DAN SOUTHERN AFRICA

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How to Manage Diving Problems

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This book is dedicated to
Italo Martinengo,
my close friend for so very many years.

Contents

Introduction

This e-book was adapted from the *How to Manage Diving Problems* pocket guide and put into electronic format to be readily available on your electronic device. It is an e-book that is intended to be as much a part of a diver's kit as a mask or a wetsuit, always at hand when needed.

When divers are in trouble, they don't want fine theory or philosophy. They want straight, cold, hard facts that will help them out of a dangerous situation, especially when they are far away from doctors and hospitals. That's why I wrote *How to Manage Diving Problems* – to get diving victims out of hot water fast and on the road to health or emergency-trained back-up.

This e-book doesn't bother with theory or reasons. It ignores the "why" of trouble and fixes only on the "what to do".

Emergency problems are handled first, then the ubiquitous ear and sinus problems. A cascade of other diving stresses follows, with straightforward, step-by-step advice on what to do.

How to Manage Diving Problems is meant for use in the field, but your own doctor must always be in the background, because medicines are needed in order to prepare for diving problems. Speak to him or her about preparing your emergency kit. Get sound advice and the necessary prescriptions before buying any medications. They may be very harmful or contraindicated in your own particular case. Make sure that emergency oxygen is available before diving. It still remains the cornerstone of treatment for all emergencies, dive-related or not.

In conclusion to the Introduction, it seems fitting to include a table of medical conditions that may take place during a dive, and at which depth they are likely to occur. (see opposite page).

Safe diving!

	EFFECTS OF DESCENT		EFFECTS OF ASCENT
0 m 0_2	**OXYGEN TOXICITY** Cerebral: convulsions, pallor, twitching, features of hypoxia Pulmonary: scratchy throat, cough, burning chest, breathlessness	**SQUEEZE** Lung, ear, sinus, mask, suit, diver	**ACUTE DECOMPRESSION ILLNESS, OSTEONECROSIS** **BAROTRAUMA OF ASCENT** Gas embolism, pneumothorax, mediastinal emphysema, lung tissue damage, reverse ear and sinus block, gut barotrauma of ascent, suit blow-up
10 m AIR	**NITROX TOXICITY** **NITROGEN NARCOSIS** (see features of hypoxia)	**FEATURES OF HYPOXIA** - Higher cerebral function ~ Irritability, anger, fear, laughter, irresponsibility, hysteria, hallucinations, apathy, sullenness, illusions, confusion, automatism, amnesia, unconsciousness - Changes in the senses ~ Visual: blurring, double vision, tunnel vision, blindness, dazzle ~ Hearing: deafness, ringing in the ears (tinnitus), loss of balance with nausea, vertigo, vomiting ~ Touch: numbness, itching, pins and needles, burning ~ Taste: loss of taste or abnormal taste awareness ~ Smell: loss of smell or abnormal smell awareness - Changes in motor activity ~ Weakness, loss of balance, inco-ordination, tremor, abnormal gait, twitching, slurred speech, paralysis	
50 m AIR	**SEVERE NARCOSIS** Dense air → more work to breathe → **CO_2 TOXICITY** Flushing, headache, breathlessness, features of hypoxia		
90 m	Absolute limit to air dive: ppO_2 = **2 ATA CEREBRAL OXYGEN TOXICITY**		
100 m He + 0_2 MIX	**DIFFICULT TEMPERATURE REGULATION** Hypothermia Hyperthermia Garbled speech Strict ppO_2 and $ppCO_2$ and gas purity control		
150 m	**HIGH PRESSURE NERVOUS SYSTEM** Tremors, features of hypoxia		
600 m ????? limit	Deep saturation diving Liquid breathing???		

Table 1 - Diving disorders

This e-book doesn't bother with theory or reasons. It ignores "why" and focuses on "what to do".

1.1 Diving Medical Emergencies

This diagram provides a detailed, step-by step approach to take during a diving medical emergency.

TAKE CONTROL OF THE SITUATION

Ensure that the victim is in a safe place on the shore or on the boat.

Determine whether a CPR-trained person is present to assist.

Assess the victim's airway, breathing, circulation and injuries.

Control bleeding and, if required, begin rescue breathing or CPR.

ASSESS THE POSSIBLE CAUSE
Marine animal bite (see p15)
Trauma (see p15)
Near-drowning (see p19)
Decompression illness (see p20)
Pulmonary barotrauma (see p23)
Hypothermia (see p30)
Hypoxia (see p52)
Oxygen toxicity (see p53)
Carbon dioxide toxicity (see p54)
Carbon monoxide poisoning (see p56)
Marine animal sting (see p74)
Other medical: heart disease, high blood pressure, diabetes, low blood sugar, epilepsy, alcohol abuse, drugs, allergy

Get someone to do the contact duties as below.

Determine whether the victim belongs to a diver rescue service.

YES – Contact the service
NO – Contact the nearest emergency service
DAN Hotline: 0800 020 111 (local)
+27 828 10 60 10 (international)

Keep calm. Relay information clearly and accurately: name, age, home address, telephone number and membership particulars of the victim.
Any known illnesses, allergies, treatments?
Give the contact person's name, contact number and area code.
Relay the exact geographical site of the victim (see p9):
- Remote: nearest town and details of major landmarks
- Urban: street number and nearest cross street

Clearly relay the approximate cause and severity of the case.
Hyperbaric or non-hyperbaric?
Ensure someone stays at the contact telephone number in case the service needs any further information.

Collect all the diver's equipment for expert assessment. These must be given to the responsible authority, hospital, recompression facility or, in the event of death, the police.

Figure 1: Step-by-step how to handle diving emergencies

1.2 Transport for a Diving Emergency

This diagram provides a guide to arranging transport for a victim during a diving medical emergency.

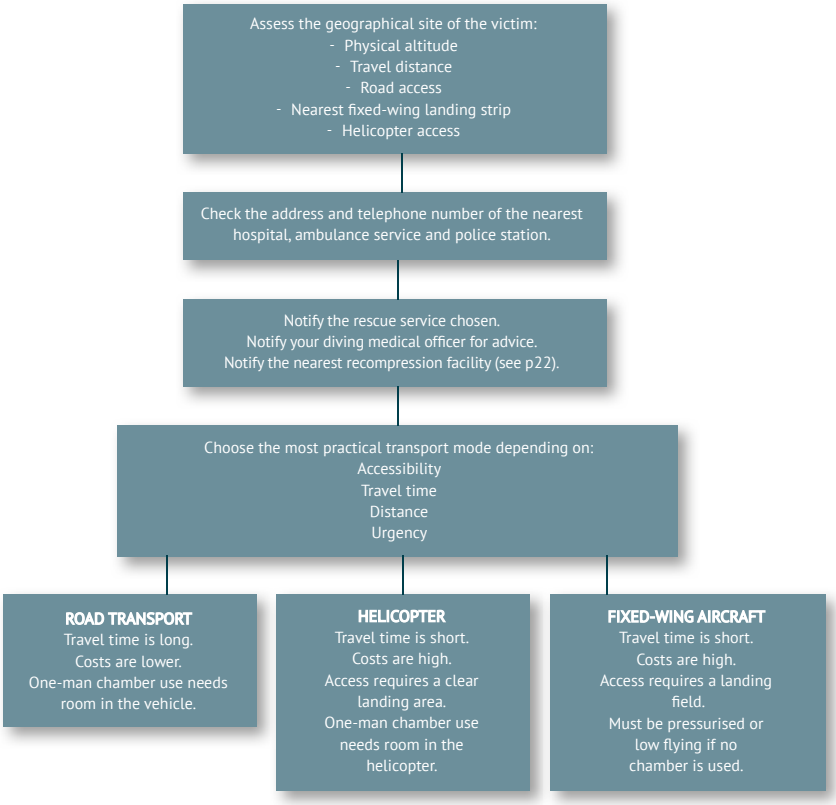
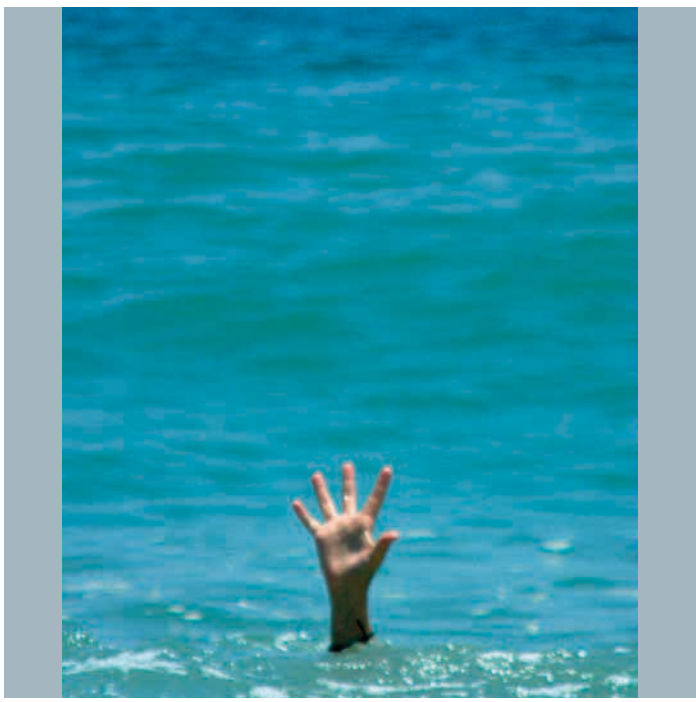


Figure 2: Step-by-step transport arrangement in an emergency

> Choose the most practical transport mode depending on accessiblilty, travel time, distance and urgency.



1.3 Unconscious Diver

This diagram provides assistance with the steps to be taken in the event that you discover an unconscious diver.

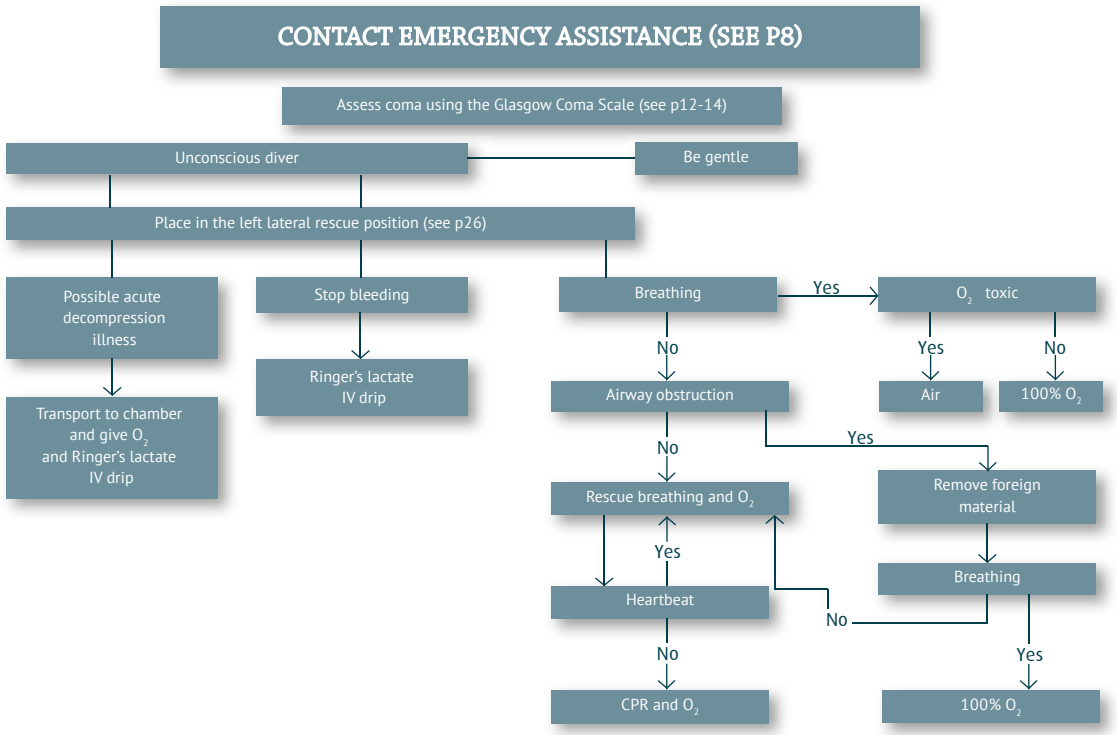


Figure 3: Contact emergency assistance

The following tables indicate the possible causes of medical conditions leading to unconsciousness at different stages of diving.

