
Guidelines for Early Specific Management of Acute Stroke

EDITORS

Dr. Samarth Singh
Prof. Upendra P. Devkota

1st Edition
2016

Courtesy:
NeuroCardio & Multispeciality Hospital, Biratnagar

Guidelines for Early Specific Management of Acute Stroke

1st Edition (2016)

2nd print (2018)

© **Editors**

Dr. Samarth Singh

Prof. Upendra P. Devkota

Contact:

E-mail: drsamarthsingh@yahoo.com
national@neuro.org.np

ISBN

978-9937-0-0480-0

Design and Production

Ultimate Marketing (P.) Ltd.

+977-1-4352223/4385610

info@marketingultimate.com

Stroke is an emergency

... where virtually no allowances for delay and worsening is tolerated

Message

National Institute of Neurological and Allied Sciences is ***dedicated to prevent paralyses and disabilities***. We continue this tradition by presenting the ***Guidelines for Early Specific Management of Acute Stroke***. Stroke is the second leading cause of death following ischemic heart disease and third leading cause of disease burden world wide. WHO predicts an impending epidemic of diseases of the vascular system including stroke by the year 2020. In Nepal about 60-65% of stroke cases entail acute ischemic infarcts and 30-45% are of hemorrhagic origin.

Management of ischemic stroke, intracerebral hemorrhage and subarachnoid hemorrhage requires different approaches. We have outlined step by step guidelines for early specific management of both acute ischemic and hemorrhagic strokes. Specific focus is given to thrombolysis for ischemic strokes particularly because it is the only effective treatment till date and the procedure requires highest degree of clinical efficiency, speed and inter disciplinary approach. It is hoped that this guideline will enable a disciplined approach to early recognition and management of patients presenting with acute stroke.



Dr. Samarth Singh



Prof. Upendra Devkota

NINAS Committee for the Guidelines

Neurosurgery

Dr. D.N. Gongal
Prof. Upendra Devkota
Dr. Suraj Thulung
Dr. Nikunj Yogi
Dr. Shyam Babu Prasad
Dr. Shikher Shrestha
Dr. Pankaj Raj Nepal
Dr. Suman Rijal
Dr. Pratyush Shrestha
Dr. Bibek Vaidya

Neurology

Dr. Lekhjung Thapa
Dr. Samarth Singh
Dr. Suman Bhattarai

Neuroradiology

Prof. R.K. Ghimire
Dr. Prateek Shrestha
Dr. Prity Agrawal

Neuroanesthesia

Dr. Madhav P. Gautam
Dr. Sarita Shrestha
Dr. Mayush B. Munankami
Dr. Sadeep Joshi

Contents

1. Early Specific Management of Acute Stroke	1
2. Thrombolysis in Acute Stroke	9
3. Neuroprotection	17
4. Surgical Management of Acute Stroke	19
5. Subarachnoid Hemorrhage	23
6. Neuroimaging in Acute Stroke	28
7. Blood Pressure Management in Acute Stroke	31
8. Neuroanaesthetic Concerns	35
9. Appendix	37

Abbreviations

AEDs	Anti epileptic drugs
aPTT	Activated partial thromboplastin time
AVM	Arterio venous malformation
BP	Blood pressure
CBC	Complete blood count
CBF	Cerebral blood flow
CBG	Capillary blood glucose
CEA	Carotid endarterectomy
CMRO ₂	Cerebral metabolic rate of oxygen
CPP	Cerebral perfusion pressure
CT	Computerized tomographic scan
CTA	Computerized tomographic angiography
CVP	Central venous pressure
DBP	Diastolic pressure
DSA	Digital subtraction angiography
DVT	Deep vein thrombosis
ECG	Electrocardiogram
EEG	Electroencephalogram
GCS	Glasgow coma scale
IBP	Invasive blood pressure
ICH	Intra cerebral hemorrhage
ICP	Intra cranial pressure
INR	International normalized ratio
IVF	Intra venous fluid
MAC	Minimum alveolar concentration
MAP	Mean arterial pressure
MCA	Middle cerebral artery
MRA	Magnetic resonance angiography
MRI	Magnetic resonance imaging
mRS	modified Rankin scale

NCCT	Non contrast computerized tomographic scan
NGT	Nasogastric tube
NIHSS	National institutes of health stroke scale
NOACs	New oral anticoagulants
NPO	Nothing per os
PT	Prothrombin time
RBS	Random blood sugar
RSI	Rapid sequence intubation
rt-PA	Recombinant tissue plasminogen activator
SAH	Subarachnoid hemorrhage
SpO ₂	Oxygen saturation in blood by pulse oxymetry
SaO ₂	Oxygen saturation in blood in arterial blood
SBP	Systolic blood pressure
TCD	Transcranial doppler
TIVA	Total intravenous anesthesia
VAE	Venous air embolism

Early Specific Management of Acute Stroke

Definitions of Stroke Severity

Mild Stroke

Alert patients with any or a combination of the following:

1. Mild pure motor weakness of one side of the body, defined as: can raise arm above shoulder, has clumsy hand, or can ambulate without assistance.
2. Pure sensory deficit
3. Slurred but intelligible speech
4. Vertigo with incoordination (e.g., gait disturbance, unsteadiness or clumsy hand)
5. Visual field defects alone

OR

NIHSS score = 0 – 5

Moderate Stroke

Awake patient with significant motor and/or sensory and/or language and/or visual deficit.

OR

Disoriented, drowsy or light stupor with purposeful response to painful stimuli

OR

NIHSS score = 6 – 21

Severe Stroke

Deep stupor or comatose patient with non-purposeful response, decorticate, or decerebrate posturing to painful stimuli.

OR

Comatose patient with no response to painful stimuli

OR

NIHSS score > 22

Early Specific Management of Mild Acute Ischemic Stroke

Management Priorities

- ▶ Ascertain clinical diagnosis of stroke (history and physical exam).
 - Exclude common stroke mimickers (Refer to appendix).
- ▶ Provide basic emergent supportive care (ABCs of resuscitation).
- ▶ Monitor neuro-vital signs, BP, MAP, RR, temperature, pupils and O₂ saturation.
- ▶ Perform and monitor stroke scales (NIHSS, GCS).
- ▶ Provide O₂ support to maintain O₂ saturation > 95%.
- ▶ Monitor and manage BP; treat if MAP>130mmHg (Refer to section on blood pressure management in acute stroke).
- ▶ Precautions:
 - **Avoid** precipitous drop in BP (not > 15% of baseline MAP). **Do not** use rapid acting sublingual agents; when needed, use easily titratable IV or oral antihypertensive medication.
- ▶ Ensure adequate hydration. Recommended IVF- 0.9% NaCl

Emergent Diagnostics

- ▶ CBC with platelet count
- ▶ CBG or RBS
- ▶ PT/PTT
- ▶ Serum Na⁺ and K⁺
- ▶ ECG
- ▶ Non-contrast CT scan of brain or MRI-DWI as soon as possible.
If ICH, compute for hematoma volume (Kothari's Formula)
(Refer to section on neuroimaging in acute stroke)

Early Specific Treatment

Non-cardioembolic (Thrombotic, Lacunar)

- ▶ Aspirin 75 mg/day (start as early as possible)
- ▶ Neuroprotection (Refer to section on neuroprotection)
- ▶ Early rehabilitation once stable within 72 hours

Cardioembolic

- ▶ Consider careful anticoagulation with IV heparin or subcutaneous low molecular-weight heparin (LMWH) for those at high risk with early recurrence (e.g. AF with thrombus, valvular heart disease or MI).

OR

- ▶ Aspirin 75 mg/day (if anticoagulation is not possible or contraindicated)
- ▶ Neuroprotection (Refer to section on neuro protection)
- ▶ Early rehabilitation once stable within 72 hours
- ▶ If infective endocarditis is suspected, give antibiotics and do not anticoagulate.

Hemorrhagic

- ▶ Early neurology and/ or neurosurgeon consult for all ICH is recommended.
- ▶ Monitor and maintain BP: Target MAP of 110 mmHg or SBP of 140-160 mmHg
- ▶ Neuroprotection (Refer to section on neuroprotection)
- ▶ Early rehabilitation once stable within 72 hours
- ▶ Give AEDs for clinical seizures and proven subclinical or electrographic seizures.
- ▶ Prophylactic AEDs are generally not recommended.
- ▶ Steroids are not recommended.
- ▶ Monitor and correct metabolic parameters.
- ▶ Correct coagulation/bleeding abnormalities
- ▶ Follow recommendations for neurosurgical intervention.
- ▶ For aneurysmal SAH, refer to specific chapter

Admit to Acute Stroke Unit / Regular Room

Early Specific Management of Acute Moderate Stroke

Management Priorities

- ▶ Ascertain clinical diagnosis of stroke (history and physical exam are very important)
 - Exclude common stroke mimickers (Refer to appendix)
- ▶ Basic emergent supportive care (ABCs of resuscitation)
- ▶ Neuro-vital signs, BP, MAP, RR, temperature, pupils and O₂ saturation
- ▶ Perform and monitor stroke scales (NIHSS, GCS)
- ▶ Monitor and manage BP. Treat if MAP > 130 mmHg (Refer to section on blood pressure management in acute stroke)
- ▶ Precaution: Avoid precipitous drop in BP (not > 15% of baseline MAP). Do not use rapid-acting sublingual agents; when needed use easily titratable IV or oral antihypertensive medication.
- ▶ Provide O₂ support to maintain O₂ saturation > 95%
- ▶ Identify comorbidities (cardiac disease, diabetes, liver disease, gastric ulcer, etc.)
- ▶ Recognize and treat early signs and symptoms of increased ICP.
- ▶ Ensure adequate hydration. Recommended IVF- 0.9% NaCl

Emergent Diagnostics

- ▶ CBC with platelet count
- ▶ CBG or RBS
- ▶ PT/PTT
- ▶ Serum Na⁺ and K⁺
- ▶ ECG
- ▶ Non-contrast CT scan of brain or MRI-DWI as soon as possible.
If ICH, compute for hematoma volume (Kothari's Formula)
(Refer to section on neuroimaging in acute stroke)

Early Specific Treatment

Non-cardioembolic (Thrombotic, Lacunar)

- ▶ If within 4.5 hours of stroke onset, consider IV rt-PA.
(Refer to section on thrombolytic therapy)
- ▶ Refer to neurologist for evaluation and decision.
- ▶ If within 8 hours of stroke onset and in specialized centers, consider intra-arterial (IA) thrombolysis.
- ▶ Start Aspirin 75mg 24 hours after rtPA treatment.
- ▶ If rtPA ineligible, start Aspirin 75 mg/day as soon as possible.

