



PROVIDING HIGH CONCENTRATION OXYGEN TO A DIVING ACCIDENT VICTIM IN A CLINIC OR HOSPITAL WARD

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Victims of scuba diving accidents may be taken to medical centres which do not have staff trained or knowledgeable in diving medicine. This can sometimes lead to less than optimal management, and consequently an increase in the likelihood of morbidity or mortality. The aim of this newsletter is to provide some advice and protocols for dealing with an injured scuba diver. The Divers Alert Network is a non-profit scuba diving safety association with a mission to improve the safety of all divers. Please contact us if we can be of any assistance.

SCUBA divers breathe compressed gas (usually air) from cylinders underwater. This can lead to several unique problems, the major ones being decompression illness (DCI) and pulmonary barotrauma (lung rupture). In addition, divers may suffer from the same in – or – on-water mishaps as swimmers, snorkellers and boating enthusiasts, as well as general medical conditions.

Decompression illness and pulmonary barotrauma require special first aid considerations, including the prompt and continued administration of near-100% oxygen. However, if resuscitation is required, the basic principles still apply (i.e. DRABCD).

BACKGROUND

Decompression Illness

During a dive, nitrogen from the breathing air is dissolved in the diver's blood. Unless the diver ascends slowly enough to allow the excess nitrogen to leave the body in an orderly manner, nitrogen bubbles may form in the diver's blood and body tissues. These bubbles, and the biochemical changes associated with them, can reduce the blood supply to various organs causing hypoxia and subsequent damage. This is known as Decompression Illness (DCI).

Pulmonary Barotrauma

As a diver ascends, the gas in the lungs expands and, unless expanding gas is adequately exhaled, the diver's lungs can distend and tear. This can result in a pneumothorax and/or mediastinal emphysema, or subcutaneous emphysema. Escaped gas may also enter the cerebral arterial circulation (cerebral arterial gas embolism) causing similar symptoms to that of a stroke.

RECOGNITION

Decompression Illness

- extreme fatigue
- numbness/tingling or altered sensations
- headache or other body pain, especially at or around joints
- poor balance or coordination
- reduced consciousness, collapse, convulsions
- weakness, paralysis
- rash
- speech, visual or hearing disturbances

Pulmonary Barotrauma

- chest pain
- difficulty breathing
- coughing
- cyanosis
- voice changes
- difficulty swallowing
- crepitus under the skin around neck
- reduced consciousness
- signs/symptoms of decompression illness may be present

MANAGEMENT

POSITIONING – Position a diver with early neurological manifestations flat

If a diver has neurological symptoms which have developed within an hour of the dive, it is important to manage them in a horizontal position without the head raised to reduce the likelihood of bubbles migrating to the brain (i.e. no pillow).

HIGH CONCENTRATION OXYGEN

It is very important to administer **oxygen** to the diver **at the highest concentration possible**. Increasing the inspired oxygen concentration increases the rate of elimination of nitrogen from the offending bubbles. This reduces their size and impact, and reduces the likelihood of permanent injury. In addition, the elevated oxygen concentration increases oxygenation to hypoxic tissues.

PERFORM A THOROUGH NEUROLOGICAL EXAMINATION

Divers with decompression illness often have paraesthesias, altered sensations, weakness and sometimes co-ordination and balance dysfunction that may go unnoticed unless tested for. Mentation may also be affected.

GIVE I.V. FLUIDS

Divers are often dehydrated from breathing dry gas underwater and this can increase the biochemical effects of the bubbles in the blood of divers with decompression illness. I.V. fluids should be provided where possible. Normal saline, Hartmanns Solution and Ringers Lactate are suitable, 5% Dextrose is not recommended. Depending on the clinical appearance, infusion of 1 litre over 1 hour would not be unusual and more may be required after this. Monitoring by urine output is reasonable.

GET EXPERT ADVICE FROM A DIVING MEDICAL SPECIALIST – Call a DAN Hotline promptly

The Divers Alert Network (DAN) funds Diving Emergency Hotlines throughout the world to provide fast and expert advice from diving medical specialists. These hotlines are available 24 /7 to provide advice to physicians, other medical professionals, divers and their companions in the event of an accident.

