

Neurocritical Care Strategies in Acute Stroke Management

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What is acute stroke?

Acute stroke:

An episode of symptomatic neurological dysfunction caused by **focal brain**, retinal or spinal cord **ischemia or hemorrhage** with evidence of acute infarction or hemorrhage on imaging (MR, CT, retinal photomicrographs), and regardless of symptomatic duration.

What is neurocritical care?

Neurocritical care or neurointensive care
is a medical field that
treats life-threatening diseases of the
nervous system
and identifies, prevents, and
treats secondary injury.

Neurocritical care is the intensive care

- ▶ Provides
 - ▶ to patients with severe neurological and neurosurgical conditions
 - ▶ the interface between the brain and other organ systems

Neurocritical care is the intensive care

- ▶ Provides
 - ▶ comprehensive medical and specialized neurological support for patients
 - ▶ with life-threatening neurological diseases
 - ▶ by integrating and balancing the management of
 - ▶ both the brain and the body
- ▶ A neurocritical intensive care unit
 - ▶ also known as a neuro ICU

Evaluation matrix

- ▶ Perform a
 - ▶ rapid, focused, neurological exam in patients with critical illness
- ▶ Triage patients
 - ▶ who need immediate attention
 - ▶ who can wait temporarily
- ▶ Manage fluids, electrolytes, and blood pressure
- ▶ Describe the principles of ventilator management

Evaluation matrix

- ▶ Describe the indications for placement of
 - ▶ intracranial pressure monitors
 - ▶ external ventricular drains
 - ▶ and multimodality monitors
- ▶ Describe how to manage
 - ▶ acute subarachnoid hemorrhage

Evaluation matrix

- ▶ Communicate effectively with requesting
 - ▶ clinical services
 - ▶ Nurses
 - ▶ and other members of the patient's team
- ▶ Participate in
 - ▶ family meetings regarding goals of care
 - ▶ help negotiate conflicts among
 - ▶ family members and the treatment team

Goals of NSU care of ischemic stroke are fourfold:

- ▶ To reverse brain ischemia before it causes permanent brain injury
- ▶ To prevent secondary or progressive stroke
- ▶ To optimize the patient's medical condition and prevent the common medical sequelae that occur after stroke or after a stroke intervention
- ▶ To optimize functional recovery after the residual permanent injury that has occurred.

Reverse

Prevent
progression

Prevent
sequelae

Functional
recovery

CT manifestations of stroke

- ▶ Three main stages are used to describe
 - ▶ Hyper-acute (0 – 6 hours)
 - ▶ Acute (less than 24 hours)
 - ▶ Acute stroke represents cytotoxic edema, and the changes can be subtle but are significant
 - ▶ Subacute (24 hours to 5 days)
 - ▶ Chronic (weeks)

DIAGNOSTIC TESTING IN POTENTIAL STROKE PATIENTS

Required

- ▶ Cerebral imaging
- ▶ Complete blood count with platelets
- ▶ Electrocardiograph
- ▶ Serum electrolytes
- ▶ Serum glucose
- ▶ Serum troponin

Consider as indicated

- ▶ Arterial blood gas
- ▶ Coagulation parameters (INR, PT, PTT)
- ▶ Chest radiograph
- ▶ CSF analysis
- ▶ Ethanol level
- ▶ Pregnancy test
- ▶ Urine analysis
- ▶ Urine toxicology screen

Acute Stroke Cases

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- ▶ Mr. Iman Ali, 60 years old male, diabetic and hypertensive with regular drugs for 2 years.
- ▶ Suddenly he developed headache, vomiting followed by left sided weakness 3 days back.
- ▶ Patient had similar type of attack twice over the last 2 months. His bowel and bladder was normal. **Delayed by 72 hours**
- ▶ CT scan of Brain showed subacute cerebral infarction including lacunar infarct.
- ▶ CT Angiogram showed non-visualization of peripheral branches of cerebral arteries (mostly posterior and middle cerebral arteries) and developmental narrowing in the right vertebral arteries.

- ▶ A 70-year-old man presents with a two-and-a-half-hour history of right-sided arm, leg and face weakness and loss of speech. He has no headache and is mildly confused. He has a history of ischaemic heart disease.
- ▶ On examination he has a global dysphasia, full visual fields, upper motor neurone distribution right facial weakness and dense weakness (UMN distribution) of the right side with absent reflexes and an up-going plantar response on that side. His pulse was regular.
- ▶ Delayed 2 and half hours only
- ▶ A clinical diagnosis of left middle cerebral artery ischaemic stroke is made.



