

Unconsciousness

Causes & Mechanisms

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Unconsciousness

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Outline & Learning Objectives

- Definitions of key terms
- Physiology of consciousness
- Assessment & Differential Diagnosis
- Management
- Medically Induced Coma

Definitions

Definitions

- Consciousness
- Sleep
- Delirium
- Dementia
- Coma

Consciousness

- Self-awareness
- Access to memories
- Ability to manipulate abstract ideas
- Focus of attention

Sleep

- A state of reduced interaction with the environment
- Reversible
- Different from anaesthesia/coma.

Delirium

- Acute condition with altered mental state
- Organic basis
- Syndrome (not a diagnosis)
 - **Multiple causes.**
 - inability to focus attention & mental confusion
 - impairments in awareness & temporal and spatial orientation
 - **Many similarities to coma.**

Coma

- Unrousable unresponsiveness.
 - No response to pain.
 - Reflects a lack of CNS function
- Usually has preserved brainstem function
 - Brain mediated reflexes are preserved.

Brain Death

- Irreversible state
- Loss of all brain function
 - No response to pain
 - No brainstem reflexes
- Exclusions
 - Temperature, drugs

Pathology with normal conscious states

Dementia

- Not the same as alteration of consciousness
- Alert mental state
 - Anosognosia (unawareness of illness)

Ischaemic Stroke

- Ischaemic stroke will only affect consciousness if brainstem affected
 - Hemorrhagic stroke is different.
- Usually has focal neurology.

Locked in syndrome

- Awareness, sleep-wake cycles
- May have some meaningful behaviour

- Due to
 - High level spinal injury
 - Guillain-Barré syndrome
 - Parkinson's disease (severe) or similar

Pathology with altered conscious states

Epilepsy

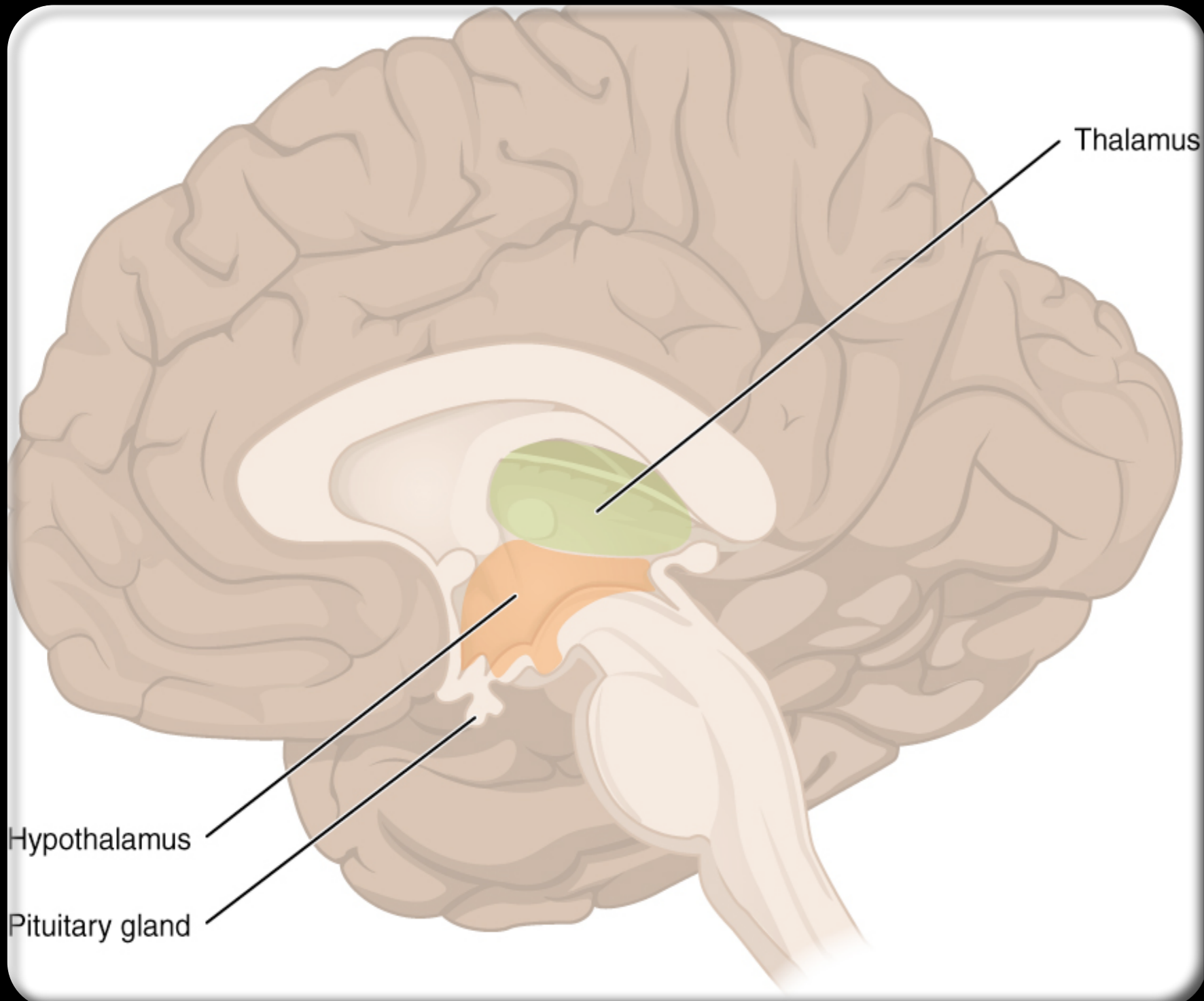
- Epilepsy is a condition of uncontrolled discharge of neurones
 - Generalised seizures are associated with a loss of consciousness
 - Partial seizures are associated with an altered conscious state

