Approach to a Child with Altered Consciousness

Hussain Imam Hj Muhammad Ismail
Coma

• Coma is a state of unconsciousness from which an individual cannot be roused.
• Coma occurs when the pathways between the cerebral cortex and the rostral reticular activating system, located in the pons, are disrupted.
• Isolated, uncomplicated lesions in the cerebral hemispheres have no effect on consciousness.
Coma

Coma should be distinguished from:

• The locked-in syndrome (which describes complete paralysis below the third cranial nerve nuclei with preservation of consciousness)

• Persistent vegetative state (prolonged coma for longer than 1 month with preservation of some brainstem function).

• Often defined as a Glasgow Coma Scale of less than 12 for at least 6 hours.
Possible Causes of Coma

Diffuse bilateral hemispheric process

*Toxins and drugs*
- Alcohol, narcotics, benzodiazepines

*Metabolic*
- Diabetic ketoacidosis/hyperosmolar coma
- Hepatic encephalopathy
- Hypercarbia
- Hypoglycaemia
- Hypothyroidism
- Hypo/hypernatraemia
- Hypo/hyperthermia
- Hypo/hypercalcaemia
- Hypoxia
- Porphyria
- Uraemia

*Other*
- Head trauma/ NAI
- Hypertensive encephalopathy
- Meningitis, encephalitis, Reye’s syndrome
- Seizures, post-ictal
- Sepsis
- Subarachnoid haemorrhage

*Brainstem pathology*
- Brainstem infarction or haemorrhage
- Herniation from any space-occupying lesion
- Posterior fossa tumour
- Severe trauma
- Wernicke’s encephalopathy
Incidence of Coma

- UK study 1994-95, 30/100,000 children <18yr per year.

- KL Coma study in 1992, 14.5 cases a month were admitted to the Paeds Institute.

- Actual local incidence unknown.

- Based on UK study, there will be at least 2700 cases a year in Malaysia.

1. Incidence, aetiology, and outcome of non-traumatic coma: a population based study

Age Distribution: UK study 278 cases

*Figure 1*  Incidence of non-traumatic coma by age.
Age Distribution : Malaysia 116 cases

- 1-11 months : 50%
- 12-23 months : 13%
- 24-15 months : 9%
- 36-47 months : 5%
- 48-59 months : 5%
- 60-71 months : 3%
- >71 months : 14%
Local Causes of Coma

• Infection : 80(69%)
• Haemorrhage : 4(3%)
• Hypoxia : 6(5%)
• Metabolic/toxic : 15(13%)
• Miscellaneous : 9(7%)
• Unknown : 2(3%)

Total : 116
Causes of Coma in Malaysia

• Infection: 19 meningitis, 10 dengue encephalopathy, 10 aseptic meningitis. 31 fever with coma but no LP done.

• Toxic metabolic: 11/15 fulfilled CDC criteria for Reyes syndrome, 3 toxic ingestion and 1 MCAD.

• HIE: 4 had CHD, 1 post status, 1 post anaesthesia.

• Haemorrhagic: 1 NAI, 1 aplastic, 1 hemophilia, 1 spontaneous

• Miscellaneous: 3 intussusception, 3 post burns, 2 ALL with CNS relapse, 1 hypernatraemic dehydration after AGE
Causes of Coma : UK

278 children, 283 episodes

- **Infection**: 107 (38%), 82 isolations, 47% N. meningitis.
- **Intoxication**: 29 (10%), 18 deliberate
- **Epilepsy**: 28 (10%), half prolonged febrile fits.
- **Congenital**: 23 (8%) 17 Complications of CHD, 5 CSF blockage.
- **Accidents**: 9 (7%) smoke inhalational 7, accidental strangulation 4, drowning 3, burns 3.
Causes of Coma: UK

- Metabolic: 14 (5%) DKA 8, MCAD 3, IEM 3. Apart from the DKA group only the 3 patients with MCAD were not already known to have a metabolic problem.
- Unknown: 41 (14%) half suspected infection (no culture), quarter ?metabolic (probably only 3 on follow-up), 2 each ?intoxication, ?epilepsy, ?V P shunt malformation.
- IEM presenting for the first time with coma is rare, 2/283 or 2.5% of all cases.
Altered consciousness

• More common than coma.
• All severe illnesses that lead to death will result in altered consciousness.
• A child in coma is critical ill, but potentially reversible.
• The aim of medical intervention is to address this reversible component.
Acute management

• Rapid assessment of general state.

• Non Specific interventions for all ill children.

• Specific measures to rapidly categorize cause of coma.