Steps of Neurocritical Care Strategies

Neurocritical Care Protocols for Evaluation and Management

- ▶ Step 1: Identify possible signs of stroke - **BEFAST**
 - ▶ B: Sudden Balance Impairment
 - ▶ E: Sudden vision loss in one Eye or one field
 - ▶ F: Facial droop (show teeth or smile)
 - ▶ A: Arm drift
 - ▶ S: Abnormal Speech
 - ▶ Time to call emargency

Neurocritical care protocols ...

- ▶ Step 2: Prehospital management and Exclude common mimics
 - ▶ Assess ABC, SpO2, Blood sugar, 12 lead ECG
 - ▶ Quick Neuro exam, exclude stroke mimics
 - ▶ Open IV Channel, avoid Dextrose
 - ▶ Check BP, Do not Lower unless $>220/120$
 - ▶ Prenotification
 - ▶ Update ED, Early transport

Post-ictal paralysis

Conversion reaction

Hypoglycemia

Hypertensive encephalopathy

Syncope

Neurocritical care protocols...

- ▶ Step 3: Triage management
 - ▶ EDS faster better
 - ▶ NINDS and ACLS recommended Stroke Evaluation Time Benchmarks for Potential Thrombolysis candidate
 - ▶ NINDS time goal
 - ▶ Remember
 - ▶ patients eligibility for IV rtPA upto 4.5 hr from onset

Neurocritical care protocols...

- ▶ Step 3: Triage management
 - ▶ Stroke Evaluation Time Benchmarks for Potential Thrombolysis candidate

Time interval	Time target
Door to Doctor	10 min
Access to neurologic expertise	15 min
Door to CT scan completion	25 min
Door to CT scan interpretation	25 min
Door to treatment	60 min
Admission to stroke unit or ICU	3 hr

Neurocritical care protocols...

- ▶ Step 3: Triage management ..
 - ▶ Intubation GCS <8
 - ▶ Determine or reconfirm LSN(Last seen normal)
 - ▶ Assess with NIHSS tool: 11 point exam tool
 - ▶ Perform non-contrast CT scan
 - ▶ Rule out hemorrhage
 - ▶ ASPECTS score

NIHSS score (Max 42)	Stroke severity
0	No deficit
1-4	Minor stroke
5-15	Moderate stroke
16-25	Moderate to senior stroke
>25	Secure stroke

Neurocritical care protocols...

- ▶ Step 4: If within 4.5 hr – IV thrombolysis by rtPA 0.9mg/kg max upto 90 mg
 - ▶ 10% bolus over 1 min
 - ▶ Remainder over 1 hr infusion
- ▶ Step 5: Managing hemodynamics in tPA candidates
- ▶ Step 6: Managing complication of IV tPA
- ▶ Step 7: Consider thrombectomy within 6 hrs
- ▶ Step 8: Consider thrombectomy within 6 – 24 hrs

Neurocritical care protocols...

- ▶ Step 9: Shift the pt. to Stroke ICU - Initiate general supportive care and treatment of complications
 - ▶ Monitoring for atrial fibrillation and other cardiac arrhythmias at least the first 24 hr

Neurocritical care protocols...

► Step 9: BP Management

- High BP treatment with IV rtPA should carefully lowered
- Keep at SBP <185 DBP <110 mm Hg before thrombolytic therapy is initiated
- Maintain at 180/105 mm Hg for at least the first 24 h after intravenous rtPA treatment.
- If patient is not receiving tPA,
 - lower blood pressure by 15% during the first 24 h after onset of stroke
 - and antihypertensive medications should be withheld unless the systolic blood pressure is >220 mm Hg or the diastolic blood pressure is >120 mm Hg.

Neurocritical care protocols...

▶ Step 9: BP Management

- ▶ Restarting antihypertensive medications is reasonable
 - ▶ after the first 24 h for patients who have
 - ▶ preexisting hypertension and are neurologically stable
- ▶ Patients who have malignant hypertension or other medical indications for aggressive treatment of blood pressure should be treated accordingly
- ▶

Neurocritical care protocols...

▶ Step 9:

- ▶ Optimise head bed position
 - ▶ Neutral position or elevate head 30 degree
- ▶ Airways support and ventilator assistance may be needed
- ▶ Sources of hyperthermia (temperature > 38 C) should be identified and treated
- ▶ Hypoglycemia (blood glucose <60 mg/dL) should be treated
- ▶ Treat hyperglycemia to achieve blood glucose levels in a range of 140 to 180 mg/dL and to closely monitor to prevent hypoglycemia.
- ▶ Hypovolemia should be corrected with intravenous normal saline

Neurocritical care protocols...