Narcolepsy

- Due to the lack of orexin in the hypothalamus
- Loss of stabilising switch
- Sudden onset of sleep

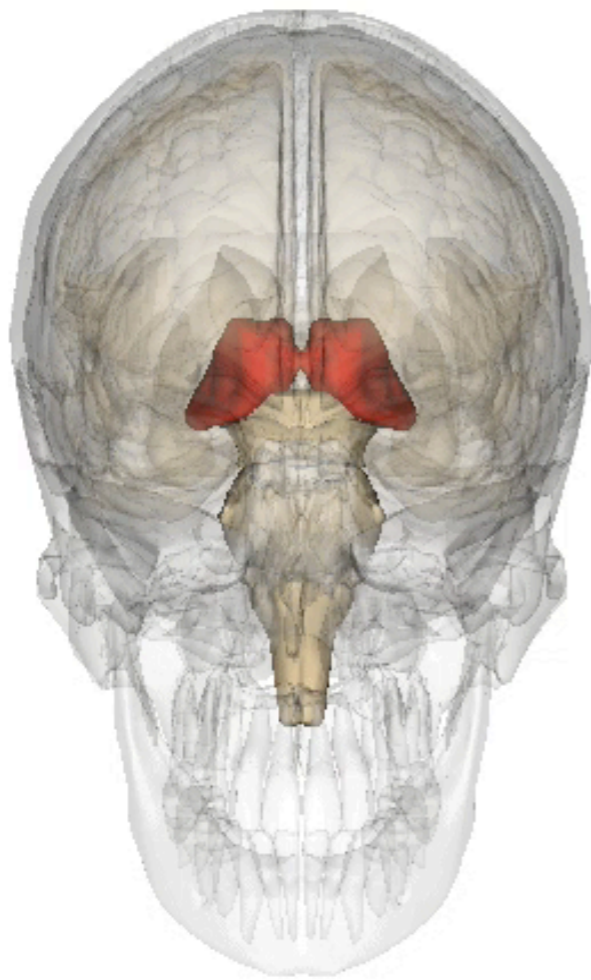
Physiology of Consciousness

The Diencephalon



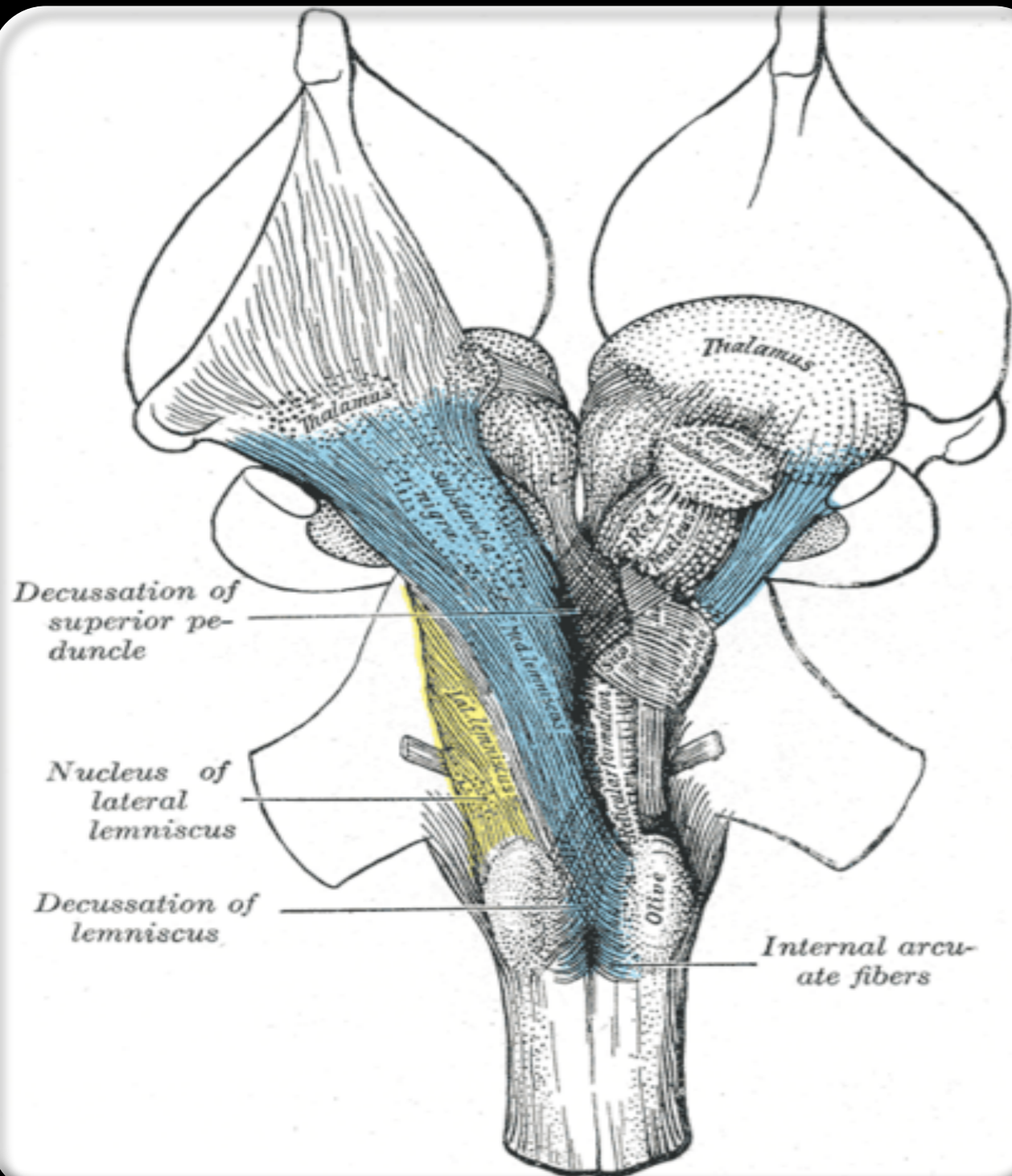
- “Interbrain”