ONSET OF UNCONSCIOUSNESS					
	On descent	At bottom	On ascent	At surface	After dive
N_2 narcosis	X	X			
Hypoxia	X	X	X		
O_2 toxicity	X	X	X		
Co_2 toxicity	X	X	X		
CO poisoning	X	X	X	X	
Water inhaled	X	X	X	X	
Foreign matter	X	X	X	X	X
Pulmonary barotrauma			X	X	X
Decompression illness			X	X	X
Squeeze	X				
Marine sting				X	X
Marine bite	X	X	X	X	X
Sea snake					X
Seafood					X
Hypothermia		X	X	X	
Head injury		X	X	X	X
Other medical	X	X	X	X	X
Electrocution		X			
Explosion		X	X	X	

Table 2: The possible causes of unconsciousness for a diver with X marked at the stage(s) of the dive at which it can occur

N_2 narcosis	Deep air dive, wrong nitrox mix
Hypoxia	Cylinder empty, faulty regulator, wrong mix
O_2 toxicity	Pure oxygen, nitrox, heliox, trimix
CO_2 toxicity	Air contamination, tight gear, dense nitrox
CO poisoning	Air contamination
Water inhaled	Panic, alcohol, equipment problem, coughing
Foreign matter	Dentures, vomit
Squeeze	Rapid negative descent with regulator failure
Marine bite	Shark, barracuda, grouper, etc.
Other medical	Epilepsy, diabetes, heart attack, stroke

Table 3: Causes of unconsciousness on decent using scuba

A coma is assessed using the Glascow scale.

N_2 narcosis	Deep air dive, wrong nitrox mix
Hypoxia	Cylinder empty, faulty regulator, wrong mix
O_2 toxicity	Pure oxygen, nitrox, heliox, trimix
CO_2 toxicity	Air contamination, tight gear, dense nitrox mix, strenuous exercise, skip breathing
CO poisoning	Air contamination
Water inhaled	Panic, alcohol, equipment problem, coughing
Foreign matter	Dentures, vomit
Marine bite	Shark, barracuda, grouper, etc.
Hypothermia	Alcohol, inadequate insulation, ice diving
Head injury	Wreck diving, cave diving
Other medical	Epilepsy, diabetes, heart attack, stroke
Electrocution	Contact with underwater cables, welding
Explosion	Explosives in wrecks, setting explosives

Table 4: Causes of unconsciousness at the bottom using scuba

Arterial gas embolism	Inadequate exhalation, tight gear, rapid ascent, asthma, respiratory infection, patent foramen ovale
Tension pneumothorax	Inadequate exhalation, tight gear, rapid ascent, asthma, respiratory infection
Acute decompression illness	Rapid ascent with substantial gas load and missed decompression stops
Hypoxia	Cylinder empty, faulty regulator, wrong mix
O_2 toxicity	Pure oxygen, nitrox, heliox, trimix
CO_2 toxicity	Air contamination, tight gear, dense nitrox, strenuous exercise, skip breathing
CO poisoning	Air contamination
Water inhaled	Panic, alcohol, equipment problem, coughing
Foreign matter	Dentures, vomit
Marine bite	Shark, barracuda, grouper, etc.
Head injury	Wreck diving, cave diving
Hypothermia	Alcohol, inadequate insulation, ice diving
Other medical	Epilepsy, diabetes, heart attack, stroke
Explosion	Too short fuse after setting explosives

Table 5: Causes of unconsciousness on ascent using scuba

Arterial gas embolism	Inadequate exhalation, tight gear, rapid ascent, asthma, respiratory infection, patent foramen ovale
Tension pneumothorax	Inadequate exhalation, tight gear, rapid ascent, asthma, respiratory infection
Acute decompression illness	Rapid ascent with substantial gas load and missed decompression stops
CO poisoning	Air contamination – persisting effect
Water inhaled	Panic, alcohol, equipment problem, coughing, strong currents
Foreign matter	Dentures, vomit
Marine bite	Shark, barracuda, grouper, etc.
Marine sting	Following vertebrate or invertebrate stings
Head injury	Wreck diving, cave diving, collision with boat or rock
Hypothermia	Alcohol, inadequate insulation, ice diving
Other medical	Epilepsy, diabetes, heart attack, stroke
Explosion	Too short fuse after setting explosives

Table 6: Causes of unconsciousness at the surface using scuba

Arterial gas embolism	Occurs immediately or very soon after diving
Tension pneumothorax	Occurs very soon after diving
Mediastinal emphysema	Compression of heart and lung function, occurs soon after diving
Acute decompression illness	Majority occur within 30 minutes of diving
Marine bite	Shark, barracuda, grouper, etc.
Marine sting	Following vertebrate or invertebrate stings
Snake bite	Occurs soon after diving, bite may be painless
Head injury	May be delayed after head injury under water
Seafood	Ingestion of poisonous or contaminated seafood
Other medical	Epilepsy, diabetes, heart attack, stroke

Table 7: Causes of unconsciousness later after scuba

1.4 Neurological Assessment

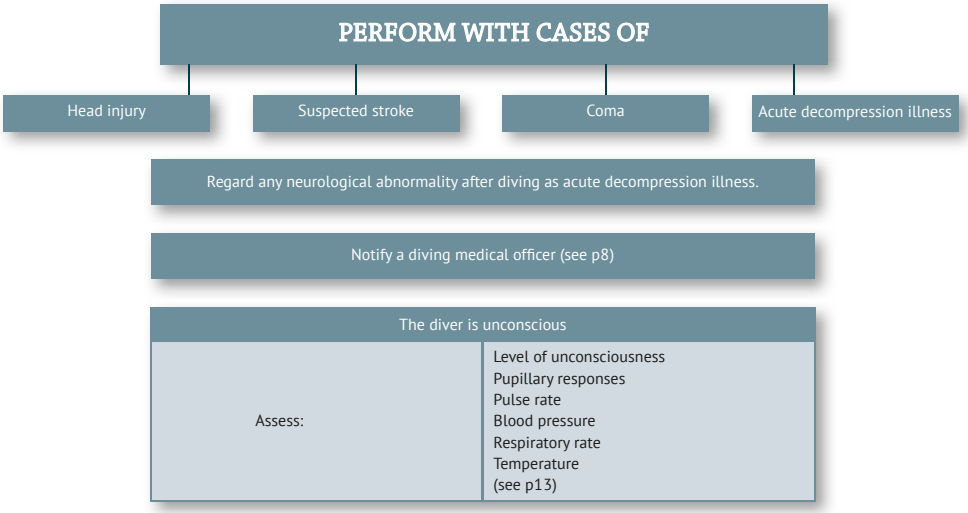


Figure 4: Performing a neurological assessment

Use the Glasgow Coma Scale to assess the level of consciousness.

- A fully conscious victim will score 15 points.
- A deeply unconscious victim will score three points.
- Assess the victim's pain responses by firmly squeezing his or her Achilles tendon between your thumb and forefinger for two seconds.
- A painful stimulus normally causes limb withdrawal from the source of pain as the knee and hip joints flex. This is called a flexion response. If the limb is thrust straight out following a painful stimulus, it is an abnormal "extension to pain" response.
- All responses must be noted as indicated below.

Repeat all these observations every 15 minutes while consciousness is reduced or confusion and disorientation are present. When the victim is fully conscious, repeat these observations at hourly intervals. Pinpoint or unequal pupil size, slowing of the pulse and respiratory rate, and an increase in blood pressure indicate increased pressure on the brain.

GLASGOW COMA SCALE	SCORE
EYE OPENING	
Spontaneous	4
To speech	3
To pain	2
None	1
VERBAL RESPONSE	
Oriented	5
Confused	4
Inappropriate words	3
Incomprehensible sounds	2
None	1
MOTOR RESPONSE	
Obeys commands	6
Localises to pain	5
Flexion to pain	4
Abnormal flexion	3
Extension to pain	2
None	1
SCORE 3 TO 15	

Table 8: The Glasgow Coma Scale

Instruments required

- Light source
- Patellar hammer
- Cotton wool ball
- Pin
- Blunt-pointed object
- Sphygmomanometer to measure blood pressure
- Rectal thermometer
- Timing device
- Tuning fork

THE DIVER IS UNCONSCIOUS		
EYE PUPILLARY RESPONSES	NORMAL	ABNORMAL
Normal in size	Yes	No
Equal in size	Yes	No
Contract in bright light	Yes	No
Contract equally and together	Yes	No
PULSE RATE	COMMENTS	
60 to 90 beats per minute	Normal	
Above 100 beats per minute and weak	Possible circulatory shock	
Below 50 beats per minute	Possible high brain pressure	
BLOOD PRESSURE	COMMENTS	
100/60 to 140/90	Normal	
Above 140/90	Possible high brain pressure	
Below 100/60	Possible circulatory shock	
RESPIRATORY RATE	COMMENTS	
16 to 20 breaths per minute	Normal	
Above 20 breaths per minute	Possible fever/hyperthermia	
Below 10 breaths per minute	Possible high brain pressure	
RECTAL TEMPERATURE	COMMENTS	
37°C	Normal	
Above 37°C	Hyperthermia	
Below 37°C	Hypothermia	

