

香港糖尿科護士協會
Association of Hong Kong Diabetes Nurses

The 18th AHKDN Annual Symposium
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Time is Brain: Medical Strategies in Managing Acute Ischemic Stroke

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Disclosures

I have no disclosure



Time is Brain

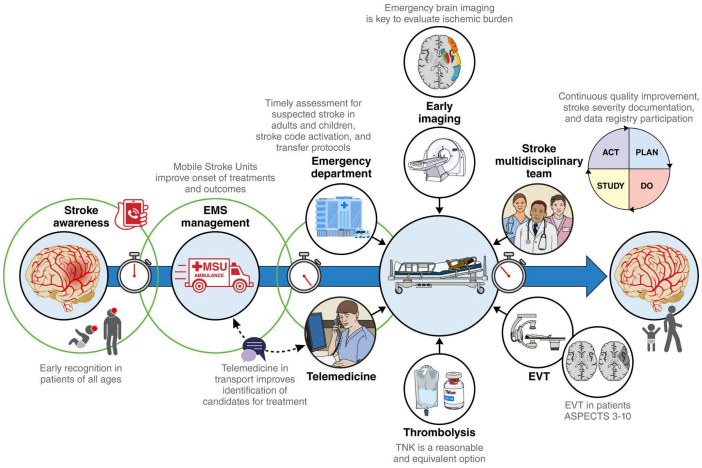




Time is Brain

1 Minute of ischemia
= 2M neuron loss!!





Acute Stroke Recognition and Assessment Protocol based Hyperacute Reperfusion Pathway

Contents of Today's Talk

- Hyperacute reperfusion therapy: Protocol based rapid pathway; IV rTPA
- ASU and close monitoring
- Cardiovascular risk factor optimisation
- Post-stroke complications
- Rehabilitation: rTMS, Botox
- DM specific topics

Clinical Signs Recognition

Facial asymmetry

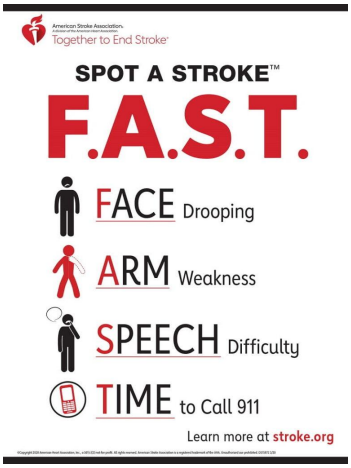
Limb weakness

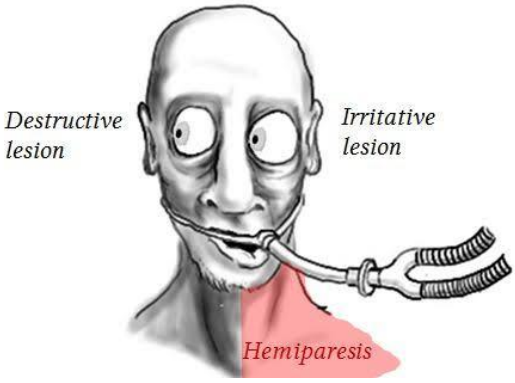
Slurring

Gaze deviation

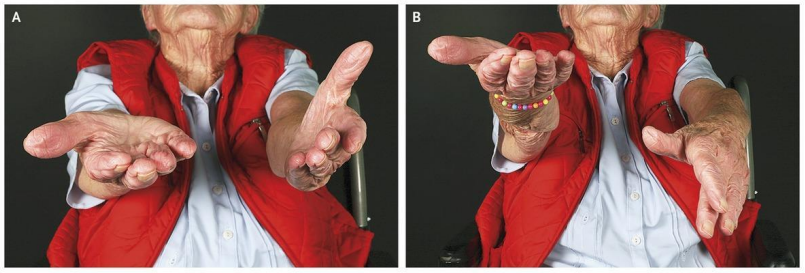
Dysphasia

Neglect





https://derangedphysiology.com/main/required-reading/neurological-intensive-care/Chapter-463/examination-eye-movements-cn-iii-iv-vi