- Region of the embryonic vertebrate neural tube
- Gives rise to posterior forebrain structures

Role of Thalamus



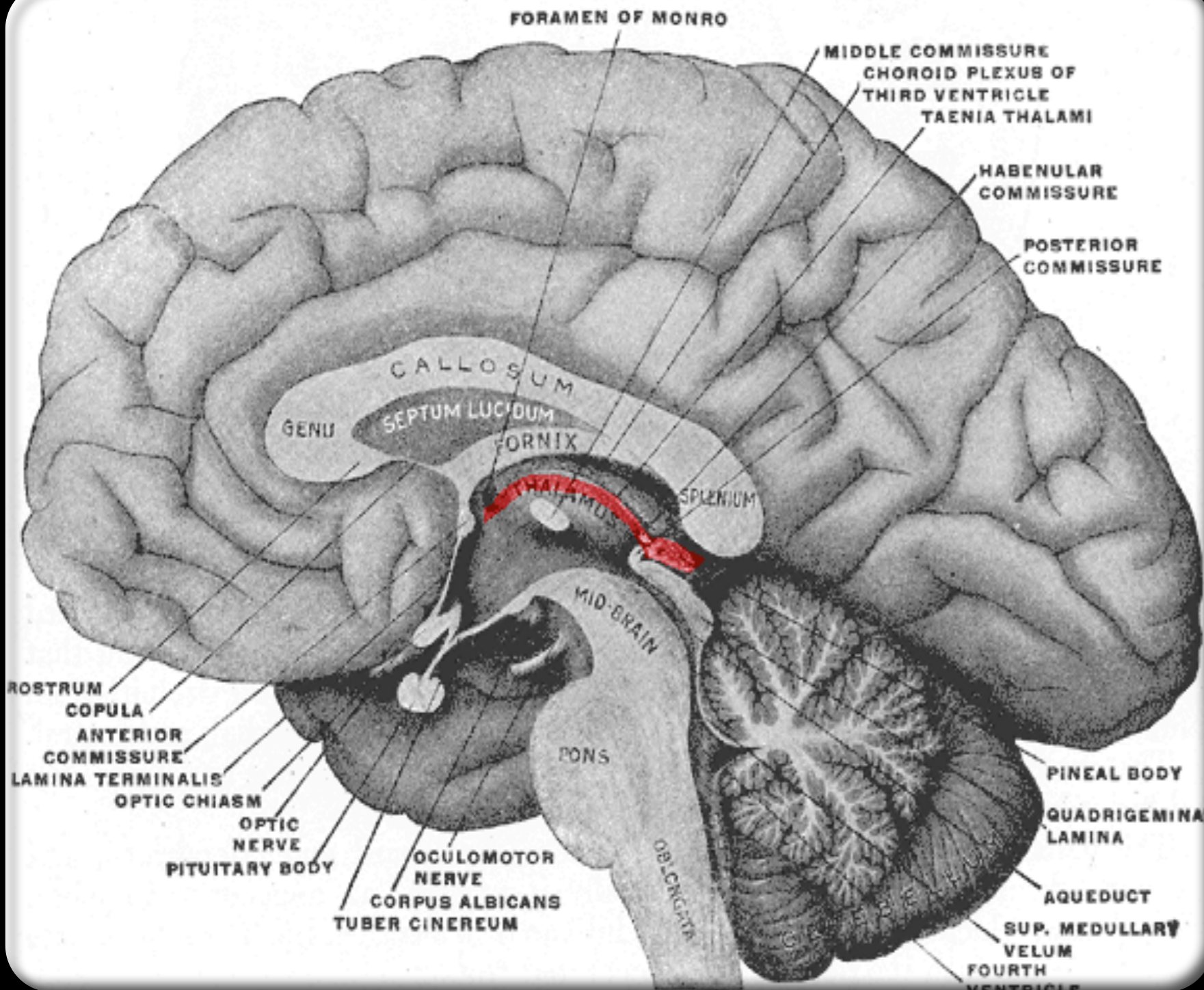
- Directing sensory input (except olfaction)
- Motor function control
- Autonomic and endocrine function control
- Homeostasis

