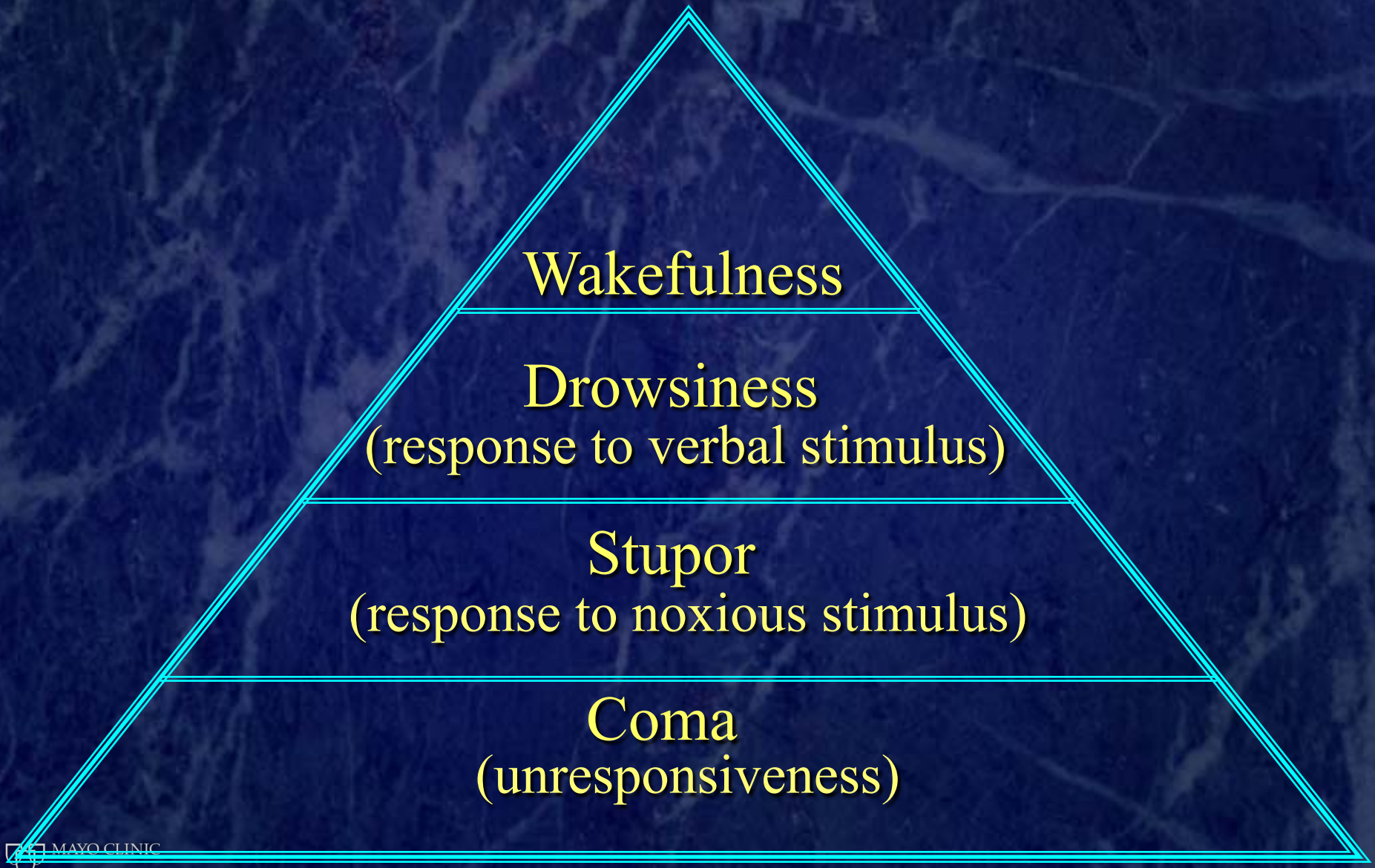
Disclosures

- None

Learning Points

- Understand the components of consciousness
- Recognize the categories of causes of coma
- Discuss the priorities in the evaluation of coma
- Developed a structure approach to the assessment of the comatose patient

Levels of Consciousness



Components of Consciousness

- **Arousal** → **Level of Consciousness**
- **Awareness** → **Content of Consciousness**

Traditional classification of Coma

- Structural supratentorial
- Structural infratentorial
- Structural multifocal or diffuse
- Metabolic-toxic
- Psychogenic

