Anoxia/Hypoxia

Symptoms/Etiology]

The terms *anoxia* and *hypoxia* are often used interchangeably, although anoxia refers to a complete lack of oxygen in the arterial blood or tissue and hypoxia refers to a reduction in oxygen in the tissue. The term *hypoxemia*, also sometimes used interchangeably, refers to the reduction of oxygen saturation in arterial blood. Although the brain is only 2% of an individual’s body mass, it utilizes 20% of available oxygen while at rest (2, 3, 4). Neurons are unable to store oxygen and glucose for later use, therefore both are constantly required to maintain the function of the central nervous system (CNS) (3).

There are two main situations that result in hypoxia when they occur. The first situation, described in the most basic way, is a reduction of blood flow to the brain, which limits the available oxygen. The second situation is from an oxygen deficiency in the red blood cells themselves (2). There are several known causes of hypoxia including cardiac arrest, obstructive sleep apnea, attempted suffocation or strangulation, exposure to high altitude, near drowning, carbon monoxide poisoning, chronic obstructive pulmonary disease, acute respiratory distress syndrome and asthma, to name a few (1, 2, 3, 4, 5). General anesthesia also carries the risk of anoxia/hypoxia (5).

The brain has regulatory mechanisms that work to correct the problem when the blood supply to the brain is reduced; however, when these mechanisms begin to fail, brain damage can occur (2). In fact, the brain is only able to function for five to six minutes without oxygen before cell death begins to occur. Cell death results from cellular swelling and injury due to excitotoxicity (2). Such damage is sometimes called an Anoxic Brain Injury (ABI) (3).

Hypoxia can result from both chronic and acute conditions; however, acute oxygen deprivation is more likely to result in more serious damage and more permanent consequences than in a chronic condition (2). In acute conditions, focal deficits may be more prominent rather than global deficits, particularly if consciousness is lost (2).

Cognitive Symptoms

Not all parts of the brain are affected equally by hypoxia/anoxia. Different areas have different metabolic rates which affect the amount of oxygen required (3). The areas most sensitive to hypoxia/anoxia are the hippocampus, basal ganglia, neocortex, cerebellar Purkinje cells, primary visual cortex, frontal regions and thalamus (1, 2, 3, 4). Although the hippocampus has typically been thought of as the most sensitive of all regions to oxygen deprivation, a study found that to be true in only 8 out of 43 cases (1). However, memory problems are still the most commonly reported issue (1).

Due to the various etiologies of anoxia and hypoxia, the different areas of the brain that are affected, and the level of severity of the

injury (i.e., loss of consciousness and duration), patterns of neuropsychological deficits can vary (1). The most common findings include impaired memory, attention, mental processing speed, executive functioning, visual spatial skills, and motor coordination (as well as motor disturbance including poor posture, gait, and involuntary movements) (1, 3, 4). General cognitive decline was also reported, as well as personality changes such as emotional lability, impulsivity, irritability and apathy (1, 4). In a study where 67 cases of anoxia/hypoxia were examined, thirty-six cases (54%) had amnesia, 31 cases (46.2%) had impaired executive functioning or personality changes, 21 cases (31.3%) had visual spatial deficits and 6 cases (9%) had language impairments (3).

The main treatment for anoxia/hypoxia is to treat the etiology, or source of the problem, and restore the oxygen supply to the brain as soon as possible. The initial phase of treatment may involve the use of a ventilator or hyperbaric oxygen therapy, which is particularly beneficial for patients with carbon monoxide poisoning (3). One study found that after 6 weeks of hyperbaric oxygen therapy cognitive impairment in patients was reduced by 46% (3). Other treatment options may involve inducing hypothermia or administering medication to slow down the brain while trying to increase the amount of oxygen available to the brain allowing more time to heal.

Unfortunately the prognosis after an anoxic/hypoxic injury varies. Depending on the level of severity, the individual may not return to their previous level of functioning (3). After life-threatening issues have been treated and the individual is stable, rehabilitation is often the next step in treatment, although there is little outcome data available on this type of treatment (3). Rehabilitation may consist of speech therapy, occupational therapy, physical therapy, and counseling therapy which will be recommended dependent on the level of severity of the patient. Neuropsychological testing may also be beneficial in helping to assess the level of cognitive impairment and provide treatment recommendations.

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References

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