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ISCCM MANUAL OF CRITICAL CARE NURSING

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CHAPTER 14

Critical Care Neurology and Neurosurgery

Urvi Shukla, Sachin Tambhare

INTRODUCTION

Neurological emergencies commonly present in the emergency department and intensive care. These emergencies need a multidisciplinary team of emergency physicians, neurologists, intensivists, and critical care nurses. In this chapter, we review a few common neurological emergencies such as acute stroke, traumatic brain injury, status epilepticus, meningitis/encephalitis, and comatose patients of unknown cause. The chapter is written in a format that is easy to understand and read. It may be used as a ready reckoner to help the reader in an emergency.

STROKE

A stroke can occur when blood flow to the brain is stopped. Stroke is a medical emergency; it can cause lasting brain damage, disability, and even death. Treatment for stroke needs to be done in a time-bound fashion, and there is strong evidence that ischemic stroke should be thrombolyzed if the onset of symptoms is within 3–4.5 hours.

Across the world, stroke is recognized as an emergency and hospitals have designed their processes to recognize stroke early, to do brain imaging early and thrombolyze a patient early. The pneumonic explained here is one of the ways to help early identification of a stroke patient. The rest of the stroke treatment pathway is explained in a tabular format **(Table 1)**.

INTRACEREBRAL/ INTRAPARENCHYMAL BLEED

This is a hemorrhagic stroke. The patient presents with symptoms similar to ischemic stroke but in this case, there is a bleed in the parenchyma of the brain. Without a computed tomography (CT) scan, it is difficult to clinically differentiate between ischemic and hemorrhagic stroke. Thrombolysis is contraindicated in this type of stroke **(Table 2)**.

SUBARACHNOID HEMORRHAGE

These can be life-threatening bleeds in the brain. This bleeding happens between the arachnoid membrane and the pia mater (the innermost lining of the brain). This happens suddenly and is associated with the rupture of an aneurysm of large intracerebral arteries. This blood can easily track into the cerebrospinal fluid (CSF) spaces and ventricles. There are multiple complications associated with vasospasm, obstructive hydrocephalus, cerebral ischemia, coma, and sometimes even death **(Table 3)**.

STATUS EPILEPTICUS

It is a seizure with 5 minutes or more of continuous clinical and/or electrographic seizure activity or recurrent seizure activity without recovery between seizures. It is recognized as a medical emergency as prolonged seizures may be associated with brain damage and status epilepticus (SE) gets more difficult to treat as seizure activity is prolonged **(Table 4)**.

TABLE 1: Stroke.

Condition	***Acute ischemic stroke***
Symptoms: This pneumonic BEFAST is a quick and easy way to remember the symptoms of stroke	• B = Loss of *B*alance • E = Loss or blurry or double vision (*EYES*) • F = *F*acial deviation • A = *A*rm drop or weakness • S = Slur in *S*peech • T = last known well *T*ime
Signs	• HR >90 or <60 beats/min • SBP = N or >140 mm Hg • Loss of balance, hemiplegia, or hemiparesis may be present • In posterior circulation stroke, there may be diplopia, vomiting, ataxia, loss of balance, or sudden onset coma (*Note:* All or a few signs may be present.)
What you need to do	• A clear *last-known well* time has to be documented • When stroke is suspected, a stroke code is to be announced • NIHSS scoring has to be done bedside • Stroke mimics have to be ruled out • They are hypoglycemia, drug intoxication, acute alcohol intoxication, OPP poisoning, and postictal TODD's palsy • NIHSS scoring should not take more than 10 minutes. If the patient has come to the hospital within 3 hours of the onset of stroke symptoms, the patient should be urgently scanned to decide eligibility for thrombolysis • If NIHSS <5, no need for thrombolysis • If NIHSS 6–15, thrombolyze the patient if in a window period • If NIHSS >15, the risk of post-thrombolysis bleeding is very high and a neurologist should be consulted before a decision is made • Do ECG and ABG • Send CBC, urea/creatinine, and electrolytes • Ideally a platelet count and serum creatinine should be available before thrombolysis but thrombolysis cannot wait till the laboratory is ready
Primary treatment	• O_2 support via Hudson mask to keep SpO_2 >95% • Titrate SBP to 160–180 mm Hg and diastolic BP to <100 if the patient is for thrombolysis • Urgently do a CT brain/MRI brain (limited study) as per neurologist • Take consent for thrombolysis • Injection tenecteplase 0.25 mg/kg should be given as a quick bolus. It should be followed by a flush of 50 mL water for injection or a running NS pint • Another drug that can be used for thrombolysis is injection alteplase 0.9 mg/kg. Of which 0.1 mg/kg is given as a bolus, and the rest as an infusion over 1 hour • The patient should not receive any IM injections, no Foley's catheter insertion for at least 6–8 hours post-thrombolysis • The patient should be transferred to the ICU for further monitoring and care

(ABG: arterial blood gas; CBC: complete blood count; CT: computed tomography; ECG: electrocardiogram; HR: heart rate; ICU: intensive care unit; IM: intramuscular; MRI: magnetic resonance imaging; OPP: organophosphate; SBP: systolic blood pressure; SpO_2: oxygen saturation)

TABLE 2: Intracerebral/intraparenchymal.