- ▶ Neuroprotection (Refer to section on neuroprotection)
- ▶ Early supportive rehabilitation
- ▶ Consider early decompressive hemicraniectomy for large malignant MCA infarction (Refer to section on surgical management of stroke).
- ▶ Antiplatelets (aspirin, clopidogrel, cilostazol, triflusal, dipyridamole, extended-release dipyridamole + aspirin combination)
- ▶ Control of risk factors
- ▶ Recommend vascular studies such as carotid ultrasound to document extracranial stenosis. If this reveals >70% stenosis, refer to neurologist /neurosurgeon/vascular surgeon for decision making regarding CEA or stenting.
- ▶ To document intracranial stenosis, recommend either TCD or MRA or CTA.

Cardioembolic

- ▶ If within 4.5 hours of stroke onset, consider IV rt-PA.
(Refer to section on thrombolytic therapy)
- ▶ Refer to neurologist for evaluation and decision.
- ▶ If within 8 hours of stroke onset and in specialized centers, consider IA thrombolysis
- ▶ If rt-PA ineligible or 24 hours after rt-PA treatment, consider either careful anticoagulation with IV heparin or subcutaneous LMWH for those at high risk for early recurrence or aspirin 75 mg/day.
- ▶ Neuroprotection (Refer to section on neuroprotection)
- ▶ Early supportive rehabilitation
- ▶ If infective endocarditis is suspected, give antibiotics and do not anticoagulate.
- ▶ Echocardiography and/or cardiology consult
- ▶ If age < 75 years, anticoagulation with warfarin (target INR: 2-3)
- ▶ If age > 75 years, warfarin (target INR: (1.6 – 2.5)
- ▶ If anticoagulation is contraindicated, give antiplatelets (Aspirin 75 mg).

Hemorrhagic

- ▶ Early neurology and/or neurosurgical consult for all ICH is recommended.
- ▶ Monitor and maintain BP. Target MAP=110 mmHg or SBP <160 mmHg
- ▶ Neuroprotection (Refer to section on neuroprotection)
- ▶ Give AEDs for clinical seizures and proven subclinical or electrographic seizures.
- ▶ Prophylactic AEDs are generally not recommended.
- ▶ Steroids are not recommended.
- ▶ Monitor and correct metabolic parameters.
- ▶ Correct coagulation/bleeding abnormalities.
- ▶ Follow recommendations for neurosurgical intervention.
- ▶ Early rehabilitation once stable.
- ▶ For aneurysmal SAH, (Refer to section on subarachnoid hemorrhage)

Admit to Intensive Care Unit or Stroke Unit

Early Specific Management of Acute Severe Stroke

Management Priorities

- ▶ Ascertain clinical diagnosis of stroke (history and physical examination are very important)
 - Exclude common stroke mimickers (Refer to appendix)
- ▶ Basic emergent supportive care (ABCs of resuscitation)
- ▶ Neuro-vital signs, BP, MAP, RR, temperature, pupils, oxygen saturation
- ▶ Perform and monitor stroke scales (NIHSS, GCS)
- ▶ Monitor and manage BP. Treat if MAP > 130 mmHg (Refer to section on blood pressure management in acute stroke)
- ▶ Provide O₂ support to maintain O₂ saturation > 95%
- ▶ Precaution: Avoid precipitous drop in BP (not > 15% of baseline MAP). Do not use rapid-acting sublingual agents; when needed use easily titratable IV or oral antihypertensive medication.
- ▶ Identify comorbidities (cardiac disease, diabetes, liver disease, gastric ulcer, etc.)
- ▶ Recognize and treat early signs and symptoms of increased ICP
- ▶ Ensure adequate hydration. Recommended IVF- 0.9% NaCl

Emergent Diagnostics

- ▶ CBC with platelet count
- ▶ CBG or RBS
- ▶ PT/PTT
- ▶ Serum Na⁺ and K⁺
- ▶ ECG
- ▶ Non-contrast CT scan of brain or MRI-DWI as soon as possible.
If ICH, compute for hematoma volume (Kothari's Formula)
(Refer to section on neuroimaging in acute stroke)

Early Specific Treatment

Non-cardioembolic (Thrombotic, Lacunar)

- ▶ **May** give aspirin 75 mg/day (risk of early hemorrhagic transformation within 48 hrs, subject of physician discretion)
- ▶ Refer the cases of posterior circulation strokes to neurologist within 12 hours of onset for evaluation and decision regarding thrombolytic therapy.
- ▶ Neuroprotection (Refer to section on neuroprotection)
- ▶ If cerebellar infarct, consult neurosurgeon as soon as possible.
- ▶ Early supportive rehabilitation

Cardioembolic

- ▶ **May** give aspirin 75 mg/day (subject of physician discretion)
- ▶ Refer cases of posterior circulation strokes to neurologist within 12 hours of onset for evaluation and decision regarding thrombolytic therapy.
- ▶ Neuroprotection (Refer to section on neuroprotection)
- ▶ If cerebellar infarct, consult neurosurgeon as soon as possible.
- ▶ Early supportive rehabilitation

Hemorrhagic

- ▶ Supportive treatment:
 1. Mannitol 20% 0.5-1g/kgBW q 4-6 hours for 3 -7 days
 2. Neuroprotection (Refer to section on neuroprotection)
 3. Give AEDs for clinical seizures and proven subclinical or electrographic seizures.
- ▶ Prophylactic AEDs are generally not recommended
- ▶ Neurosurgery consult if:
 1. Patient not herniated; Lobar bleed or located in putamen, pallidum, cerebellum; Family is willing to accept consequences of irreversible coma or persistent vegetative state. Goal is reduction of mortality.
 2. ICP monitoring is contemplated and salvage surgery is considered.
- ▶ Early supportive rehabilitation

Admit to Intensive Care Unit

References

1. Jauch, Edward C., 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* 44.3 (2013): 870-947.
2. Hemphill, J. Claude, et al. "Guidelines for the management of spontaneous intracerebral hemorrhage a guideline for healthcare professionals from the american heart association/american stroke association." *Stroke* (2015): STR-000000000000006
3. Bellolio, M. Fernanda, Rachel M. Gilmore, and Latha Ganti. "Insulin for glycaemic control in acute ischaemic stroke." *The Cochrane Library* (2014).
4. Capes, Sarah E., et al. "Stress hyperglycemia and prognosis of stroke in nondiabetic and diabetic patients a systematic overview." *Stroke* 32.10 (2001): 2426-2432.
5. Hajat, Cother, Shakoor Hajat, and Pankaj Sharma. "Effects of poststroke pyrexia on stroke outcome a meta-analysis of studies in patients." *Stroke* 31.2 (2000): 410-414.
6. Lizarasoain, I., et al. "Targets of cytoprotection in acute ischemic stroke: present and future." *Cerebrovascular Diseases* 21.Suppl. 2 (2006): 1-8.

Thrombolysis in Acute Stroke

Eligibility for IV Treatment with rt-PA

- ▶ Age
 - 18 years or older
 - 80 years or younger
- ▶ Clinical diagnosis of ischemic stroke causing a measurable neurological deficit.
- ▶ Time of symptom onset well established to be less than 4.5 hours before treatment would begin.
- ▶ NIHSS score 6 to 21/moderate stroke

Contraindications and Warnings

- ▶ Evidence of intracranial hemorrhage on pretreatment CT.
- ▶ Only minor or rapidly improving stroke symptoms.
- ▶ Clinical presentation suggestive of subarachnoid hemorrhage, even with normal CT.
- ▶ Active internal bleeding
- ▶ Known bleeding diathesis, including but not limited to:
 - Platelet count < 100,000/mm
 - Patient has received heparin within 48 hours and has an elevated aPTT (greater than upper limit of normal for laboratory).
 - Current use of oral anticoagulants (e.g., warfarin sodium) or recent use with an elevated prothrombin time > 15 seconds.
- ▶ The use of rt-PA in patients receiving NOACs (e.g., direct thrombin inhibitors, direct factor X inhibitors) maybe harmful and is not recommended unless PT, INR, aPTT, and platelet counts are normal, or if the patient has not received any dose of these agents > 2 days (if with normal renal function).
- ▶ Abnormal blood glucose (i.e. < 50 mg/dL or > 400 mg/dL)
- ▶ On repeated measurements, the systolic blood pressure (SBP) is greater than 185 mmHg or diastolic blood pressure (DBP) is greater than 110 mmHg at the time of initiation of therapy, and the patient requires aggressive treatment (3 attempts of lowering BP with intravenous agents) for reducing blood pressures to within these limits.

Relative Contraindications

- ▶ Consider risk-benefit of IV thrombolysis carefully if any of the following is present.
 - Surgery/trauma within 14 days (Excluding head trauma)
 - Gastrointestinal, urinary tract hemorrhage within 21 days
 - Minor or rapidly improving stroke symptoms clearing spontaneously
 - Myocardial infarction within 3 months

- Seizure at the time of onset of stroke symptoms with postictal neurological impairment.
- Pregnancy

Imaging Recommendations Before Intravenous Thrombolysis.

- ▶ Step 1: NCCT scan of brain: To exclude intracranial hemorrhage.
- ▶ Step 2: MRI Brain: If NCCT does not show intracranial hemorrhage MR imaging should be performed.
 - MR imaging includes FLAIR sequence, DWI at b values 0 and 1000 sec/mm² and MR perfusion study in the same setting + 3D TOF MR angiography (of the circle of Willis and Neck Vessels).

Diffusion-Perfusion mismatch can predict the ischemic area of reversibility after 4.5 hrs and before intravenous thrombolysis.