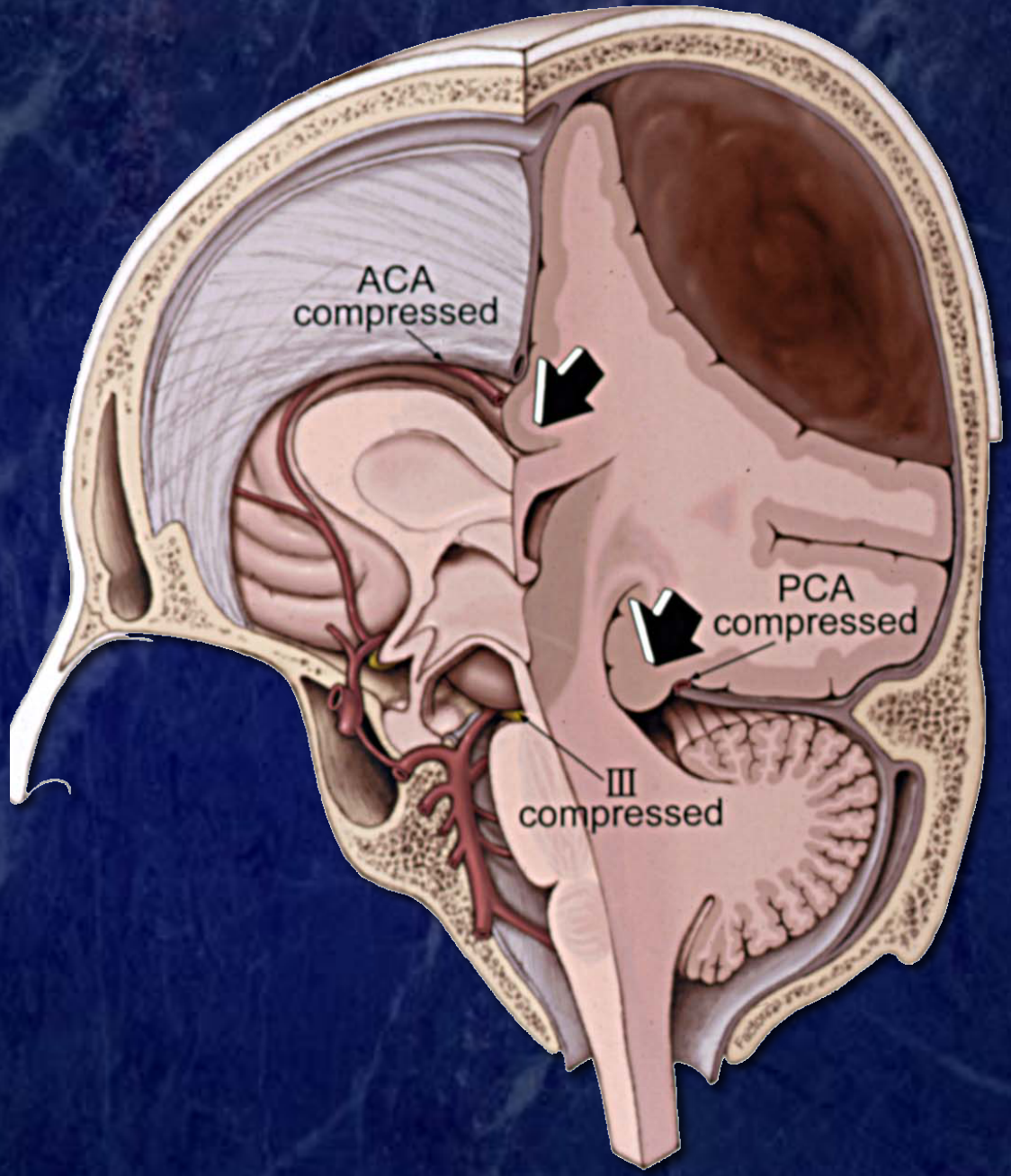
Practical Classification of Coma

- Reversible *(e.g. drug intoxication)*
- Non-reversible *(i.e. structural injury)*
  - Treatable *(e.g. SDH)*
  - Non-treatable *(e.g. global anoxia)*

Classification and Major Causes of Coma
Structural Brain Injury

Unilateral Hemisphere (with displacement)

- Intraparenchymal hematoma
- Massive infarction
- Extra-axial hemorrhage
- Cerebral abscess
- Brain tumor