Table 9: When the diver is unconscious

THE DIVER IS CONSCIOUS					
FUNCTION	NORMAL		ABNORMAL		QUESTION(S) OR TASK(S) TO PERFORM
Orientation - Time - Place - Person					What is the time? What day is it? Where are you? What is your name?
Memory - Immediate - Recent - Remote					Repeat: 11, 3, 79, 8 What did you last eat? What is your telephone number?
Arithmetic					Subtract serial 7s from 100
EYES	R	L	R	L	TASKS TO PERFORM
Sight					Can count one to five fingers, one eye at a time. Can read this page.
Light reflexes					The pupils are normal and equal in size. They contract in bright light.
Accommodation					The pupils are larger when looking far off and smaller when looking close by.
Movements					Both eyes can follow a moving finger up, down, left and right.
FACE	R	L	R	L	TASKS TO PERFORM
Movement					Can close/open eyes, smile, clench teeth, wrinkle forehead, whistle.
Sensation					Can feel light touch on both sides of the chin, cheeks, forehead and nose.
Hearing					Can hear two fingers rubbed 50 cm from each ear in a quiet place.
Speech					Any huskiness, misplaced words, slurring?
Tongue					Can put out the tongue and move it left and right.
Taste					Can taste sweet: sugar; salty: salt; sour: lemon.
Smell					Can smell coffee, garlic, vinegar, etc., with each nostril.
Swallowing					The larynx moves with swallowing.
MUSCLE POWER	R	L	R	L	TASKS TO PERFORM
Shoulders					Can shrug against hand resistance.
Grip					Can grasp and squeeze two fingers.
Arms					Can pull and push against resistance.
Legs					Can lift, part and close against resistance.
MUSCLE TONE	R	L	R	L	TASKS TO PERFORM
Spastic					One or more limbs are very stiff.
Flaccid					One or more limbs are very floppy.
SENSATION (TEST ALL FOUR TYPES)	R	L	R	L	Use cotton wool for light sensation. Use pinpoint for sharp sensation. Use blunt point for dull sensation. Use tuning fork for vibration sense.
Hands					Hand, base of thumb and fifth finger
Arms					Back and front of arms
Torso					Back and front of torso
Legs					Back and front of legs
Feet					Tops and soles of feet
CO-ORDINATION	R	L	R	L	TEST CEREBELLAR FUNCTION
Pointing					Can accurately point at a close object.
Finger-nose test					Can repetitively touch his or her nose and then your finger held before him or her.
Gait					Check unsteadiness or staggering. Can he or she walk heel-to-toe?
Balance (Rhomberg)					Check for swaying when standing with eyes shut and feet together.
REFLEXES	R	L	R	L	The victim sits on a chair with feet free of the ground and arms loosely resting on the lap. Use a patellar hammer or blunt object.
Knee					Tap the tendon below the kneecap – the lower leg jerks forward.
Ankle					Tap the Achilles tendon – the foot jerks down.
Biceps					Place your free thumb in front of the diver's elbow and tap your thumb – the lower arm jerks up.
Triceps					Tap above the back of the elbow – the lower arm jerks down.
Babinski response					Run a blunt object up the soles of the feet. Normal – toes curl down. Babinski – big toe moves up with other toes fanning out.

Table 10: When the diver is conscious

1.5 Shark Bites and Major Wounds

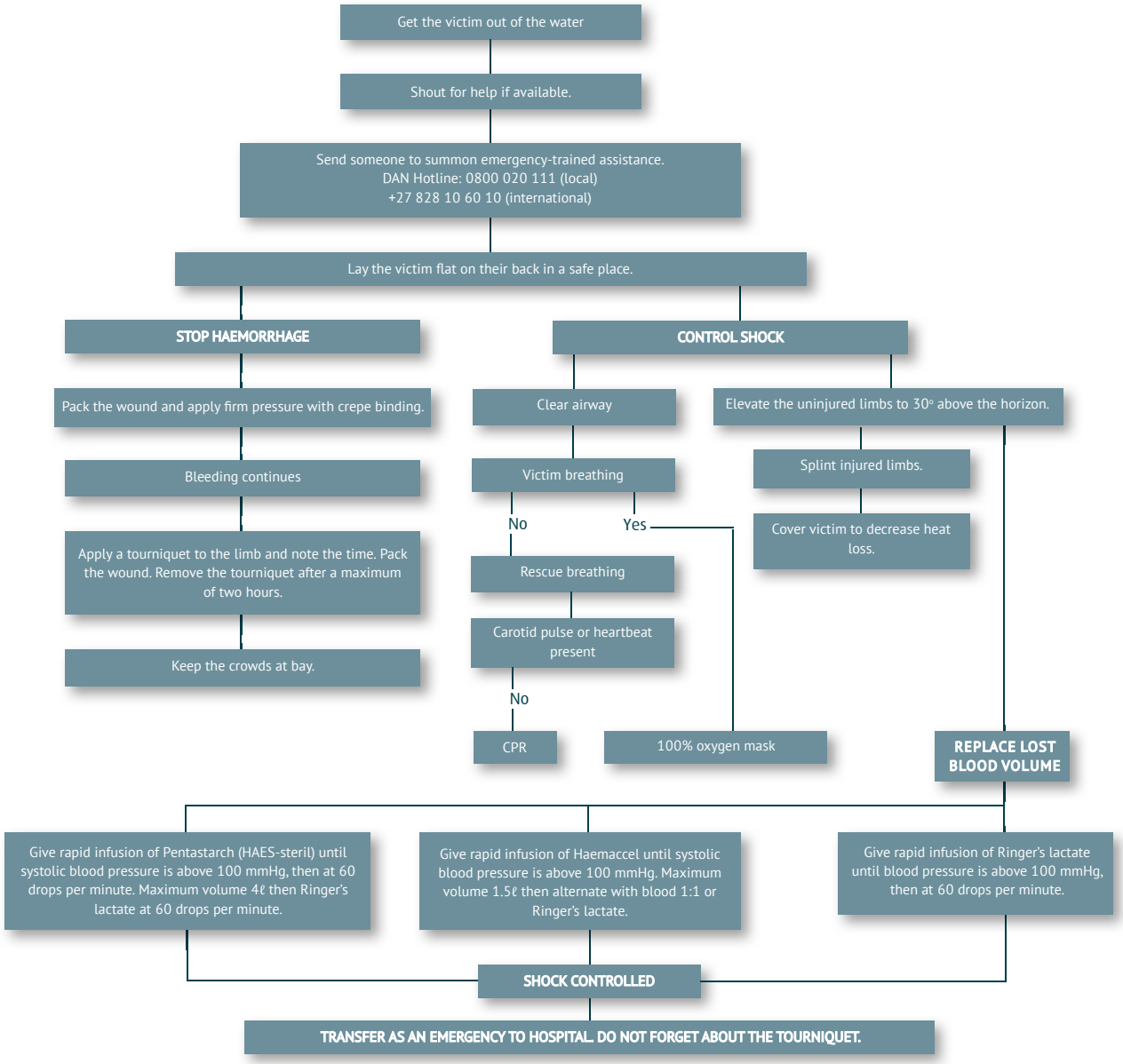


Figure 5: Process for shark bites and major wounds

What to include in a shark attack pack

- One non-return airway
- Two pairs of elbow-length rubber gloves
- Two full-length plastic aprons
- Two goggles

} HIV protective wear for CPR operators

- Two 1ℓ Ringer's lactate solution
- Three 500 ml Haemaccel or three 500 mℓ 10% HAES-steril
- Three IV administration sets with blood filters and 18 gauge needles
- Three Medican 16 gauge IV cannulae
- One 21 gauge butterfly needle
- Two 10 mℓ plastic syringes
- One 50 mℓ plastic syringe
- Five 21 gauge disposable needles
- Five packs of alcohol swabs
- One 2.5 cm wide adhesive tape reel
- Four 25 cm x 50 cm trauma pads ("gamgee") – sterile
- Four 15 cm crepe bandages
- One 10 cm crepe bandage
- Five 12.5 cm x 10 cm Steripad dressings
- One Esmarch's bandage 10 cm (tourniquet)
- Two disposable 10 cm artery forceps
- One aluminium foil blanket (space blanket)

1.6 Distressed Diver at the Surface

- Ensure personal safety at all times.
- Get the victim high in the water with his or her face dry.
- Push or tow the victim to shore or to the boat.
- Get the victim to land or onto the boat.

Handling a diver in distress requires:
- Recognition of distress
- Surface action
- Approach and contact
- Transport at the surface
- Exiting from the water

Recognition of distress

Early recognition permits rapid management.

Surface action

This could entail action from the dive boat or shore, by the buddy or by both. *Surface action depends on physical ability, available equipment and sea conditions.*

Non-swimming boat rescue

- Throw a line to the victim.
- Throw a line and buoy.
- Throw any flotation device.
- Extend a boat hook if the victim is next to the boat.
- Move the boat to the diver. Beware of propeller or collision injuries to the diver or other divers in the area.

Swimming boat rescue

- Notify the shore that a diver is in trouble.
- Ensure a minimum of masks, snorkels, BCs and fins.
- Take a spare flotation device with you – BC, rescue buoy or tube.

Figure 6: Recognition of distress

- Keep ongoing visual contact with the victim. Use a crawl stroke and keep your head up.

Approach and contact

WARNING! The rescuer is exposed to maximum danger at this time. A panicky victim may attempt to grab you, cling to you or even climb onto your head. Your personal safety must come first! It is essential to determine whether the victim is rational:
- Stop 1 m to 2 m from the victim.
- Attempt to visually assess the difficulty.
- Ask, "Are you OK?"
- Tell the diver that you have come to help.

If the diver responds rationally:
- Add positive buoyancy to your BC.
- Reassure him or her that everything is now under control.
- Explain that you are going to resolve the difficulty.
- Give simple, clear instructions, e.g.
  - ~ "Inflate your BC."
  - ~ "Drop your weight belt."
  - ~ "Hold this buoy."
- Explain what you are about to do, e.g.
  - ~ "You are tangled in the float line. I am now going to free you."
  - ~ "I am going to return your demand valve to your mouth."
  - ~ "I am going to stretch your leg to relieve the cramp."
  - ~ "I am going to free the kelp from you."
- Ensure that the diver can always see you. If you move out of sight the victim will assume that you have left without assisting.
- If the victim grabs at you, move away and repeat that everything is under control.

If the diver responds irrationally:
- Keep a short distance away.
- Do not allow the victim to grab you.
- Shout and signal to the boat or shore for help.
- Add positive pressure to your BC.
- Ensure that your demand valve is in your mouth. You are in imminent danger of being forced under water!
- If possible, give the victim something buoyant to clutch on to – push the spare flotation device towards the victim.
- If the victim does grab you, attempt to power-inflate his or her BC.
  - ~ If unsuccessful and the victim is struggling violently with you, dump air from your BC and allow yourself to submerge. The victim will not continue to hold a sinking rescuer.

> Ensure personal safety at all times.

Transport at the surface

A fatigued or injured diver may need assistance to return to the boat or shore.

- Ensure that the victim is buoyant with his or her face out of the water.
- Ensure that you can control the victim while swimming.
- Try to maintain visual and voice contact with the victim.

Several methods may be used, depending on the circumstances:

Underarm push

- Lie the victim horizontally and face up in the water.
- Grasp the victim by the upper arm.
- Push the victim through the water.

Advantage: It allows easy transfer into the do-si-do position and rescue breathing if required.

Cylinder or BC tow

- Grasp the victim's cylinder valve or BC collar.
- Tow the victim through the water.

Advantage: It allows rapid progress through the water.
Disadvantages: Loss of visual contact with the victim. Pulling on the BC can cause it to ride up the victim's chest and make breathing difficult.

Float and line (rescue line)

- Push the float to the victim.
- Tow the victim by the line.

Advantage: It allows the victim buoyancy without endangering the rescuer.

Drift (stern) line

- Get to the stern line.
- Pull yourself and the victim along the line to the boat or let the crew on the boat pull you to safety.

Exiting from the water

At the boat

- Remove the victim's heavy equipment (weigh belt and cylinder).
- Remove the victim's fins. This makes climbing much easier.
- Getting aboard depends on:
  - ~ victim's size
  - ~ rescuer's strength
  - ~ state of fatigue of both rescuer and victim
  - ~ type of boat and access height above water
  - ~ presence or absence of a ladder
  - ~ available help of others
- A rope looped around the back and under the arms can help in hauling a heavy victim aboard or assisting the victim to climb the ladder.