https://www.rugd.net.au/pocit/PronatorDrift.htm

CT Brain Interpretation

Lacunar

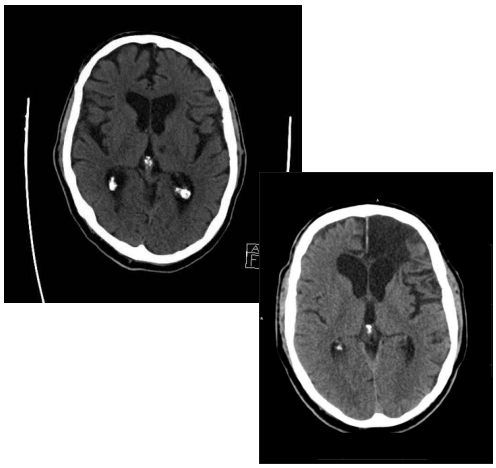
Cortical

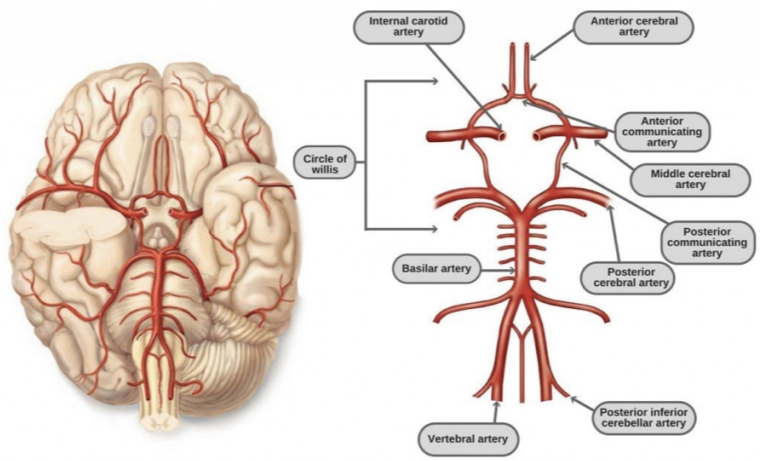
By Vascular territories

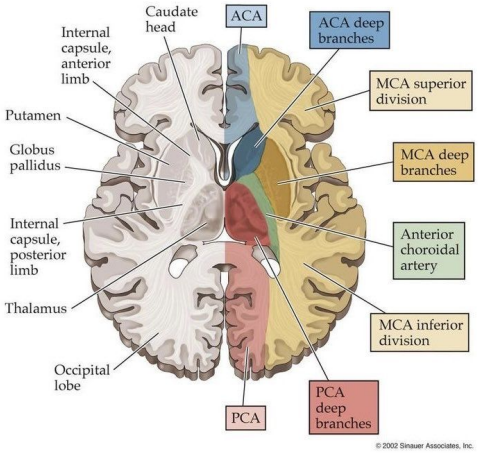
MCA

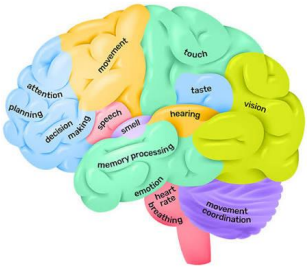
ACA

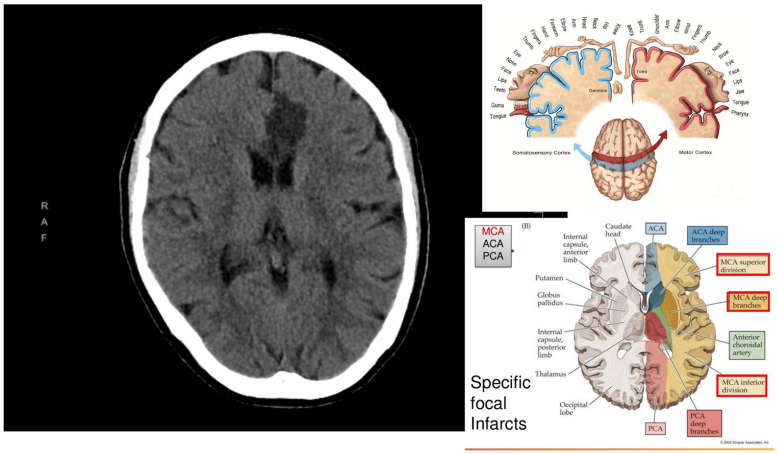
PCA

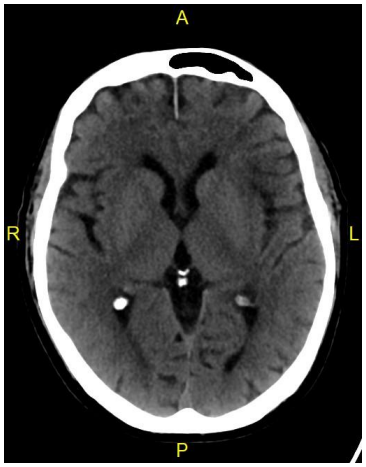














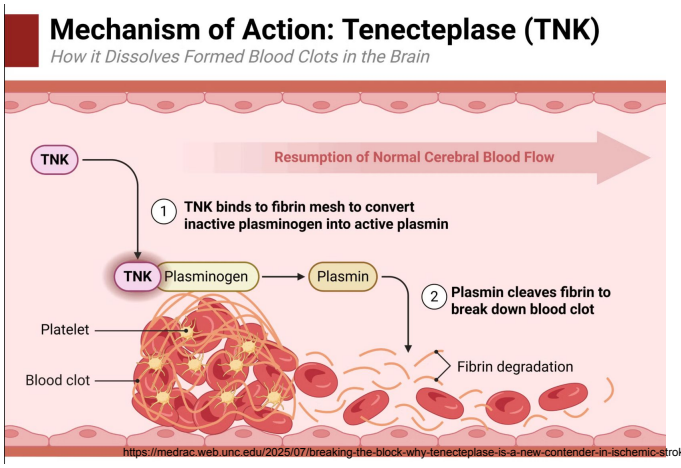


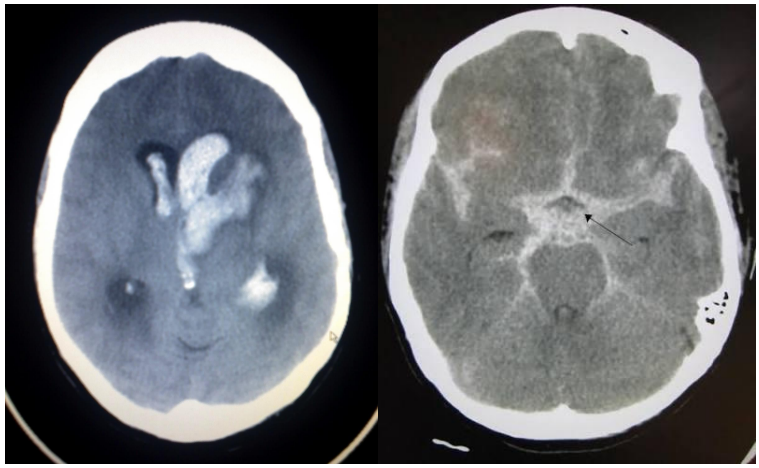
IV Thrombolysis - rTPA

Recombinant Tissue Plasminogen Activator



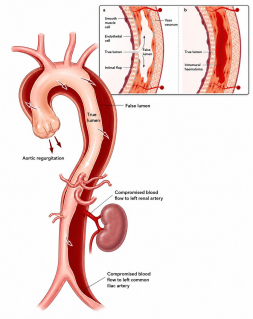




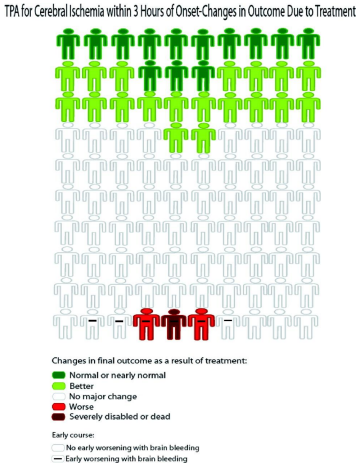


Absolute Contraindications

- CT brain with hemorrhage
- CT brain with extensive hypodensity (established infarct)
- Intra-axial brain tumour
- Aortic dissection
- Recent Neurosurgery
- Recent Moderate to severe traumatic brain injury
- Severe Coagulopathy or thrombocytopenia
- And others..