▶ Step 9:

- ▶ Treat raised ICP
- ▶ Prevent and treat pneumonia, UTI, bed sore
- ▶ Prophylactic anticoagulants to prevent DVT
- ▶ Maintain nutrition, calorie, fluid and electrolytes
- ▶ Treat comorbidities

Case follow up

2

- ▶ A 70-year-old man presents with a two-and-a-half-hour history of right-sided arm, leg and face weakness and loss of speech. He has no headache and is mildly confused. He has a history of ischaemic heart disease.
- ▶ On examination he has a global dysphasia, full visual fields, upper motor neurone distribution right facial weakness and dense weakness (UMN distribution) of the right side with absent reflexes and an upgoing plantar response on that side. His pulse was regular.
- ▶ Delayed 2 and half hours only
- ▶ A clinical diagnosis of left middle cerebral artery ischaemic stroke

What immediate action would we take in this case (i.e. cerebral infarct)?

2

- ▶ Is thrombolysis to be considered?
 - ▶ Yes
 - ▶ This stroke occurred less than 180 min ago
 - ▶ Immediate diffuse weighted MRI (more sensitive than CT) if available should be performed
 - ▶ Unfortunately, it was not available for this patient

What immediate action would we take in this case (i.e. cerebral infarct)?

2

- ▶ CT showed no evidence of haemorrhage,
 - ▶ therefore, cerebral infarction was likely
- ▶ He was given IV tPA
 - ▶ after ruling out contraindications and consenting the patient as soon as possible
- ▶ Total dose 0.9 mg/kg maximum 90 mg. Given 10% of total dose over 1 min and the remainder over 60 min by infusion (thrombolytic therapy is recommended by Cochrane reviews)

Other immediate action

2

- ▶ O₂ by mask.
- ▶ Blood tests (Hb, WCC, U&Es, glucose, ESR).
- ▶ Admit to multidisciplinary hospital stroke unit.
- ▶ Checked -
 - ▶ Blood pressure: do not over-correct systemic hypertension in acute phase
 - ▶ Swallowing: nil by mouth and IV fluids in any major stroke, assess properly by speech therapist

Other immediate action

2

- ▶ Asymptomatic aspiration is common, therefore early referral to physiotherapy and other support services
- ▶ Treat for any concurrent infection, other illness or electrolyte disturbance.
- ▶ If there is evidence of cerebral oedema and risk of coning,
 - ▶ give IV mannitol.

Further management

- ▶ Start aspirin 75 mg daily (24 hours after if tPA has been given)
- ▶ Dipyridamole slow release
- ▶ Anti-coagulants if in atrial fibrillation
- ▶ Serum cholesterol: if fasting > 3.5 mmol/L (not in acute situation), give atorvastatin 10 mg daily