At the shore

- Remove the victim's heavy equipment (weight belt and cylinder).
- Remove the victim's fins – this makes wading much easier.
- Tell the victim to roll over and crawl on hands and knees from the water.
- Help the victim stand and support him or her by the arm, or help the victim stand and sling one of the victim's arms across your shoulders and hold his or her hand.
- Assist the victim to the beach and let him or her lie down to recover.

WARNING
Exercise caution when approaching a distressed diver at the surface. A panicky victim may attempt to grab you, cling to you or even climb onto your head!

1.7 Deep Diver Rescue

All unconscious divers, unless they fortuitously still have their regulators in their mouths and are actively exhaling gas bubbles, must be presumed to have attempted to breathe under water and have inhaled water. The moment water is inhaled, the vocal cords in the larynx contract together, closing the larynx and sealing off the lungs. More water cannot enter, but lung air can also not leave. This is called laryngospasm.

All unconscious divers disconnected from their air supply have laryngospasm and their airways are totally obstructed. They cannot inhale or exhale at all. Attempting to restore breathing by shoving a regulator into their mouths and pressing the purge button is totally futile. No air will reach the lungs. It will simply bubble from the mouth. If they are then rescued and brought to the surface, expanding air trapped in the chest will burst and shred the lungs, and they will die of massive pulmonary barotrauma of ascent. The same applies to a convulsing diver. During a convulsion, the diver is not breathing, the jaws are clenched and if the mouthpiece is bitten through or free in the water, the first inhalation after the convulsion passes will cause water inhalation and immediate laryngospasm.

It is essential to wait for laryngospasm to pass before initiating the rescue ascent.

The problem is that relaxation of laryngospasm only occurs shortly before brain death. At this stage, a near-drowned diver will not even attempt to inhale during a rescue. This means that saving an unconscious diver requires urgent action only in the perilously short time corridor between relaxation of laryngospasm and death. The rescuer must understand this and resist the natural instinct which will prompt an immediate and fatal rescue ascent.

Method

Under water

- Ditch the diver's weight belt.
- Wait until any convulsions stop (they always will).
- Turn the diver's head to one side.
- Clear the mouth of any foreign material by sweeping your forefinger around the diver's mouth from cheek to cheek. Do not worry about water entering the mouth – this already happened and caused laryngospasm when the diver tried to breathe under water.
- If the diver's regulator is functional and you are confident about the diver's gas supply, replace it into the diver's mouth and hold it there with one hand. Otherwise, use your octopus regulator. This may assist if the diver tries to breathe during the rescue ascent. Air will then be inhaled, not water.
- Ascend 2 m or 3 m, holding the diver upright and the hand holding the regulator keeping the diver's jaw well up. Keeping the diver's neck extended will allow the expanding lung air to vent freely from the mouth during the ascent. Water will not enter the airway under these conditions. If air does not vent and the airway is clear, laryngospasm is still present. Stop and wait for it to pass before continuing the ascent – expanding air will then bubble freely from the mouth and drive most of the water in the mouth and throat out of the regulator.
- Do not attempt buddy breathing with a semi-conscious diver.
- Perform a controlled emergency ascent. Breathe normally on your rig and ensure free exhalation by the diver. Be careful that any expanding air in your (or the victim's) BC does not initiate an uncontrolled buoyant ascent.

WARNING
It is essential to wait for laryngospasms to pass before initiating a rescue ascent. The expanding air trapped in the chest will burst and shred the lungs.

At the surface

- Inflate the diver's BC and signal for help.
- Check that the diver is breathing. If no breathing is evident, begin rescue breathing.
- Rescue the diver from the water, with stops for rescue breathing every 15 seconds. If you see help is on the way, stay where you are and give continuous rescue breathing.
- On land or on the boat, lay the diver flat and face down. Straddle the diver's hips and turn the head to one side. Lift the pelvis to drain any water from the airway.
- If the diver is breathing, place him or her in the unconscious left lateral rescue position.
- If no breathing is evident, roll the diver on to his or her back and begin mouth-to-mouth rescue breathing or commence CPR if no heartbeat or carotid arterial pulse is found (see p29). If available, 100% oxygen should be administered.
- Summon an emergency rescue service urgently (see p8-10).
- Do not forget about any missed decompression stops! If these have occurred, begin pure oxygen breathing yourself and urgently notify a diving physician about the event.

RESCUE BREATHING

The most efficient method is via a plastic mouth-to-mouth airway fitted with a non-return valve to avoid contamination of the rescuer by blood fluid or vomit from the victim.

If an airway is not available, mouth-to-snorkel rescue breathing should be done. This is easier to do than mouth-to-mouth rescue breathing in a choppy sea. Position yourself behind the diver. Ensure that the diver's snorkel is drained of water and that his or her mask is properly fitted on his or her face. With one hand, hold the snorkel mouthpiece in the diver's mouth, lift the jaw up and, using the thumb and forefinger, pinch off the diver's nostrils through the mask nosepiece. Tilt the diver's forehead back with your other hand. Blow slowly and deeply into the snorkel, then allow the diver to exhale passively. Repeat this 10 times.

1.8 Near-Drowning

Causes

- Alcohol
- Panic
- Gas problems
  - ~ Hypoxia
  - ~ Oxygen toxicity
  - ~ Carbon dioxide toxicity
  - ~ Carbon monoxide poisoning
  - ~ Nitrogen narcosis
- Pulmonary barotrauma (ascent and descent)
- Hypothermia
- Seasickness, vomiting and inhalation
- Marine animal stings and attacks
- Underwater injuries or entrapment
- Underwater explosions
- Underlying medical problems – known and unknown

Presentation

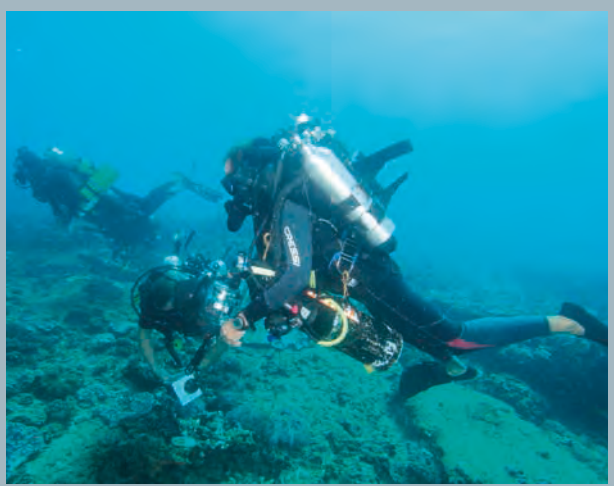
- The victim is unconscious and limp.
- The skin is pale.
- The skin is cold.
- No breathing is evident.
- There is no pulse or heartbeat.
- The pupils may or may not react to light.
- Frothy, blood-stained foam may be flowing from the mouth.

Treatment

- Rescue breathing at the surface, while bringing the victim to shore or the boat
- CPR

Resuscitation should be continued until a doctor calls off the attempt because of definite death. For more help, see CPR (p26-29), Deep Diver Rescue (p18), Diving Emergency (p8) and Unconscious Diver (p10-11).

> Resuscitation should be continued until a doctor calls off the attempt because of definite death.



1.9 Acute Decompression Illness

Decompression illness is caused by:

- nitrogen bubble formation in tissues and blood
- arterial gas embolism from lung tearing

Predisposing factors for nitrogen bubble formation

- Missed decompression stops or incomplete decompression
- Repetitive dives
- Exposure to heat post-dive
- Exposure to cold pre-dive and during diving
- Excessive movement including exercise post-dive
- Rapid ascents
- Increased age
- Obesity
- Dehydration
- Increased carbon dioxide
- Alcohol excess
- Physical injury
- Altitude post-dive
- Prolonged limb flexion post-dive
- Previous decompression illness
- Patent foramen ovale – a "hole-in-the-heart" between the right and left atria (upper heart chambers)

Predisposing factors for arterial gas embolism

Breath-holding with:

- Panic
- Free ascents
- Skip breathing during ascent
- Unco-ordinated buddy breathing during ascent

TIP
Exhalation during a free ascent should be an ongoing steady whistling or humming through the demand valve.

- Aborted ditch and recovery training
- Apparatus difficulties
- Water, foreign body or vomit inhalation
- Lung disorders, e.g. asthma and respiratory infections

Excessively rapid and forceful exhalation causing:

- Involuntary fluttering or closure of the vocal cords in the larynx
- Spasm of the muscles of the small airways and increased resistance to exhalation of expanding alveolar air

Exhalation during a free ascent should be an ongoing steady whistling or humming through the demand valve.

Time of occurrence of acute decompression illness

Immediately post-dive to 24 hours or longer.

Presentation of acute decompression illness

Any of the following:

- Joint or limb pain
- Changes in higher brain function – personality changes, confusion or coma
- Sensory changes – vision, hearing, taste, smell or touch
- Motor changes e.g. weakness, paralysis, inco-ordination or loss of balance
- Other e.g. rash, restlessness, loss of appetite, undue fatigue, chest pain, breathlessness, coughing, coughing blood, vomiting, headache and abdominal or back pain

> Presentation of acute decompression illness includes joint or limb pain.