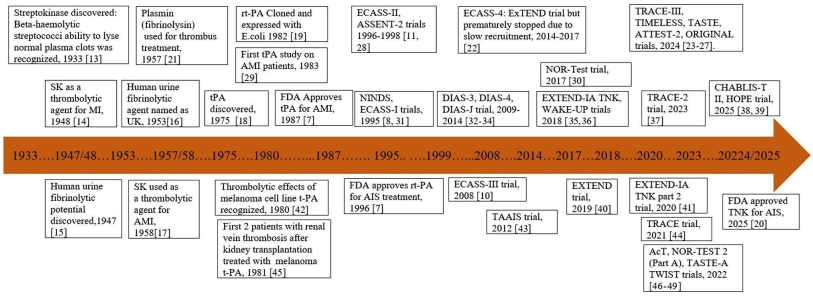


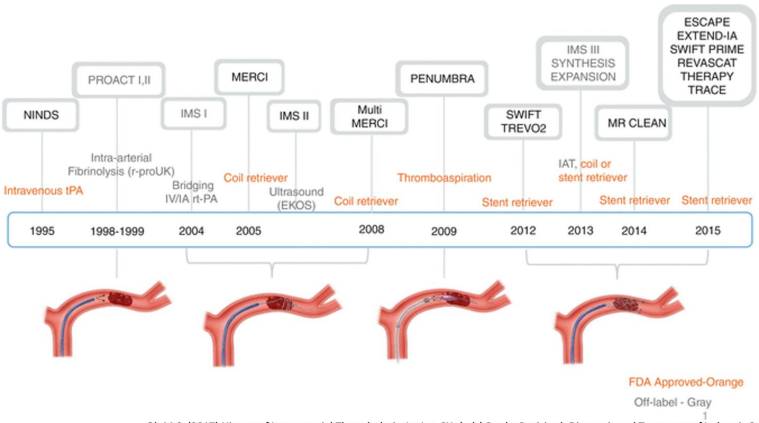
Gadhia J, Starkman S, Ovbiagele B, Ali L, Liebeskind D, Saver JL. Assessment and improvement of figures to visually convey benefit and risk of stroke thrombolysis. Stroke. 2010 Feb;41(2):300-6. doi: 10.1161/STROKEAHA.109.566935. Epub 2010 Jan 7. PMID: 20056928; PMCID: PMC2909659.



Decision to IV thrombolysis

- Patient's premorbid
- Patient's stroke symptoms and severity / disabling symptoms
- Time window
- CT to exclude contraindications
- Exclude major contraindications
- Consent
- Ensure BP suitable for IV thrombolysis
- Proceed to IV thrombolysis ASAP





Oh M.S. (2017) History of Intra-arterial Thrombolysis. In: Lee SH. (eds) Stroke Revisited: Diagnosis and Treatment of Ischemic Stroke. Stroke Revisited. Springer, Singapore. https://doi.org/10.1007/978-981-10-1424-6_7

Monitoring in ASU

After patient is admitted...

- Swallowing assessment, NGT insertion if unfit for oral feeding
- BP control → permissive hypertension if no comorbidities (< 220/120)
- Hstix control → poor hstix control in acute stroke is associated with poor prognosis (2026 AHA guideline aim around 7-10)
- Neurological observation
- Cardiac investigations → how extensive?
- Vascular investigations → what modality?
- Blood monitoring, risk factor control
- Antithrombotic
- Treatment of acute brain complications
- Treatment of other stroke complications
- Early mobilization and rehabilitation
- Prevention of future stroke
- Stroke education

4.5. Blood Glucose Management

Recommendations for Blood Glucose Management Referenced studies that support the recommendations are summarized in the online data supplement.		
COR	LOE	Recommendations
1	C-LD	1. In patients with AIS, hypoglycemia (blood glucose <60 mg/dL) should be treated to avoid complications.[1,2]
2a	C-LD	2. In patients with AIS, it is reasonable to treat persistent hyperglycemia to achieve blood glucose levels in a range of 140 to 180 mg/dL with close monitoring to prevent worse functional outcomes.[1,2]
3: No Benefit	A	3. In hospitalized patients with AIS with hyperglycemia, treatment with IV insulin to achieve blood glucose levels in the range of 80 to 130 mg/dL is not recommended to improve 3-month functional outcomes.[3–5]

Prabhakaran et al — 2026 Acute Ischemic Stroke Guideline

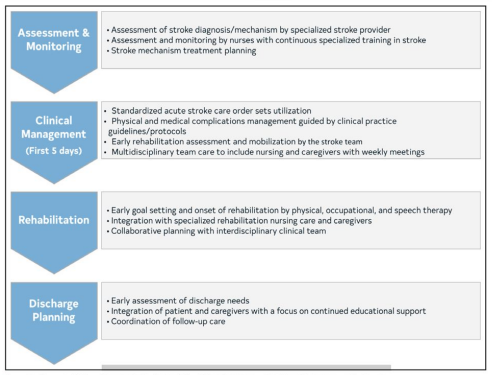


Figure 5. Characteristics of an organized specialized inpatient care unit: flow diagram.

AHA 2026

Blood Glucose Management

7.8 - 10 mmol/L

~~4.4 - 7.2 mmol/L~~

4.5. Blood Glucose Management

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Stress induced hyperglycemia

Acute stroke → high probability of stress hyperglycemia

Higher admission glucose levels in non-survivors of stroke than in AIS survivors

Glucose level at admission is a meaningful independent predictor of mortality or poor functional prognosis after stroke

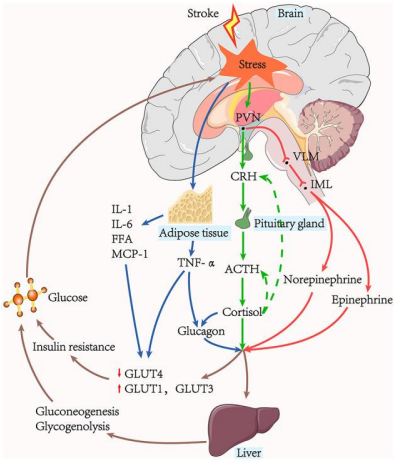
Peng, Zhouzhou, et al. "Association between stress hyperglycemia and outcomes in patients with acute ischemic stroke due to large vessel occlusion." *CNS neuroscience & therapeutics* 29.8 (2023): 2162-2170.