Reticular Activating System



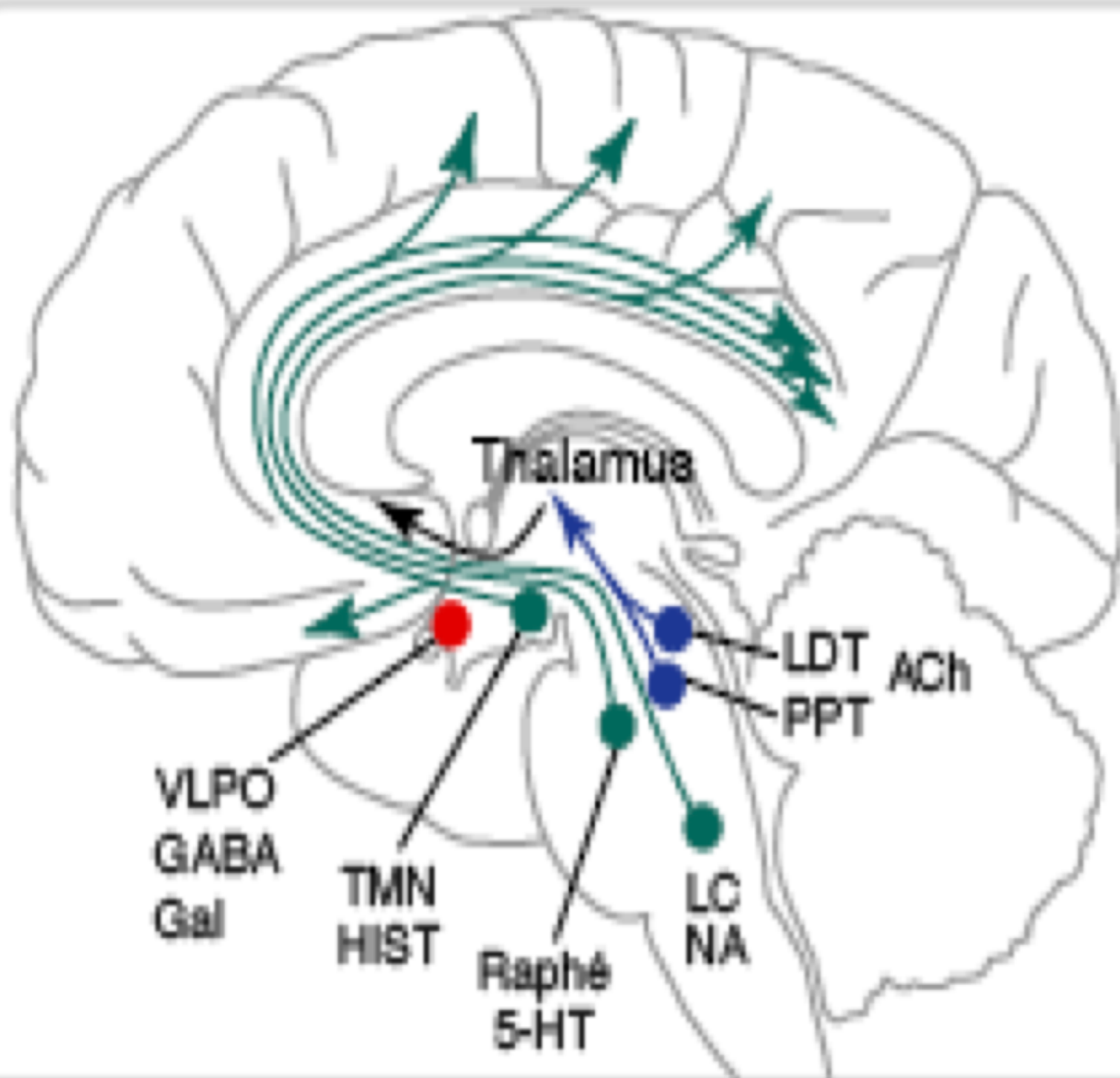
- Very Broad term
- Several nuclei:
 - Midbrain Reticular Formation
 - Mesencephalic nuclei
 - Pontine Tegmentum
 - Thalamic intralaminar nucleus
 - Hypothalamus
- Is not the sole component of alertness