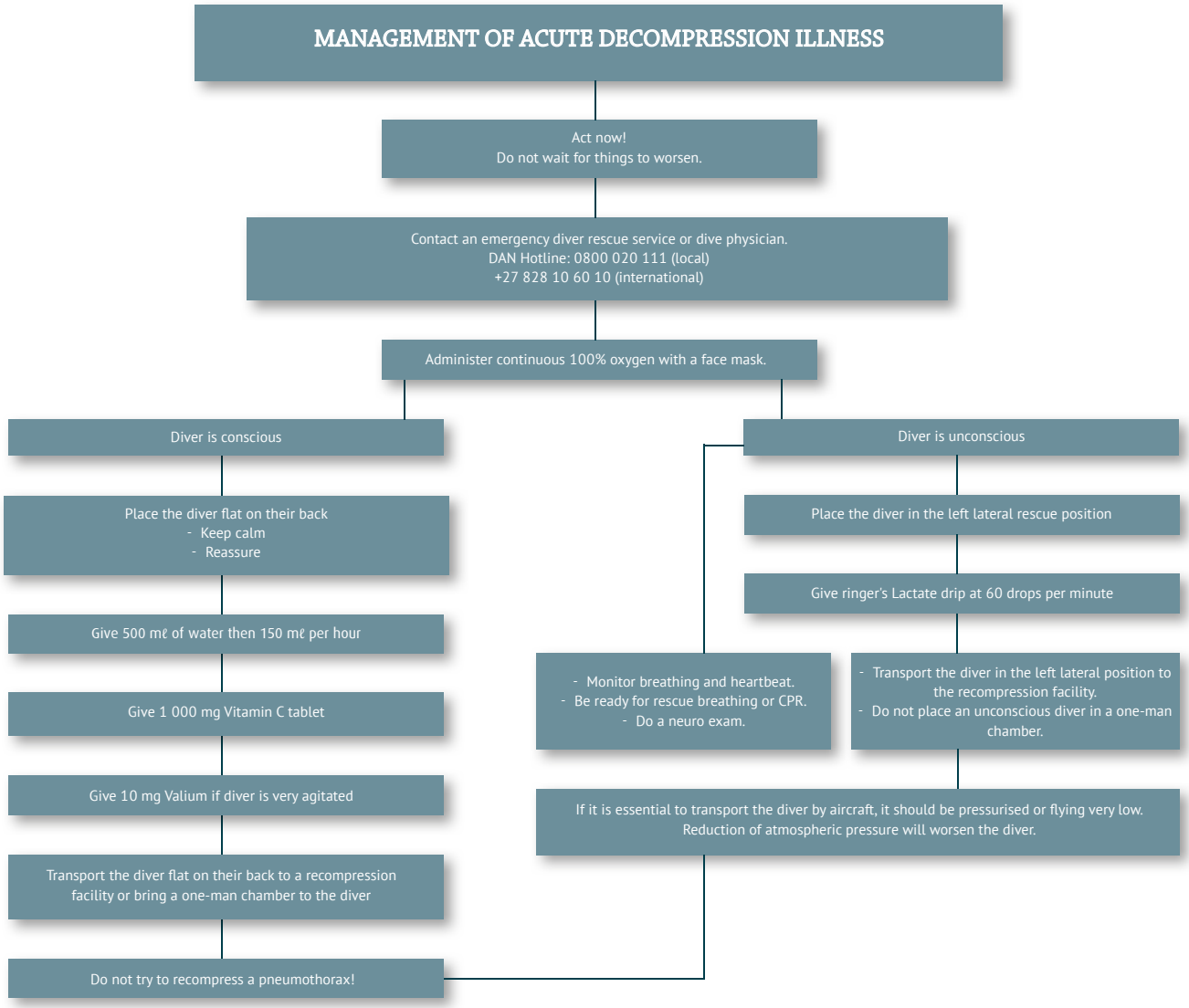
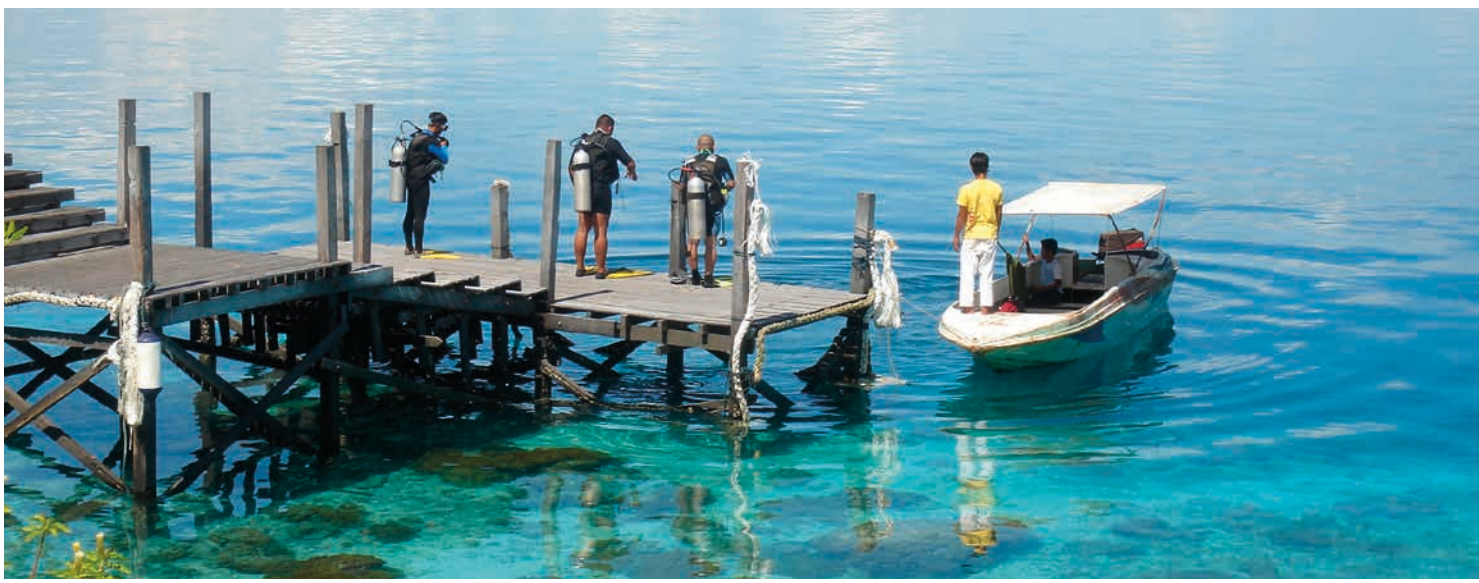


Figure 7: Management of acute decompression illness

For more help, see CPR (p26), Diving Emergency (p8) and Unconscious Diver (p10).



1.10 Paramedic Assistance with Decompression Illness

- Ensure access and safety of site.
- Control airway, breathing, circulation and bleeding.
- Administer 100% oxygen.
- Perform field neurological assessment.
- Establish IV line
  - ~ Ringer's lactate at 60 drops per minute for decompression illness and an arterial gas embolism
  - ~ Request advice from the diving medical officer regarding the possible use of Dextran 40 (Rheomacrodex): 500 mℓ in first half hour, then 1 000 mℓ over an eight-hour period (maximum total dose of 2g/kg body mass)
- Drugs
  - ~ Very limited use in hyperbaric disease
  - ~ The mainstay of treatment is oxygen
  - ~ No sedatives (e.g. Valium) without permission from the diving medical officer
  - ~ No aspirin or anticoagulants (heparin) with spinal or vestibular decompression illness or pulmonary barotrauma as these may precipitate bleeding and worsen the victim's condition
  - ~ No steroids (e.g. Decadron and Dexamethasone) without permission from the dive medical officer as these can worsen acute spinal and cerebral decompression illness
  - ~ Ascorbic acid (Vitamin C) 1 000 mg may be given orally
  - ~ With non-hyperbaric disease, drugs as per emergency medical assistance protocol
- Monitor urine output and insert a urinary catheter if the victim is unconscious or urinary retention is present.




1.11 Recompression Chambers in Southern Africa

DAN CONTACT NUMBERS: (+27) 10 209 8112 or TOLL FREE 0800 020 111

NO	NAME	PHYSICAL ADDRESS	NEAREST CASUALTY
1	Institute for Aviation Medicine	Lionel Slade Street, Lyttelton, Centurion	Unitas
2	Eugene Marais Hyperbaric	Eugene Marais Hospital, Cnr Booysen Street and 5th Avenue, Les Marais, Pretoria	Eugene Marais
3	SAPS Task Force	2 Rebecca Street, Pretoria West, Pretoria	Pretoria West Hospital
4	Portnet, Richard's Bay	Portnet, Small Craft Harbour, Richard's Bay	The Bay Hospital
5	Professional Dive Institute	Ship Repair Jetty No 2, Bayhead, Durban	St Augustine's Hospital
6	East London Hyperbaric	SAS Port Rex Unit, Pontoon Road, East London Harbour	Frere Hospital
7	Mossel Bay Hyperbaric Unit	Pentow Mulgas, Tug Bout, Pentow Marine, Mossel Bay	Bay View Hospital
8	SAS Donkin Port Elizabeth	Naval Base, Port Elizabeth Harbour, Port Elizabeth	Green Acres Hospital
9	SAS Simonsberg Diving School	SA Navy Diving Centre, Westyard, Simonstown	Military Hospital
10	Alexander Bay	Alexander Harbour, Alexander Bay	Alexander Bay Hospital
11	Mombasa	Kenya Navy Base, Mtongwe Mtongwe, Mombasa, Kenya	Kenya Navy Sickbay
12	Réunion	Unite de Soins Hyperbares, CHSR, BP350, 97448, St Pierre, Réunion	Centre Hospitalier Sud Réunion (CHSR) St Pierre
13	Mauritius	Special Mobile Force, Enceinte Militaire Vacoas, Mauritius	Vacoas Hospital
14	Seychelles	Unite de Medicine Hyperbares, Hospital Victoria, BP52, Mont – Fleuri, Mahe	Victoria Hospital
15	Kariba (not operational)		Harare Hospital
16	St Augustine's Hyperbaric Meds	107 Chelmsform, entrance at 4 Cato Road, Durban	St Augustine's Hospital
17	National Hyperbarics	100 Fairfield Medical Suites, Claremont, Cape Town	Claremont Hospital
18	Welwitchia Hospital Hyperbarics	Dr Putch Harries Drive, Hermes, Walvisbay	Welwitchia Hospital
19	Subtech Diving	10 Rotterdam Road, Bayhead, Durban	St Augustine's Hospital

Table 11: Recompression chambers in Southern Africa

1.12 Suspected Lung Injury after Diving

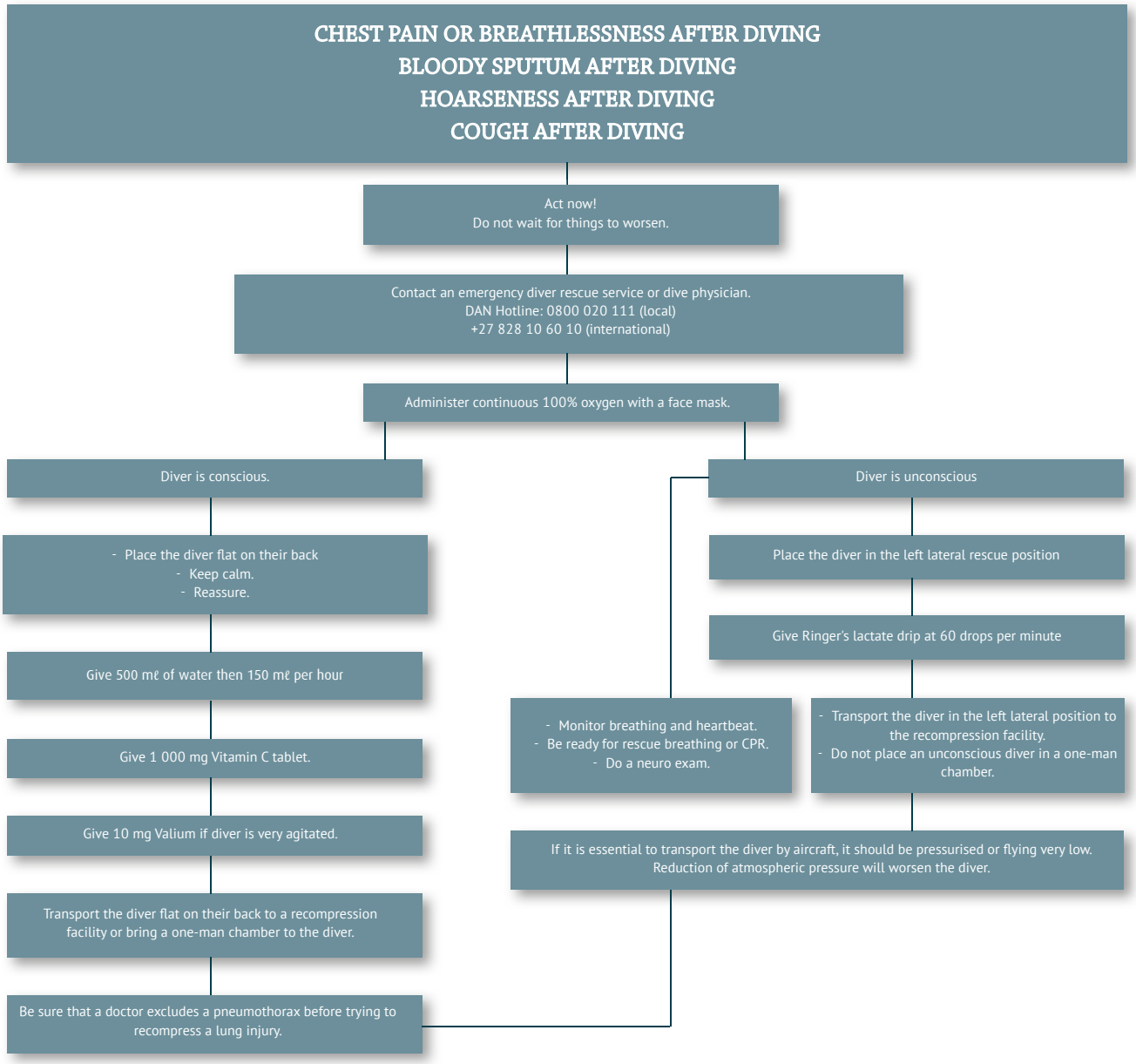


Figure 8: Managing a suspected lung injury after diving

> Emergency underwater oxygen recompression is a procedure for remote areas only.