Neuroprotective effects of hyperglycemia in acute stroke

Glucose regulatory center,

Hypothalamic–pituitary–adrenal (HPA) axis

Sympathetic adrenomedullary system



Yao, Mengyue, et al. "A review of stress-induced hyperglycaemia in the context of acute ischaemic stroke: definition, underlying mechanisms, and the status of insulin therapy." *Frontiers in Neurology* 14 (2023): 1149671.

Where there is Imbalance

- Stressful inflammatory response: release of neurotoxic and vasoconstrictive factors that further damage vascular endothelial cells
- Directly poison ischemic brain tissue: lactic acid deposition; impair cortical collateral perfusion
- Abnormal aggregation of platelets
- Damage the blood–brain barrier and promote the transformation of hemorrhagic infarction

Peng, Zhouzhou, et al. "Association between stress hyperglycemia and outcomes in patients with acute ischemic stroke due to large vessel occlusion." *CNS neuroscience & therapeutics* 29.8 (2023): 2162-2170.

Future Research Direction

Criteria for initiating glucose lowering after AIS ?

Timing of dosing and duration of treatment?

Target range of glycaemic control?

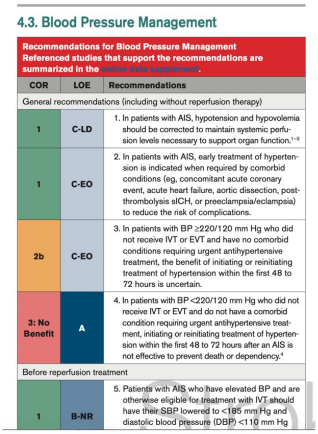
Treatment options other than insulin?

Yao, Mengyue, et al. "A review of stress-induced hyperglycaemia in the context of acute ischaemic stroke: definition, underlying mechanisms, and the status of insulin therapy." *Frontiers in Neurology* 14 (2023): 1149671.

General recommendation without reperfusion therapy:

Permissive HT if BP < 220 / 120 and without other comorbidity in 48-72 hours

75% patient will have their BP automatically go down



4.3. Blood Pressure Management

Recommendations for Blood Pressure Management
Referenced studies that support the recommendations are summarized in the Tables and Synopses.

COR	LOE	Recommendations
General recommendations (including without reperfusion therapy)		
1	C-LD	1. In patients with AIS, hypotension and hypovolemia should be corrected to maintain systemic perfusion levels necessary to support organ function.[1-3]
1	C-EO	2. In patients with AIS, early treatment of hypertension is indicated when required by comorbid conditions (eg, concomitant acute coronary event, acute heart failure, aortic dissection, post-thrombolysis sICH, or preeclampsia/eclampsia) to reduce the risk of complications.
2b	C-EO	3. In patients with BP ≥220/120 mm Hg who did not receive IVT or EVT and have no comorbid conditions requiring urgent antihypertensive treatment, the benefit of initiating or reinitiating treatment of hypertension within the first 48 to 72 hours is uncertain.
3: No Benefit	A	4. In patients with BP <220/120 mm Hg who did not receive IVT or EVT and do not have a comorbid condition requiring urgent antihypertensive treatment, initiating or reinitiating treatment of hypertension within the first 48 to 72 hours after an AIS is not effective to prevent death or dependency.[4]
Before reperfusion treatment		
1	B-NR	5. Patients with AIS who have elevated BP and are otherwise eligible for treatment with IVT should have their SBP lowered to <185 mm Hg and diastolic blood pressure (DBP) <110 mm Hg

High Intensity Statin

Use lifestyle and high-intensity statin therapy to reduce LDL cholesterol by ≥50% from baseline to a goal of <55 mg/dL (<1.4 mmol/L).

→ Add ezetimibe or a PCSK9-directed therapy with demonstrated benefit if LDL cholesterol goals are not met on maximum tolerated statin therapy.

→ Use an alternative lipid-lowering treatment for those who are statin intolerant:

- PCSK9 inhibitor with monoclonal antibody treatment
- Bempedoic acid
- PCSK9 inhibitor with siRNA inclisiran

High-intensity statin therapy	Moderate-intensity statin therapy	Low-intensity statin therapy
LDL-C reduction ≥ 50%	LDL-C reduction 30-50%	LDL-C reduction <30%.
Atorvastatin 40-80 mg Rosuvastatin 20-40 mg	Atorvastatin 10-20 mg Rosuvastatin 5-10 mg Simvastatin 20-40 mg Pravastatin 40-80 mg Lovastatin 40 mg Fluvastatin XL 80 mg Fluvastatin 40 mg b.i.d. Pitavastatin 2-4 mg	Simvastatin 10 mg Pravastatin10-20 mg Lovastatin 20 mg Fluvastatin 20-40 mg Pitavastatin

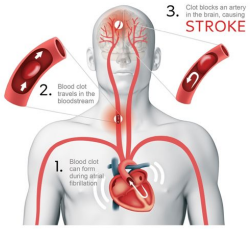
Section 10: Cardiovascular Disease and Risk Management. *Clin Diabetes* 18 April 2025; 43 (2): 212–214. https://doi.org/10.2337/cd25-a010

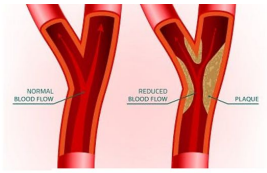
Anti-thrombotic Agents – Simple Scenarios

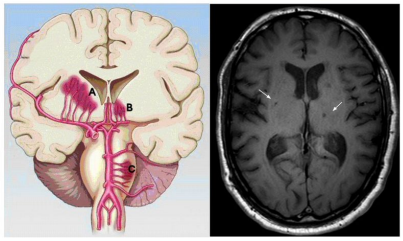
- Stroke/ TIA with AF: anticoagulation
- Moderate to severe stroke: single antiplatelet
- Minor stroke or high risk TIA: DAPT for 21 days then single antiplatelet
- Intracranial Atherosclerotic Disease (ICAD): DAPT for 90 days than single antiplatelet