Condition	***Intracranial bleed***
Symptoms	• B = loss of *B*alance • E = loss or blurry or double vision (*EYES*) • F = *F*acial deviation • A = *A*rm drop or weakness • S = slur in *S*peech • T = last known well *T*ime Headache, dizziness, and unconsciousness
Signs	• HR >90 or <60 beats/min • SBP = N or >140 mm Hg • Loss of balance, hemiplegia or hemiparesis, and loss of speech may be present • In posterior circulation bleed, there may be diplopia, vomiting, ataxia, loss of balance, or sudden onset coma (*Note:* All or few signs may be present.)
What you need to do	• Urgent CT brain is indicated • Ask for a history of drug use such as warfarin, NOACs, acitrom, steroids, and recreational drugs. Ask for a history of previous hypertension (HTN), compliance to anti-HTN medicines
Primary treatment	• O_2 support via Hudson mask to keep SpO_2 >95% • Titrate SBP to 140–150 mm Hg and diastolic BP to <100. Lowering BP is an emergency. Injection labetalol 5–10 mg bolus followed by infusion of 2–4 mg/hour is recommended • Lowering BP prevents expansion of hematoma and therefore reduces brain damage • Urgently do a CT brain • Involve a neurosurgeon if the bleed volume >30 mL or there is a posterior fossa bleed or GCS <8, or the patient is on anticoagulant drugs • Send PT/INR and APTT for all patients. Hold all anticoagulant and antiplatelet drugs. Ask the time when the last dose was taken • If there is a suspicion of an overdose of these medicines, consider doing MLC • If the patient's GCS >8, no need for early intubation • If the patient's GCS <8, early intubation is needed to prevent the risk of aspiration and hypoxemia • However, intubation should be done once BP is well controlled and by a senior member of the team

(APTT: activated partial thromboplastin time; CT: computed tomography; GCS: Glasgow Coma Scale; HR: heart rate; INR: international normalized ratio; NOACs: new oral anticoagulants; PT: prothrombin time; SBP: systolic blood pressure; SpO_2: oxygen saturation)

TABLE 3: Subarachnoid hemorrhage.

Condition	***Subarachnoid hemorrhage***
Symptoms	• *Sudden severe headache:* Thunderclap headache, which may be associated with vomiting, loss of consciousness, seizures, or focal neurological deficit • Other symptoms include decreased focus or alertness, confusion, dizziness, photophobia, blind patches in vision, double vision, and transient blindness
Signs	• HR >90 *or* <60 beats/min • SBP = N *or* >140 mm Hg • Hemiplegia, hemiparesis, loss of consciousness, nuchal rigidity, diplopia, blurring of vision, dizziness, and vomiting
What you need to do	• Urgent CT brain plain is indicated • Ask for a history of smoking, alcohol intake, cocaine or methamphetamine use, history of hypertension, connective tissue disorders, head trauma, and family history of aneurysm rupture • Send CBC, PT/INR, and APTT along with routine laboratory investigations
Primary treatment	• O_2 support via Hudson mask to keep SpO_2 >95% • Target SBP <160 mm Hg, MAP >75 mm Hg • Injection labetalol 10–20 mg IV every 10–15 minutes as needed • Give tablet nimodipine 60 mg Q4H and begin therapy within 96 hours of SAH • Reducing BP prevents further hematoma and decreases the chances of re-bleeding • If patient's GCS >8, no need for early intubation • If patient's GCS <8, early intubation is needed to prevent the risk of aspiration and hypoxemia • However, intubation should be done once BP is well controlled and by a senior member of the team • Urgently do CT brain angiography if aneurysmal rupture is suspected • Correct coagulation abnormality if any • Involve neurosurgeon, neurophysician, and interventional radiologist urgently for aneurysmal clipping or coiling in patients with aneurysm rupture and Hunt and Hess grades 1–3. For grades 4–5 surgery can be delayed if there is no spontaneous clinical improvement or the patient does not respond to therapy for decreasing intracranial pressure (ICP) • External ventricular drain (EVD) can be placed if a patient develops a hydrocephalus • These patients have a prolonged ICU stay; hence, general intensive care nursing such as thromboprophylaxis, the elevation of the head end of the bed, keeping the head in the midline position, nutrition, preventing bed sores, and oral hygiene play an important role in ICU outcomes

(APTT: activated partial thromboplastin time; CT: computed tomography; CBC: complete blood count; GCS: Glasgow Coma Scale; HR: heart rate; INR: international normalized ratio; PT: prothrombin time; MAP: mean arterial pressure; SAH: subarachnoid hemorrhage; SBP: systolic blood pressure; SpO_2: oxygen saturation)

TABLE 4: Status epilepticus (SE).