- ▶ Step 3: If MR perfusion imaging is unavailable then CT perfusion imaging with CT angiography of the circle of Willis including the neck vessels is performed.
 - CT angiography can detect stenosis or occlusion of the Vessels. CT Perfusion imaging can detect the infarcted core and the ischemic penumbra.

Treatment

- ▶ Tenecteplase 0.25 mg/kg body wt in a bolus dose.

OR

- ▶ Alteplase 0.9 mg /kg body wt (10% as bolus in 1 minute and the remainder over 1 hr, max 90 mg) can also be used and an alternative thrombolytic agent.

BP Management During and After Thrombolysis

- ▶ Monitor blood pressure every 15 minutes. It should be below 185/110 mmHg. If over 185/110 mmHg, BP may be treated with labetalol 10-20 mg, may be repeated upto 3 times. Nicardipine infusion can alternatively used as infusion at 5 mg/hour. Titrate nicardipine infusion up by 2.5 mg every 5 - 15 mins interval.
- ▶ If these measures do not reduce BP below 185/110 mmHg and keep it down, the patient should not be treated with rt-PA.
- ▶ Monitor blood pressure for the first 24 hours after starting treatment
 - Every 15 minutes for 2 hours after starting the infusion, then
 - Every 30 minutes for 6 hours, then
 - Every hour for 18 hours

- ▶ If systolic BP > 230 mmHg and/or diastolic BP is 121-140 mmHg, give labetalol 20 mg intravenously over 1 to 2 minutes. The dose may be repeated and/or doubled every 10 minutes, up to 150 mg. Alternatively either an intravenous infusion of 2 to 8 mg/min labetalol may be initiated after the first bolus of labetalol or nicardipine infusion 5 mg / hr infusion is started and titrated up by 2.5 mg / hr every 5 – 15 mins interval until the desired BP is reached.
- ▶ If systolic BP is 180 to 230 mmHg and/or diastolic BP is 105 to 120 mmHg on two readings 5 to 10 minutes apart, give labetalol 10 mg intravenously over 1 to 2 minutes. The dose may be repeated or doubled every 10 to 20 minutes, up to 150 mg.
- ▶ Alternatively, following the first bolus of labetalol, an intravenous infusion of 2 to 8 mg/min labetalol may be initiated and continued until the desired blood pressure is reached.
- ▶ Monitor blood pressure every 15 minutes during the antihypertensive therapy. Observe for hypotension.
- ▶ If an intracranial hemorrhage is suspected, the administration of rt-PA should be discontinued and an emergency CT scan or other diagnostic imaging method sensitive for the presence of intracranial hemorrhage should be obtained.

Management of ICH Following Thrombolytic Therapy

- ▶ Discontinue rt-PA infusion unless other causes of neurological deterioration are apparent.
- ▶ Immediate CT scan or other diagnostic imaging method sensitive for the presence of hemorrhage.
- ▶ Draw blood for PT, aPTT, platelet count, fibrinogen, and type and cross.
- ▶ Prepare for administration of 6 to 8 units of cryoprecipitate containing factor VIII. Alternatively 6-8 units of FFP can be infused.
- ▶ Prepare for administration of 6 to 8 units of platelets
 - Obtain fibrinogen results.
 - Consider administering cryoprecipitate or platelets if needed.
 - Consider alerting and consulting a hematologist or neurosurgeon.
 - Consider decision regarding further medical and/or surgical therapy.
 - Consider second CT to assess progression of intracranial hemorrhage.
- ▶ Neurosurgery consultation

Expansion of IV rTPA Treatment Time Window up to 4.5 Hours

The eligibility criteria for thrombolysis beyond 3 hrs is same with following relative exclusion criteria.

- ▶ Patients older than 80 years old
- ▶ Patients on oral anticoagulants, regardless of INR level
- ▶ Patients with NIHSS > 25
- ▶ Patients with stroke and diabetes
- ▶ Patients can be thrombolysed intravenously beyond 4.5 hrs depending on perfusion diffusion mismatch.

A combined intravenous and endovascular intervention may be performed upto 12 hrs.

Acute Stroke Team and Time Based Approach to Thrombolysis

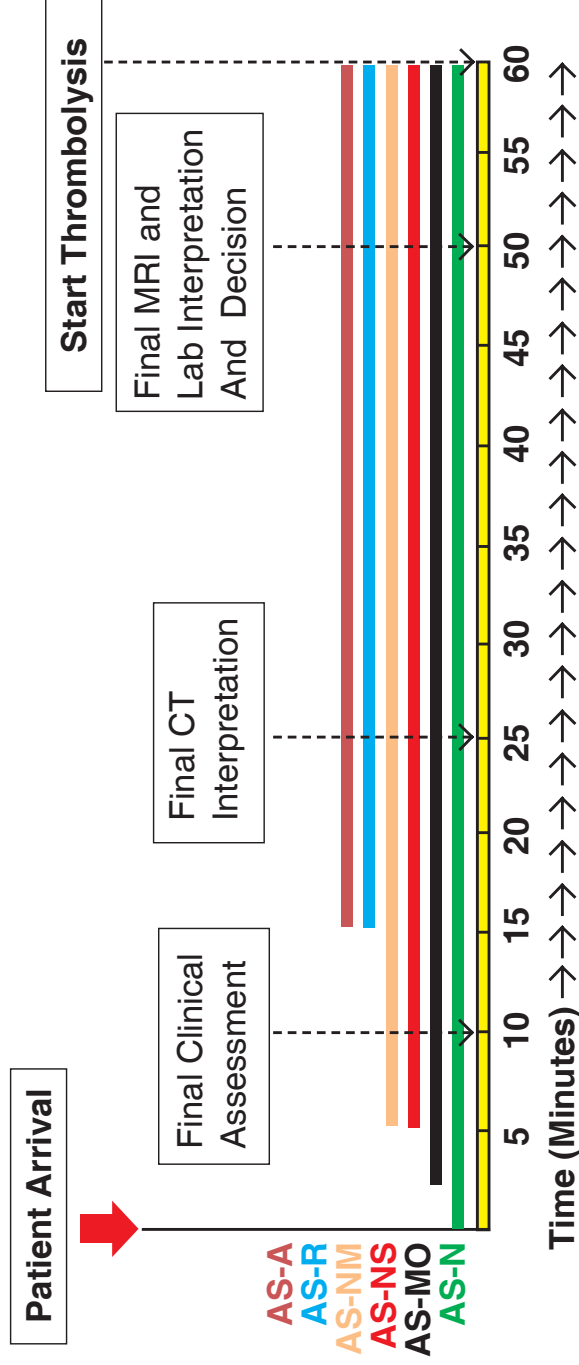
Members of Acute Stroke Team (AST)

1. NEUROSURGERY : AS-NS
2. NEUROLOGY: AS-NM
3. RADIOLOGY : AS-R
4. ANAESTHESIOLOGY: AS-A
5. LABORATORY STAFF
6. EMERGENCY STAFF: AS-N, AS-MO
7. OTHERS:
 - a. Administrative Officer on Duty
 - b. Pharmacist on-duty
 - c. House-keeping on duty
 - d. Receptionist on duty

REMEMBER
‘TIME IS BRAIN’

Time Frame for Acute Stroke Medical team Involvement for Thrombolysis

Door-to-Needle Time: 60 minutes



Emergency Department Process Measure Assessment Tool

Activity	Responsibility	Time target	Checklist √ (00:00)
Assess "FAST". Notify AS-MO on-duty and Registrar on-duty.	Nurse on-duty	Within 1 minute of arrival	
SET ACUTE STROKE CLOCK IN ER TO 00:00 (Time-Keeper: Acute Stroke Admin-on Duty)			
Open IV Line (18G) with NS Check GRBS, Do ECG and send Stroke Package	Nurse on-duty	Within 10 minutes of arrival	
Evaluate patient: Fill stroke Proforma Check: Indication and CI for thrombolysis	AS-MO [AS-NS to help and approve for correct complete entry]	Within 10 minutes of arrival	
Transfer patient to CT room	AS-MO, AS-N, AS-NS	Within 20 minutes of arrival	
Notify Reception about AST : If Ischemic Stroke <2/3 rd of MCA territory "OR" VBS and Transfer to MRI	AS-MO Receptionist (Name Lists by departments to be informed and General Hospital announcement)	Within 25 minutes of arrival	
Time from notification of AST to response of team member by phone, or at patient bedside to assess patient as appropriate		Within 20 minutes of being called	
Time from completion of MRI scan to interpretation	AS-R, AS-NS, AS-NM	Within 45 minutes of arrival	
If "IA" Thrombolysis planned, Transfer the patient to Cath-Lab	AS-R, AS-NS, AS-NM	Within 50 minutes of arrival	
Time from order of chest X-Ray, if indicated, to performance through completion of chest X-Ray and interpretation	AS-NS, AS-MO	Within 50 minutes of arrival	
Time from order of Lab-Stroke pack-A Tests through completion and interpretation	AS-NS, AS-MO	Within 50 minutes of arrival	
Time from notification to drug availability	Pharmacist, AS-NS	Within 50 minutes of arrival	
ED door-to-needle time for IV thrombolytic (t-PA or TNK) treatment	AS-NS, AS-NM, AS-MO, AS-N	Within 60 minutes of patient arrival in ED	
Neurosurgical intervention		As needed urgently	
* Checklist for time: Stroke Admin-on Duty [Please tick and note time]			
* AS-MO should be with the patient and Acute Stroke Team till the patient is stabilized			
* AS-MO should arrange and collect all the reports and verify at the end of the procedure and hand over to NS-R for FINAL VERIFICATION.			

References

1. *Jauch, Edward C., 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 44.3 (2013): 870-947.*
2. *del Zoppo, Gregory J., et al. "Expansion of the time window for treatment of acute ischemic stroke with intravenous tissue plasminogen activator a science advisory from the American Heart Association/American Stroke Association." Stroke 40.8 (2009): 2945-2948.*
3. *Ramaiah, Siva Seeta, and Bernard Yan. "Low-dose tissue plasminogen activator and standard-dose tissue plasminogen activator in acute ischemic stroke in Asian populations: a review." Cerebrovascular Diseases 36.3 (2013): 161-166.*

Neuroprotection

▶ The **5H** Principle

AVOID Hypotension, Hypoxemia, Hyperglycemia, Hypoglycemia, and Hyperthermia during acute stroke in an effort to salvage the ischemic penumbra.

