Headway
the brain injury association

# Hypoxic brain injury

This publication explains what a hypoxic brain injury is, how hypoxic brain injuries are diagnosed and treated and the long-term effects of hypoxic brain injury.

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# Introduction

A hypoxic brain injury is a type of brain injury that occurs when there is a disruption in supply of oxygen to the brain. A diagnosis of hypoxic brain injury might not always be obvious, as the circumstances that caused the injury might not directly involve the brain, for example having a heart attack or inhaling smoke. This is especially true if the initial condition is successfully treated and the impact on the brain was relatively mild.

This publication is intended as an overview of the causes, effects, treatment and rehabilitation of hypoxic brain injury. The information will be particularly useful for the family members of people who have sustained such an injury.

**The information in this publication does not replace clinical guidance from medical professionals. You should always get advice from your GP or other suitably qualified professional for help with managing the effects of brain injury.**

## What is hypoxic brain injury?

To understand what hypoxic brain injury is, it is important to understand a little bit about how the brain works.

The brain relies on a constant supply of oxygen to survive. Indeed, it uses around 20% of the body's total oxygen intake. Oxygen is needed by the brain to sustain chemical processes that ultimately create energy. If the oxygen supply is interrupted, the functioning of the brain is immediately disturbed, and irreversible damage can quickly follow. Consciousness can be lost within 15 seconds, and damage to the brain begins after about four minutes without oxygen.

A complete interruption of the supply of oxygen to the brain is referred to as cerebral anoxia - this can cause what is known as anoxic brain injury. Partial oxygen supply interruption is known as cerebral hypoxia and can cause what is known as a hypoxic brain injury.

In practice, these two terms tend to be used interchangeably. However, this publication will use the terms hypoxia and hypoxic brain injury.

Nerve cells in the brain are particularly sensitive to an interruption in oxygen supply. Although hypoxia can injure cells throughout the brain, some areas are more vulnerable than others. These include the cerebral cortex (especially the parietal and occipital lobes), the hippocampus, the basal ganglia and the cerebellum.

Severe hypoxic brain injury may occasionally cause damage to the hypothalamus and pituitary gland, areas of the brain which are responsible for regulating the body's hormones.

## Causes of hypoxic brain injury

There are many potential causes of cerebral hypoxia, which can subsequently cause a hypoxic brain injury. These include:

- cardiac or respiratory arrest
- irregular heart rhythm or poor function of heart muscle after a heart attack
- very low blood pressure resulting from loss of blood or disturbed heart function
- suffocation and choking
- electric shock
- strangulation
- very severe asthma attack
- very severe allergic reaction causing the body to experience an anaphylactic shock
- complications of administering general anaesthesia
- near drowning
- exposure to high altitudes
- smoke inhalation
- carbon monoxide inhalation
- poisoning
- drug overdose

## Diagnosis and acute treatment

Due to the wide variety of causes of hypoxia, a diagnosis of hypoxic brain injury can sometimes depend on what details are available of the circumstances. In some cases it can be quite obvious that a hypoxic brain injury has been sustained. In other cases, the circumstances that caused the injury are not directly related to the brain so the diagnosis is less obvious. In all cases, efforts will be directed at restoring a normal heartbeat, blood pressure and a good supply of oxygen to the brain.

Patients who have suffered a serious hypoxic episode will usually be admitted to an intensive care unit and put on a ventilator, sometimes in a specialist neurosciences centre. Medication may be required to maintain adequate blood pressure and a normal heartbeat. Seizures are quite common after a hypoxic brain injury, and they can be prolonged and sometimes difficult to bring under control.

## Predicting the outcome of hypoxic brain injury

At the acute stage, it is quite common for families to want to know about the timescales of recovery after cerebral hypoxia. As with any kind of brain injury, it is difficult to give definitive rules about this.

A number of factors can help to predict the outcome after cerebral hypoxia:

### Age

As with other forms of brain injury, people under the age of 50 years tend to do better in terms of long-term recovery. However, there is evidence that older people are able to benefit from rehabilitation programmes after cerebral hypoxia as well, so everyone deserves equally vigorous efforts to achieve the best possible outcome.

### Duration of hypoxic episode

The outcome of the injury will depend on how extensive damage to the brain has been. This, in turn, depends on the length of time the brain was deprived of oxygen, which can often be estimated from information about what has happened. For example, it may be known that it took 15 minutes to restore a normal heartbeat after a cardiac arrest, or that someone was

immersed in a swimming pool for six minutes in a near-drowning accident.

## Duration of coma

The duration of unconsciousness after a hypoxic episode is a good indicator of the severity of the injury to the brain and can help to predict outcome. More information about this is available in our publication *Coma after brain injury.*

## Pupil reaction

Normally, the pupils will constrict when a bright light is shone into the eyes. However, following brain injury, this reflex might be lost, causing the pupils to become dilated and fixed, no longer reacting to the light. This is an unfavourable sign following a hypoxic brain injury and indicates a disturbance in the function of the brainstem.

## Brain imaging

There are a range of scans and tests that are commonly used to identify the areas and extent of damage to the brain following an injury. These tests and scans can also help in predicting outcome and trying to anticipate what level of neurological disability is likely. However, brain scans do not always reveal injury in the brain, and what they are able to show depends on the nature of the injury, time since the hypoxic episode and which type of brain imaging is used.