The main number for the Asia-Pacific Region is the **DAN /DES (Diving Emergency Service)** :

+61-8-8212 9242 (outside Australia)

1800 088200 (within Australia)

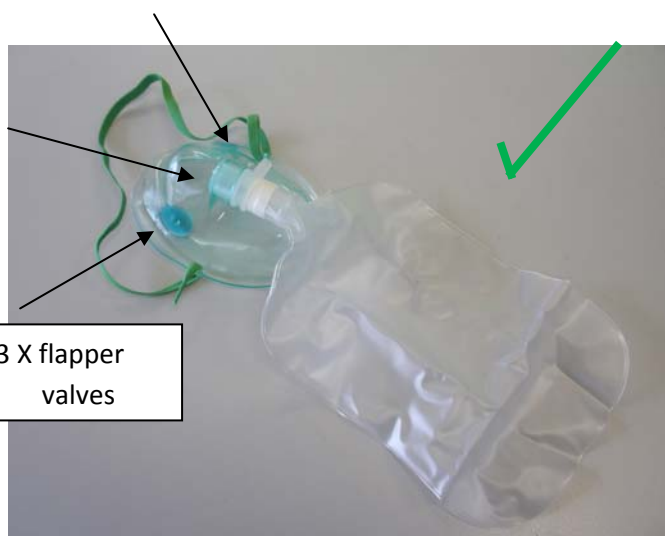
TRANSFER TO RECOMPRESSION FACILITY IF REQUIRED

Divers suffering from decompression illness will usually require treatment in a recompression chamber. **This is urgent if the symptoms are severe**. The hyperbaric oxygen therapy rapidly compresses the bubbles and accelerates their resolution. It also substantially increases oxygenation of compromised tissues.

PROVIDING HIGH CONCENTRATION OXYGEN

Although medical oxygen cylinders contain almost 100% oxygen, the concentration inspired by the patient will depend on the system used to deliver it to them. Most medical oxygen systems deliver oxygen at a selected flowrate via an oxygen therapy mask or nasal cannula. Most of these systems allow a lot of air to be entrained and this reduces the percentage of oxygen actually delivered.

The most common delivery devices used in medical centres or hospitals are the simple face mask and nasal cannula. Although better than nothing, **these are not suitable for managing a diver with decompression illness as they deliver a relatively low concentration of oxygen.**



Non-rebreather masks are recommended for delivering high concentration oxygen to a spontaneously breathing diver with decompression illness. They are cheap, readily available and effective if used properly.

A non-rebreather mask is fitted with both a reservoir bag and ideally three one-way valves - one over the reservoir and one each side over the air-intake holes. This type of mask is designed to reduce the amount of air and carbon dioxide inhaled, thereby increasing the concentration of oxygen. The reservoir bag fills with oxygen and, when the wearer inhales, a one-way

valve ensures that primarily oxygen is breathed from the reservoir. When the wearer exhales, the one-way valve system prevents exhaled gas from entering the reservoir. If valves cover both sets of holes the wearer cannot breathe easily unless there is an adequate flow of oxygen, so this needs to be monitored.

For proper use, the reservoir bag must be primed and should always contain enough oxygen so that it does not deflate fully (ideally no more than one third) when the wearer takes the deepest inhalation. In addition, all three one-way valves should be fitted and seated properly. A good seal also needs to be achieved. Under these ideal circumstances, a non-rebreather mask is reported to be capable of supplying an oxygen concentration of up to 95% with flowrates of 10 to 15 lpm. However, in practice such a high concentration is difficult to achieve and the mask will generally deliver a substantially lower oxygen concentration, probably around 70-80%.

If using a non-rebreather mask it is important to ensure the reservoir is distended with oxygen before the mask is fitted to the wearer. When the mask is fitted, the oxygen flowrate should be adjusted so the reservoir does not deflate completely.

An initial flowrate of 15 lpm is recommended when a non-rebreather mask is first fitted to an adult. The flowrate is increased to prevent the reservoir from deflating, or it is decreased if the reservoir constantly remains inflated, which is more likely to occur with a small wearer. Flowrates below 8 lpm are not recommended for divers.

We, at DAN Asia-Pacific, hope that this advice is helpful and that you will make it available to the appropriate personnel at your centre. Please contact us if you have any questions at all about the man accident of a diving accident victim.

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