Condition	*Status epilepticus*
Types of status epilepticus	• *Convulsive status epilepticus (CSE):* Characterized by prolonged seizures that have physical abnormal movements • *Nonconvulsive status epilepticus (NCSE):* Characterized by prolonged and continuous electrical seizure activity in the brain which results in behavioral changes, altered mental status, coma, and evident on the EEG • Both types of seizure activity have either generalized or partial involvement
What you need to do	• A person who is convulsing needs the following done immediately • Roll the person onto their side when possible • Attach a cardiac monitor • O_2 support if SpO_2 <94% • Try to get two large bore IV access, if IV is established, send blood samples • If the patient's GCS <8, early intubation is needed to prevent the risk of aspiration and hypoxemia • Check finger glucose level, hypoglycemia can be the most easily treatable cause of seizures • Send CBC, RFT, LFT, SR, calcium, magnesium, ABG, toxicology screening (blood and urine) if drug abuse is suspected • IV access should be used for antiseizure medicines and antiepileptic medicines • Patients may need supportive investigations such as CT scan or MRI, or a lumbar puncture if infectious pathology is suspected • If seizures do not stop after a full dose of antiepileptic medicine or last more than 10 minutes, then this is classified as refractory status epilepticus. In such situations, electroencephalographic (EEG) monitoring may be helpful
Primary treatment	• *Stage 1:* Early SE (0 to 10 minutes): Injection lorazepam 0.1 mg/kg IV diluted slow push at 2 mg/min. If the seizure persists, repeat another 2 mg bolus dose of injection lorazepam • *Stage 2:* Established SE (10–30 minutes): Injection phenytoin infusion 15 mg/kg *or* injection sodium valproate 25 mg/kg IV infusion *or* injection levetiracetam 1 g IV infusion f/b 10 mg/kg IV BD • *Stage 3: Refractory SE*: Continuous seizures despite treatment after 30–60 minutes. General anesthesia is recommended such as midazolam/thiopental/propofol infusion

(ABG: arterial blood gas; CBC: complete blood count; CT: computed tomography; GCS: Glasgow Coma Scale; IV: intravenous; LFT: liver function test; RFT: renal function test; MRI: magnetic resonance imaging; SpO_2: oxygen saturation)

COMA OF UNKNOWN CAUSE

Multiple reasons can cause a coma in patients arriving in the emergency/ICU. These conditions are associated with an increased risk of death, but currently, there are no treatment guidelines **(Table 5)**.

TABLE 5: Coma of unknown cause.

Condition	***Coma of unknown cause***
What is coma	• Unresponsive state in which patients do not respond to any external stimuli or internal needs • Objectively it is defined as a Glasgow Coma Scale (GCS) <8
What you need to do	• Immediate evaluation and concurrent stabilization and assessment are required • Try to do a head-to-toe neurological examination before you intubate this patient • Patients with a GCS <8 will need intubation and mechanical ventilation • *A:* Airway (intubation) and cervical spine stabilization • *B:* Ensure appropriate and adequate ventilation • *C:* Optimize hemodynamics • *D:* Neurological deficit evaluation • Check pupillary and brain stem reflexes • Collateral history and head-to-toe examination • Do a random finger prick BSL, send CBC, blood and urine toxicology screening, LFT, RFT, PT/INR. Electrolytes, calcium, magnesium, ABG, and ECG • *Neuroimaging:* CT/MRI brain • Fundoscopy to rule out raised ICP and papilledema • EEG to rule out status epilepticus • CSF study if strong suspicion of Meningitis or encephalitis
Primary treatment	• Injection mannitol 1–1.5 g/kg if suspicion of raised ICP • Injection dextrose 50% if hypoglycemia • Injection thiamine 500 mg IV bolus if history of alcohol abuse • Injection naloxone 0.01 mg/kg IV if suspicion of opioid overdose (Do not exceed 10 mg) • Injection flumazenil 0.2 mg every 15–30 seconds, maximum dose of 3 mg/h if suspected benzodiazepine poisoning • Anticonvulsant if suspicion of NCSE • Antibiotics for meningitis or septic shock • Gastric lavage if suspicion of intoxication
Some medical conditions that can cause coma	• Cardiac arrest • Stroke • Brain tumors • Vasculitis • Airway obstruction • Hypoglycemia • Overdose/drug abuse • Hypotension • Anaphylaxis • Hyperkalemia • Myocardial infarction • Sepsis • Alcohol withdrawal • Metabolic problems • Status epilepticus

(ABG: arterial blood gas; BSL: blood sugar level; CBC: complete blood count; CSF: cerebrospinal fluid; CT: computed tomography; ECG: electrocardiogram; EEG: electroencephalogram; ICP: intracranial pressure; INR: international normalized ratio; LFT: liver function test; PT: prothrombin time; MRI: magnetic resonance imaging; NCSE: nonconvulsive status epilepticus; RFT: renal function test)

FURTHER READING

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It is a manual and also a textbook. It deals with the day-to-day nursing care in the critical care units. It also imparts a thorough theoretical background for it. Renowned Intensivists as well as Nurse Trainers have joined hands to write a compact *Manual of Critical Care Nursing*. All the important topics have been covered including the practical bedside nursing protocols. The issues like disaster management, organ donation and communication have been included. There are illustrations, flowcharts, and tables to explain salient points. It will be a perfect companion for the critical nurses.

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