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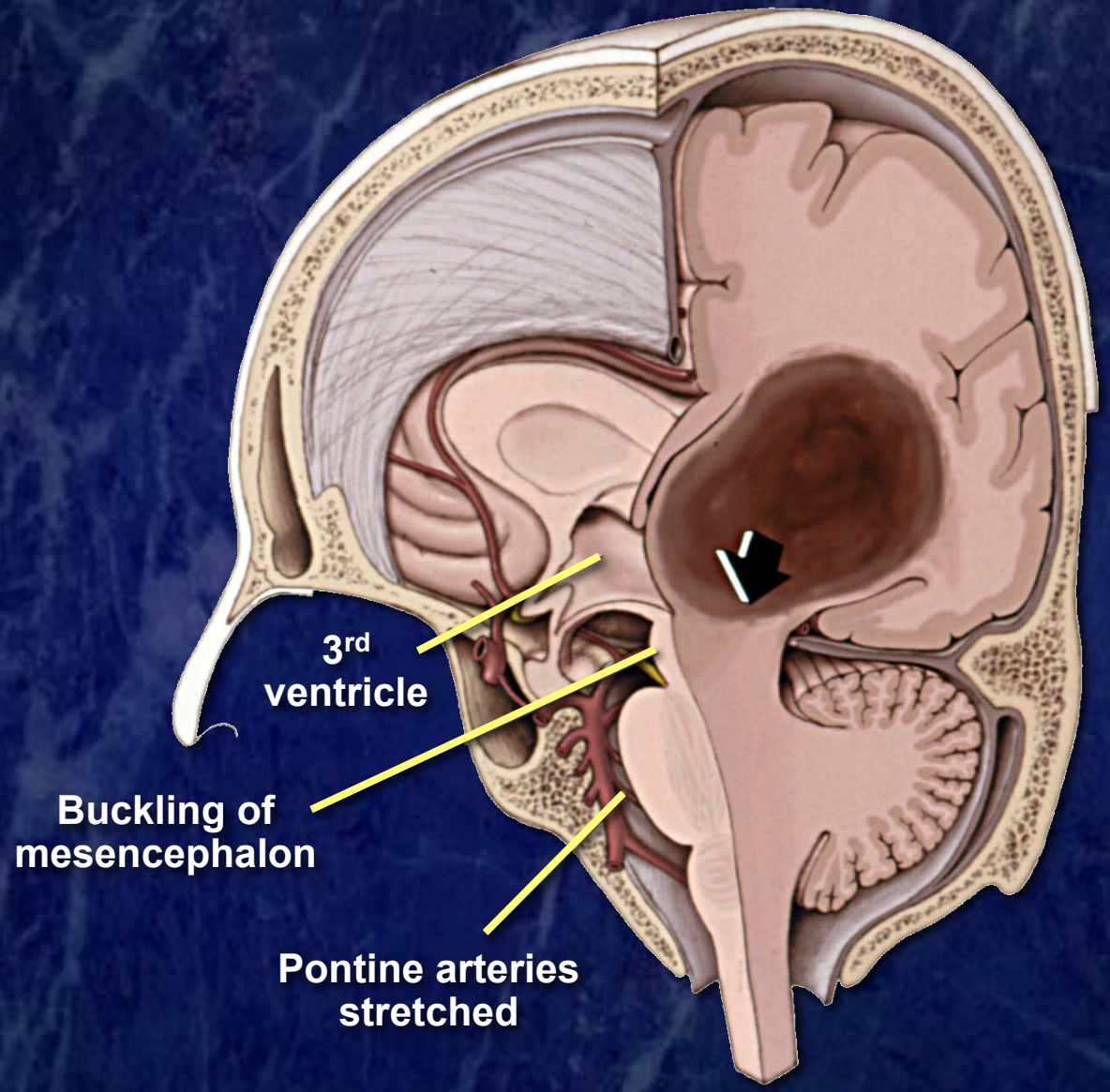
3rd ventricle
Buckling of mesencephalon
Pontine arteries stretched