Physiology of consciousness

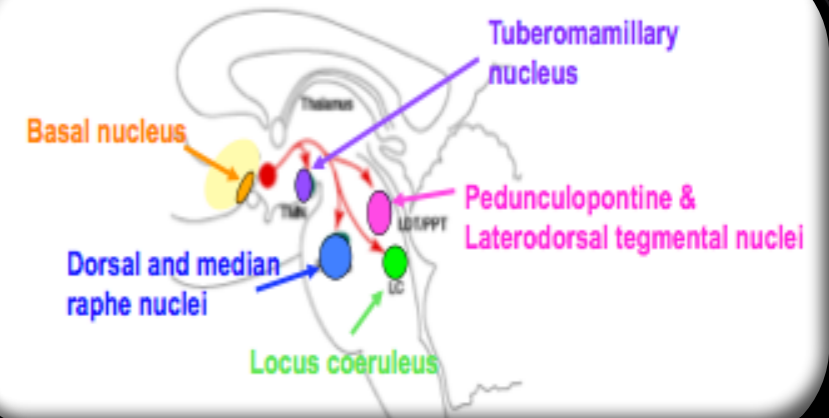


- Within the diencephalon
 - Thalamus
 - Hypothalamus
 - Epithalamus
 - Ventral/Pre-Thalamus
 - Third Ventricle

