treatment for acute ischemic stroke (SWIFT PRIME) trial: protocol for a randomized, controlled, multicenter study comparing the Solitaire revascularization device with IV tPA and IV tPA alone in acute ischemic stroke. *Int J Stroke*. 2015;10:439-448
- Schrader J, Luders S, Kulschewski A, et al. The ACCESS Study: evaluation of Acute Candesartan Cilxetil Therapy in Stroke Survivors. *Stroke* 2003;34(7):1699-703. [PMID 12817109](#)
- Schwab S, Steiner T, Aschoff A, et al. Early hemispherectomy in patients with complete middle cerebral artery infarction. *Stroke* 1998;29(9):1888-93. [PMID 9731614](#)
- Schwarz S, Georgiadis D, Aschoff A, Schwab S. Effects of body position on intracranial pressure and cerebral perfusion in patients with large hemispheric stroke. *Stroke* 2002a;33(2):497-501. [PMID 11823659](#)
- Schwarz S, Georgiadis D, Aschoff A, Schwab S. Effects of induced hypertension on intracranial pressure and flow velocities of the middle cerebral arteries in patients with large hemispheric stroke. *Stroke* 2002b;33(4):998-1004. [PMID 11935051](#)
- Sherman DG, Albers GW, Bladin C, et al. The efficacy and safety of enoxaparin versus unfractionated heparin for the prevention of venous thromboembolism after acute ischaemic stroke (PREVAIL Study): an open-label randomised comparison. *Lancet* 2007 21;369(9570):1347-55.
- Shuaib A, Bornstein NM, Diener HC, et al. Partial aortic occlusion for cerebral perfusion augmentation: safety and efficacy of NeuroFlo in Acute Ischemic Stroke trial. *Stroke* 2011;42(6):1680-90. [PMID 21566232](#)
- Singhal AB, Benner T, Roccatagliata L, et al. A pilot study of normobaric oxygen therapy in acute ischemic stroke. *Stroke* 2005;36(4):797-802. [PMID 15761201](#)
- Singhal AB, Ratai E, Benner T, et al. Magnetic resonance spectroscopy study of oxygen therapy in ischemic stroke. *Stroke* 2007;38(10):2851-4. [PMID 17761914](#)
- Tanne D, Kasner SE, Demchuk AM, et al. Markers of increased risk of intracerebral hemorrhage after intravenous recombinant tissue plasminogen activator therapy for acute ischemic stroke in clinical practice: the Multicenter rt-PA Stroke Survey. *Circulation* 2002;105(14):1679-85. [PMID 11940547](#)
- Tong X, Kuklina EV, Gillespie C, George MG. Medical complications among hospitalizations for ischemic stroke in the United States from 1998 to 2007. *Stroke* 2010;41(5):980-6. [PMID 20203317](#)
- Vahedi K, Hofmeijer J, Juettler E, et al. Early decompressive surgery in malignant infarction of the middle cerebral artery: a pooled analysis of three randomised controlled trials. *Lancet Neurol* 2007;6(3):215-22. [PMID 17303527](#)

Van den Berghe G, Wouters P, Weekers F, et al. Intensive insulin therapy in the critically ill patients. *N Engl J Med* 2001;345(19):1359-67. [PMID 11794168](#)

Wagner S, Schnippering H, Aschoff A, et al. Suboptimum hemicraniectomy as a cause of additional cerebral lesions in patients with malignant infarcts of the middle cerebral artery. *J Neurosurg*. 2001;94:693-696

Wang Y, Lim LL, Levi C, Heller RF, Fisher J. Influence of admission body temperature on stroke mortality. *Stroke* 2000;31(2):404-9. [PMID 10657413](#)

Westendorp WF, Nederkoorn PJ, Vermeij JD, Dijkgraaf MG, van de Beek D. Post-stroke infection: a systematic review and meta-analysis. *BMC Neurol* 2011;11:110. [PMID 21933425](#)