▶ Neuroprotective Interventions

1. Avoid hypotension and allow permissive hypertension during the first week. (Refer to section on blood pressure management in acute stroke)
2. Avoid hypoxemia and maintain $\text{SaO}_2 > 94\%$ and monitor oxygenation by pulse oximetry \pm arterial blood gases (ABG).
3. Avoid hyperglycemia and hypoglycemia. Maintain glucose targets of 140 to 180 mg/dl.
4. Avoid hyperthermia. Maintain normothermia for all stroke patients. Treat fever with antipyretics and cooling blankets. Investigate the cause of fever.

▶ Neuroprotective and Neurorestorative Drugs.

Prescribing neuroprotective and neurorestorative drugs in acute stroke is a subject of physician discretion.

1. Cerebrolysin (Post hoc analysis shows favorable trend towards the more severe stroke, NIHSS > 12)
2. Neuroaid (Neuroaid treatment was associated with significant reduction in the risk of recurrent vascular events)
3. Citicholine (It appears to be more beneficial in patients aged > 70 years, patients with moderate stroke NIHSS < 14 and patients not treated with rt-PA)

References

1. Jauch, Edward C., 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* 44.3 (2013): 870-947
2. Lizasoain, I., et al. "Targets of cytoprotection in acute ischemic stroke: present and future." *Cerebrovascular Diseases* 21.Suppl. 2 (2006): 1-8.
3. Hajat, Cothar, Shakoor Hajat, and Pankaj Sharma. "Effects of poststroke pyrexia on stroke outcome a meta-analysis of studies in patients." *Stroke* 31.2 (2000): 410-414.
4. Capes, Sarah E., et al. "Stress hyperglycemia and prognosis of stroke in nondiabetic and diabetic patients a systematic overview." *Stroke* 32.10 (2001): 2426-2432.
5. Bellolio, M. Fernanda, Rachel M. Gilmore, and Latha G. Stead. "Insulin for glycaemic control in acute ischaemic stroke." *Cochrane Database Syst Rev* 9 (2011).
6. Heiss, Wolf-Dieter, et al. "Cerebrolysin in patients with acute ischemic stroke in asia results of a double-blind, placebo-controlled randomized trial." *Stroke* 43.3 (2012): 630-636.
7. Chen, Christopher LH, et al. "Chinese medicine neuroaid efficacy on stroke recovery a double-blind, placebo-controlled, randomized study." *Stroke* 44.8 (2013): 2093-2100.
8. Alvarez-Sabín, Jose, et al. "Long-term treatment with citicoline may improve poststroke vascular cognitive impairment." *Cerebrovascular Diseases* 35.2 (2013): 146-154.

Surgical Management of Acute Stroke

Selection of Patients for Surgical and Non Surgical Management of ICH

Candidates for Immediate Surgery

- ▶ Patients with Age < 70 years
- ▶ For > 70 years: No major surgery involving hematoma evacuation; surgery is limited to shunt diversion procedures only.

Lobar Hematomas

Infratentorial: Removal of hematoma is indicated if

- a. hematoma volume \geq 10 ml
- b. presence of hydrocephalus
- c. IVth ventricular distortion
- d. GCS > 5

Supratentorial: Removal of hematoma is indicated if

- a. Temporal bleed is \geq 20ml
- b. Lobar hematoma \geq 30 ml
- c. Ganglionic hematomas: Removal if hematoma volume \geq 50ml
(For ganglionic hematomas, direct surgical evacuation is required and in selected cases, only shunt diversion procedure should be performed. In the later, serial CT scan is required. Any evidence of hematoma warrants immediate hematoma evacuation)
- d. Especially a young patient deteriorating from hemorrhage (reduction in baseline GCS \geq 1 with biochemical parameters excluded)
- e. GCS > 5

Primary/Secondary Intraventricular Hemorrhage with moderate to severe hydrocephalus requires EVD

- ▶ Thrombolysis is indicated if one of the lateral ventricles is filled with hematoma, **or** both halves of ventricles are filled with hematoma **or** if both ventricles are filled with hematoma.
- ▶ May administer Ateplase 1-mg every 8 hours to a maximum of 4 days, each administration is followed by locking the EVD drainage for one hour. Serial neuroimaging is required to monitor the resolution. Tenecteplase may also be used as alternative thrombolysing agent.
- ▶ Endoscopic clot removal is an alternative to intraventricular thrombolysis

- ▶ Neurosurgery should be considered in patients with a structural lesion (AVM, cavernous angioma) if there is chance for good outcome and the vascular lesion is surgically negotiable.

Non Surgical Candidates

- ▶ Patients with small hemorrhages or minimal neurological deficits
- ▶ GCS < 5, except in cerebellar hemorrhage with brainstem compression

Criteria for Patient Selection for Hemispherectomy

Patients presenting with severe hemispheric stroke syndrome/hemiplegia, forced eye deviation and ipsilateral head deviation, contralateral neglect and progressive decline in level of consciousness usually within 48 hrs.

- ▶ Infarct volume > 50% of MCA territory/ 145 cu cm
- ▶ Patients 65 years and below
- ▶ GCS > 5 or NIHSS > 15 (non dominant) and > 20 (dominant)
- ▶ Premorbid mRS < 3

Exclusion Criteria

- ▶ Terminal illness
- ▶ Significant comorbidities (cardiac, pulmonary, renal, hematological, etc)

Emergency Hemispherectomy is indicated for those who meet above criteria and with early signs of herniation (asymmetry in pupil size) midline shift (> 10 mm at septum pallidum and > 5mm of pineal shift).

Early Hemispherectomy (within 48 hrs) has better survival and morbidity rates.

Pre-Surgical and Surgical Management

- ▶ If hemispherectomy is offered, withhold anti-coagulants and anti-platelets until deemed safe post-procedure.
- ▶ For adequate external decompression, the size of the bone flap removed should ideally be 12 cm (anterior-posterior) by 9 cm (superior-inferior), combined with duraplasty.
- ▶ Temporal lobectomy may be considered during the procedure, at the neurosurgeon's discretion. If performed, tissue should be submitted for neuropathological examination.
- ▶ The bone flap should be placed in a subcutaneous abdominal pouch or stored in the bone bank.

Post-Surgical Management

- ▶ Admit the patient to an intensive care unit, preferably the neuro ICU.
- ▶ Once appropriate, a protective helmet should be worn until the bone flap is replaced.
- ▶ The bone flap should be replaced as soon as the patient can tolerate the surgery, preferably within 12 weeks, unless the patient develops intercurrent infections or other complications requiring delay.

Adjunctive Therapy

- ▶ **General management:** raised intracranial pressure require special attention to pain relief, avoidance of noxious stimuli, proper head positioning, adequate oxygenation, maintenance of normothermia, and prevention of DVT. Avoid oral or gastric feedings if the patient is likely to go to surgery imminently.
- ▶ **Hyperventilation:** a temporary measure to reduce ICP if signs of brain herniation develop. Should be avoided unless other measures are exhausted and there is a plan to proceed immediately to surgery.
- ▶ **Osmotic therapy**
- ▶ **Invasive ICP monitoring** (subarachnoid screw or bolt) is not required to determine suitability for decompressive surgery. An external ventricular drain should be considered if brain imaging shows evidence of acute hydrocephalus. It may be useful to monitor the ICP post-operatively if there is concern that the decompression was insufficient.

References

1. Jauch, Edward C., 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* 44.3 (2013): 870-947.
2. Heinsius, Thomas, Julien Bogouslavsky, and Guy Van Melle. "Large infarcts in the middle cerebral artery territory Etiology and outcome patterns." *Neurology* 50.2 (1998): 341-350.
3. Vahedi, Katayoun, et al. "Sequential-design, multicenter, randomized, controlled trial of early decompressive craniectomy in malignant middle cerebral artery infarction (DECIMAL Trial)." *Stroke* 38.9 (2007): 2506-2517.
4. Jüttler, Eric, et al. "Decompressive surgery for the treatment of malignant infarction of the middle cerebral artery (DESTINY) a randomized, controlled trial." *Stroke* 38.9 (2007): 2518-2525.
5. Hofmeijer, Jeannette, et al. "Surgical decompression for space-occupying cerebral infarction (the Hemicraniectomy After Middle Cerebral Artery infarction with Life-threatening Edema Trial [HAMLET]): a multicentre, open, randomised trial." *The Lancet Neurology* 8.4 (2009): 326-333.
6. Arac, Ahmet, et al. "Assessment of outcome following decompressive craniectomy for malignant middle cerebral artery infarction in patients older than 60 years of age: A review." *Neurosurgical focus* 26.6 (2009): E3.
7. Ji, Frank. "Hemicraniectomy and durotomy upon deterioration from infarction related swelling trial (HeADDFIRST): first public presentation of the primary study findings." *Neurology* 60.Suppl 1 (2003): A426.

Subarachnoid Hemorrhage

Neurodiagnostic Examinations

- ▶ **NCCT scan** should be done and interpreted immediately. Hyperdense blood in the basal cisterns is usually diagnostic, but parenchymal clot in the temporal or basal frontal, and intraventricular hemorrhage are also suggestive of a ruptured aneurysm. Sensitivity of CT scan depends on the timing of imaging in relation to ictus from hemorrhage.
- ▶ **Cerebral angiography** is the gold standard in determining the cause of SAH. Early catheter angiography should be performed in good and poor grade cases of SAH. If the initial angiogram is negative, a repeat cerebral angiogram should be performed after 2 weeks.
- ▶ Good quality **Computerized Tomographic Angiography (CTA)** or **Magnetic Resonance Angiography (MRA)** are acceptable options to catheter angiography in the following situations:
 - poor grade patients,
 - when angiogram cannot be performed in a timely fashion or
 - as follow up when initial angiogram is negative.
 (Refer to section on neuroimaging in acute stroke)
- ▶ **Lumbar tap** with CSF analysis in the absence of focal neurological signs is strongly recommended if cranial CT scan is negative or is unavailable. Multiple specimens (at least 3 tubes) should be collected to rule out traumatic tap. Opening pressures should be measured. CSF spectroscopy is diagnostic.