The electroencephalogram (EEG) displays electrical activity of the brain with electrodes placed on the scalp. There has been a good deal of research on the use of EEG following cardiac arrest. Generally people with a normal EEG in the early stages after the cardiac arrest have a very good chance of making a full recovery, while those with profoundly abnormal EEG results

often either do not survive at all or will have severe disabilities. However, there is a large group who have intermediate degrees of EEG abnormality, where the outcome is less predictable.

## Initial effects of hypoxic brain injury

The body will respond to cerebral hypoxia by increasing blood flow to the brain in an attempt to compensate for the lost supply of oxygen. However, it is only possible to increase brain blood flow to about twice the normal level. If this is not enough to compensate for the hypoxia, brain function will be disturbed and symptoms will become apparent.

If the cerebral hypoxia is mild, there will be problems with concentration, attention, co-ordination and short-term memory, which may be relatively subtle to begin with. There may also be headache, light-headedness, dizziness, an increase in breathing rate and sweating. There can be a restriction in the field of vision, a sensation of numbness or tingling and feelings of euphoria.

As the degree of hypoxia becomes more pronounced, confusion, agitation or drowsiness appear, along with cyanosis (a bluish tinge to the skin most apparent around the lips, mouth and fingertips, which reflects the lowered oxygen content of the blood). There may be brief jerks of the limbs and seizures, both resulting from the damaging effects of lack of oxygen to the brain.

Severe hypoxia is often fatal. This can be a very distressing time for families. Headway's helpline is available to offer emotional support on 0808 800 2244 (Monday - Friday, 9am-5pm) or helpline@headway.org.uk.

## Long-term effects of hypoxic brain injury

The long-term impact of hypoxic brain injury will depend on the severity of the cerebral hypoxia and on how much irreversible damage has occurred in the brain. If there has only been mild or short-lived hypoxia, there may well be recovery back to a normal or near-normal level of functioning.

However, if the injury has been more marked the outcome is less certain and there are likely to be long-term effects. The nature of these problems will vary from person to person, depending on the severity of the injury and the areas of the brain affected.

There is considerable overlap with the effects of other kinds of brain injury. However, the vulnerability of certain parts of the brain (see the section *What is hypoxic brain injury?*) also gives some distinctive features to this particular type of injury.

- Damage to the cerebral cortex, the cerebellum and the basal ganglia may lead to limb weakness and disturbances of movement, balance and co-ordination. There may be spasticity or rigidity, with increased muscle tone.

- Hypoxic injury to the basal ganglia may lead to abnormal movements, including tremor, involuntary writing movements and brief, jerky movements.

- The occipital lobe at the back of the brain is particularly susceptible to hypoxia, which may cause a loss of visual function known as cortical blindness.

- Damage to the hippocampus can cause problems with memory.

- Speech and language can be disrupted following damage to parts of the brain that are involved in the production and comprehension of speech. Spoken and written communication may both be affected.

- Injury to the frontal lobes of the brain can cause issues of executive dysfunction, problems with personality, lack of insight, mood swings, problems with anger and depression.

## Rehabilitation of hypoxic brain injury

The principles for rehabilitation after cerebral hypoxia are the same as for other types of brain injury. The goal is to provide support from an integrated team with a range of specialised skills, able to help with the different problems which may occur after brain injury, in order to support the brain injury survivor to achieve the best possible outcome.

The outlook for hypoxic brain injury can be uncertain and different specialists have expressed quite varied views on the timescales of recovery, based on their own individual experiences. Good improvement within the first month after a hypoxic episode suggests that the outcome may be more favourable.

The most rapid recovery is usually in the first six months, and by about one year the likely long-term outcome will have become clearer. However, improvement may continue for much longer after brain injury, certainly for several years, although the progress may become more modest and gradual after the first few months. Adequate rehabilitation from the earliest possible stage is vital in order to achieve the best outcome.

For more information on rehabilitation, see our publication *Rehabilitation after brain injury*.

## Glossary

**Anoxic brain injury** - a brain injury caused by a total interruption of oxygen to the brain

**Basal ganglia** - a part of the brain involved in movement

**Brainstem** - a part of the brain responsible for controlling basic functions such as breathing and heart rate

**Cerebellum** - a part of the brain responsible for co-ordinating movement

**Cerebral anoxia** - a state in which there is a complete interruption of oxygen to the brain

**Cerebral cortex** - the topmost layer of the brain that comprises four lobes. For more information, see our publication About the brain.

**Cerebral hypoxia** - a state in which there is a partial interruption of oxygen to the brain

**Executive dysfunction** - a collective term for the disruption of a range of cognitive skills following injury to the frontal lobes. For more information, see our publication *Executive dysfunction after brain injury.*

**Glasgow Coma Scale** - a scale that is routinely used to assess levels of consciousness in a person following brain injury

**Hippocampus** - a part of the brain involved in memory and emotions

**Intensive care unit** - often abbreviated to ICU. An area in hospital in which patients at the acute stage are treated with 24-hour care and highly trained staff. For more information on

this, see our publication *Hospital treatment and early recovery after brain injury*.

**Occipital lobe** - a part of the brain responsible for processing vision

**Parietal lobe** - a part of the brain involved in spatial processing

**Ventilator** - a piece of hospital equipment that assists a patient with breathing

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We hope that this has been a helpful resource. Please consider sharing your feedback with us by scanning the QR code or by visiting our publication feedback survey https://uk.surveymonkey.com/r/hwpublications.

Learn more and support our work at www.headway.org.uk/get-involved.

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# We're here to listen.

**If you need support, or have a question about brain injury, contact our free nurse-led helpline:**

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