

# The management of coma

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## Abstract

Coma is a medical emergency that can challenge the diagnostic and management skills of any clinician. A systematic and logical approach is necessary to make the correct diagnosis, the broad diagnostic categories being neurological, metabolic, diffuse physiological dysfunction and functional. Even when the diagnosis is not immediately clear, appropriate measures to resuscitate, stabilize and support a comatose patient must be performed rapidly. The key components in the assessment and management of a patient, namely history, examination, investigation and treatment, are performed in parallel, not sequentially. Unless the cause of coma is immediately obvious and reversible, help from senior and critical care colleagues is necessary. In particular, senior help is needed to make difficult management decisions in patients with a poor prognosis.

**Keywords** Acute brain injury; alcohol intoxication; coma; diabetic coma; drug intoxication; metabolic emergencies; neurological emergencies; post-ictal; stroke; unconscious

## Definition

Unconsciousness or coma is defined as a sleep-like state, resulting from a diverse range of aetiologies and pathologies, from which the patient cannot be aroused. The patient is completely unaware of and unresponsive to external stimuli, with the exception of motor responses such as eye opening and/or limb withdrawal to painful stimuli.<sup>1</sup>

## Pathophysiology of coma

The pathophysiology of coma is complex. It is caused by two primary mechanisms. The first is a diffuse insult to both cerebral hemispheres. The second is a disruption of the ascending reticular activating system in the midbrain and pons, where signals are carried to the thalamus and cortex. The thalamus plays a crucial role in maintaining arousal. The thalamus and ascending reticular activating system can be damaged either by direct insult or by problems arising within the brainstem.<sup>2</sup>

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## Key points

- Coma is a time-dependent medical emergency
- The traditional components of patient assessment should be performed in parallel and not sequentially
- Physicians should be familiar with the common causes of coma – neurological, metabolic, physiological brain dysfunction and psychiatric
- Reversible causes of coma are more likely in patients with a normal computed tomography scan of the brain and no focal neurology
- Prognosis of coma is determined by the underlying cause and often cannot be performed accurately in the early stages

## Differential diagnosis of coma

The most likely diagnoses in an unconscious patient are shown in [Table 1](#). They can be categorized as:

- neurological – due to structural injury of the cerebral hemispheres, or direct injury to or extrinsic compression of the brainstem
- metabolic – usually an acute metabolic or endocrine derangement (e.g. hypoglycaemia)
- diffuse physiological brain dysfunction (e.g. intoxication with alcohol, drug overdose, seizures, hypothermia)
- psychiatric – a functional as opposed to an organic cause. Psychiatric conditions can be mimicked by structural brain pathologies, and these should only be diagnosed after a thorough medical assessment.

## Assessment of coma

Management of coma is a time-sensitive process. The clinical approach to an unconscious patient should be structured. [Figure 1](#) outlines a management algorithm. By necessity, it requires the clinician to deviate from the traditional sequential approach of history, examination, investigation and management<sup>1,2</sup>; instead, all four components can and should proceed in parallel through a team approach. Below, we consider the important aspects of each of the four domains in the traditional order.

## Key components of the history

Comatose patients by definition cannot give a history. Gaining a collateral history from relatives or other witnesses to the event that preceded admission, or from the paramedics who attended the patient, can provide vital clues to the aetiology of the condition.<sup>3</sup> This can and should be done simultaneously with managing the patient.

Important aspects of the history include recent symptoms or illnesses, significant previous medical history, recent surgery or treatments and a medication history. An understanding of the

### Differential diagnoses in an unconscious patient

Neurological	Metabolic	Diffuse physiological brain dysfunction	Psychiatric
Ischaemic stroke	Hypoglycaemia	Seizures	Psychiatric coma
Intracerebral haemorrhage	Hyperglycaemia	Alcohol intoxication	Malingering
Subarachnoid haemorrhage	Hyponatraemia	Opioid toxicity	
Subdural haematoma	Hypernatraemia	Drug overdose	
Brain tumour	Hypercalcaemia	Poisoning	
Cerebral lymphoma	Addisonian crisis	Hypothermia	
Multiple brain metastases	Hypothyroidism	Neuroleptic malignant syndrome	
Central nervous system infection	Uraemia	Serotonin syndrome	
Cerebral abscess	Hypercapnia		
Cerebral oedema	Septic encephalopathy		
Hydrocephalus			
PRES			
Trauma			

**Table 1**

patient's existing functional status and pre-morbid condition is important; this helps to inform decisions regarding escalation of care and whether admission to intensive care and cardiopulmonary resuscitation are appropriate. Urgent review of the patient's previous medical notes and results can also provide essential clues.