ASCOD Classification

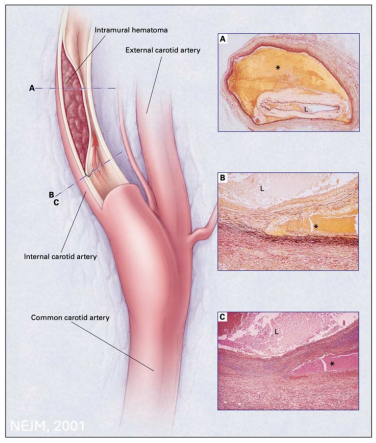
- Atherosclerosis
- Small vessel disease
- Cardiac pathology
- Other causes
- Dissection







https://www.flintrehab.com/atherosclerosis-and-stroke/
Norrving, Bo. "Lacunar infarcts: no black holes in the brain are benign." *Practical neurology* 8.4 (2008): 222-228.
http://syllabus.cwru.edu/YearThree/neuroscience/NeurLrngObjectives/Lacunar%20Stroke.htm
https://www.heartfoundation.org.nz/your-heart/heart-conditions/atrial-fibrillation



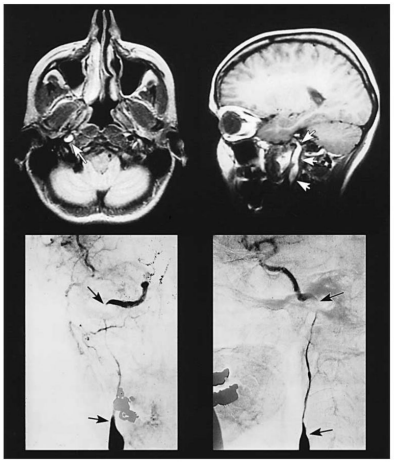


TABLE 10-1 Uncommon Causes of Stroke

Inherited

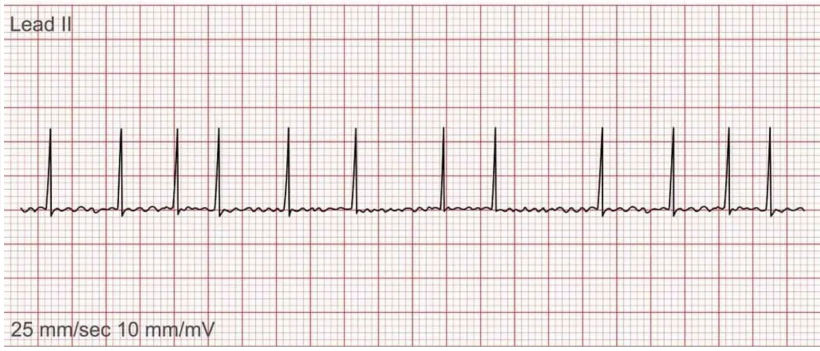
- ▸ **Primarily Ischemic Stroke**
  - Genetic causes
    - Fabry disease[a]
    - Cerebral autosomal dominant arteriopathy with subcortical infarcts and leukoencephalopathy (CADASIL)[a]
    - Cerebral autosomal recessive arteriopathy with subcortical infarcts and leukoencephalopathy (CARASIL)[a]
    - Retinal vasculopathy with cerebral leukodystrophy[a]
    - *COL4A1*-related cerebral small vessel disease[a]
  - Cervical and intracranial arterial dissection
  - Hypercoagulability (acquired and genetic)
  - Vasculopathy
    - Fibromuscular dysplasia
    - Radiation-induced vasculopathy
  - Cardioembolic
    - Endocarditis
    - Autoimmune valvular disease
  - Central nervous system infection
    - HIV
    - Varicella-zoster virus
    - Bacterial meningitis
    - Others
  - Migrainous infarction

Non-inherited

- ▸ **Intracerebral Hemorrhage**
  - Cerebral amyloid angiopathy[a]
  - Cerebral cavernous malformations (genetic and sporadic)
  - Hereditary cerebral hemorrhage with amyloidosis (Dutch type and Icelandic type)
- ▸ **Both Ischemic Stroke and Intracerebral Hemorrhage (Either or Mixed)**
  - Moyamoya (disease and syndrome)[a]
  - Sickle cell anemia
  - Hereditary hemorrhagic telangiectasia
  - Vasculitis and inflammatory conditions
  - Posterior reversible encephalopathy syndrome (PRES)
  - Reversible cerebral vasoconstriction syndrome (RCVS)
  - Cerebral venous sinus thrombosis (CVST)
  - Pregnancy (preeclampsia/eclampsia, hypercoagulability, CVST, RCVS, PRES)[a]
  - Recreational drug use

Continuum, AAN, 2017

Atrial Fibrillation (AF)



The CHA_2DS_2VASc Score to Estimate Risk of Stroke in Patients with Atrial Fibrillation[a]

CHA_2DS_2VASc Score[b]	Annual Stroke Risk Percentage (95% Confidence Interval)	Recommendation
0	0.8 (0.6–1.0)	No antithrombotic
1	2.0 (1.7–2.4)	Antiplatelet or anticoagulation
2	3.7 (3.4–4.1)	Anticoagulation
3	5.9 (5.5–6.3)	Anticoagulation
4	9.3 (8.7–9.9)	Anticoagulation
5	15.3 (14.3–16.2)	Anticoagulation
6	19.7 (18.2–21.4)	Anticoagulation
7	21.5 (18.8–24.6)	Anticoagulation
8	22.4 (16.3–30.8)	Anticoagulation
9	23.6 (10.6–52.6)	Anticoagulation

[a] Modified with permission from Olesen JB, et al, BMJ.[49] © 2011 British Medical Journal Publishing Group Ltd.
[b] CHA_2DS_2VASc