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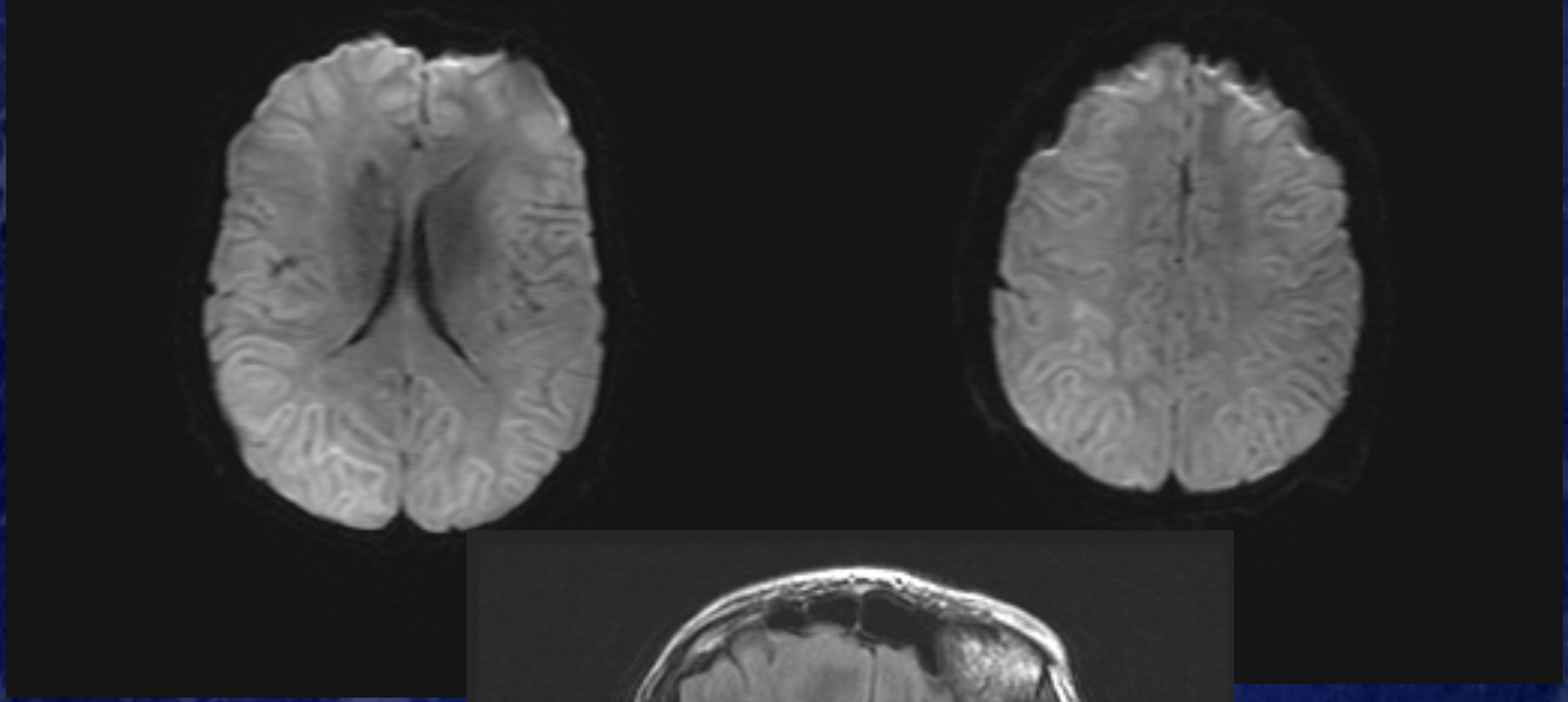
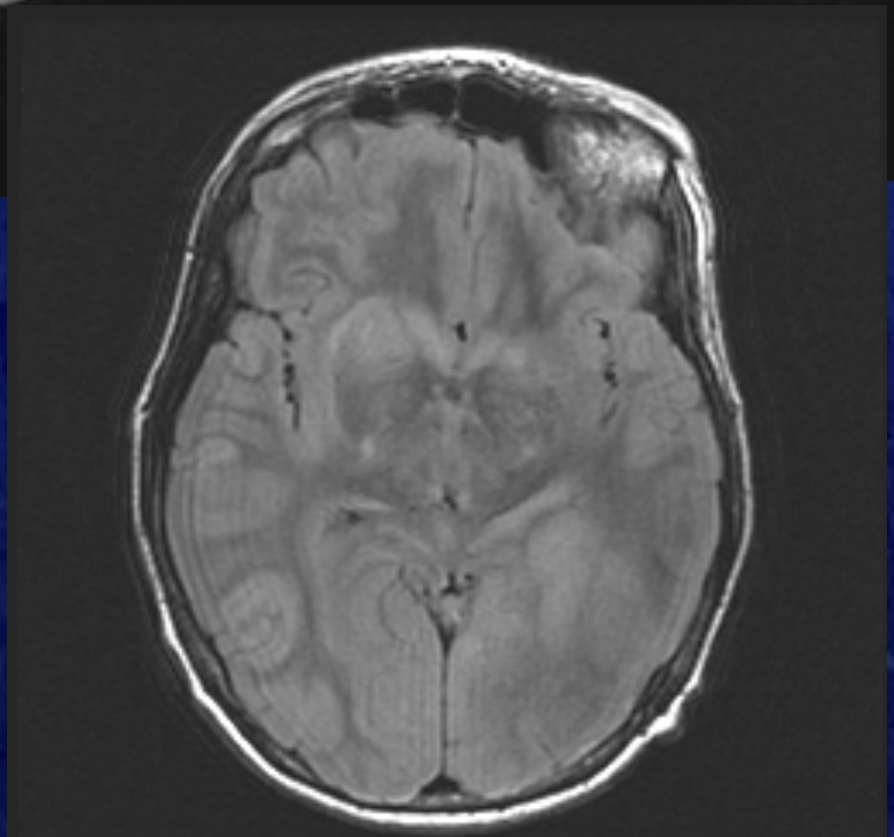
Classification and Major Causes of Coma
Structural Brain Injury