Paramedic teams or bystander witnesses may notice additional clues, such as used syringes or evidence of other recreational drug use, alcohol, empty medication packets or a suicide note. The paramedics are likely to have instituted pre-hospital treatments; it is important to ascertain the patient's response to these and to enquire about their conscious state at the scene to assess whether they are more or less responsive when reviewed.

#### Clinical examination of the unconscious patient

**Determining unresponsiveness:** initially, the patient has their eyes closed with a lack of facial expression, and is oblivious to environmental stimuli. A stepwise approach evaluates response to graded stimuli<sup>3</sup>:

- *verbal stimulus* – 'Can you hear me?' or 'Are you OK?'
- *tactile stimulus* – to either the hands or face
- *noxious stimulus* – which should be intense but not cause injury. Pressure on the supraorbital ridge or nail bed pressure is appropriate.

**Neurological assessment:** initial neurological examination focuses on determining the level of consciousness using the Glasgow Coma Scale (GCS) score (Table 2).

Assessment of the cranial nerves and motor response to pain should be performed. Pupil examination can provide useful clues as to the aetiology:<sup>1</sup>

- *small pupils (<2 mm)* – can be due to either opioid toxicity or a pontine lesion
- *midsize pupils (4–6 mm) unresponsive to light* – can be the result of a midbrain lesion
- *maximally dilated pupils (>8 mm)* – can be caused by drug toxicity (amphetamines, cocaine) or oculomotor nerve pathology
- *unilateral fixed pupil* – from a IIIrd cranial nerve lesion.

Motor function is assessed by noxious stimuli as described above. It is important to distinguish between purposeful and reflexive responses.<sup>3</sup> Purposeful responses include the patient following commands, pushing the examiner away, localizing to the noxious stimulus and reaching for airway adjuncts. Reflexive responses are withdrawal, flexion or extension in response to the stimulus.

Fundoscopy can reveal key diagnostic findings, for example papilloedema in patients with hypertensive crisis and posterior reversible encephalopathy syndrome (PRES; see below), or subhyaloid haemorrhage in patients with subarachnoid haemorrhage.

**General physical examination:** doctors with a sensitive sense of smell may recognize the musty smell of hepatic encephalopathy or the garlic smell associated with organophosphate poisoning. While alcohol can be smelt on the breath of an unconscious patient, it is strongly recommended that all unconscious patients who appear to be intoxicated are fully assessed for other causes of unconsciousness, as the alcohol may be masking the true cause of unconsciousness, for example a head injury. Look for potential drug injection sites (groins, arms) or sites of subcutaneous insulin injections.

Breathing pattern abnormalities can provide useful clues:

- Cheyne–Stokes breathing can occur with many underlying pathologies and is not helpful in differentiating between diagnoses in the unconscious patient
- ataxic breathing (Biot's respiration) is an abnormal pattern of breathing characterized by groups of quick, shallow inspirations followed by regular or irregular periods of apnoea; it indicates a lesion in the lower pons
- central neurogenic hyperventilation is an abnormal pattern of breathing characterized by deep and rapid breaths at a rate of at least 25 breaths per minute, and indicates a lesion in the pons or midbrain.

#### Investigations

- Blood glucose
- Urea and electrolytes
- Calcium
- Liver function tests
- Clotting screen
- Toxicology screen, including paracetamol and salicylate concentrations
- Electrocardiogram (ECG)
- Chest X-ray
- Arterial blood gases, including carbon monoxide concentrations.

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