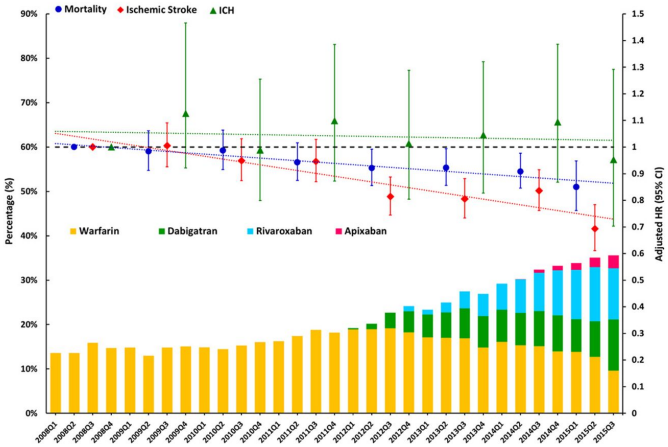
Congestive heart failure	1 point
Hypertension	1 point
Age ≥ 75 years	2 points
Diabetes mellitus	1 point
Stroke/transient ischemic attack/thromboembolism	2 points
Vascular disease (prior myocardial infarction, peripheral artery disease, or aortic plaque)	1 point
Age 65–74 years	1 point
Sex category (female)	1 point

CHA_2DS_2-VASc risk factor	Points
Congestive heart failure Signs/symptoms of heart failure or objective evidence of reduced left-ventricular ejection fraction	+1
Hypertension Resting blood pressure >140/90 mmHg on at least two occasions or current antihypertensive treatment	+1
Age 75 years or older	+2
Diabetes mellitus Fasting glucose >125 mg/dL (7 mmol/L) or treatment with oral hypoglycaemic agent and/or insulin	+1
Previous stroke, transient ischaemic attack, or thromboembolism	+2
Vascular disease Previous myocardial infarction, peripheral artery disease, or aortic plaque	+1
Age 65–74 years	+1
Sex category (female)	+1

Continuum, AAN

Anticoagulation in AF Stroke Prevention

- Anticoagulation is effective in AF stroke prevention
- Warfarin reduced the primary event rate in the randomized SPAF trial (Stroke Prevention in Atrial Fibrillation Study) by 67%
- NOAC has similar efficacy but lower bleeding risks
- The ease of NOAC use improves compliance



Chao, Tze-Fan, et al. "Evolving changes of the use of oral anticoagulants and outcomes in patients with newly diagnosed atrial fibrillation in Taiwan." *Circulation* 138. 14 (2018): 1485-1487.

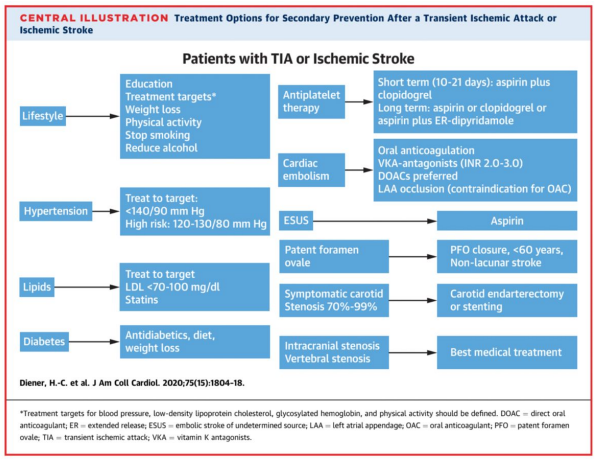
NOAC Compliance

Cost e.g. SFI

Capsule format - Dabigatran

GI upset / Bleeding Tendency

Route of administration - Dabigatran cannot be crushed (NGT not applicable)



Stroke and DM

Epidemiology

The prevalence of diabetes in people with all types of stroke is 28%.

The rate is greater in those with ischemic (33%) compared with hemorrhagic (26%) stroke.

Diabetic stroke patients are relatively younger and have more comorbidities than those without diabetes.

High stroke recurrence in diabetic patients

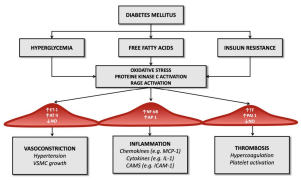


Figure 1. Diabetes' mechanisms of vascular damage.

Maida, Carlo Domenico, et al. "Diabetes and ischemic stroke: an old and new relationship an overview of the close interaction between these diseases." *International journal of molecular sciences* 23.4 (2022): 2397.

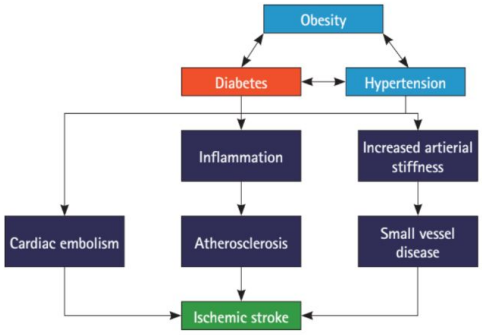


Figure 2. Potential pathophysiological mechanisms wherein diabetes leads to (ischemic) stroke.

Mosenzon, Ofri, et al. "Diabetes and stroke: what are the connections?." *Journal of stroke* 25.1 (2023): 26-38.

Mosenzon, Ofri, et al. "Diabetes and stroke: what are the connections?." *Journal of stroke* 25.1 (2023): 26-38.

DM and Stroke Outcome

Hyperglycemia during acute phase associated with poor stroke outcome

Poor post-stroke outcome in DM patients
-Cognitive impairment
-Length of stay
-Dependence

Mosenzon, Ofri, et al. "Diabetes and stroke: what are the connections?." *Journal of stroke* 25.1 (2023): 26-38.

Approach to DM after ischemic stroke / TIA

Screening for DM / Prediabetes with HbA1c, Fasting Glucose, or OGTT

Shifting from glycemic control (Glucose-centric approach) to complication driven, risk-stratified therapeutic approach

Choice of agents depends on presence of ASCVD / Risk profiles

Multi-factorial approach to manage glucose, blood pressure, and lipids, along with the use of renin-angiotensin system inhibitors, statins, and aspirin (where appropriate), has been shown to reduce both microvascular and cardiovascular complications of diabetes.

Mosenzon, Ofri, et al. "Diabetes and stroke: what are the connections?." *Journal of stroke* 25.1 (2023): 26-38.