Bilateral Hemisphere

- Diffuse anoxia - ischemia
- Encephalitis
- Bilateral thalamic injury (e.g. deep CVT)
- Severe diffuse axonal injury
- Subarachnoid hemorrhage





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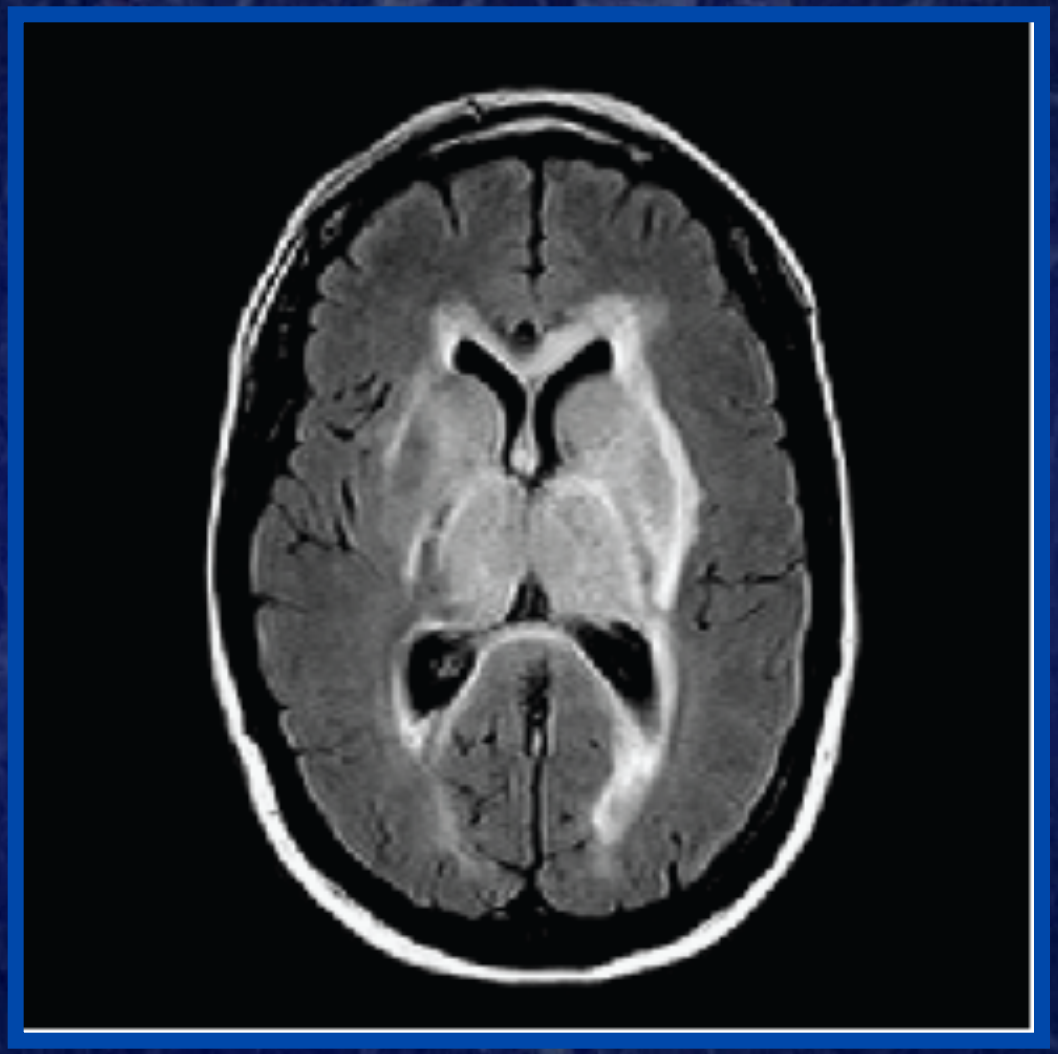