1.13 Emergency Underwater Oxygen Recompression

NOTE

- This is an emergency procedure for remote areas *only* and is not a replacement for chamber therapy.
- It must only be used for acute pain, limb, joint or skin decompression illness.
- It is not intended for severe decompression illness or an arterial gas embolism.
- Placing an unconscious diver on a demand valve and returning him or her to the water *can never be acceptable or condoned.*
- The technique was developed in Australia by the Royal Australian Navy School of Underwater Medicine as a result of acute decompression illness occurring in areas very remote from a proper recompression facility.

Method

The preparation

- A large oxygen cylinder as used in hospitals is needed.
- This is fitted to a two-stage regulator, the first-stage gauge indicating cylinder pressure and the second stage indicates delivery pressure. This should be set to 550 kPa.
- A 12 m length of clean hosing is attached to the second-stage outlet.
  - ~ The other end of the hose is attached to a non-return valve on a full face mask (e.g. Kirby Morgan or AGA) inlet.
- The diver must be fully dressed and negatively weighted so that there is no difficulty in maintaining depth under water. A tendency to drift upward is contraindicated.
- The attendant will breathe *air* using conventional scuba. Adequate full spare cylinders plus attached demand valves must be available on the shot line.
- A shot line clearly marked in metres and adequately weighted is suspended from a buoy large enough to easily support two divers.
- If the recompression cannot be done in a sheltered, quiet area, the buoy must be tethered close to the boat.
- Hand and foot loops and a seating system must be fitted to the shot line to assist the diver and the attendant.

The recompression

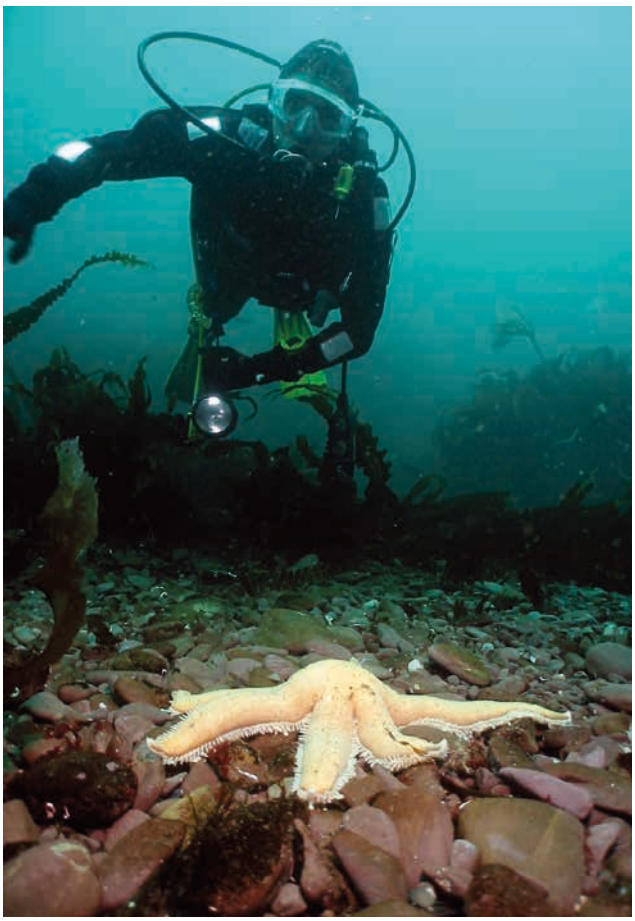
- The diver and the attendant descend to 9 m.
- A timed stay of 30 minutes is done in mild cases, 60 minutes in worse cases and 90 minutes if improvement does not occur.
- Ascent is then commenced at 12 minutes per metre. This is more readily accomplished by spending 11.5 minutes at each metre mark and then ascending over 30 seconds to the next mark.

If necessary, this recompression may be repeated twice daily.

> This technique was developed by the Royal Australian Navy School of Underwater Medicine.

9 METRES OF SEAWATER BOTTOM TIME	ASCENT AT 12 MINUTES/ METRE	TOTAL TIME
30 minutes	96 minutes	126 minutes: 2 hours, 6 minutes
60 minutes	96 minutes	156 minutes: 2 hours, 36 minutes
90 minutes	96 minutes	186 minutes: 3 hours, 6 minutes

Table 12: Emergency underwater oxygen recompression times



1.14 Acute Decompression Illness Report

ACUTE DECOMPRESSION ILLNESS REPORT				
Evolution:		Name:		
Static		Age:	Sex:	Date:
Progressive		Address:		
Improving				
Relapsing		Tel work:	Home:	
MANIFESTATIONS				
Musculoskeletal:				
Neurological:				
Cutaneous:				
Lymphatic:				
Constitutional:				
Other:				
Time to onset:		Gas burden:		
During ascent		No deco stops needed		
On surfacing		Completed deco stops		
After surfacing	mins	Missed deco stops		
Evidence of barotrauma:		Emergency ascent		
		Uncontrolled ascent		
RESPONSE TO TREATMENT				

Table 13: Acute decompression illness report

1.15 Rescue Breathing and CPR

Rescue breathing is required in victims who have stopped breathing but have a heartbeat. CPR is required in victims who have stopped breathing and have no detectable heartbeat. If breathing is absent it should be assisted in the water, while bringing the victim to shore or to the boat. Supporting the head in the water and giving mouth-to-mouth or mouth-to-snorkel resuscitation may make all the difference. *Resuscitation should be continued until a doctor calls off the attempt because of definite death.*

Cardiopulmonary resuscitation

Do not rush blindly into administering CPR. A 20-second initial assessment of the victim is vital. Six essential questions must first be answered.

WARNING
The disease AIDS has made CPR a potentially dangerous procedure for the rescuer. It has become essential that rescuers protect themselves if any bleeding is present by using a non-return airway, gloves, goggles and a plastic apron, unless the victim is known to be HIV-negative.

Assessment

Are the victim and the rescuers in a safe place?	H	HAZARDS?
Is the victim rousable?	H	HELLO?
Is anyone on hand to help?	H	HELP?
Is the airway clear?	A	AIRWAY?
Is the victim breathing?	B	BREATHING?
Can a pulse be felt?	C	CIRCULATION?

Are the victim and the rescuer in a safe place?

Both must be in a safe place – out of the water and on the beach beyond the tidal action of the sea, on the deck of the dive boat or, if inland, out of the way of oncoming traffic or chemical, electrical, thermal or physical hazards.

TIP
The first question to ask before performing CPR is: Are you and the victim in a safe place?

Is the victim rousable?

Assess whether the victim is rousable by gently shaking the victim's shoulders and yelling "Are you OK?". Use your shouting voice – not forceful shaking – to gain attention. Violent shaking may aggravate spinal or internal injuries.

- *If the victim responds* check for injuries, render assistance, summon help if required and then wait with the victim until trained aid comes.
- If the victim does not respond yell for help and immediately clear the victim's airway.

Is anyone on hand to help?

If available, you need two kinds of help:

- Someone to summon emergency trained assistance (see p5-6)
- Someone to assist with the resuscitation of the victim

Is the airway clear?

Quickly partially unzip the victim's wetsuit or loosen any tight neckwear.

- Perform the "head tilt-chin lift" manoeuvre:
  - ~ Place one hand on the victim's forehead and tilt the victim's head well back. This straightens the windpipe and provides a good airway.
  - ~ Use the fingers of your other hand to lift up the front of the victim's jaw. This pulls the tongue forward and prevents it from flopping backwards and blocking the airway.
- *Look inside the mouth.*

Quickly remove any foreign material. Clear away any vomit, blood or water by wiping the mouth from cheek to cheek with a forefinger wrapped in any piece of cloth.

- *Dentures, unless very loose or ill-fitting, must be left in place* – they will support a proper lip seal with mouth-to-mouth resuscitation.
- *In near-drowning there is often copious pink froth welling up from the lungs.* This must continuously be wiped away.

Is the victim breathing?

- While maintaining the Head tilt-chin lift position, use the next five seconds:
  - ~ to listen for breathing next to the victim's mouth and nose
  - ~ to feel for any movement of breath with your cheek
  - ~ to watch the victim's chest for movement
- *If the victim is unconscious and breathing:* Turn the victim as a unit (head and body together to avoid worsening possible neck trauma) into the left lateral recovery position:
  - ~ victim lying on the left side with the left leg extended
  - ~ head resting on the left arm extended in line with the body
  - ~ right knee flexed and resting on the ground in front of the victim
  - ~ right elbow flexed and resting on the ground in front of the victim

This position ensures that the tongue cannot obstruct the airway and allows drainage of vomit, blood and water. Summon emergency help (p5-7) then wait with the victim until professional aid arrives while constantly monitoring satisfactory pulse and breathing.

Can a pulse be felt?

- The carotid arteries are the large arteries in the neck supplying blood to the head. They are easily found by placing the fingertips on the larynx and then moving them round to either side *into the*

TIP
In an emergency, call out your steps to help keep a level head.
A= Airway
B= Breathing
C= Circulation

{Contents}

hollow next to the neck muscles and gently pressing back. A pulse is normally easily felt.

It is essential to spend five to 10 seconds in finding a pulse. A very slow or weak pulse will not be found with a too rapid or cursory feel. Do not:

- try to find a wrist pulse – it is invariably impalpable
- use a thumb to find a carotid pulse – you will feel your own pulse
- press too hard – you will not feel a weakly pulsating artery

If the victim is not breathing but a pulse can be felt, perform mouth-to-mouth rescue breathing immediately.

Mouth-to-mouth rescue breathing

- Ensure that the victim is on a firm, flat surface.
- Roll the victim as a unit on to his or her back.
- Ensure the "head tilt-chin lift" position.
- If available, and especially if the victim is a stranger or it is known the viction is HIV positive, place a disposable non-return airway between the victim's lips, with the thin plastic skirt of the airway covering the victim's face.
- Pinch off the nostrils, using the thumb and forefinger of the head-tilt hand *under* the skirt of the airway. (Do not forget to pinch off the nose. It is pointless to commence blowing through the victim's mouth and venting through the victim's nostrils.)
- Inhale deeply, then place your mouth firmly over the victim's mouth or the non-return airway. Blow slowly and fully into the victim's mouth or the airway. *Take a full two seconds to do this.* Allow the victim to exhale passively while you take another deep breath. Repeat this ventilation 10 times. There should be very little resistance. Watch the victim's chest. It should rise when you blow. Be sure that it is not the victim's stomach that is rising. If this happens, you are filling the stomach with air which will predispose the victim to vomiting. *If the victim's chest does not move, it means obstruction or leakage.* Then:
  - ~ ensure that the head is tilted well back
  - ~ ensure that the jaw is well lifted
  - ~ ensure that the nostrils are pinched closed
  - ~ ensure that the victim's mouth is partially open
  - ~ ensure a good mouth-to-mouth or mouth-to-airway seal
  - ~ if the chest still does not rise when you blow slowly and fully, there is foreign material in the airway. Then:

    With the victim flat on the back, straddle the victim's upper legs. Place the palm of one hand on the back of the other and link your fingers. Place the heel of the lower hand on the victim's abdomen just above the navel and well below the breastbone. Push sharply upwards and inwards.