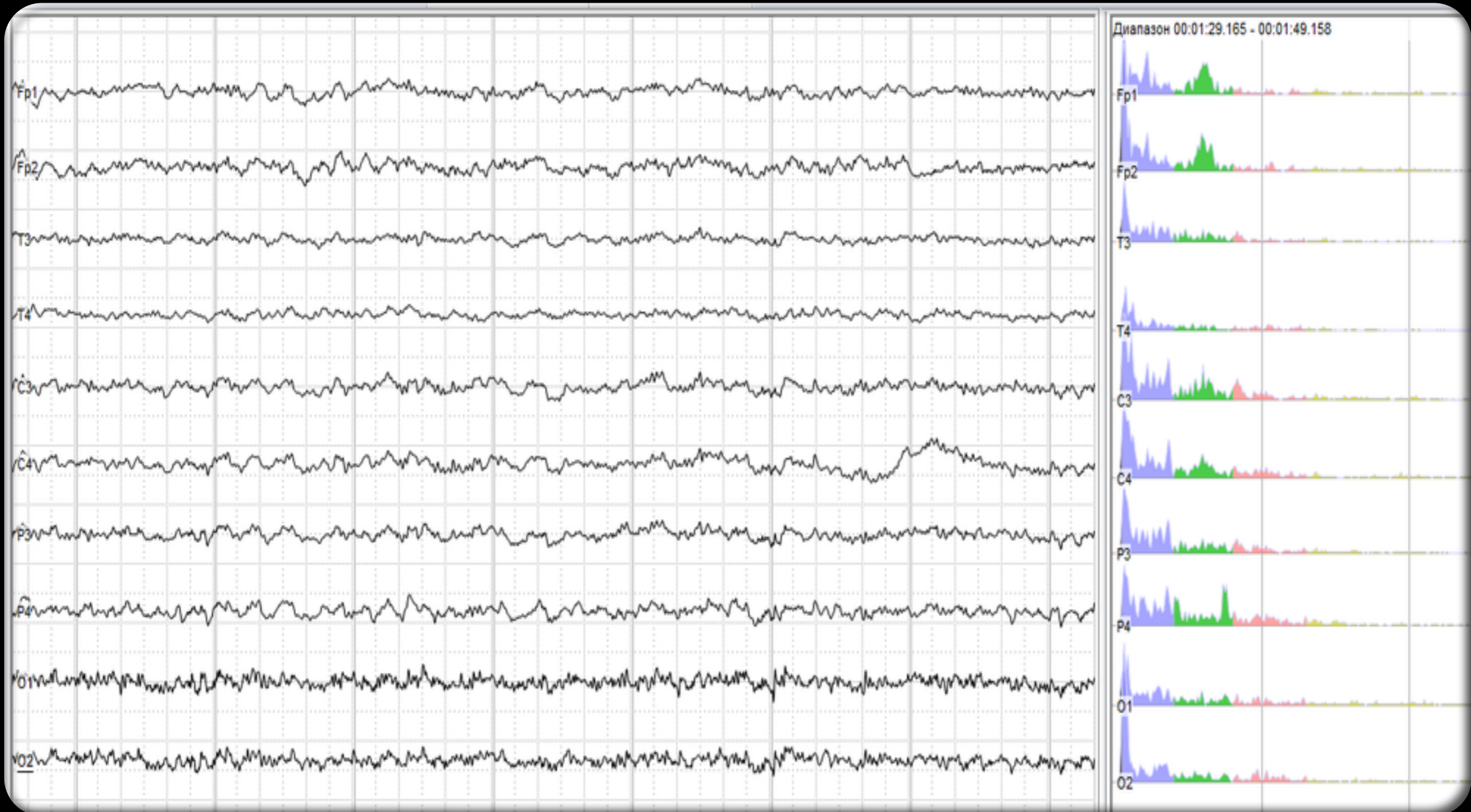
Cortical alertness systems



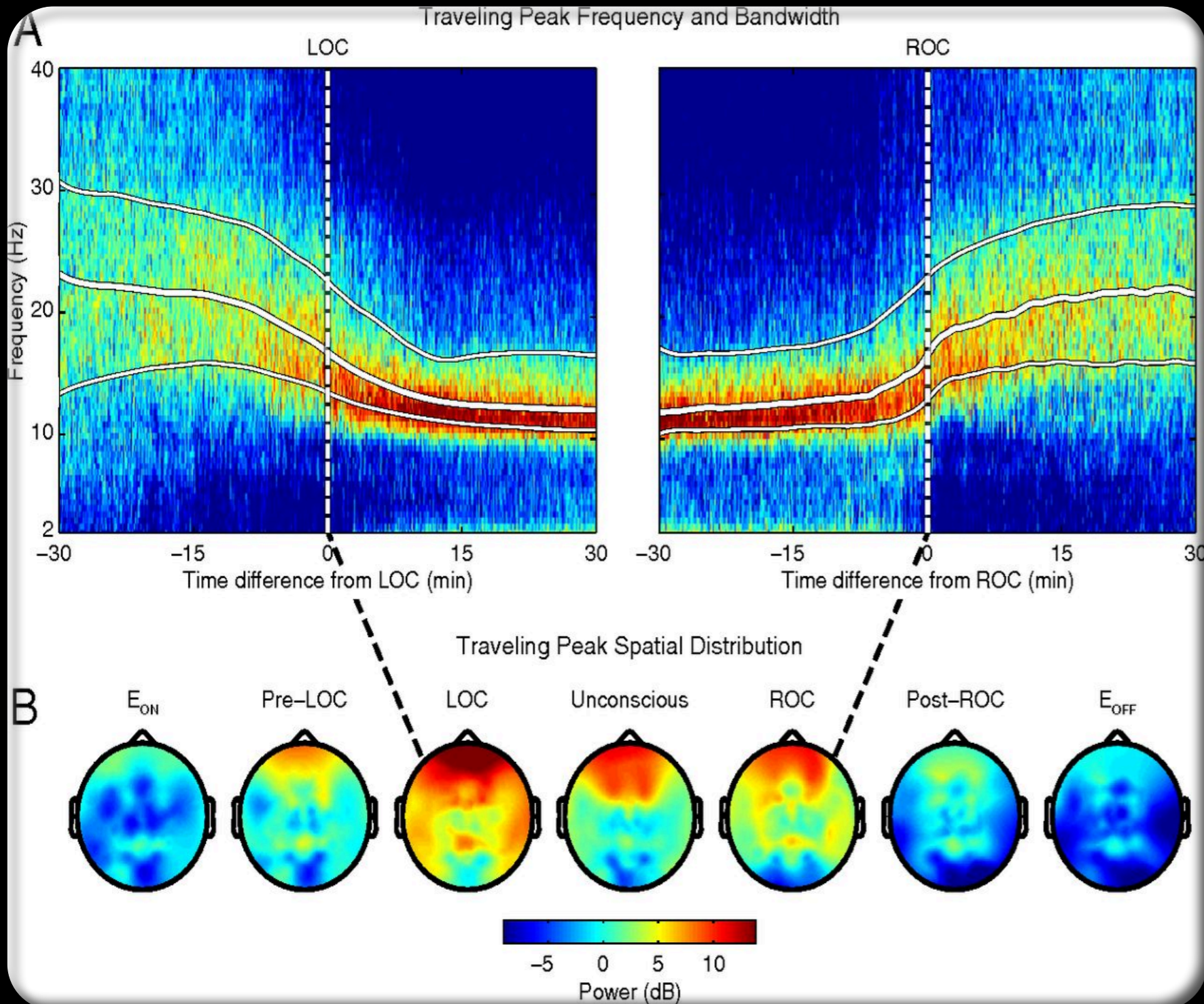
- Forward projections into cortex



Electroencephalography



Spectral Frequency



- Consciousness is associated with:
 - Higher frequency firing of neurones
 - Synchronised discharges across larger areas of the brain.