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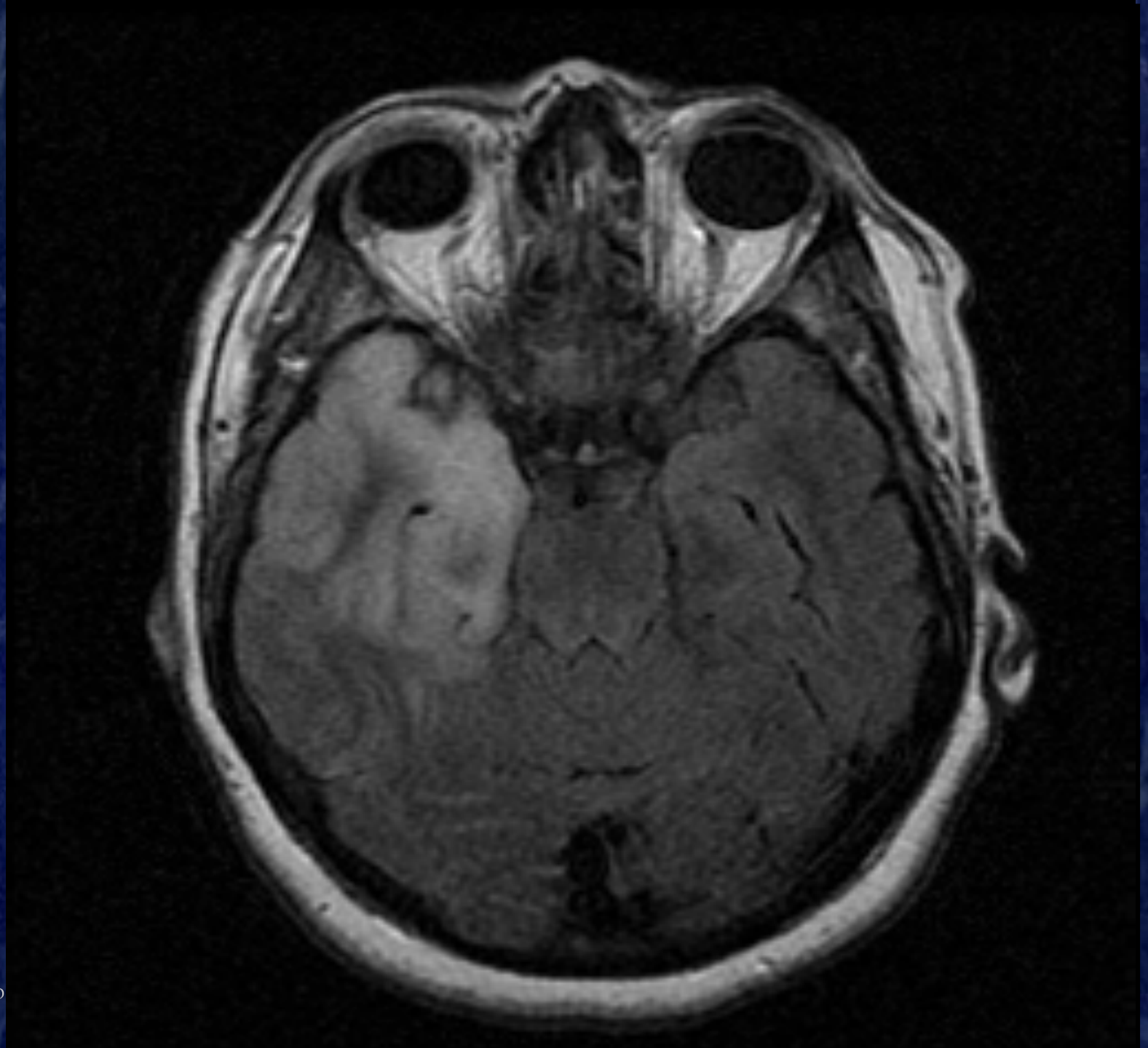