Antiglycemic Agents with CVS Benefits

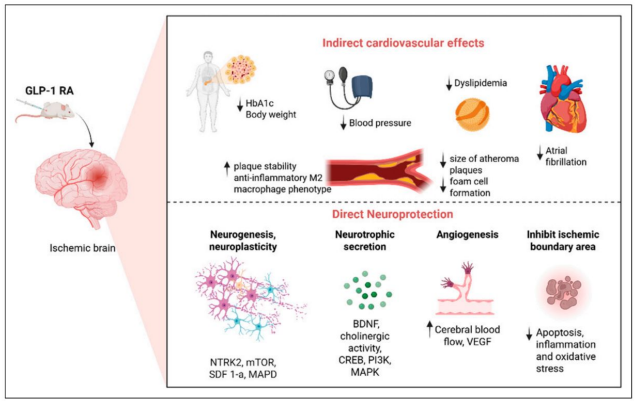
Cardiovascular Benefits: GLP-1 RAs, SGLT 2- i

Stroke risk reduction from Meta-analysis: GLP 1 RAs, Thiazolidinediones

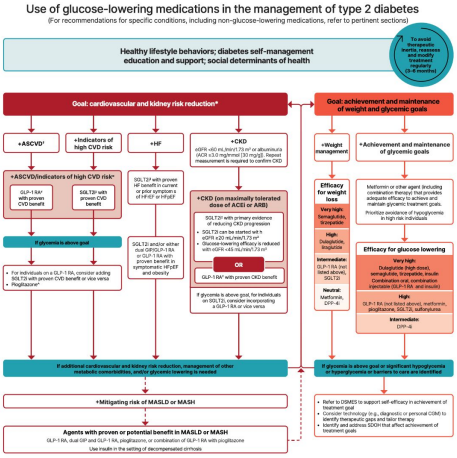
"Intensive glycemic control achieved with agents other than GLP-1 RAs or pioglitazone has not been shown to have any significant effect on stroke events in people with T2D. This suggests that the beneficial effect of GLP-1 RAs on stroke is not solely due to glycemic control. "

→ inflammation, fat distribution, lipid and protein metabolism, and vascular endothelial function

Mosenzon, Ofri, et al. "Diabetes and stroke: what are the connections?." *Journal of stroke* 25.1 (2023): 26-38.



Samanidou, Valentini, et al. "GLP-1 Receptor Agonists in Acute Ischemic Stroke and Secondary Stroke Prevention: A Narrative Review of Preclinical and Clinical Evidence." *Journal of Central Nervous System Disease* 18 (2026): 11795735261444425.



American Diabetes Association Professional Practice Committee for Diabetes*; 9. Pharmacologic Approaches to Glycemic Treatment: Standards of Care in Diabetes—2026. *Diabetes Care* 1 January 2026; 49 (Supplement_1): S183–S215. https://doi.org/10.2337/dc26-S009

A holistic, multifaceted, person-centered approach

Individualized glycemic goals

Weight goals

Risk for hypoglycemia

History of or risk factors for cardiovascular, kidney, liver, and other comorbidities and complications of diabetes

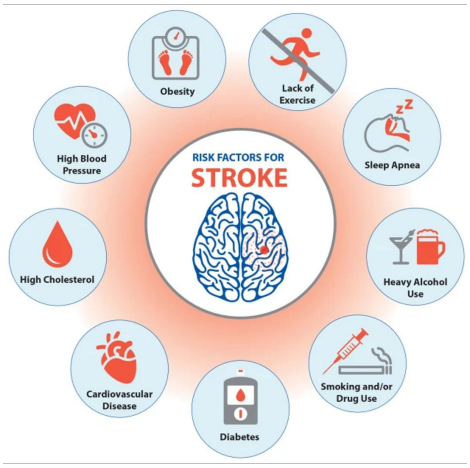
Tolerability and side effect profiles of medications

Complexity of the medication plan

Individual's capacity to implement it given their specific situation and context, and the access, cost, and availability of medications

Lifestyle modifications and health behaviors should be emphasized along with any pharmacologic therapy.

American Diabetes Association Professional Practice Committee for Diabetes*; 9. Pharmacologic Approaches to Glycemic Treatment: Standards of Care in Diabetes—2026. *Diabetes Care* 1 January 2026; 49 (Supplement_1): S183–S215. https://doi.org/10.2337/dc26-S009



Stroke Rehabilitation - Start Early!

Physical Impairments, Activity Limitations, Participation Restriction (Personal and Environmental factors)

Goal setting and Rehab plan formulation

Community integration

STROKE REHABILITATION



Common Complications Encountered in Stroke Rehab

Post-stroke depression

Post-stroke cognitive impairment

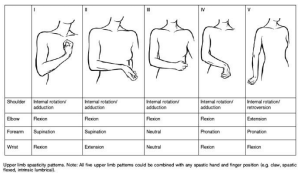
Post-stroke pain syndrome (Hemiplegic shoulder pain, thalamic pain syndrome, complex regional pain syndrome etc)

Spasticity Management

Botox indication: Spasticity Management

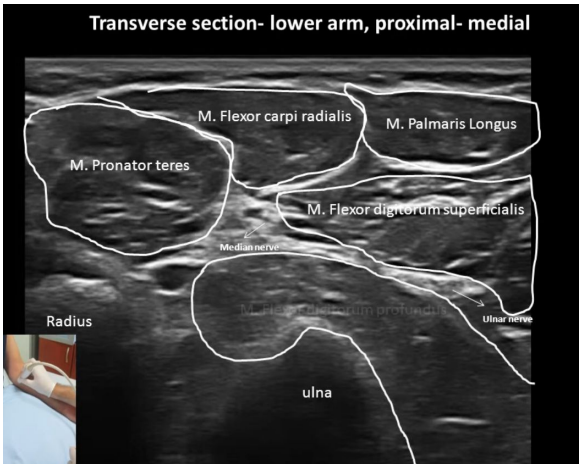
- Pain or spasm
- Interference with motor and functional rehab
- Personal hygiene interference
- Fitting orthosis
- Reduce deformity or contracture