Transmitter systems associated with alertness

- Monoamine systems

- Serotonin (raphe)

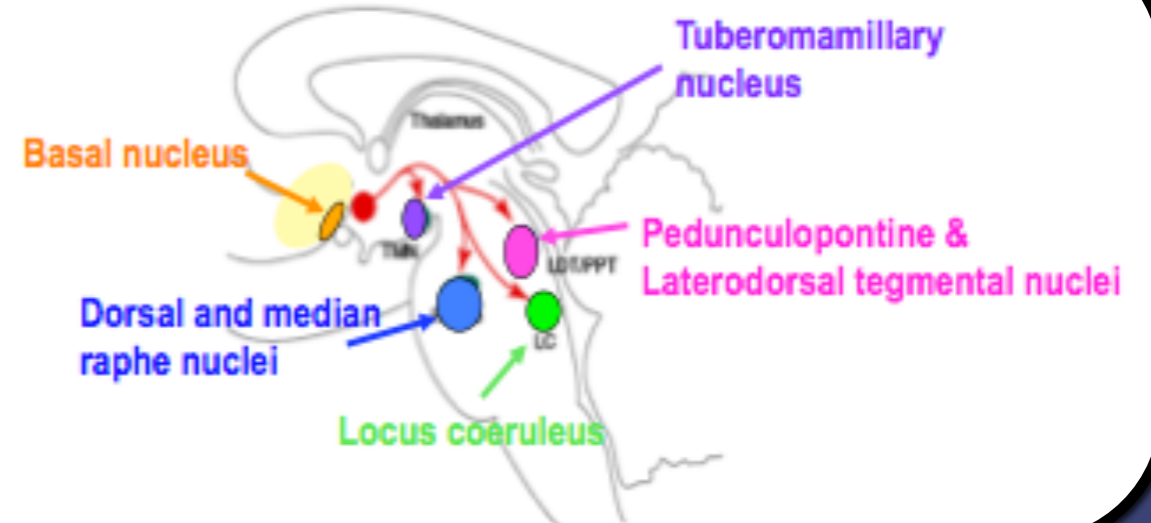
- Histamine (TMN)

- Noradrenaline (locus ceruleus)

- Cholinergic systems AcetylCholine

- Brain stem (LDT and PPT) project to thalamus

- Forebrain (basal nucleus of Meynert) to cortex



Assessment and Diagnosis

Assessment

- Start from basics.
- Is the person unresponsive
 - Airway
 - Breathing
 - Circulation
- If so
 - ALS or BLS algorithms apply

ALS causes of unconsciousness

- These are emergencies
- Need to treat quickly
 - Usually within a few minutes

The H's of ALS

Cause	Altered mental state
Hypovolaemia	When MAP < 60mmHg (\approx 80/50)
Hypoxia	When DO_2 < 400ml/min (SaO_2 < 60%)
H ⁺ (Acidosis)	With pH < 7.0 or > 7.6
Hyper/hypokalaemia	Only with arrhythmias (K^+ < 3.0 or > 8.0)
Hypoglycaemia	When BSL < 3.0 or > 30
Hypothermia	When core temp < 28° Celcius

The T's of ALS

Cause	Altered mental state
Toxins	Depends on drug
Tamponade	When MAP < 60mmHg (\approx 80/50)
Tension Pneumothorax	When MAP < 60mmHg (\approx 80/50)
Thrombosis (AMI, PE)	When MAP < 60mmHg (\approx 80/50)
Trauma (Head)	Need raised pressure (CPP > 60 mmHg) *Head injuries may cause hypertension*

Cerebral Perfusion Pressure

- Cerebral Perfusion Pressure
 - Mean Arterial Pressure - Intracranial Pressure
- Needs to be > 60 with acute head injuries
 - Normal ICP 11 mmHg
 - Mild head injury 20 mmHg
 - Severe head injury >40 mmHg

Assess Conscious State

- Glasgow coma scale probably the best
- Three areas of assessment
 - Eye movement (Scale of 1-4)
 - Verbal responses (Scale of 1-5)
 - Motor responses (Scale of 1-6)

Assess Conscious State

	Eye	Verbal	Motor
1	Closed	Silent	Immobile
2	Opens to pain	Incomprehensible sounds	Extension to pain Decerebrate
3	Opens to voice	Inappropriate words	Flexion to pain Decorticate
4	Opens spontaneously	Confused or disoriented	Flex/Withdraw to pain
5		Oriented, conversations normal	Localises pain
6			Obeys command

Interpreting the GCS

- Assessing head injury
 - Severe, with GCS < 8 (coma)
 - Moderate, GCS 8 –12
 - Minor, GCS ≥ 13.
- Any reduction in GCS from 15 is abnormal
- GCS falling over time is an emergency.