SAH Grading (refer to appendix)

General Symptomatic Treatment

- ▶ Absolute bed rest in a quiet, comfortable environment is recommended. Limit visitors until aneurysm has been secured.
- ▶ Monitor neurovital signs closely, including cardiac and pulmonary status.
- ▶ Start soft diet for alert patients, nasogastric tube (NGT) feedings if with impaired consciousness, but keep on nothing per orem (NPO), if there is planned immediate intervention.
- ▶ Give analgesics for headache. Avoid aspirin and other NSAIDS.
- ▶ Give gastrointestinal prophylaxis for stress gastritis. Use proton pump inhibitors or H2 blockers.
- ▶ Give anti-emetics for nausea and vomiting.
- ▶ Maintain euthermia. May give antipyretics and use cooling blankets.
- ▶ Maintain euglycemic status.
- ▶ Give sedatives for restlessness or agitation.
- ▶ Give stool softeners.

- ▶ Start DVT prophylaxis using pneumatic compression devices, if available, or thigh high anti-embolic stockings for unsecured aneurysms.

(Withhold subcutaneous LMWH or unfractionated heparin until aneurysm has been secured.)

Early Specific Treatment

- ▶ Calcium Channel Blockers:
Nimodipine 60mg every 4 hours by mouth or via NGT for 21 days is recommended.
- ▶ AEDs: Prophylactic AEDs may be considered in the immediate post-hemorrhagic period. Long term AEDs are generally not recommended but may be considered in patients at higher seizure risk such as: patients with prior seizures, parenchymal hematoma, infarct, or middle cerebral artery aneurysms.
- ▶ Anti-fibrinolytic agents are not recommended. Although they reduce the risk of rebleeding, they are associated with higher rate of cerebral ischemia.
- ▶ Managed increased ICP. Ensure proper patient positioning with 30 degree head of bed position to facilitate adequate venous outflow.
- ▶ BP Management: Use IV nicardipine to a target SBP of < 150 mmHg in the preoperative phase (unsecured aneurysms).
- ▶ Avoid using large amounts of hypotonic fluids. Maintain euvolemic to slightly hypervolemic status.
- ▶ Manage hyponatremia.
- ▶ Steroids: Corticosteroids have no proven role and are not recommended for use in SAH.

Prevention and Management of Vasospasm

- ▶ Monitoring: Serial transcranial doppler (TCD) study is recommended for the diagnosis and management of vasospasm. Other newer modalities such as CT and MRI perfusion studies are helpful in the detection and management of ischemia.
- ▶ Triple-H Therapy (hypervolemia, induction of hypertension, and hemodilution) is a reasonable approach for the management of symptomatic vasospasm after aneurysm has been secured although a universal treatment protocol is still lacking.
- ▶ Treatment with intravenous magnesium sulfate and statins (simvastatin and pravastatin) is safe and can help reduce cerebral vasospasm based on preliminary studies.
- ▶ Endovascular angioplasty (chemical ± mechanical) is an effective way of managing vasospasm. Intervention has to be performed early before clinical signs suggesting irreversible infarction are noted.

Treatment of SAH

Obliteration of the aneurysm as soon as possible is the treatment. This can be achieved through surgical clipping or endovascular coiling.

Timing of surgery

- ▶ Early surgery is ideally performed within 72 hours from ictus and late surgery usually \geq 10-14 days post SAH.

(perform late surgery only if there is no vaso spasm on TCD and the patient is neurologically stable)

- ▶ Indications:
 - Early, immediate surgery is recommended for good to moderate grade (Hunt and Hess or WFNS grades I-III) aneurysmal SAH patients to minimize the chance of a devastating rebleed.
 - For poor grade patients (Hunt and Hess or WFNS Grades IV-V), early surgery is recommended in the presence of:
 - Hematoma
 - Hydrocephalus
 - Surgery may be delayed in the presence of:
 - Ischemia or infarction
 - Severe angiographic / TCD vasospasm
 - Advanced age (elderly) is not a contraindication for early surgical management in the absence of organ failure.

Coiling

- ▶ Can be performed early in both good and poor grade patients.
- ▶ Reduces the rate of rebleeding for poor grade patients who would otherwise be treated conservatively.
- ▶ Vasospasm is not a contraindication and can be dealt with endovascular coiling and administration of drugs.
- ▶ Can be performed under local anesthesia if needed.

Where to Admit

SAH patients should be admitted at the Acute Stroke Unit or Intensive Care Unit. In the absence of an ASU/ICU, patients may be placed in a quiet, regular room with very close monitoring.

Indications of Clipping vs Coiling

- ▶ Factors Favoring Clipping
 - Younger age
 - Middle cerebral bifurcation aneurysm
 - Giant aneurysm > 2 cm
 - Small aneurysm < 1.5-2 mm diameter
 - Wide neck aneurysm
 - Patients with residual filling of aneurysm after coiling

- ▶ Factors Favoring Coiling
 - Elderly patient > 75 years
 - Poor clinical grades
 - Inaccessible ruptured aneurysm
 - Aneurysm configuration: Dome to neck ratio > 2, absolute neck diameter < 5mm
 - Posterior circulation aneurysm

References

1. Connolly, E. Sander, et al. "Guidelines for the management of aneurysmal subarachnoid hemorrhage a guideline for healthcare professionals from the American heart association/ American stroke association." *Stroke* 43.6 (2012): 1711-1737.
2. Meretoja, Atte, et al. "SMASH-U a proposal for etiologic classification of intracerebral hemorrhage." *Stroke* 43.10 (2012): 2592-2597.
3. Hemphill, J. Claude, et al. "Guidelines for the management of spontaneous intracerebral hemorrhage a guideline for healthcare professionals from the american heart association/ american stroke association." *Stroke* (2015): STR-000000000000006
4. Hemphill, J. Claude, et al. "The ICH score a simple, reliable grading scale for intracerebral hemorrhage." *Stroke* 32.4 (2001): 891-897.
5. Yasaka, Masahiro, et al. "Correction of INR by prothrombin complex concentrate and vitamin K in patients with warfarin related hemorrhagic complication." *Thrombosis research* 108.1 (2002): 25-30.

Neuroimaging in Acute Stroke

Hyperacute or Acute Ischemic Stroke

- ▶ Step 1: NCCT scan of head (To exclude intracranial hemorrhage)
- ▶ If no intracranial hemorrhage is present, assess for early signs of ischemia:
 - Early signs of ischemia:
 - Hyperdense MCA sign
 - Obscuration of lentiform nucleus
 - Sulcal effacement with loss of grey white differentiation
 - Insular ribbon sign
 - Hypoattenuating brain tissue
- ▶ Step 2: MRI Brain: Includes T1, T2, FLAIR, DWI, T2*W sequences (includes GRE/SWI sequences) + 3D TOF MRA (including the circle of Willis and the Neck vessels).

Note: DW images are very sensitive and specific for the detection of hyperacute and acute infarctions, with a sensitivity of 99% and a specificity of 92%

- ▶ Step 3: CT perfusion/ MR perfusion study.
 - Imaging should not delay administration of IV thrombolysis, in patients who are potential candidates for IV thrombolysis as “time is brain”. If NCCT does not show signs of intracranial hemorrhage and the candidate is potential for intravenous thrombolysis then MR perfusion study is done in the same setting. If MR perfusion study is not available then CT Perfusion is done to assess for the ischemia and infarction.
 - CT Angiography of the circle of Willis and the neck vessels is performed in the same setting with CT perfusion study to detect any vascular stenosis or occlusion present.

Intracerebral Hemorrhage

- ▶ Step 1: CT can accurately document the location of the hemorrhage and the presence of mass effect, ventricular extension and hydrocephalus.
- ▶ In hypertensive ICH, a repeat NCCT scan after 24 hours of ictus is recommended especially in cases showing clinical deterioration to document hematoma enlargement and/or development of hydrocephalus.
- ▶ Computation of hematoma volume (modified Khotari method) that is fairly demonstrable
CT scan and MRI T2 appear to have equal efficacy documenting acute intracranial hemorrhage (ICH).
- ▶ Step 2: In suspected cases of AVM, aneurysm or tumor bleed, a contrast CT and or CTA or MRI/MRA of the head may be warranted.

Subarachnoid Hemorrhage

- ▶ Step 1: NCCT of the head is strongly recommended as the initial procedure for diagnosis.

The diagnostic yield of CT goes down from 92% within the first 24 hours to 50% within 7 days of onset.

- ▶ Step 2: CT scan should be followed by CT angiography.

DSA is the gold standard to study cerebral vessels. Its is recommended if CT angiography is negative. A negative DSA should be followed up by repeat DSA after 2 weeks.

References

1. Jauch, Edward C., 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* 44.3 (2013): 870-947
2. Hemphill, J. Claude, et al. "Guidelines for the management of spontaneous intracerebral hemorrhage a guideline for healthcare professionals from the american heart association/american stroke association." *Stroke* (2015): STR-000000000000006
3. Camargo, Erica CS, et al. "Acute Brain Infarct: Detection and Delineation with CT Angiographic Source Images versus Nonenhanced CT Scans 1." *Radiology* 244.2 (2007): 541-548.
4. Latchaw, Richard E., et al. "Recommendations for Imaging of Acute Ischemic Stroke A Scientific Statement From the American Heart Association." *Stroke* 40.11 (2009): 3646-3678.
5. de Lucas, Enrique Marco, et al. "CT Protocol for Acute Stroke: Tips and Tricks for General Radiologists 1." *Radiographics* 28.6 (2008): 1673-1687.
6. Wintermark, Max, et al. "Imaging recommendations for acute stroke and transient ischemic attack patients: a joint statement by the American Society of Neuroradiology, the American College of Radiology, and the Society of NeuroInterventional Surgery." *American Journal of Neuroradiology* 34.11 (2013): E117-E127.