Classification and Major Causes of Coma
Structural Brain Injury

Brain stem

- Pontine hemorrhage
- Basilar artery occlusion
- Central pontine myelinolysis
- Brain stem hemorrhagic contusion

Classification and Major Causes of Coma

Structural Brain Injury

Cerebellum (with displacement of brain stem)

- Cerebellar infarct
- Cerebellar hematoma
- Cerebellar abscess
- Cerebellar glioma

Classification and Major Causes of Coma
Diffuse Brain Dysfunction

- Metabolic disorders
- Toxins and poisons
- PRES
- Status epilepticus
- Extreme hypothermia

Classification and Major Causes of Coma

Acute Metabolic-Endocrine Derangement

- Hypoglycemia
- Diabetic ketoacidosis /nonketotic hyperosmolality
- Uremia
- Liver failure
- Sepsis
- Panhypopituitarism
- Adrenal failure
- Myxedema
- Thiamine deficiency (Wenicke's)
- Hyponatremia - Hypernatremia
- Hypercalcemia

Classification and Major Causes of Coma
Toxic Derangements

- Carbon monoxide
- Ethanol and atypical alcohols
- Organophosphates
- Drugs – Recreational
  Prescription
- Neuroleptic malignant syndrome
- Serotonin syndrome

Classification and Major Causes of Coma

Psychogenic Unresponsiveness

- Catatonia
- Disorders of Somatization
- Malingering

Exam of the patient with impaired consciousness

- General inspection
- Brainstem: pupils, corneals, OCP, oculocalorics, eye position and abnormal eye movements
- Motor response to pain
- Breathing pattern
- Adventitious movements
- Meningeal signs

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Glasgow Coma Scale

Activity/Response		Score
Eye Opening (E)		
Spontaneous		4
After verbal stimulus		3
After painful stimulus		2
None		1
Verbal Response (V)		
Oriented	5	
Confused		4
Inappropriate but recognizable words		3
Incomprehensible sounds		2
None		1
Best Motor Response (M)		
Obeys verbal commands		6
Localizes painful stimulus		5
Withdraws to painful stimulus		4
Abnormal flexion posturing		3
Abnormal extensor posturing		2
None		1

