



## **Altered Levels of Consciousness**

This course provides a review of the pathophysiology of altered levels of consciousness and the techniques used to determine the etiology of these changes. The importance of level of consciousness, pupils, extraocular movements, respirations, and motor function in evaluating the comatose patient is outlined. A cost-effective approach to the diagnostic workup will be included in the discussion of the emergency management of the comatose patient. Specific case studies are used to illustrate concepts.

- Review the pathophysiology of altered levels of consciousness.
- Discuss the differential diagnosis of coma and a cost-effective approach to the diagnostic workup.
- Describe the assessment and emergency management of the comatose patient.

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## **FACULTY**

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## The **KEY** question for the emergency department physician:

Is ALOC secondary to a diffuse toxic/metabolic disorder, to structural central nervous system disease or to functional disease??

### **Organic vs. functional**

#### **Organic disorders:**

Abnormal behavior due to central nervous system/systemic disease or exogenous substances

##### **Delirium** (acute confusional state)

- Rapid deterioration in all higher cortical functions
- Mental status fluctuates widely
- Short duration of symptoms (hours to days)
- Disturbance in both level and content of consciousness
  - Impaired alertness, awareness, and attentiveness
  - Disorganized thought processes (delusions)
  - Vivid visual hallucinations are most common when the cause is organic
  - Disorientation
  - Impaired short term memory
  - Emotional lability
  - Extremes of activity, somnolence to agitation
- Abnormal vital signs (autonomic instability)
- Predisposing factors: age >60, drug/alcohol addiction, prior history of brain damage (vascular or traumatic)
- >**80% reversible**

##### **Dementia**

- Insidious, gradual onset (months) of deterioration of all higher cortical functions, mild fluctuations in severity
- Long duration of symptoms
- Normal level of consciousness, but altered content of consciousness
  - Normal alertness, awareness, attentiveness
  - No hallucinations/delusions
  - Disorientation
  - Memory impaired (short term>>remote)
  - Judgement and language impaired
  - Shallow affect (distinction between depression/dementia may be difficult)
- Vital signs typically normal

**Note:** 20% of cases due to reversible problem (medication/chemical intoxication, thyroid disease, electrolyte imbalance)

\*Must maintain high degree of clinical suspicion for reversible causes of dementia when evaluating elderly patients presenting with acute behavioral changes.

	<b><u>Delirium</u></b>	<b><u>Dementia</u></b>
<u>Time course</u>	Acute onset lasts hours to days: fluctuating severity	Evolves over months - years; stable course
<u>Vital signs</u>	Fever, tachycardia, hypertension	Normal
<u>Underlying process</u>	Acute CNS/systemic insult	Chronic illness
<u>Reversibility</u>	>80%	<20%

## **Functional disorders:**

Includes most psychiatric causes of altered contents of consciousness

### **Acute psychosis**

- Abrupt onset, stable course
- No evidence of acute medical illness or drug intoxication
- Normal level of consciousness with clear sensorium
- Auditory hallucinations
- Fixed delusions
- Orientation and memory normal or minimally impaired
- Changes in mood/affect common
- First attack usually occurs in younger patients (<age 40)

## **Coma**

Levels of altered consciousness

### Standard terminology:

- Lethargy - drowsiness
- Stupor - responsive only to vigorous stimulation
- Coma (unarousable to verbal or physical stimuli)

### Common nomenclature of a more descriptive nature:

AVPU

- A = awake and aware
- V = responds to verbal stimuli
- P = responds to painful stimuli
- U = unresponsive

Other states of unresponsiveness (although patient may >appear awake=

- Abulic state (akinetic mutism)
- Locked in syndrome
- Psychogenic unresponsiveness

## **Pathophysiology of Coma**

### **Bilateral cortical disease**

Unilateral hemispheric conditions do not cause coma unless brainstem failure occurs. Usually secondary to toxic/metabolic derangement. Focal neurologic signs are absent except in some cases of hypoglycemia.

### **Suppression of Reticular Activating System (RAS)**

RAS=small group of fibers which maintain wakefulness

Supratentorial pressure

Lesions displace tissue resulting in decreased cerebral perfusion and compression of opposite hemisphere/brainstem structures  
(Subdural/epidural hematoma, abscess, hemorrhage, tumor)

Infratentorial pressure

Increased pressure displaces posterior fossa contents through tentorial notch/foramen magnum  
(cerebellar hemorrhage, posterior fossa tumors)

Intrinsic brainstem lesions

Directly compress or destroy RAS fibers  
(Traumatic/hypertensive pontine hemorrhage, tumors, degenerative diseases)

RAS may also be interrupted by torque on brainstem (sudden blow to head)

## **Assessment and Management of Patients with ALOC**

### **Prehospital Care**

1. Assess ABC=s and LOC - treat appropriately
2. Protect Patient & staff from injury
3. C-spine immobilization - if there is any suspicion of trauma
4. Abbreviated history & physical exam
5. Scene evaluation
6. IV, obtain blood sample, oxygen,
7. Dextrostick/D50, thiamine, naloxone (may withhold if breathing ok)
9. Transport

