

Chapter 18

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NITROGEN NARCOSIS

(COMPRESSED AIR INTOXICATION, RAPTURE OF THE DEEP, INERT GAS NARCOSIS, NARCS)

Intoxication in divers is not confined exclusively to beach barbeques and hotel bars. When breathed under pressure, nitrogen (which makes up 78% of air) has an intoxicating effect which, like alcohol, is variable and may lead to pleasure or disaster.

This phenomenon was regarded as an annoyance to the helmet diver who could be pulled to the surface by his attendant if he behaved irrationally, but the consequences to the scuba diver, who's safety is dependent on a buddy exposed to the same effect, can be more serious.

It will be present in all divers breathing air at a depth in excess of 30 metres, although some will notice it earlier. Others may not be aware of the effect, as judgment and perception are affected. The severity of symptoms and the exact depth of their onset varies between individuals. Because of narcosis, diving on air beyond 30 metres (100 feet) is not prudent, and 40 metres is considered unsafe for most recreational divers. A 50 metres depth is considered the maximum safe depth for experienced professional divers breathing air.

CAUSES OF NITROGEN NARCOSIS

The exact cause of this narcotic effect is uncertain. Nitrogen is classified as an inert gas because it does not participate in any chemical reactions within the human body. The influence of nitrogen on narcosis must therefore be due to some physical reaction.

When other inert gases such as neon, xenon and argon were investigated, it was found that their narcotic effect at depth correlated approximately with the relative weights of their individual molecules (i.e. their molecular weights). An increased molecular weight caused a greater narcotic effect. It was further shown that the inert gases which were more soluble in fat than water, tended to have a greater narcotic effect. There were unfortunately several inconsistencies in the behaviour of these gases, including hydrogen, which cast some doubt on these generalisations.

Other theories have been proposed implicating oxygen or carbon dioxide toxicity, lipid solubility and enzyme changes in the brain.

CLINICAL FEATURES

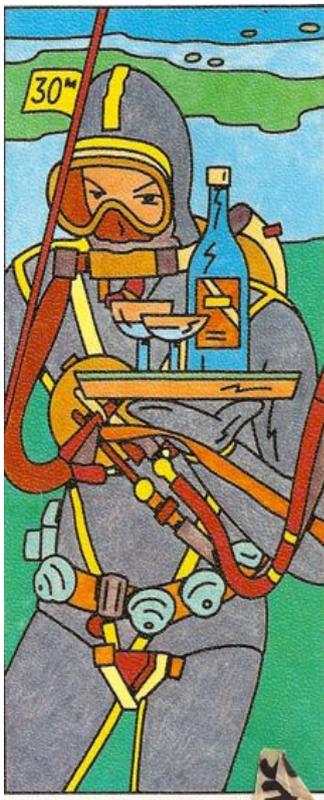


Fig. 18.1

The narcotic effect usually becomes effective within a few minutes of reaching a particular depth and does not worsen as exposure continues at this depth. Rapid descents may increase the effect, but with ascent it is dissipated.

The higher brain functions such as reasoning, judgment, memory, perception, concentration and attention tend to be the first affected by narcosis. This often leads to a feeling of well-being and stimulation in a diver secure in his surroundings. In a novice or an apprehensive diver, a panic reaction may follow. Some degree of tolerance develops at a given depth or with repetitive exposures.

The influence of narcosis may not be evident if the dive is uneventful, thus giving a false impression that the diver is in control of the situation. Memory and perception deficits may only be evidenced by a failure to follow instructions or the dive plan, or being inattentive to buoyancy, air supply or buddy signals. When a problem develops, the diver may be unaware of this – attention and perception being focused elsewhere (perceptual narrowing or "tunnel vision"). Thus emergency signals will go unheeded, emergency air supplies will not be offered, weight belts will not be released, rescue attempts will be crude and amateurish. Survival instincts and responses may be dampened. The safety of both the diver and his buddy are compromised.

Death may supervene due to errors provoked by impaired judgment or perception, and by over confidence. Loss of consciousness may happen without warning and be unnoticed by the diver's buddy. At great depths the diver may lose consciousness from the narcosis itself or the interaction between it and other factors such as sensory deprivation, carbon dioxide or oxygen toxicity.

Martini's Law - Table

20-30 metres	Mild impairment of performance on unpracticed tasks, mild euphoria
30-50 metres	Overconfidence and inadequate responses to danger. Perceptual narrowing, fixation on a particular function or exercise. Judgment impairment, affecting; air supply, buoyancy control. navigation, decompression obligations, ascent rates etc. Anxiety
50 metres	sedation , loss of judgment. Hallucinations possible.
50-70 metres	In a chamber, depending on conditions - talkative or terrified.
70 metres	Poor reasoning ability. Very poor response to signals or instructions.
70-90 metres	Poor concentration and mental confusion, stupefaction and loss of memory.
> 90 metres	Hallucinations and loss of consciousness.

Factors which are known to **increase** the effects of nitrogen narcosis include:

- **low intelligence**
- **fatigue or heavy work**
- **anxiety, inexperience or apprehension**
- **cold (hypothermia)**
- **recent alcohol intake or use of sedative drugs**
(includes seasickness medications), marijuana etc.
- **poor visibility**

Factors which tend to **reduce** the effects of narcosis include:

- **strong motivation to perform a given task**
- **acclimatisation following prolonged or repeated exposures**
- **tolerance to heavy alcohol intake**

A diver who can "hold his liquor" is said to have a greater tolerance to nitrogen-narcosis. A plea of "acclimatising to narcosis" is generally not accepted by the courts however, as defence for an alcoholic intoxication charge.

The effect of nitrogen narcosis has been likened by some to that of drinking one martini on an empty stomach for every 10 metres depth (**Martini's Law**). The "olive" appears to be optional.

Case History Examples:

1. A group of divers descended into a deep clear freshwater cave in order to savour the pleasant intoxication of narcosis. Their bodies were found some weeks later in a deep confine of the cave. They were victims of over-confidence and impaired judgment induced by nitrogen narcosis.
2. Another diver became so elated during his dive that he removed his regulator and offered it to the other marine inhabitants.
3. A diver developed problems with his air supply but, possibly because of the 40 metre depth and narcosis, he did not attempt to ditch his weight belt. He triggered the dump valve of his BC instead of the inflation valve, and drowned with minimal struggling.

PREVENTION

Avoidance of compressed air diving to depths known to cause narcosis is a good policy. This implies a depth limit of 30 – 40 metres (100 – 130 feet) depending on the diver's experience, his tolerance to narcosis and the task performed. Safe diving beyond 30 metres requires an awareness of the ever increasing risk of this condition and its effects on human performance and judgment. Some experienced professional divers may be able to perform certain practised tasks at depths up to 60 metres with competency, but dives greater than 30 metres should be a source of concern for recreational divers and greater than 50 metres should be regarded as excessive even for professionals.

TREATMENT

A diver incapacitated by narcosis should be protected from injury and inappropriate behaviour, and brought to a shallow depth with a controlled ascent, bearing in mind decompression requirements. Symptoms clear rapidly as the nitrogen pressure is reduced. Any other symptoms present on surfacing (e.g. salt water aspiration and near drowning, decompression sickness etc.) are due to complications of experiencing narcosis at depth and not narcosis *per se*.