Blood Pressure Management in Acute Stroke

Following BP goals should be achieved and maintained in acute stroke:

Primary Intracerebral Hemorrhage

- ▶ Monitor and maintain SBP of about 140-160 mmHg or MAP of about 110 mmHg

Unsecured Aneurysmal SAH

- ▶ SBP < 150 mmHg in the pre operative (unsecured aneurysm) phase seems to be reasonable.
- ▶ SBP of < 220 mmHg in post operative (secured aneurysm) phase can be maintained if there is ongoing vasospasm.

Acute Ischemic Stroke

- ▶ Allow 'permissive hypertension' during the first week to ensure adequate CPP but ascertain cardiac and renal protection.
- ▶ Treat if SBP > 220 mmHg or DBP > 120 mmHg or MAP > 130 mmHg.
- ▶ Defer emergency BP therapy if MAP is within 110-130 or SBP=185-220 mmHg or DBP=105-120 mmHg, unless in the presence of acute MI, congestive heart failure, aortic dissection, acute pulmonary edema, acute renal failure and hypertensive encephalopathy.
- ▶ Treat with small doses of IV antihypertensives patients who are potential candidates for rtPA therapy who have persistent elevations in SBP > 185 mmHg or DBP > 110 mmHg. Maintain BP just below these limits.
- ▶ Use intravenous anti-hypertensives in acute stroke (Refer to table: Intravenous Antihypertensive Drugs, Pg: 32)

Recommendations for ICP Monitoring in Raised ICP

- ▶ Maintain CPP 50-70 mmHg
- ▶ Treat ICP > 25 mmHg

Recommendations for Arterial hypotension in Acute ischemic stroke

- ▶ Baseline SBP < 100 mmHg or DBP < 70 mmHg is associated with higher rates of neurological worsening, poor neurological outcomes and death.
- ▶ Cause of arterial hypotension should be sought (aortic dissection, volume depletion, blood loss, and decreased cardiac output or arrhythmia)
- ▶ Correct hypovolemia with normal saline and treat arrhythmias to optimize cardiac output
- ▶ Available vasopressor agents include dopamine, dobutamine and phenylephrine and adrenaline.

Tabel: Intravenous Antihypertensive Drugs

Drug	Dose	Onset of Action	Duration of Action	Stability	Contraindication	Adverse Reactions	Action
Nicardipine	1-15 mg/hour	5-10 mins	1-4 hours	1 to 4 hours	hypersensitivity, advanced aortic stenosis	tachycardia, headache, flushing, dizziness, somnolence, nausea	inhibits calcium ion from entering slow channel, producing coronary, vascular, smooth muscle relaxation & vasodilatation
Hydralazine	IV push 10-20 mg/dose every 4-6 hours as needed, may increase to 40 mg/dose	10-20 mins	3-8 hours	4 days	hypersensitivity, coronary artery disease, mitral valve-RHD	tachycardia, flushing, headache, vomiting, increased angina	direct vasodilatation of arterioles & decreased systemic resistance

Drug	Dose	Onset of Action	Duration of Action	Stability	Contraindication	Adverse Reactions	Action
Labetalol	5 mg IV push over 2 mins, repeat with incremental dose of 10, 20, 40, 80 mg until desired BP is achieved or a total dose of 300 mg has been administered	2-5 mins	2-4 hours	72 hours	asthma, obstructive airway disease, severe bradycardia, cardiogenic shock, cardiac failure, hypersensitivity, sinus bradycardia, SSS without permanent pacemaker, conditions related with prolonged and severe hypertension.	orthostatic hypotension, drowsiness, dizziness, lightheadedness, dyspnea, wheezing & bronchospasm	alpha- & b etablocker. beta adrenergic blocking activity is 7x > than alpha- drenergic blockers. produces dose dependent decrease in BP without significant reduction in HR or cardiac output
Esmolol	0.25-0.5 mg/ kg IV push 1-2 mins followed by infusion of 0.05 mg/kg/min. If there is no response, repeat 0.5 mg/kg bolus dose & infusion to 0.10 mg/kg/min. maximum infusion rate=0.30 mg/kg/min	2-10 mins	10-30 mins	48 hours	hypersensitivity, sinus bradycardia, 2nd 3rd degree hert block, cardiogenic shock, cardiac failure, asthma/ COAD, SSS without permanent pacemaker	hypotension, bradycardia, AV block, agitation, confusion, wheezing / bronchoconstriction, phlebitis	short-acting beta-adrenergic blocking agent. at low doses, has little effect on beta2 receptors of bronchial & vascular smooth muscle

References

1. Jauch, Edward C., 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* 44.3 (2013): 870-947.
2. Hemphill, J. Claude, et al. "Guidelines for the management of spontaneous intracerebral hemorrhage a guideline for healthcare professionals from the american heart association/american stroke association." *Stroke* (2015): STR-000000000000006
3. Connolly, E. Sander, et al. "Guidelines for the management of aneurysmal subarachnoid hemorrhage a guideline for healthcare professionals from the American heart association/American stroke association." *Stroke* 43.6 (2012): 1711-1737.
4. Anderson, Craig S., et al. "Intensive blood pressure reduction in acute cerebral haemorrhage trial (INTERACT): a randomised pilot trial." *The Lancet Neurology* 7.5 (2008): 391-399.
5. Hubert, Gordian J., Peter Müller-Barna, and Roman L. Haberl. "Unsolved issues in the management of high blood pressure in acute ischemic stroke." *International journal of hypertension 2013* (2013).
6. Qureshi, Adnan I., and Yuko Y. Palesch. "Antihypertensive Treatment of Acute Cerebral Hemorrhage (ATACH) II: design, methods, and rationale." *Neurocritical care* 15.3 (2011): 559-576.

Neuroanaesthetic Concerns

For Intracranial Hematoma Evacuation and Decompressive Hemicraniectomy

- ▶ Goals-optimize CBF, CPP and CMRO₂
- ▶ Prevent brain edema/ ICP increment
- ▶ Patient with history of stroke frequently have co-existing vascular disease and multiple vessel involvement including coronary arteries.
- ▶ Other co-morbidities: hypertension, diabetes, alcoholic, under haemostatic medications.
- ▶ Chronic hypertension shifts the cerebral autoregulation curve to the right. CPP should be maintained above 50 mmHg to prevent cerebral ischemia.
- ▶ Target hemodynamic goals
 - IBP
 - CVP
 - CPP

(Refer to section of BP management in acute stroke)
- ▶ Airway control : RSI technique with sellick's maneuver
- ▶ Anaesthetic agents
 - Induction agents - propofol, thiopental, midazolam (avoid ketamine)
 - Volatile agents - sevoflurane > isoflurane > desflurane (<1 MAC)
 - Muscle relaxants - atracurium, vecuronium, rocuronium (avoid suxamethonium)
- ▶ To blunt the sympathetic surge : lignocaine, esmolol, dexmedetomidine
 - Optimal positioning to decrease ICP and brain swelling :
 - reverse trendelenburg 15-20°
 - supine > prone
 - sitting position - risk of VAE and paradoxical embolism
 - avoid extreme neck flexion
- ▶ Pressure points padding
- ▶ Monitoring :
 - ECG
 - CVP
 - IBP
 - EEG
 - ICP
 - Core temperature
- ▶ Maintenance of anaesthesia : TIVA > inhalation technique
- ▶ Avoid N₂O
- ▶ Emergence - systemic HTN, pain, nausea/vomiting to be managed.
- ▶ Postoperative ICU care and mechanical ventilation.

References

1. *Ramani, Ramachandran. "Neuroanesthesia update." Current Opinion in Anesthesiology 25.5 (2012): 513-515.*
2. *Hirsch, Nick. "Advances in neuroanaesthesia." Anaesthesia 58.12 (2003): 1162-1165.*
3. *Davies, Rhys, and Mary McLoone. "Anaesthesia for neurosurgery." Anaesthesia & Intensive Care Medicine 8.10 (2007): 427-430.*

APPENDIX

Stroke Mimickers

The presence of any of the following should alert the physician to consider conditions other than stroke

1. Pure hemifacial weakness including forehead (Bell's palsy)
2. Gradual progressive course and insidious onset
3. Weakness with atrophy
4. Isolated dizziness or vertigo
5. Recurrent seizures
6. Fever prior to onset of symptoms
7. No vascular risk factor
8. Recurrent headaches (migraine, tension-type headache)
9. Trauma

Conditions that can mimic stroke in the emergency department or clinics

1. Seizures
2. Brain tumor
3. Subdural hematoma
4. Hypertensive encephalopathy
5. Dementia
6. Positional vertigo
7. Toxic-metabolic
8. Cardiac
9. Syncope
10. Systemic infection
11. Demyelinating disease
12. Parkinsonism
13. Myasthenia gravis
14. Trauma
15. Herpes encephalitis
16. Transient global amnesia
17. Conversion disorder
18. Cervical spine fracture

Commonly Used Scales in Management of Acute Stroke

Glasgow Coma Scale (GCS)

	1	2	3	4	5	6
Eye	Does not open eyes	Opens eyes in response to painful stimuli	Opens eyes in response to voice	Opens eyes spontaneously	N/A	N/A
Verbal	Makes no sounds	Incomprehensible sounds	Utters inappropriate words	Confused, disoriented	Oriented, converses normally	N/A
Motor	Makes no movements	Extension to painful stimuli (decerebrate response)	Abnormal flexion to painful stimuli (decorticate response)	Flexion/Withdrawal to painful stimuli	Localizes painful stimuli	Obeys commands

modified Rankin Score (mRS)

The scale runs from 0-6, running from perfect health without symptoms to death.

- ▶ 0 - No symptoms.
- ▶ 1 - No significant disability. Able to carry out all usual activities, despite some symptoms.
- ▶ 2 - Slight disability. Able to look after own affairs without assistance, but unable to carry out all previous activities.
- ▶ 3 - Moderate disability. Requires some help, but able to walk unassisted.
- ▶ 4 - Moderately severe disability. Unable to attend to own bodily needs without assistance, and unable to walk unassisted.
- ▶ 5 - Severe disability. Requires constant nursing care and attention, bedridden, incontinent.
- ▶ 6 - Dead.