### **Initial Emergency Department Management**

1. Repeat or complete the field assessment and care
2. Complete the physical exam and attempt to get more history
3. Initiate diagnostic studies

### **Restraint**

Document justification for restraint as well as frequent reassessments (including vital signs)

#### **Physical**

Applied by at least 5 individuals (one for each limb, one holding patient's head)

Leather restraints (soft restraints may be adequate for elderly patients)

Seclusion room

Chemical

Lorazepam (ativan) 1-2mg IV/IM

**Midazolam (Versed) 5 mg IM**

Haloperidol (haldol) 5-10mg IV/IM

Droperidol (inapsine) 1.25-2.5mg IV, 2.5-10.0mg IM

\*Add 1 mg of cogentin with the latter two agents

\*use lower doses in elderly patients

Pharmacologic Assessment / Intervention

Dextrose Rapid bedside glucose determination first if possible

50 ml of 50% dextrose IV in adults

4 ml/kg 25% dextrose (0.5-1.0 g/kg) IV in children

5 ml/kg 10% dextrose (0.5g/kg) IV in neonate

Flumazenil 0.2 to 1.0 mg IV

Precautions in tricyclic ingestions and patients suspected to be addicted to benzodiazepines

Naloxone 2-4mg IV in adults 0.1mg/kg IV in children

Oxygen Makes everyone feel a little better – even the practitioners

Thiamine 100 mg IV in adults 10-25mg IV in children

Wernicke's Encephalopathy

Abrupt onset of oculomotor disturbances, ataxia, and confusion.

If not treated promptly may progress to Korsakoff's Psychosis

(confabulation, retrograde amnesia, impaired ability to learn)

History

Sources: medics, relatives, friends, Medic Alert tag, wallet, personal physician, hospital records, pill bottles

**Specific questions:**

Rate of onset of behavioral changes

Recent trauma or medical illness

Despondency

Past medical history (including suicidal ideation/suicide attempts)

Current medications

Social history (substance abuse)

Physical Examination

**Vital signs:** Repeat frequently

-Hyperventilating - consider acidosis/hypoxemia

-Heart rate and rhythm may be helpful to begin to narrow the differential

-Abnormal blood pressure may help to prioritize the emergency and to focus the differential

-Obtain rectal temperature

**General examination:**

Breath - alcohol, fruity, almonds, insecticide  
 Head - hemotympanum, cephalhematoma, CSF leak, shunt  
 Neck - meningismus, thyroid (large?, surgical scar)  
 Chest - rales/wheezes, scars, murmurs, irregular rhythm  
 Abdomen - Bowel sounds inc./ dec., ascites, hepatomegaly, pulsatile mass  
 Skin - jaundice, needle tracks, petechiae, temperature and moisture

**Neurologic examination (coma exam)**

Principle goal to distinguish between toxic/metabolic and structural cause of coma  
 serial examination mandatory

1. Observation

Autisms (involuntary acts carried out as protective mechanisms)  
 Yawning Hiccups Sneezing Swallowing  
 Respiratory patterns

2. Mental status examination - Consider the Mini-Mental State Examination (MMSE) or the **Confusion Assessment Method (CAM)**

**Confusion Assessment Method (CAM): to diagnose delirium**

- 1 - Acute onset with a fluctuating course and
- 2 - Easily distracted, inattentive

**And**

- 3 - Altered level of consciousness **or**
- 4 - Disorganized thinking

**Alert patient-** evaluate behavior, mood, and cognition

Alertness	Memory
Appearance	Orientation
Attentiveness	Perceptions
(hallucinations)	
Language (speech flow & content)	
Thought processes (coherent vs disorganized)	

**Patient not alert** - assess response to voice, light touch, painful stimuli

Glasgow Coma Scale (GCS) - eyelid opening, verbal activity,  
 motor activity (not really designed for medical coma)

3. Cranial nerves and the eye exam

CNII, III, IV and VI enter and exit brainstem at levels ranging from upper midbrain to lower pons - **the same area occupied by RAS**

**Pupils**

Size  
 Shape  
 Direct/consensual response to light (marcus gunn pupil)  
 A unilaterally dilated pupil in a comatose patient is indicative of herniation

A unilaterally dilated pupil in an alert patient is **not** secondary to an acute increase in intracranial pressure (may be due to compression of CNIII by posterior communicating artery aneurysm)  
If dilated pupil does not constrict with topical instillation of pilocarpine, either local eye trauma has occurred or topical anticholinergic agent present in eye  
Ciliospinal reflex: pupillary dilation with painful stimulus below neck  
Most opiate overdoses cause pinpoint pupils responsive to naloxone (synthetic opiates may be resistant to naloxone)  
Pinpoint pupils from pontine lesions will not respond to naloxone  
Absence of pupillary light reflex suggests structural lesion (exceptions include hypothermia, barbiturate and opiate overdoses)

**Fundoscopy exam**

Papilledema - absent venous pulsations  
Retinal/subhyaloid hemorrhage  
Blood in center of disc seen with SAH. Choked disc, engorged veins seen in methanol ingestions

