

COMA

→ Consciousness includes Both arousal or wakefulness (as well as awareness)

→ It is maintained by neurons in the pons and midbrain that form Ascending Reticular activating system or ARAS -

→ ARAS sends neuronal connection to cerebral hemisphere (Both) for producing awareness.

→ So damage to the ARAS in brainstem, both cerebral hemisphere or the tracts carries ↓ consciousness.

Coma → Decreased arousal resembling sleep, But cannot be aroused by external stimuli

Normal arousability

↓
Lethargy
↓
Obtundation
↓
Stupor
↓
COMA

→ Cannot be aroused

→ Can be aroused by external stimuli like shouting on ears, or nociceptive stimulation like pricking on supraorbital ridge or squeezing trapezius.

Differential Diagnosis (My TIPS)

Metabolic → Electrolyte Imbalance, Organ dysfunction, Sugar

Toxic → Opioid, Cocaine

Injury/Infections → Sepsis, Meningitis, Encephalitis

Psychiatric → Depression, Schizophrenia → suicidal overdose

Structural → Stroke, Subdural hemorrhage, Tumor

① History → Always elicit from witness, family, friends.

① Sudden

→ Stroke, Subarachnoid hemorrhage, Seizure, Cardiac arrest.

② Gradual →

→ Brain Tumor, Subdural Hematoma, infection, Metabolic disorder.

→ H/O of Metabolic cause:

→ Hypo or Hyperglycemia on Diabetes suggests
Hyperglycemic or Hyperosmolar state, DKA.
→ Rapid correction of electrolyte imbalance
correction of Hyponatremia → Osmotic demyelination syndrome
or Hypernatremia → Cerebral edema

H/O of Toxins → Drug abuse.

H/O of Infections, Infection → Fever, or Trauma

H/O of Psychiatric → Suicidal notes, or pills and
and child intake.

H/O of structural → Before onset of
Hemiparesis, Homonymous loss or diplopia

Reviewing all medical reports.

② Physical Examination

① Vital Sign

① BP → Hypertension → Hypertensive encephopathy.
Hypotension → Hypovolemia → Sepsis, Cardiac failure.

② Pulse rate/Heart rate → Tachycardia → Sepsis, Hypovolemia
Bradycardia → Beta blockers, Calcium channel blockers.

↑ BP, Bradycardia & ↑ Breathing → Cushing's Triad

③ Temperature
Fever → Heat stroke, thyrotoxicosis.

④ Respiration →

- ① Cheyne Stokes Breathing → Waxing and Waning of Hyperventilation & Hypoventilation followed by total cessation or apnea → where Brain stem doesn't give enough oxygen (Heart stroke, Cardiac Failure)
- ② Kussmaul's Breathing → Deep, laboured breathing → Acidosis → Diabetic ketoacidosis.

⑤ Local Examination

- ① Skin → Jaundice, Spider angioma, palmar erythema
↳ Liver disease
Tongue → Cherry red → Carbon Monoxide poisoning.
Bitten tongue → Epileptic seizures.
Needle pricks → Intravenous drug use.
- ② O/E of Eyes → Exotropia
Subhyaloid hemorrhage → Subarachnoid hemorrhage
Exudates (Cotton wool) → Hypertensive Encephalopathy.
Flame shaped Bitot hemorrhage
Papilloedema → Increased Intracranial pressure
- ③ O/E of Thyroid (Goitre)
↳ Hypothyroidism (Myxoedema Coma)
→ Thyrotoxicosis.

④ Assessing Level of Consciousness

Glasgow Coma Scale → 15 point scale.

① Eye movement - 4

② Verbal → 5

③ Motor → 6

15

⑤ Anocervical Brainstem Test Function

↓
Pupillary reflex

↓
Corneal reflex

↓
Vestibulo-ocular reflex

① Pupillary reflex → By shining light

a) Pinpoint pupil → Damage to Pons or opioid overdose.

b) Unilateral, unreactive dilated pupil
Intraocular mass → Cerebral herniation → compression of 3rd nerve

c) Bilateral, unreactive dilated pupil
→ Overdose of Cocaine, antidepressants.

d) Fixed, mid sized pupils → Midbrain injury.

e) Normal Pupils → Metabolic disorders.

② Corneal reflex → Touching cornea with cotton.

- Normally Both eyes blink.

→ In Brainstem injury corneal reflex absent.

③ Vestibuloocular reflex

① Oculocephalic or Doll's eye maneuver.
Normal → Head is turned one side to the other and eyes move opposite side.

- But in Brainstem dysfunction → The eyes move on same side.

② Caloric testing:

→ Cold ice water at the external auditory canal and normally eyes turn towards that side.

→ Absence of this shows Brainstem injury.

⑥ Assessing motor examination

- ① Muscle tone → Difficult to elicit in Coma.
↳ Generalized muscle rigidity → Neuroleptics.
- ② Posture → It will show the lesion like
CNS where it is roughly But not exactly.
 - a) Decorticate posture → Flexion of ~~both~~ upper limb and extension of lower limb indicating lesion above brainstem.
 - b) Decerebrate posture → Lesion at the level of Brain stem. Extension of Both upper and lower limb.

Immediate Response after identifying Coma

A → Airway

B → Breathing

C → Circulation.

→ Cardiac monitor, ECG, O₂ given.

→ "Coma Cocktail" →

Three



thiamine → Vitamin B₁₂

Naloxone → Opioid toxin

Dextrose → Hypoglycemia

Investigation

- ① Metabolic → Plasma Glucose, Creatinine, Electrolyte levels. Organs → LFT, RFT, Angiography, CBC, O₂, LDH, etc.
- ② Toxins → Urine & Serum toxin levels.
- ③ Infection → Suscepted, CT, MRT.
Injury → Lumbar puncture.
Structural

Medical legal implications

PVS Brain death

① Permanent Vegetative state:

→ All cerebral cortical functions are lost, and unaware and unresponsive. But Brainstem and hypothalamic functions intact → So they can breathe on their own, Regulate Body temperature, sleep wake cycles.

② Brain death

→ Irreversible loss of all cerebral and Brainstem functions that is equivalent to death → i.e. they are both legally and clinically dead.

How would diagnose?

- Start by excluding all the reversible causes of coma, like medication overdose, metabolic etc.

After that 3 essential factors should be considered:

① Identifiable and irreversible cause of coma should be there.

② Absence of brainstem reflexes.

③ Absence of Breathing (Apnea)

Apnea is identified by apnea testing, which is performed only when the individual has normal Body temperature, BP, PO_2 , & PCO_2 and the first two criteria is fulfilled

Procedure $\rightarrow$ Ventilator is disconnected and, the individual is oxygenated and ~~PO_2~~ PCO_2 is measured, if there is no respiratory drive, PCO_2 exceeds 60 mm Hg confirming Brain death.

$\rightarrow$ Need atleast two physicians with him to certify the brain death.

Mimic of coma But consciousness preserved.

① Locked in Syndrome $\rightarrow$ Damage to Bilateral pons resulting in quadriplegia and mute. But vertical eye movements preserved so he is able to communicate.

② Generalized neuromuscular paralysis $\rightarrow$ Toxin like Botulinum, Snake venom or tetrodotoxin.

$\rightarrow$ But purely motor, consciousness retained.

③ Damage to prefrontal cortex.

$\rightarrow$ Akinetic mutism $\rightarrow$ Individual cannot initiate movements or speech, although they are not paralyzed or aphasic.