Intra Cerebral Hemorrhage Score (ICHS)

Component	ICH Score Points
GCS score	
3–4	2
5–12	1
13–15	0
ICH volume, cm³	
≥30	1
<30	0
IVH	
Yes	1
No	0
Infratentorial origin of ICH	
Yes	1
No	0
Age, years	
≥80	1
<80	0
Total ICH Score	0–6

GCS score indicates GCS score on initial presentation (or after resuscitation); ICH volume, volume on initial CT calculated using ABC/2 method; and IVH, presence of any IVH on initial CT.

30 Day Mortality Rate Based on ICH Score

ICH Score	Risk
0	0%
1	13%
2	26%
3	72%
4	97%
5	100%
6	100% (estimated)

Hunt and Hess (H&H)

The H&H scale describes the severity of subarachnoid haemorrhage, and is used as a predictor of survival.

- ▶ Grade 1
 - asymptomatic or minimal headache and slight neck stiffness
 - 70% survival
- ▶ Grade 2
 - moderate to severe headache; neck stiffness; no neurologic deficit except cranial nerve palsy
 - 60% survival
- ▶ Grade 3
 - drowsy; minimal neurologic deficit
 - 50% survival
- ▶ Grade 4
 - stuporous; moderate to severe hemiparesis; possibly early decerebrate rigidity and vegetative disturbances
 - 20% survival
- ▶ Grade 5
 - deep coma; decerebrate rigidity; moribund
 - 10% survival

Fischer Grade (FG)

The **FG** is a way of grouping subarachnoid haemorrhage CT scans into four groups according to the amount of blood, and is useful in predicting cerebral vasospasm

- ▶ Grade 1
 - no blood detected
- ▶ Grade 2
 - diffuse thin (< 1 mm) SAH with no clots.
- ▶ Grade 3
 - localised clots and/or layers of blood > 1 mm in thickness
- ▶ Grade 4
 - intracerebral or intraventricular blood (\pm SAH)

World Federation of Neurosurgical Societies (WFNS)

The **WFNS grading system** uses the Glasgow Coma Scale and presence of focal neurological deficits to grade the severity of subarachnoid haemorrhage.

Grading

- ▶ Grade 1
 - GCS 15
- ▶ Grade 2
 - GCS 13-14 without deficit
- ▶ Grade 3
 - GCS 13-14 with focal neurological deficit
- ▶ Grade 4
 - GCS 7-12
- ▶ Grade 5
 - GCS <7

The presence or absence of a focal neurological deficit is used to distinguish between grades 2 and 3. The scale reflects that the biggest determinant of mortality is conscious state, whilst the predictor of morbidity is the presence of hemiparesis or aphasia

NIHSS

The National Institutes of Health Stroke Scale, or NIH Stroke Scale (NIHSS) is a tool used by healthcare providers to objectively quantify the impairment caused by a stroke. The NIHSS is composed of 11 items, each of which scores a specific ability between a 0 and 4. For each item, a score of 0 typically indicates normal function in that specific ability, while a higher score is indicative of some level of impairment. The individual scores from each item are summed in order to calculate a patient's total NIHSS score. The maximum possible score is 42, with the minimum score being a 0.

NIH Stroke Scale

The NINDS tPA Stroke Trial No. _____ - _____ - _____

Pt. Date of Birth ____/____/____

Hospital _____ (____ - ____)

Date of Exam ____/____/____

Interval: 1 Baseline 2 2 hours post treatment 3 24 hours post onset of symptoms 6 minutes
 4 7-10 days 5 3 months 6 Other _____ (_____)

Time: ____:____ 1 am 2 pm

Administer stroke scale items in the order listed. Record performance in each category after each subscale exam. Do not go back and change scores. Follow directions provided for each exam technique. Scores should reflect what the patient does, not what the clinician thinks the patient can do. The clinician should record answers while administering the exam and work quickly. Except where indicated, the patient should not be coached (i.e., repeated requests to patient to make a special effort).

IF ANY ITEM IS LEFT UNTESTED, A DETAILED EXPLANATION MUST BE CLEARLY WRITTEN ON THE FORM. ALL UNTESTED ITEMS WILL BE REVIEWED BY THE MEDICAL MONITOR, AND DISCUSSED WITH THE EXAMINER BY TELEPHONE.

Instructions	Scale Definition	Score
<p>1a. Level of Consciousness: The investigator must choose a response, even if a full evaluation is prevented by such obstacles as an endotracheal tube, language barrier, orotracheal trauma/bandages. A 3 is scored only if the patient makes no movement (other than reflexive posturing) in response to noxious stimulation.</p>	<p>0 = Alert; keenly responsive. 1 = Not alert, but arousable by minor stimulation to obey, answer, or respond. 2 = Not alert, requires repeated stimulation to attend, or is obtunded and requires strong or painful stimulation to make movements (not stereotyped). 3 = Responds only with reflex motor or autonomic effects or totally unresponsive, flaccid, areflexic.</p>	_____
<p>1b. LOC Questions: The patient is asked the month and his/her age. The answer must be correct — there is no partial credit for being close. Aphasic and stuporous patients who do not comprehend the questions will score 2. Patients unable to speak because of endotracheal intubation, orotracheal trauma, severe dysarthria from any cause, language barrier or any other problem not secondary to aphasia are given a 1. It is important that only the initial answer be graded and that the examiner not “help” the patient with verbal or non-verbal cues.</p>	<p>0 = Answers both questions correctly. 1 = Answers one question correctly. 2 = Answers neither question correctly.</p>	_____
<p>1c. LOC Commands: The patient is asked to open and close the eyes and then to grip and release the non-paretic hand. Substitute another one-step command if the hands cannot be used. Credit is given if an unequivocal attempt is made but not completed due to weakness. If the patient does not respond to command, the task should be demonstrated to them (pantomime) and score the result (i.e., follows none, one or two commands). Patients with trauma, amputation, or other physical impediments should be given suitable one-step commands. Only the first attempt is scored.</p>	<p>0 = Performs both tasks correctly 1 = Performs one task correctly 2 = Performs neither task correctly</p>	_____

Instructions	Scale Definition	Score
<p>2. Best Gaze: Only horizontal eye movements will be tested. Voluntary or reflexive (oculocephalic) eye movements will be scored but caloric testing is not done. If the patient has a conjugate deviation of the eyes that can be overcome by voluntary or reflexive activity, the score will be 1. If a patient has an isolated peripheral nerve paresis (CN III, IV or VI) score a 1. Gaze is testable in all aphasic patients. Patients with ocular trauma, bandages, pre-existing blindness or other disorder of visual acuity or fields should be tested with reflexive movements and a choice made by the investigator. Establishing eye contact and then moving about the patient from side to side will occasionally clarify the presence of a partial gaze palsy.</p>	<p>0 = Normal 1 = Partial gaze palsy. This score is given when gaze is abnormal in one or both eyes, but where forced deviation or total gaze paresis are not present. 2 = Forced deviation, or total gaze paresis not overcome by the oculocephalic maneuver.</p>	<p>_____</p>
<p>3. Visual: Visual fields (upper and lower quadrants) are tested by confrontation, using finger counting or visual threat as appropriate. Patient must be encouraged, but if they look at the side of the moving fingers appropriately, this can be scored as normal. If there is unilateral blindness or enucleation, visual fields in the remaining eye are scored. Score 1 only if a clear-cut asymmetry, including quadrantanopia is found. If patient is blind from any cause, score 3. Double simultaneous stimulation is performed at this point. If there is extinction, patient receives a 1, and the results are used to answer question 11.</p>	<p>0 = No visual loss 1 = Partial hemianopia 2 = Complete hemianopia 3 = Bilateral hemianopia (blind including cortical blindness)</p>	<p>_____</p>
<p>4. Facial Palsy: Ask, or use pantomime to encourage the patient to show teeth or raise eyebrows and close eyes. Score symmetry of grimace in response to noxious stimuli in the poorly responsive or non-comprehending patient. If facial trauma/bandages, orotracheal tube, tape or other physical barrier obscures the face, these should be removed to the extent possible.</p>	<p>0 = Normal symmetrical movement 1 = Minor paralysis (flattened nasolabial fold, asymmetry on smiling) 2 = Partial paralysis (total or near total paralysis of lower face) 3 = Complete paralysis of one or both sides (absence of facial movement in the upper and lower face)</p>	<p>_____</p>
<p>Instructions</p> <p>5 & 6. Motor Arm and Leg: The limb is placed in the appropriate position: extend the arms (palms down) 90 degrees (if sitting) or 45 degrees (if supine) and the leg 30 degrees (always tested supine). Drift is scored if the arm falls before 10 seconds or the leg before 5 seconds. The aphasic patient is encouraged using urgency in the voice and pantomime but not noxious stimulation. Each limb is tested in turn, beginning with the non-paretic arm. Only in the case of amputation or joint fusion at the shoulder or hip may the score be "9" and the examiner must clearly write the explanation for scoring as a "9."</p>	<p>Scale Definition</p> <p>0 = No drift, limb holds 90 (or 45) degrees for full 10 seconds. 1 = Drift, Limb holds 90 (or 45) degrees, but drifts down before full 10 seconds; does not hit bed or other support. 2 = Some effort against gravity, limb cannot get to or maintain (if cued) 90 (or 45) degrees, drifts down to bed, but has some effort against gravity. 3 = No effort against gravity, limb falls. 4 = No movement 9 = Amputation, joint fusion explain: _____</p> <p>5a. Left Arm _____</p> <p>5b. Right Arm _____</p>	<p>Score</p> <p>_____</p> <p>_____</p>