**Eye movement** (requires intact medial longitudinal fasciculus-MLF)

Assuming the brainstem is intact, most comatose patients exhibit roving eye movements  
If both eyes cross the midline-brainstem is intact

**Oculocephalic reflex** (Doll's eyes)

**Contraindicated in presence of possible cervical spine injury**

-Reflex depends upon MLF receiving constant input about patient's head position from semicircular canals  
-In the absence of roving eye movements, if there is no cortical input eyes are typically directed straight  
-With eyes open, head is rotated briskly from side to side if brainstem is intact, eyes deviate contralaterally (head rotated right, eyes deviate left) with brainstem malfunction eyes follow direction of head rotation

**Oculovestibular testing** (cold calories)

Position patient supine with head at 30 degrees elevation to isolate input of horizontal semicircular canals  
Inject 10-20 ml iced saline into auditory canal  
Cooling of mastoid bone causes alteration in endolymphatic flow within canals  
Information then transmitted to vestibular nuclei and pontine gaze centers that head has been turned rapidly to the opposite side

**American College of Emergency Physicians  
1999 Scientific Assembly**

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**Notes**

Response

Both eyes deviate, nystagmus  
(slow phase toward stimulus,  
fast back to midline)

Interpretation

Patient is not comatose

Both eyes tonically deviate  
toward cold water

Coma, but intact brain-stem

No eye movement  
Movement only of eye ipsilateral  
to stimulus

Brainstem damage  
Internuclear ophthalmoplegia  
(brainstem structural lesion)

4. Motor testing

Observe at rest for spontaneous movements/posturing

Purposeful movements indicate functioning brainstem and cortex

Response to painful stimuli:

Abduction/adduction

Decorticate posturing (flexion of arms & hyperextension of legs)

Decerebrate posturing (arms & legs extended & internally rotated)

Triple flexion response (spinal reflex)

Asymmetric response

Flaccid paralysis

Diagnostic studies

(Helpful tests that most emergency departments can have back in 10 minutes or less)

1. Glucose (dextrostick or glucometer)
2. Pulse oximetry (hypoxemia)
3. Hematocrit (blood loss)
4. Breathalyser
5. Urine analysis (infection, hyperglycemia, ketosis)
6. Arterial blood gases (acidosis, hypercarbia, hypoxemia)
7. Electrocardiogram - monitor (electrolyte abnormalities, toxins, etc)

Other tests to consider

1. Complete blood count, electrolytes, BUN, Cr, serum osmolality, ca, mg
2. Carboxyhemoglobin level
3. Directed drug screen
4. Head CT Scan
5. Lumbar puncture
6. Peritoneal tap
7. Thyroid function studies
7. Cervical spine x-rays if trauma cannot be excluded
8. Chest x-ray



**Differential Diagnosis of Causes of Altered Mental Status and Coma**

**Start from the head and work your way down**

**Supratentorial**

- a. Unilateral hemispheric disease with herniation
  - Abscess
  - Hemorrhage (including traumatic)
  - Infarction
  - Tumor (primary or metastatic)
- b. Concussion/contusion
- c. Meningitis/encephalitis
- d. Seizure (Post-ictal period)
- e. Subarachnoid hemorrhage
- f. Cerebral Vascular Accident

**Infratentorial**

- a. Basilar artery occlusion
- b. Brainstem tumors
- c. Cerebellar hemorrhage
- d. Pontine hemorrhage
- e. Traumatic posterior fossa hemorrhage

**Mouth (Toxins - medications / drugs)**

- |                     |                              |
|---------------------|------------------------------|
| a. Alcohols         | h. Heavy metals              |
| b. Anticholinergics | I. Opiates                   |
| c. Anticonvulsants  | j. Phenothiazines            |
| d. Barbiturates     | k. Salicylates               |
| e. Carbon monoxide  | l. Sedative/hypnotics        |
| f. Cyanide          | m. Sympathomimetics          |
| g. Hallucinogens    | n. Tricyclic antidepressants |

**Neck**

- a. Thyroid disease - post op (endocrinopathies)

**Chest / Heart**

- |                |           |
|----------------|-----------|
| a. Hypoxia     | c. CHF    |
| b. Hypercarbia | d. Emboli |

**Abdomen**

- a. Hepatic encephalopathy - wernicke=s
- b. Renal insufficiency and electrolyte abnormalities
- c. Adrenal insufficiency (endocrinopathies)
- d. Pancreas (diabetes - Hyper or hypoglycemia)
- e. Peritonitis

**Other**

- |                |                             |
|----------------|-----------------------------|
| a. Heat stroke | d. Vasculitis               |
| b. Hypothermia | e. Hyperviscosity syndromes |
| c. Sepsis      |                             |

**Another mnemonic to help with the formation of a complete differential**

**A E I O U T I P S**

- |                                  |   |
|----------------------------------|---|
| A. Alcohol, other toxins, drugs  | T. Trauma, temperature                  |
| E. Endocrine, electrolytes       | I. Infection                            |
| I. Insulin(diabetes)             | P. Psychiatric, porphyria               |
| O. Oxygen, opiates               | S. Subarachnoid, Space Occupying lesion |
| U. Uremia (renal, including HTN) |   |

**Recommended Reading**

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