    Repeat this thrust up to five times. This will force inhaled foreign material from the airway. Clear this away by sweeping your forefinger around the inside of the cheek and behind the material. Listen, feel and watch for breathing. If no breathing is evident, recommence rescue breathing.

If the victim is not breathing and no pulse can be felt summon emergency assistance – CPR and defibrillation are required.

CPR

- Send someone to make the emergency call. If you are alone, make the call yourself before starting CPR. It is essential to ensure that advanced life support is rushing to help you. Quickly telephone your rescue service.
- Tell the rescue service that CPR is about to be performed or is being done. Do not waste time explaining the case. *Say "CPR".*
- Be calm and relay all asked-for information clearly (see p5-6).
- Go back to the victim immediately after the rescue service hangs up.

Remember:

- Ventricular fibrillation is uncommon in true human drowning.
- Ventricular fibrillation is commonly caused by cold water stress in adults and death is then due to cardiac arrest, not drowning.

Commence CPR and continue until professional help arrives.

One-rescuer CPR

In order to maintain proper sequence in extremely emotional and confusing circumstances, it is essential to call out each step.

A = Airway

Call A and perform the head tilt-chin lift manoeuvre.

B = Breathing

Call B and deliver two slow deep breaths to the victim. Watch that the chest movement occurs.

C = Circulation

Call C and place the heel of one hand on the centre of the chest two finger breadths above the lower end of the breastbone. Now place the other hand on top of the first with your fingers off the chest and facing away from you.

- *Keep your elbows straight.*
- *Keep your shoulders directly above the victim's breastbone.*
- *Keep your finger off the victim's chest.* You must press on the breastbone, not on the ribs.

Press *smoothly* downward using the weight of your upper body to push the breastbone down 4-5cm. Do not jerk downwards – you will break ribs and damage internal organs. Release the pressure, allowing the chest wall to spring back, but without losing your hand position on the breastbone.

This process compresses the heart between the front of the chest and the spine, forcing blood from the ventricles. On releasing pressure, the ventricles refill from the venous system. If done properly, a pulse

> It is essential to spend five to 10 seconds in finding a pulse.

will be felt in the neck with each compression.

Repeat this compression 15 times, while loudly reciting, "One and, two and, three and, four and ...". Compress with each number and release with each "and". You will achieve a rate of 80 to 100 compressions per minute.

You have completed one cycle of ABC. This must be repeated in cycles of two breaths then 15 compressions (2:15) until help arrives or the victim breathes or moves. If you are alone, do not waste time trying to find a carotid pulse again – it will break your rhythm and timing.

- Call A and return to the airway.
- Call B and give two slow deep mouth-to-mouth breaths.
- Call C and commence "One and, two and...".

It is hard and desperate work, but persistence is vital. If spontaneous breathing recurs, place the victim in the left lateral position, give 100% oxygen by mask if it is available and stop CPR.

Two-rescuer CPR

If you have someone to assist you, perform the initial assessment:

Are the victim and the rescuers in a safe place?	H	HAZARDS?
Is the victim rousable?	H	HELLO?
Is anyone on hand to help?	H	HELP?
Is the airway clear?	A	AIRWAY?
Is the victim breathing?	B	BREATHING?
Can a pulse be felt?	C	CIRCULATION?

Table 14: The initial assessment

Proceed as described above and determine whether the victim still needs any rescue breathing or CPR. If either is required, one rescuer begins immediately while the second summons emergency help, then returns.

The first rescuer kneels on one side of the victim's head. This rescuer will be in charge of *airway and breathing*. He or she ensures the airway is clear, then ventilates the victim with one deep, slow exhalation.

The second rescuer kneels on the opposite side next to the victim's chest (the two rescuers can then see each other and co-ordinate their actions). This rescuer will be in charge of *circulation*. He or she places his or her hands correctly on the victim's breastbone, waits for the victim's chest to inflate, then performs five smooth compressions at a rate of 80 to 100 compressions per minute while calling, "One and, two and...".

This cycle of one breath to five compressions (1:5) is repeated continuously until a spontaneous pulse and breathing return or emergency help arrives and takes over.

The two rescuers must monitor each other:

- The rescuer in charge of airway and breathing must feel for a pulse in the carotid artery with each chest compression.

WARNING

The rescuer in charge of circulation must wait for two seconds after each fifth compression while the first rescuer administers one rescue breath. If the chest is compressed during the rescue breath, most of the delivered air will not enter the victim's lungs – it will be blown back into the first rescuer's mouth or diverted into the victim's stomach and predispose the victim to vomiting and aspiration.

- The rescuer in charge of circulation must watch that the chest expands with each rescue breath.

Every few minutes, stop CPR for five seconds while a carotid artery is checked by the airway rescuer for the reappearance of a spontaneous pulse. The rescuers can take advantage of this time to change places if the circulation rescuer is tiring. The airway rescuer always restarts CPR by giving a rescue breath – it is pointless to compress the chest five times without an initial charge of new lung air. If a pulse is felt, test for spontaneous breathing too.

If a third person is present and oxygen is available, he or she should hold the oxygen mask against the airway rescuer's face while he or she waits for five chest compressions to be performed. The airway rescuer will then deliver a much higher oxygen partial pressure to the victim with each mouth-to-mouth exhalation.

Always bear in mind that a near-drowned diver may also have substantial decompression requirements, arterial gas embolism or both. In this case, administer CPR until expert help takes over and transports the victim to a recompression facility. Always remember to notify the facility so that qualified help is waiting and the chamber can be prepared in advance (see p22).

Signs of improvement

- The victim's lips become pinker.
- The pupils start to react to light. They become smaller when a torch or other light is shone into them.
- Spontaneous heartbeat starts. Stop chest compressions.
- Spontaneous breathing begins. Stop rescue breathing and give oxygen by mask.

Even when full recovery of a near-drowned person appears to have occurred, in that he or she is breathing, the heart is beating and consciousness has returned, *medical help must be obtained* and the patient admitted to hospital for observation. The secondary effects of inhaling sea water, marine bacteria and diatomaceous and plankton material with near-drowning can cause pneumonia, respiratory collapse and death hours later (secondary drowning).

Basic Life Support

It's as simple as the ABC of CPR.

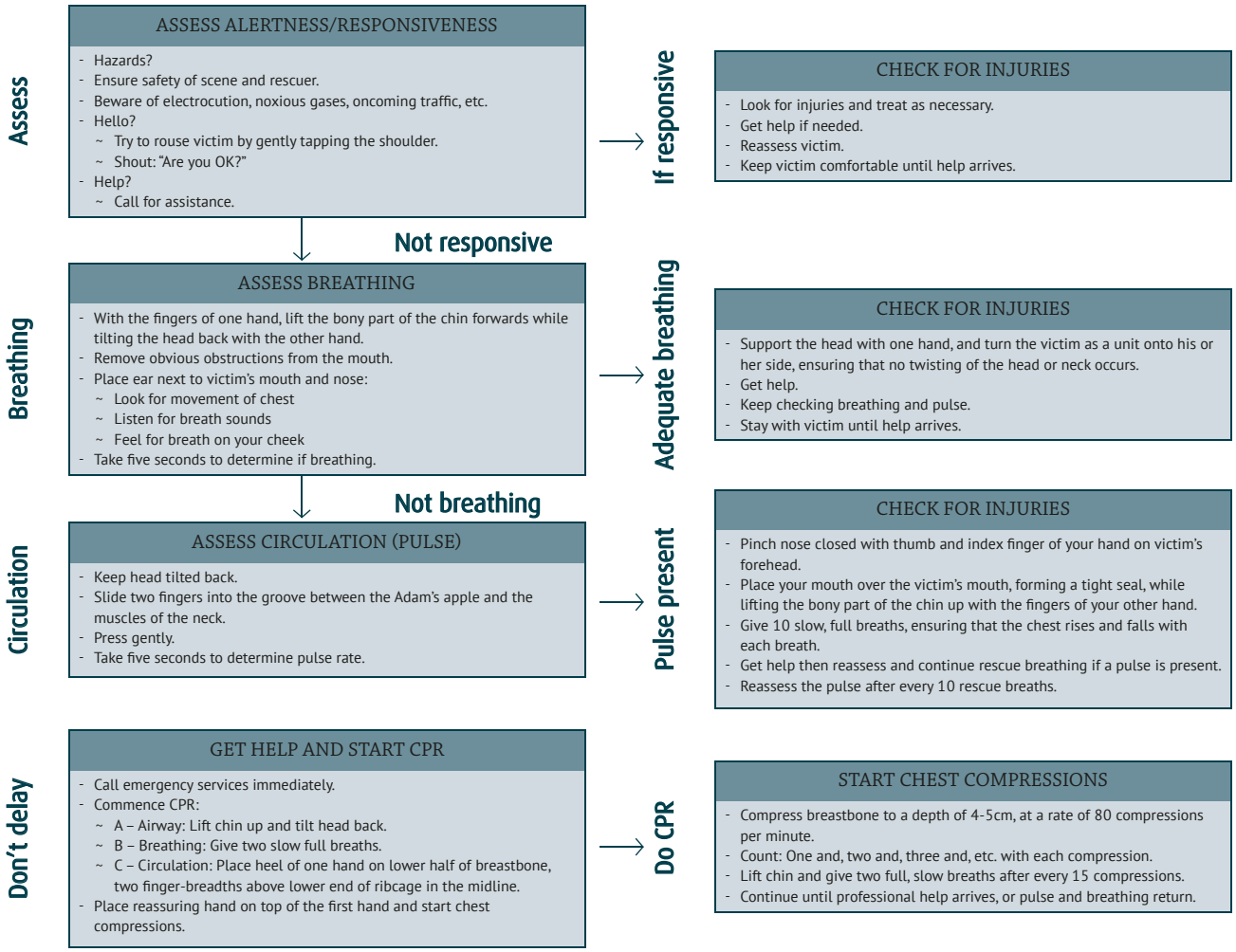


Figure 9: Basic life support

Calling the emergency services:

1. Dial 0800 020 828 10 60 10 (International).
2. Indicate emergency (CPR in progress).
3. Give the exact location (street name and number/cross-street/ landmark, etc.).
4. Replace receiver last (answer all questions).
5. Return to the victim.

Compiled by Dr WGJ Kloeck (Jan 93).

> Call emergency services immediately.

1.16 Flying after Diving

WHEN TO FLY AFTER DIVING			
DAILY EXPOSURE TO DIVING	ACCUMULATED BOTTOM TIME	ANY DECO STOPS IN LAST 48 HOURS	MINIMUM TIME BEFORE FLYING
48 hours or less	Under two hours	No	12 hours
48 hours or less	Under two hours	Yes	24 hours
48 hours or less	Under two hours	No	24 hours
Multi-day	Unlimited	No	24 hours
Multi-day	Unlimited	Yes	24 to 28 hours

Table 15: When to fly after diving

1.17 Hypothermia

The most important message in the management of hypothermia is the understanding that a diver in deep hypothermia may appear to be dead. Never assume a cold diver to be dead.