	<p>0 = No drift, leg holds 30 degrees position for full 5 seconds.</p> <p>1 = Drift, leg falls by the end of the 5-second period but does not hit bed.</p> <p>2 = Some effort against gravity; leg falls to bed by 5 seconds, but has some effort against gravity.</p> <p>3 = No effort against gravity, leg falls to bed immediately.</p> <p>4 = No movement</p> <p>9 = Amputation, joint fusion explain: _____</p>	
	6a. Left Leg	_____
	6b. Right Leg	_____
<p>Instructions</p> <p>7. Limb Ataxia: This item is aimed at finding evidence of a unilateral cerebellar lesion. Test with eyes open. In case of visual defect, ensure testing is done in intact visual field. The finger-nose-finger and heel-shin tests are performed on both sides, and ataxia is scored only if present out of proportion to weakness. Ataxia is absent in the patient who cannot understand or is paralyzed. Only in the case of amputation or joint fusion may the item be scored "9," and the examiner must clearly write the explanation for not scoring. In case of blindness, test by touching nose from extended arm position.</p>	<p>Scale Definition</p> <p>0 = Absent</p> <p>1 = Present in one limb</p> <p>2 = Present in two limbs</p> <p>If present, is ataxia in</p> <p>Right arm 1 = Yes 2 = No</p> <p>9 = amputation or joint fusion, explain _____</p> <p>Left arm 1 = Yes 2 = No</p> <p>9 = amputation or joint fusion, explain _____</p> <p>Right leg 1 = Yes 2 = No</p> <p>9 = amputation or joint fusion, explain _____</p> <p>Left leg 1 = Yes 2 = No</p> <p>9 = amputation or joint fusion, explain _____</p>	<p>Score</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>
<p>8. Sensory: Sensation or grimace to pinprick when tested, or withdrawal from noxious stimulus in the obtunded or aphasic patient. Only sensory loss attributed to stroke is scored as abnormal and the examiner should test as many body areas [arms (not hands), legs, trunk, face] as needed to accurately check for hemisensory loss. A score of 2, "severe or total," should only be given when a severe or total loss of sensation can be clearly demonstrated. Stuporous and aphasic patients will therefore probably score 1 or 0. The patient with brain stem stroke who has bilateral loss of sensation is scored 2. If the patient does not respond and is quadriplegic, score 2. Patients in coma (item 1a=3) are arbitrarily given a 2 on this item.</p>	<p>0 = Normal; no sensory loss.</p> <p>1 = Mild to moderate sensory loss; patient feels pinprick is less sharp or is dull on the affected side; or there is a loss of superficial pain with pinprick but patient is aware he/she is being touched.</p> <p>2 = Severe to total sensory loss; patient is not aware of being touched in the face, arm, and leg.</p>	<p>_____</p>
<p>9. Best Language: A great deal of information about comprehension will be obtained during the preceding sections of the examination. The patient is asked to describe what is happening in the attached picture, to name the items on the attached naming sheet, and to read from the attached list of sentences. Comprehension is judged from responses here as well as to all of the commands in the preceding general neurological exam. If visual loss interferes with the tests, ask the patient to identify objects placed in the hand, repeat, and produce speech. The intubated patient should be asked to write. The patient in coma (question 1a=3) will arbitrarily score 3 on this item. The examiner must choose a score in the patient with stupor or limited cooperation but a score of 3 should</p>	<p>0 = No aphasia, normal</p> <p>1 = Mild to moderate aphasia; some obvious loss of fluency or facility of comprehension, without significant limitation on ideas expressed or form of expression. Reduction of speech and/or comprehension, however, makes conversation about provided material difficult or impossible. For example, in conversation about provided materials, examiner can identify picture or naming card from patient's response.</p> <p>2 = Severe aphasia; all communication is through fragmentary expression; great need for inference, questioning, and guessing by the listener. Range of information that can be exchanged is limited; listener carries burden of communication. Examiner cannot identify materials provided from patient response.</p>	<p>_____</p>

be used only if the patient is mute and follows no one-step commands.	3 = Mute, global aphasia; no usable speech or auditory comprehension.	
Instructions 10. Dysarthria: If patient is thought to be normal, an adequate sample of speech must be obtained by asking patient to read or repeat words from the attached list. If the patient has severe aphasia, the clarity of articulation of spontaneous speech can be rated. Only if the patient is intubated or has other physical barrier to producing speech may the item be scored "9," and the examiner must clearly write an explanation for not scoring. Do not tell the patient why he/she is being tested.	Scale Definition 0 = Normal 1 = Mild to moderate; patient slurs at least some words and, at worst, can be understood with some difficulty. 2 = Severe; patient's speech is so slurred as to be unintelligible in the absence of or out of proportion to any dysphasia, or is mute/anarthric. 9 = Intubated or other physical barrier, explain _____	Score _____ _____
11. Extinction and Inattention (formerly Neglect): Sufficient information to identify neglect may be obtained during the prior testing. If the patient has a severe visual loss preventing visual double simultaneous stimulation, and the cutaneous stimuli are normal, the score is normal. If the patient has aphasia but does appear to attend to both sides, the score is normal. The presence of visual spatial neglect or anosagnosia may also be taken as evidence of abnormality. Since the abnormality is scored only if present, the item is never untestable.	0 = No abnormality. 1 = Visual, tactile, auditory, spatial, or personal inattention or extinction to bilateral simultaneous stimulation in one of the sensory modalities. 2 = Profound hemi-inattention or hemi-inattention to more than one modality. Does not recognize own hand or orients to only one side of space.	_____ _____

Additional item, not a part of the NIH Stroke Scale score.

A. Distal Motor Function: The patient's hand is held up at the forearm by the examiner and patient is asked to extend his/her fingers as much as possible. If the patient can't or doesn't extend the fingers, the examiner places the fingers in full extension and observes for any flexion movement for 5 seconds. Only the patient's first attempts are graded. Repetition of the instructions or of the testing is prohibited.	0 = Normal (No flexion after 5 seconds) 1 = At least some extension after 5 seconds, but not fully extended. Any movement of the fingers which is not upon command is not scored. 2 = No voluntary extension after 5 seconds. Movements of the fingers at another time are not scored.	
	a. Left Arm	_____
	b. Right Arm	_____

12. _____
Person Administering Scale

(_____) _____
Code

Fig. 1: Aphasia

Ask the patient to describe what is happening on the picture and name items.

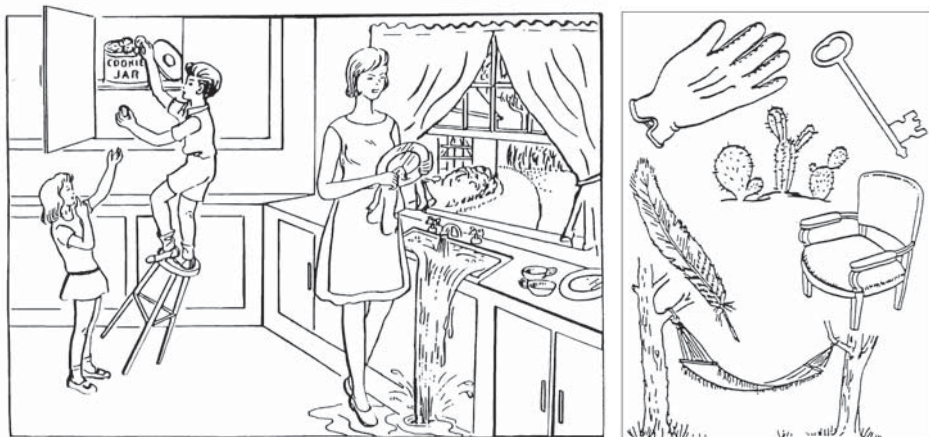


Fig. 2: Dysarthria

Ask the patient to read or repeat words from the list.

MAMA
TIP – TOP
FIFTY – FIFTY
THANKS
HUCKLEBERRY
BASEBALL PLAYER

You know how.

Down to earth.

I got home from work.

**Near the table in the
dining room.**

**They heard him speak on
the radio last night.**

BRAIN ATTACK CENTER

(मष्तिस्कघात केन्द्र)



DR. BIRENDRA KUMAR BISTA
CHAIRMAN & MANAGING DIRECTOR
SENIOR CONSULTANT NEUROLOGIST



DR. SAMARTH SINGH
INTERVENTIONAL NEUROLOGIST
Fellowship Interventional Neurology & Stroke
(Max Hospital, N.Delhi)

ब्रेन एटैक सेन्टर

Treatable Within 4.5 Hrs., Longer in Selected Cases

Services

- * Specialist Team
- * (BAT) Brain Attack Team
- * Rapid Treatment
- * State of Art Neurointervention Procedures
- * Interventional Neurology
- * Stroke Unit
- * Neurocritical Care Unit
- * Emergency Department
- * Neurosurgery
- * Internal Medicine
- * Radiology
- * Anaesthesia
- * Physiotherapy
- * Stroke Clinic

Brain Attack Interventions

- * I/V Thrombolysis
- * I/A Thrombolysis
- * Mechanical Thrombectomy
- * Thrombus Aspiration
- * Stenting(Carotid & Intracranial)
- * Aneurysm Coiling
- * Embolization of Arteriovenous Malformation

FAST

Face

मुख टेढो हुदा

Arm

हात खुट्टा कमजोर हुदा

Speech

बोल्न गाछो हुदा

Time

समयमा सम्पर्क गर्नु

मष्तिस्कमा रक्तसंचार गराउने रक्तनलीहरूमा कुनै पनि कारणले अवरुद्ध हुदा या त रक्त नली फुटेमा मष्तिस्कघात (Brain Attack) हुन्छ । प्रत्येक मिनेट २० लाख मष्तिस्क कोसीकाहरू नष्ट हुने हुदा मष्तिस्कघात (Brain Attack) भएपछि समयमानै उपचार गराउनु बाहेक अर्को विकल्प छैन ।

अधिक जानकारीका लागि

टोल फ्रि नं. १६६०२१५२७७७

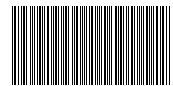


NEURO CARDIO & MULTISPECIALITY HOSPITAL Pvt. Ltd.

Jahada Road, Biratnagar-10, Nepal
Tel :- +977- 21- 417484, 416267

न्यूरो हस्पिटल

Email: info@neurohospital.com.np, www.neurohospital.com.np



9789937004800