Differential Diagnosis

- Very long list of causes
 - All disease states end in coma and death
- Focus on ones where there is no obvious other cause

“AEIOU TIPSSS”

- Alcohol
- Epilepsy
- Insulin & glycaemic changes
- Overdosage of drugs
- Uraemia & metabolic causes

TIPPSSS

- Trauma to head
- Infection (esp in elderly or if intracranial)
- Raised intracranial pressure
- Psychiatric disorder
- Stroke
- Simple Feint
- Stokes-Adams (cardiac arrythmia)

Predisposing Causes

- Cognitive impairment / dementia
- Comorbidity
 - Older Age
 - Dehydration / Malnutrition
 - Drug and alcohol use
 - Psychiatric e.g. depression
- Sensory impairment (vision, hearing)
- Functional dependence

How to assess

- History and examination, basic observations
- Basic chemistry
 - EUC, BSL, FBP, Ca⁺⁺, ABG's
 - Toxicology
 - TFT's, LFT's
- Imaging - CT Head (vs MRI)

Management

Basics

- Remember ABC's - fix these first
- Assess Glasgow Coma Scale
- If rapidly falling GCS, or if GCS < 12
 - Medical Emergency - minutes count
- If stable (over hours)
 - Requires urgent investigation.

Coma

- General management
 - Support basic organ systems
 - Obtain a diagnosis
 - Manage specific problems and complications

Rapidly Falling GCS

- ALS algorithmn
- IV access (+ take bloods)
- Intubate & mildly hyperventilate
 - Aim for $\text{PaCO}_2 = 30\text{mmHg}$
- Investigation (including brain imaging)
 - Only do lumbar puncture after imaging

Emergency Management

- Conditions you need to have a plan for
 - Seizures
 - Altered plasma glucose
 - Raised intracranial pressure
 - Head trauma
 - Sepsis

Seizures

- Management (after ABC's)
 - Midazolam 0.1 mg /kg or Diazepam 0.15mg/kg
 - Phenytoin 15mg/kg over 30 minutes
- Can consider Thiopentone/Propofol

Hypoglycaemia

- Glucose 50%
 - 25-50 mL
 - Need larger bore needles and cannula

Raised ICP

- Imaging essential to exclude masses
- Medical management
 - Mannitol (0.25-0.5 g/kg) \approx 150ml 20% mannitol
 - Hypertonic saline
 - Prevent hypercapnia
- Surgical management

Trauma

- Primary & Secondary injury
 - Aim to minimise secondary injury
- Aim to normalise
 - CO₂, BSL, ICP, CPP
- Aim to prevent
 - Seizures, Hyponatraemia.

Sepsis

- Time to intervention is important:
 - Get samples (blood/urine/sputum/etc)
 - Antibiotics
 - Supportive management (eg for BP)

Induced Coma

Rationale for Benefit

- Anaesthesia (surgery and procedures)
 - Mostly for amnesia - different from coma
- Induced coma in ICU
 - To allow hypothermia
- Trauma
 - Management of head injuries

Induced coma

- Benefit in non traumatic head injuries
 - Reduce core temperature to $< 35^{\circ}$
 - Must be done shortly after brain injury
 - No benefit with trauma
- Need to stop normal thermoregulation

Trauma

- Mostly to control airway and PaCO₂
 - Usually requires paralysis
 - Thiopentone/Propofol + suxamethonium
 - Midazolam + rocuronium
- Occasionally for oxygenation.

Drugs

- Inhalational anaesthetics
- Intravenous anaesthetics
- Benzodiazepines
- Other sedatives

Inhalational Agents

- Nitrous Oxide, Methoxyflurane
- Desflurane, Sevoflurane, Isoflurane
- Advantages
 - Easy to administer
 - Measure depth of anaesthesia
 - Minimal tolerance
 - Analgesia with N₂O and Methoxyflurane

Intravenous agents

- Propofol
 - 2 mg/kg induction, 30-50 mg/kg/hr (maintenance)
 - Fast onset and offset
- Thiopentone
 - 3-5 mg/kg induction, maintenance more complex
 - Reduces ICP and Cerebral O₂ requirements
- IV agents match O₂ with blood flow.

Benzodiazepines

- Midazolam
- Diazepam

- Note differential effects on amnesia versus coma.

Other Agents

- Analgesics: Opiates
 - μ receptor agonists
- Sedatives: Clonidine, Dexmetomidine
 - α_2 receptor agonists
- Ketamine
 - NMDA receptor antagonists

Summary

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