• Institute specific interventions when cause verified.
Preliminaries

• Check **Airway**
• **Breathing**
• **Circulation**
• Check pupil size, symmetry, and reaction to light
Acute Management

As always stabilize airway. Indications for intubation:-

• The airway obstructs if it is not supported.
• The airway is compromised by vomiting.
• The respiratory rate is inadequate for ventilation.
• The O2 saturations are < 92% despite high-flow oxygen and airway opening manoeuvres.
• Signs of shock after 40 ml/kg of fluid resuscitation.
• Signs of exhaustion.
• The GCS <8 or is deteriorating.
• There are signs of raised intracranial pressure.
Rapid Assessment

APVU scale:

- Alert
- Responds to Voice
- Responds to Pain
- Unresponsive

Monitor: Heart rate, Respiration, Oxygen saturation, BP, temperature, ECG.
Rapid History

• Fever and duration.
• Vomiting
• Headache
• Fits and duration
• Alternating periods of consciousness
• Trauma
• Drug ingestion of presence of drugs at home.
• History of neonatal deaths or metabolic disease in family
## Problem Check list

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Always check blood sugar
Clinical examination

- Skin: rash, anemia, cyanosis, jaundice, petechiae
- Temperature: fever - infection, drugs/toxin; hypothermia - circulatory failure, drugs/toxins.
- Blood pressure: Septicemia, Addison’s; Hypertensive crisis
- Pulse: Arrhythmia.
- Abdomen: organomegaly
- Neck stiffness: meningitis
- Fundoscopy: Retinal hemorrhages, papilloedema
- Breath: Poison (e.g. LMS), Fetor hepaticus, Inborn Errors of Metabolism
Raised Intracranial Pressure

Papilloedema or 2 or more of the following:-

• Reduced consciousness U on AVPU or GCS<8
• Abnormal pattern of respiration
• Abnormal pupils: unilaterally or bilaterally dilated / nonreactive
• Abnormal posture: decorticate, decerebrate, completely flaccid.
• Abnormal Doll’s eye (elicit only if no suspicion of cervical instability)
Extra ocular movements

Oculocephalic (doll’s eye) reflex:
• Based on vestibular stimulation
• Briskly rotate patients head side to side.
• Should produce conjugate horizontal deviation of eyes to opposite side, implying child is focusing on object.
• Contraindicated if spinal injury suspected
Recognizing individual problems

**Shock**

- Capillary refill $> 2$ seconds
- Mottled, cool extremities
- Diminished peripheral pulses
- Systolic BP $< 5^{th}$ percentile for age
- Decreased urine output $< 1$ml/kg/hour

**Sepsis** may have a rash

- Recognised clinically if reduced consciousness and **one or more** of the following:
- Temp $> 38^\circ$C or $< 36^\circ$C
- Tachycardia
- Tachypnoea
- White cell count $< 4000$cumm or $> 12000$cumm
Specific Causes

- Infection is most common local cause.
- Fever
- Neck stiffness
- Fluctuating levels of consciousness - Herpes
- Focal signs
- Rash
- Meningitis or Encephalitis syndrome
Specific Problems

- **Trauma**: History. NAI always suspected if previously well child suddenly presents with fits and coma. Retinal hemorrhages almost pathognomonic.
- **Diabetic Ketoacidosis**: capillary blood gas $>11\text{mmol/L}$, pH$<7.3$, urinary ketones
- **Hypoglycemia**: capillary blood sugar $<2.6\text{mmol/L}$
- **Hyperammonaemia**: plasma Ammonia $>200\text{uMol/L}$
Miscellaneous

• Hypertensive encephalopathy: BP > 95\textsuperscript{th} percentile for age.

• Prolonged convulsions: fitting for more than 10 minutes.

• Post convulsive state: altered consciousness >1 hour after a fit with normal blood sugars.

• Cause unknown: all the above excluded
Investigations

- All children must have a capillary blood sugar done.
- A CT scan is also indicated unless the cause is otherwise obvious eg. post ictal.
- Except for post trauma cases a basic panel of blood tests should be done:

  * Blood gas (capillary, venous, arterial)
  * Urinalysis (dipstick at bedside)
  * Laboratory glucose (even if capillary glucose normal)
  * Urea and electrolytes (Na, K, Cr)
  * Liver function tests
  * Plasma ammonia
  * Full blood count
  * Blood culture
  * 1-2ml plasma
  * 1-2ml plain serum
  * 10ml urine
  * to be separated,
  * frozen and saved
Neuroimaging