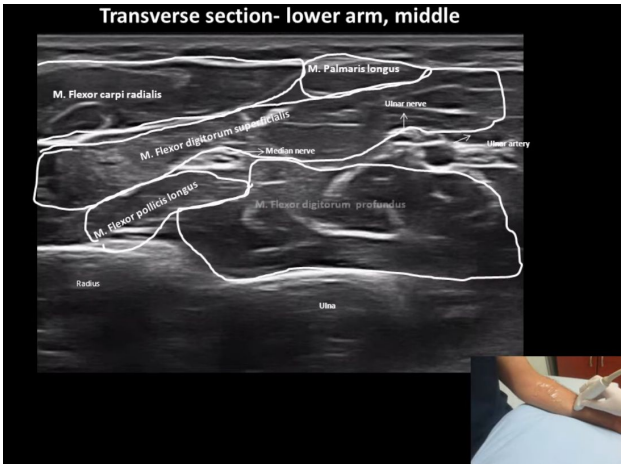


Upper limb spasticity patterns. Note: All five upper limb patterns could be combined with any spastic hand and finger position (e.g. claw, spastic flexed, intrinsic tumbrical).

Doussoulin, A., et al. "Prevalence of spasticity and postural patterns in the upper extremity post stroke." *Journal of stroke and cerebrovascular diseases* 29.11 (2020): 105253.



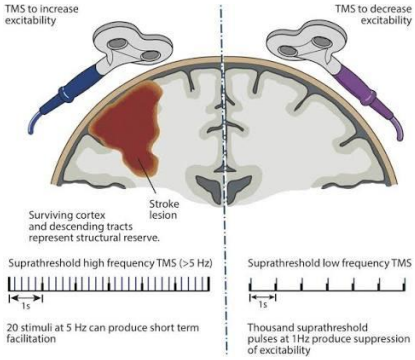
https://www.youtube.com/watch?v=plhEW7ye744



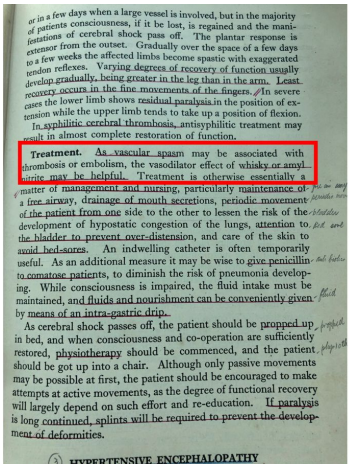
https://www.youtube.com/watch?v=plhEW7ye744







Agarwal, Smriti, et al. "Interrogating cortical function with transcranial magnetic stimulation: insights from neurodegenerative disease and stroke." *Journal of Neurology, Neurosurgery & Psychiatry* 90.1 (2019): 47-57.



or in a few days when a large vessel is involved, but in the majority of patients consciousness, if it be lost, is regained and the manifestations of cerebral shock pass off. The plantar response is extensor from the outset. Gradually over the space of a few days to a few weeks the affected limbs become spastic with exaggerated tendon reflexes. Varying degrees of recovery of function usually develop gradually, being greater in the leg than in the arm. Least recovery occurs in the fine movements of the fingers. In severe cases the lower limb shows residual paralysis in the position of extension while the upper limb tends to take up a position of flexion.

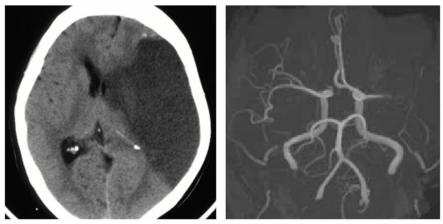
In syphilitic cerebral thrombosis, antisyphilitic treatment may result in almost complete restoration of function.

Treatment. As vascular spasm may be associated with thrombosis or embolism, the vasodilator effect of whisky or amyl nitrite may be helpful. Treatment is otherwise essentially a matter of management and nursing, particularly maintenance of a free airway, drainage of mouth secretions, periodic movement of the patient from one side to the other to lessen the risk of the development of hypostatic congestion of the lungs, attention to the bladder to prevent over-distension, and care of the skin to avoid bed-sores. An indwelling catheter is often temporarily useful. As an additional measure it may be wise to give penicillin to comatose patients, to diminish the risk of pneumonia developing. While consciousness is impaired, the fluid intake must be maintained, and fluids and nourishment can be conveniently given by means of an intra-gastric drip.

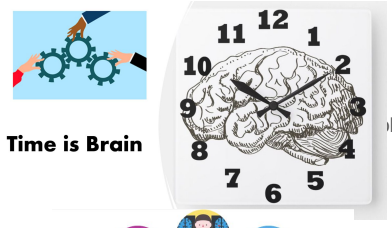
As cerebral shock passes off, the patient should be propped up in bed, and when consciousness and co-operation are sufficiently restored, physiotherapy should be commenced, and the patient should be got up into a chair. Although only passive movements may be possible at first, the patient should be encouraged to make attempts at active movements, as the degree of functional recovery will largely depend on such effort and re-education. If paralysis is long continued, splints will be required to prevent the development of deformities.

(3) HYPERTENSIVE ENCEPHALOPATHY

TREATING STROKE IN 1950s...

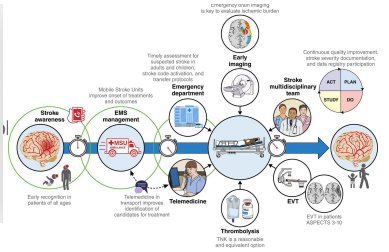








https://www.healthdata.org/research-analysis/diseases-injuries-risks/programmes/stroke



STROKE REHABILITATION



Take Home Messages

Patient Journey with acute ischemic stroke

- Hyperacute reperfusion therapy: Protocol based rapid pathway; IV rTPA
- ASU and close monitoring
- Cardiovascular risk factor optimisation, AF stroke prophylaxis and NOAC use
- Post-stroke complications
- Rehabilitation: rTMS, Botox

DM specific topics

- 2026 AHA recommendation of glycemic control in acute ischemic stroke
- Switching “glycemic control” to “ASCVD risk reduction” in choice of anti-diabetic agents, e.g. GLP-1 RA / SGLT2-i
- Exploration of neuroprotection with GLP-1 RA
- Exploration of Stress induced hyperglycemia

Thank You