2

Progress

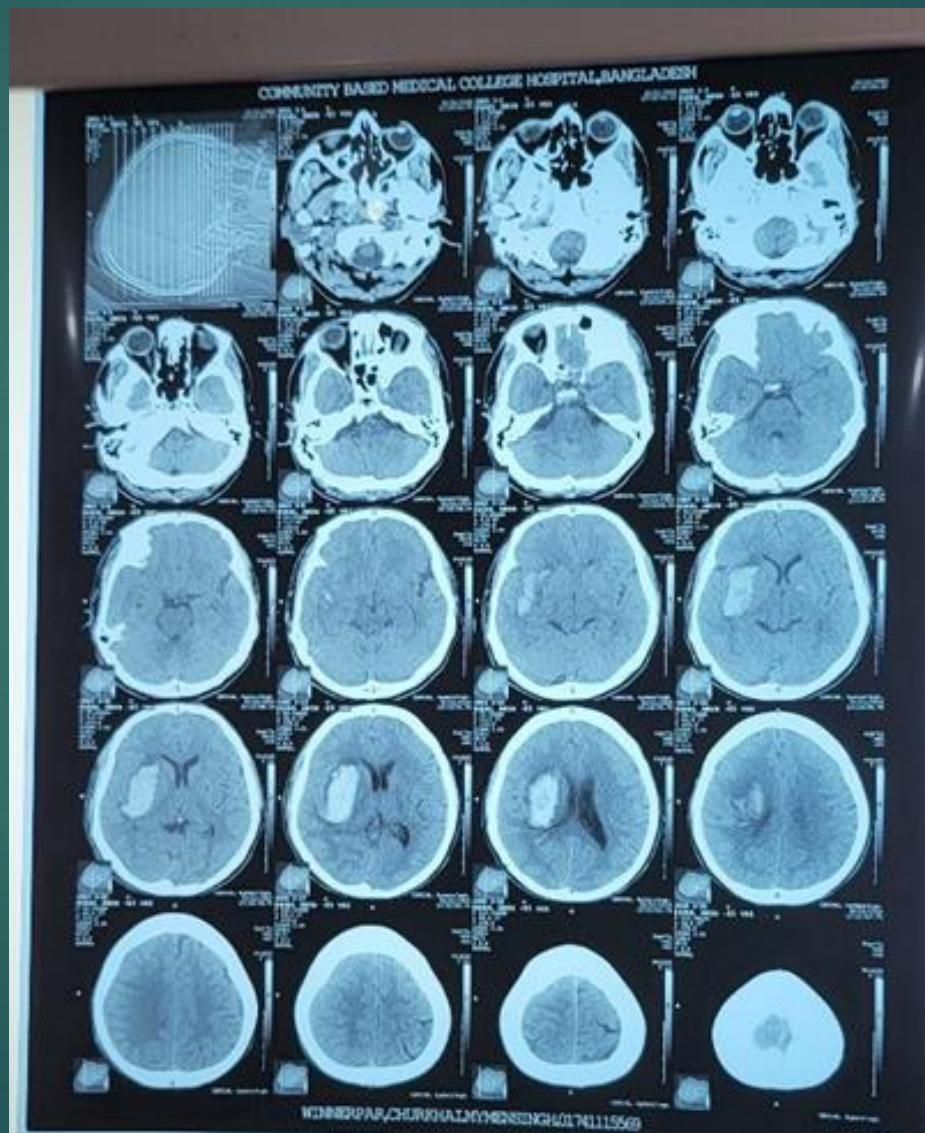
2

- ▶ No early clinical improvement was shown
 - ▶ as can occur after thrombolytic therapy (37%)
- ▶ By 3 months he was ambulant
 - ▶ with a minor neurological deficit
 - ▶ and had improved speech
- ▶ Ref: Wechsler LR. Intravenous thrombolytic therapy for acute ischemic stroke. N Engl J Med 2011; 364: 2138-2146.

- ▶ Mr. Ruhul Amin, 65 years old, male, non-smoker, irregularly treated hypertensive patient developed sudden onset of headache, vertigo and fall from standing height followed by brief unconsciousness and regained consciousness after 1 hour.
- ▶ He then noticed inability to move left side of the body, right deviation of his angle of mouth, slurring of speech, drooping of left upper eye lid and visual difficulty. Bowel and bladder revealed normal. He admitted to the hospital 48 hours later of his symptoms.
- ▶ Delayed admission by 48 hours

3

CT scan of brain showed subacute intracerebral hemorrhage



Intracerebral Hemorrhage (ICH)

3

- ▶ ICH is the second most common cause of stroke
- ▶ Hypertension is the commonest cause
- ▶ ICH should be managed in an critical care unit or stroke unit

Intracerebral Hemorrhage (ICH)

3

- ▶ Predictor of bad outcome
 - ▶ Older age
 - ▶ decreased Glasgow Coma Scale (GCS) score
 - ▶ Increased ICH volume
 - ▶ Presence of intraventricular hemorrhage and deep or infratentorial ICH location
 - ▶ The 30-day mortality from ICH varies from 35 to 52%.

Intracerebral Hemorrhage (ICH)...

3

- ▶ Step 1: Assess for ABCD and Maintain Airway
- ▶ Step 2: Neuroimaging and Its Interpretation
- ▶ Step 3: Reduce BP Judiciously

Intracerebral Hemorrhage (ICH)...

3

- ▶ Step 4: Consider Management of Raised ICP
 - ▶ It is expected to follow ICH and is defined as ICP ≥ 20 mmHg for >3 min. The therapeutic goal is to decrease ICP to <20 mmHg and maintain the cerebral perfusion pressure between 50 and 70 mmHg
 - ▶ Raised ICP is treated with bolus therapy of 20% mannitol (1 mg/kg) IV given over 10-20 min repeated as frequently as needed or hypertonic saline.

Intracerebral Hemorrhage (ICH)...