- Herpes simplex virus encephalitis. MRI FLAIR sequence illustrating the typical appearance of high signal intensity in the left temporal lobe.
Lumbar Puncture

Although infection is the most common local cause of coma, LP is contraindicated if:

- GCS ≤ 8
- deterioration of GCS
- focal neurological signs
- had a seizure lasting more than 10 mins and still has a GCS ≤ 12
- abnormal breathing pattern
- abnormal doll’s eye response
- abnormal posture

- shock
- bradycardia (heart rate <60)
- hypertension (BP >95th centile for age)
- clinical evidence of systemic meningococcal disease
- pupillary dilatation (unilateral / bilateral)
- pupillary reaction to light impaired or lost
- signs of raised ICP
Cause unknown

• A CT scan.
• A lumbar puncture, for CSF microscopy, culture and sensitivity, glucose, protein, and PCR for herpes.
• Urine organic and amino acids.
• Urine toxicology screen.
• Plasma lactate.
Cause unknown

• urgent EEG- non-convulsive status epilepticus.
• Blood, serum and urine samples for a metabolic workout.
• ESR and autoantibody screen for cerebral vasculitides such as cerebral lupus.
• Thyroid function tests with thyroid antibodies (for Hashimoto’s encephalitis).
Treating Specific Problems : Raised ICP

• Immediate management: tilt pt head up 20 to 30 degrees. Avoid necklines
• Ensure adequate circulation – do not restrict fluids routinely. Avoid hypotonic fluids
• If there is good urine output consider osmotic diuresis with either 20% mannitol or 3% saline. Oral Glycerol useful in meningitis
• Consider ventilating the child to maintain PaCO2 between 4.0 to 4.5kPa.
Osmotic Agents in Children with acute encephalopathies

- Systemic review of all studies using osmotic agents to treat raised intracranial pressure in traumatic and non traumatic encephalopathies.

- Oral Glycerol found to be useful in meningitis.

- Hypertonic saline improved ICP and maintained Cerebral Perfusion Pressure better than Mannitol.

The role for osmotic agents in children with acute encephalopathies; a systemic review. Gwer et al BMC pediatrics, 2010,10:23
Hyperosmolar agents

Figure 2 Risk ratios of death with different osmotic agents.
Inflicted versus Accidental Head Injury

- Infants presenting with non-specific symptoms or altered consciousness with seizures have may have inflicted head injury (iHI).
- Estimated incidence in UK is 21-24 per 100,000 infants annually.
- Clinicians need to be familiar with signs pointing to iHI.

Which clinical features distinguish inflicted from non-inflicted brain injury? A systematic review.
Arch Dis Child 2009 94: 860-867
Accidental versus iHI

• Apnoea has a positive predictive value of 93% and an Odds Ratio of 17.
• Retinal Hemorrhages have a PPV of 71% with an Odds Ratio of 3.5.
• A child with intracranial injury with retinal hemorrhages is significantly more likely to have iHI.
• Absence of history of trauma had PPV of 92% with a specificity of .97. Only 1 study.
Accidental versus iHI.

- Rib fractures: 73% PPV and OR of 3.02, but wide confidence interval, so not so useful.
- Seizures: PPV of 66% and OR of 2.9 also with wide confidence interval.
- Long bone fracture: PPV of 59%, OR of 1.72. Hence weak association.
- Skull fracture and bruising in head and neck region more supportive of accidental HI.
• Apnoea probably reflects hypoxic ischemic injury as a consequence of iHI.
• Final diagnosis must take into consideration history and full examination and exclusion of other possible causes like glutaric aciduria and thrombotic disorders.
• However this review gives odds ratio and PPV for the first time.
Outcome of Coma

Malaysia

- Died: 39 (33.65)
- Survived with deficit: 32 (27.5%)
- Discharged well: 38 (32.7%)
- Lost to follow up: 7 (6%)
- Worst outcome in miscellaneous, followed by infection.
- Age (<1) and sex no significant relationship with outcome.

UK

- Died: 127 (45.6%) 59 pre-hospital
- Survival with deficit: 47 (16.9%)
- Intact survival: 94 (33.8%)
- Lost to follow: 10 (3.5%)
- Worst outcome in accidental group: 84% died
- Best outcome in epileptic and metabolic group
- Aetiology most important predictor of outcome.
Conclusion

• Altered consciousness is an important and common neurological emergency.
• Locally the majority of causes are due to infection.
• Half of all cases in infancy.
• Outcome determined largely by aetiology.
• Prevention via public health measures possible in most cases.