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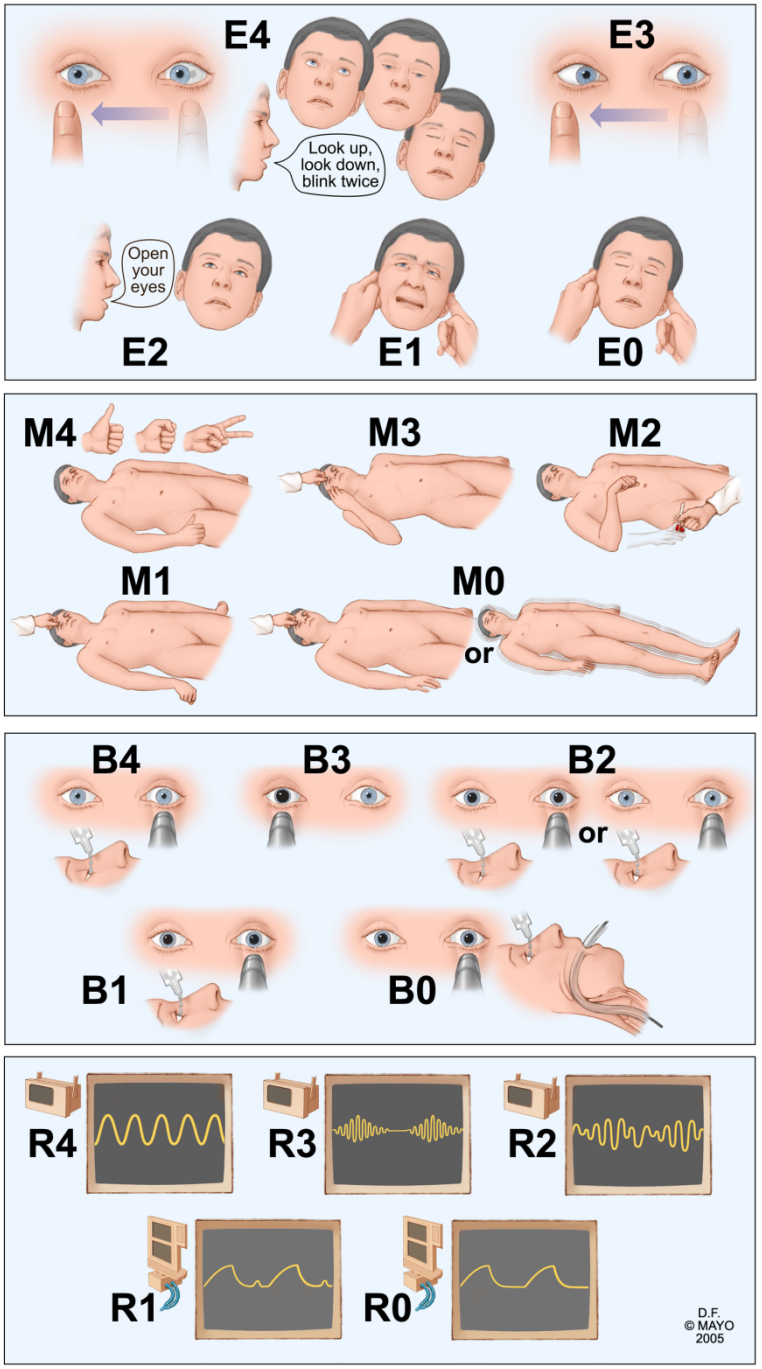
Shortcomings GCS

- No verbal testing in intubated patients (1 of 3 components invalid)
- Abnormal brainstem reflexes not included
- Changing breathing patterns not included
- Numerical skew to motor response

FOUR SCORE


E4
Look up, look down, blink twice
E3
Open your eyes
E2
E1
E0
M4
M3
M2
M1
M0
or
B4
B3
B2
or
B1
B0
R4
R3
R2
R1
R0
D.F.
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Additional Evaluation

Evaluation	Indication
Blood tests	Metabolic panel including glucose, electrolytes, BUN, liver transaminases, and serum ammonia in all cases. CK level if rigidity. Lactic acid if sepsis or acidosis. Toxicological screen in any case with no known cause. Consider carboxyHb, osmolar gap
Brain imaging	If lateralizing signs, brainstem deficits.
Lumbar puncture	Unexplained fever/sepsis. Meningeal signs.
Electroencephalogram	Rhythmic abnormal movements. "Eye-open" coma (eyes open without response to visual threat). Consider in any case of unexplained coma.

My checklist

- ✓ History (previous function, tempo, triggers, exposures)
- ✓ Examination
- ✓ Blood tests
- ✓ Imaging?
- ✓ LP?
- ✓ EEG?

My principles

- Always think of treatable causes first
- Always start with causes that would require emergency treatment
- Never assume it is untreatable until proven to be
- Minimize secondary injury

Diagnosis of reversible causes of coma

Jonathan A Edlow, Alejandro Rabinstein, Stephen J Traub, Eelco F M Wijdicks

Because coma has many causes, physicians must develop a structured, algorithmic approach to diagnose and treat reversible causes rapidly. The three main mechanisms of coma are structural brain lesions, diffuse neuronal dysfunction, and, rarely, psychiatric causes. The first priority is to stabilise the patient by treatment of life-threatening conditions, then to use the history, physical examination, and laboratory findings to identify structural causes and diagnose treatable disorders. Some patients have a clear diagnosis. In those who do not, the first decision is whether brain imaging is needed. Imaging should be done in post-traumatic coma or when structural brain lesions are probable or possible causes. Patients who do not undergo imaging should be reassessed regularly. If CT is non-diagnostic, a checklist should be used use to indicate whether advanced imaging is needed or evidence is present of a treatable poisoning or infection, seizures including non-convulsive status epilepticus, endocrinopathy, or thiamine deficiency.

Lancet 2014;384:2064-76

Key Messages

- Think of treatable causes first
- Use a checklist to avoid missing treatable diagnoses
- Non-treatable causes can be reversible
- Even if the cause of coma cannot be treated, avoidance of secondary injury can still influence outcome