3

- ▶ Step 5: : Cautious Use of Blood Components
- ▶ Step 6: Selected Use of Antiepileptics
- ▶ Step 7: Consider Cerebral Angiography
- ▶ Step 8: Consider Surgical Management
- ▶ Step 9: General Care

Intracerebral Hemorrhage (ICH)...

3

- ▶ Step 4: Consider Management of Raised ICP
 - ▶ Maintain neck in neutral position to prevent impedance of jugular venous outflow.
 - ▶ Elevate head of bed at 30", mild sedation
 - ▶ Use isotonic saline for maintenance fluid, Avoid hypotonic fluids.
 - ▶ In extreme case pharmacological paralysis, barbiturate coma is needed.

- ▶ A 56-year-old man presents with weakness of the left hand and face lasting 3 hours and resolving gradually. He had a similar episode 3 months earlier with complete recovery. He is a type 2 diabetic and a smoker.
- ▶ **Resolved within 24 hours, recurrent**
- ▶ A Doppler ultrasound reveals that he has a 90% stenosis at the origin of the right internal carotid artery.
- ▶ Transient ischaemic attack (TIA)

What should be strategy to evaluate and manage this case

- ▶ This is a transient episode of neurological dysfunction caused by focal brain, spinal cord or retinal ischaemia without acute infarction.
- ▶ TIAS may herald the onset of stroke
 - ▶ one-quarter of patients developing stroke have had a TIA, usually within the previous week
- ▶ The ABCD score can help to stratify stroke risk in the first 2 days.

What should be strategy to evaluate and manage this case

- ▶ The ABCD score can help to stratify stroke risk in the first 2 days

ABCD	Score
Age > 60 years	1 point
SBP> 140 mmHg and/or DBP> 90 mmHg	1 point
Unilateral weakness	2 point
Isolated speech disturbance	1 point
Other C/F	0 points
Duration of symptoms (min)	> 60 – 2 points, 10-59 – 1 point, <10 – 1point
Diabetes	Present 1 point, Absent 0 points

What should be strategy to evaluate and manage this case

- ▶ A score of <4 - minimal risk, > 6 - high risk
 - ▶ for a stroke within 7 days of a TIA
- ▶ High risk of a TIA, i.e. ABCD score > 4 , or have had two recent TIAs, especially within the same vascular territory, they should be admitted for investigation and treatment
- ▶ All patients should be referred to a TIA clinic and ideally seen within 24 hours.
- ▶ Investigation and treatment should be regarded as urgent and should be completed within 10 days.

Investigations in TIA

- ▶ Look for the source of the embolus - carotids (Doppler) and cardiac (echo)
- ▶ ECG
- ▶ CT brain
- ▶ Further investigation with MRI imaging of the brain and vascular system is often required

Treatment

- ▶ Antiplatelet therapy as for stroke
- ▶ Modification of vascular risk factors-smoking, hypertension, statins as above,
- ▶ Early endarterectomy for symptomatic 70-99% carotid artery stenosis (within 1 week if possible).
- ▶ Anticoagulation for atrial fibrillation (aspirin 300 mg daily for 2 weeks, then anticoagulate with heparin and warfarin or dabigatran)

Progress

- ▶ In this patient an endarterectomy was performed
- ▶ He has made lifestyle changes and has been well over the last 2 years
- ▶ Further reading
 - ▶ Brott G, Hobson RW 2nd, Howard G et al. Stenting versus endarterectomy for treatment of carotid artery stenosis. N Engl J Med 2010; 363: 11-23,
 - ▶ Rothwell PM, Algra A, Amarenco P. Medical treatment in acute and long-term secondary prevention after transient ischaemic attack and ischaemic stroke. Lancet 2011; 377: 1681-1692.

Stroke Mimic

- ▶ An 84-year-old female with a history of arthritis, congestive heart failure, diabetes, and dementia was hospitalized for pneumonia.
- ▶ She was noted to be more sleepy by the nursing staff and “code stroke” was activated.
- ▶ Upon arrival of the in-patient stroke code team, the patient was noted to be diaphoretic and lethargic.
- ▶ She had generalized weakness of arms and legs. Her blood pressure was 86/52 mm Hg, and glucose finger stick was 22 mg/dL.
- ▶ The patient’s exam improved after administration of IV dextrose.





Our



Reality

Take Home Message

- ▶ Stroke is the commonest medical emergency
- ▶ Time means brain in stroke
- ▶ Modern management can prevent many devastating sequelae of stroke
- ▶ The earlier the better
- ▶ We need to build awareness for earliest treatment
- ▶ Integrated knowledge and team work is the key



Thank You