Only a warm diver is a dead diver.

Management of mild hypothermia

This is rarely a problem.

1. Remove the diver from the cold water.
2. Place the diver flat in a protected place.
3. Cover the diver with a space blanket, normal blankets, sleeping bags, body-to-body contact etc.
4. Encourage the diver to drink warm fluids.

Management of deep hypothermia

Remember two things:

1. *The diver may appear to be dead:*

- There may be no discernible heartbeat.
- There may be no obvious breathing.
- The pupils may be fixed and non-reactive.
- No blood pressure may be measurable.

2. *Do not move or handle the diver too much.*

Grabbing a diver in an emergency situation by the arms and legs, handling the neck roughly, pounding the chest and frantically giving mouth-to-mouth resuscitation can precipitate ventricular fibrillation which will kill the diver.

- Be gentle.
- Transport the diver horizontally with the limbs supported.
- Do not move the limbs unduly or allow them to dangle.
- Check the airway. If obstructed, clear very gently.
- Check breathing. If the diver is breathing, even very shallowly and slowly, *leave the diver's chest alone*.
- Check the heartbeat. If a heartbeat is present, even if very indistinct or slow, *leave the diver's chest alone*. Do not try to improve circulation by thumping the chest.
- If a low-reading clinical thermometer is available, gently check the diver's rectal temperature. If the temperature is above 34°C, the diver is not in a hypothermic coma. Then proceed as per p5-7.
- Cover the diver with blankets, warm water bottles, sleeping bags or body-to-body contact in a sheltered place out of the wind.
- *Rapid rewarming*. Leave the diver in his or her wetsuit if one is being worn. Prepare a hot bath. It should be as hot as possible without causing scalding – i.e. hot enough for the helpers to tolerate without flinching. This is about 43°C. Place the diver in the bath for 20 to 30 minutes. *The limbs should be included in the bath*. Disturb the diver as little as possible. Do not perform CPR in a bath of hot water! Keep the water hot by adding more as required.
- *Monitor the pulse rate continuously*. If the pulse rate starts to accelerate, quickly cool the water down again until the rate settles. Then continue with hot water. If the diver is conscious, keep him or her in the bath until sweating starts.
- After the bath the diver must lie flat in a warm place with a liberal supply of blankets. Encourage warm drinks.

WARNING
Hypothermic divers may appear to be dead. Never assume a cold diver is a dead diver.

1.18 Burns

Sunburn

Predisposing factors

- Retinoids – creams and tablets used in the treatment of acne
- Antibiotics – tetracyclines and sulphonamides.

Prevention

- Ultraviolet barrier creams, but take care not to oil the mask glass – blurring or fogging may occur.
- Skin-sensitising medications should be avoided

Treatment

- Apply moist bandages to sunburnt areas.
- Apply half-strength cortisone cream in a moisturising base, e.g. Betnovate.
- In severe cases with generalised symptoms such as fever, nausea and vomiting, a doctor must be called. Oral cortisone (e.g. Meticorten 5 mg tablets, five daily as a single dose for three days) may be indicated.
- Antihistamines, by mouth or in cream form, do not help sunburns.
- Oral painkillers will afford some relief.

Burns and scalds

Burns are skin damage caused by fire or hot solids. Scalds are damage caused by hot liquids or steam.

TIP
Do not apply sugar, honey, flour, powder, etc. to a burn.

- First degree burns cause:
  - ~ skin reddening and swelling
  - ~ peeling after a few days
- Second degree burns result in:
  - ~ blistering
  - ~ bleeding into the blisters
- Third degree burns cause full-depth destruction of the skin and permanent scarring is inevitable.
- If second degree burns involve more than 9% of the skin, i.e. a whole arm, half a leg, or half of the back or front of the torso, hospitalisation and intensive local intravenous treatment are essential.
- If third degree burns affect more than 2% of the skin area (one-quarter of the above), hospitalisation is essential.

Treatment

- Move the victim to a safe area.
- Drench the burnt area immediately with copious amounts of cold water.
- Continue water cooling for 30 minutes.
- Do not waste time first removing bits of burnt clothing. Hot skin continues to burn until the temperature of the skin and underlying tissues cool down.
- Rinse off loose bits of clothing and dead skin with a very diluted antiseptic solution.
- Do not remove adherent charred skin or clothing.
- Leave blisters alone. Do not de-roof or remove blisters.
- *Do not apply sugar, honey, flour, powder, etc. to a burn.*
- Medical help must be sought if the burn is more than first degree.
- If medical help is unavailable, leave small blisters alone and use a sterile syringe and needle to drain large blisters. Once drained, blisters flatten and form a "biological bandage" over the area.
- Apply synthetic dressings such as OpSite Flexigrid, Granuflex or Omniderm if they are available. They maintain a humid environment under the dressing, allow oxygen and carbon dioxide transfer, are effective bacterial barriers and (being transparent), permit visual examination of the burn. These dressings should be changed every five to seven days.
- If synthetic dressings are unavailable, cover the burnt area with a non-adhesive dressing impregnated with silver sulphadiazine or Furacin cream or apply Vaseline/antibiotic-impregnated gauze such as Sofratulle or Fucidin tulle.
- Cover the dressing with layers of gauze then cotton wool and bind gently in place with a crepe bandage. Change the dressing daily.
- Before changing any dressing, thoroughly soak the area with a diluted antiseptic solution to loosen any sticking of the dressing to the wound.
- Oral painkillers should be given.
- If the wound becomes septic, broad-spectrum antibiotics are needed.

In severe cases and if paramedically trained:

- Set up a Ringer's lactate drip. The volume (in mℓ) required is determined by the following formula: weight (kg) x % burn x 4. Half must be given in the first eight hours and the rest in the next 16 hours.
- The victim must be catheterised. Urine output must be 30 to 50 mℓ/hour (1 mℓ/kg/hour in children). Fluid administration should be increased if required.
- Give intravenous morphine 0.1 mg/kg as a single dose, then titrate as required.
- Use mask oxygen if flame or smoke inhalation has occurred.
- Transfer urgently to a hospital.

> Antihistamines, by mouth or in cream form, do not help sunburn.

1.19 Diving Accident Report Form

DIVING ACCIDENT REPORT FORM						Pg1
PERSONAL INFORMATION						
Name of victim:						
Address:						
Work tel:	Home tel:					
Date of birth:	Sex:			Age:		
Illnesses, injuries or operations in the past five years:						
Health problems in the past three months:						
SMOKING						
No. per day:	Years smoking:					
Previous smoking history:						
WOMEN ONLY						
At the time of diving incident:						
Menstruating:	Pregnant:			Using oral contraceptives:		
DIVING EXPERIENCE						
Type of diving qualification:	NAUI:	PADI:	CMAS:	SSI:	SAUU:	Other:
Date of latest qualification:	Certification no:					
School at which trained:	Tel:					
Highest certification level:						
Speciality qualifications (e.g. ice, cave, wreck):						
Other:						
Total number of dives logged:						
Date of most recent diving medical:						
Name and address of that diving physician:						
TYPE OF DIVE						
Sea water:	Fresh water:	Surf entry:				
Boat:	Altitude:	Cave:				
Night:	Wreck:	Kelp:				
Ice:	Deep:	No decompression:				
Decompression:	Other:	Water temperature:				
Was the diver experienced in this type of dive:						
Solo dive:	Buddy system:	Trio diving:				
Names of divers in group and contact telephone numbers:						
Hazards:	Entanglement:	Entrapment:	Live boating:			
TYPE OF DIVING INCIDENTS						
Decompression illness:	Pulmonary barotrauma:					
Arterial gas embolism:	Squeeze:					
Boating:	Drowning:					
Near-drowning:	Marine bite or sting:					
Other:						
TIME AND PLACE						
Date of diving incident:	Time of incident:					
Location:						
Time of first obtaining help:						
Time when definitive treatment was begun:						

Table 16: Diving Accident Report Form

DIVING ACCIDENT REPORT FORM				Pg2
DETAILS OF CONTACTS HELPING AFTER THE INCIDENT				
Sea rescue:			Hospital:	
Physician:			Diver rescue service:	
Police:			Ambulance services:	
Dive leader or instructor:				
Other:				
DETAILS OF THE DIVING INCIDENT				
• Previous dives on the diving trip: Number of consecutive days of diving:				
Dive profiles of previous dives:				
Date and time	Depth	Bottom time	Ascent time	Decompression (depth/min)
Dive on which the incident occurred:				
Dive leader's name and address or contact telephone number:				
Time dive began:			Time of surfacing:	
Max depth:		Time at bottom:	Ascent time:	
First dive of the day: (Y/N):			Repetitive dive (how many):	
Any decompression obligations? (Y/N):			Stops actually done:	
Decompression stops missed:				
Required decompression stops (depth/mins):				
Dive completed:			Dive aborted:	
Safety stops performed: (Y/N):				
Altitude obligations: (Y/N):			Altitude correction used:	
Surface interval before the dive:				
Residual nitrogen time at start of dive:				
Ascent (state rate in metres/min where applicable):				
Normal:		Fast:	Assisted by buddy:	
Uncontrolled buoyant:			Emergency:	
Narcosis:	Vertigo:	Coughing:	Vomiting:	
Sneezing:		Skip breathing:	Buddy breathing:	
Octopus rig breathing:			Out of air:	
Other problem:				
DIVE PLAN:				
Computer (state make of computer):				
Table (state table and schedule used):				
ADDITIONAL FACTORS:				
Flying: between dives (Y/N):			After dive: (Y/N):	
If yes, how long after?			Aircraft pressurised? (Y/N):	
Alcohol: None:		Night before dive:	Pre-dive:	
		During dive:	Post-dive:	
Drugs or medicines used before the dive:				
Exercise:	Pre-dive	During dive	Post-dive	
Pre-dive fatigue or hangover:				
Hot bath or shower post-dive:				
Other symptoms before diving:				

DIVING ACCIDENT REPORT FORM				Pg3
EQUIPMENT USED				
Suit: Wet	Thickness	Dry	Other	
Cylinder size:				
Date of last visual inspection of cylinder:				
Date of last hydraulic testing of cylinder:				
Cylinder air pressure:	Pre-dive:		Post-dive:	
Cylinder contents gauge:			Depth gauge	
Compressor operator's name:				
Boat skipper's name:				
Boat skipper's ticket number:				
Weight belt:	Mass:	Own:	Borrowed:	Dumped:
Dive watch:	Own used	Buddy's used	None	
Buoyancy vest:	ABLJ	BC	None	
Buoyancy inflation: CO	cartridge	power	oral	
Second stage regulator:		Octopus rig:		
Ropes, lines and tools used:				
Dive knife	Dive torch		Cyalumes	
Equipment failure?				
Pre-dive equipment and signals check performed: (Y/N):				
Pre-dive buoyancy check performed (especially with borrowed weight belt)? (Y/N):				
Any equipment fault found with pre-dive check? (Y/N):				
Comment on any equipment fault found:				
SYMPTOMS AND SIGNS EXPERIENCED AT THE DIVE INCIDENT				
Before diving:	On descent:		At bottom:	
On ascent:			Immediately after surfacing:	
Later after surfacing (state hours / minutes):				
Tick below next to corresponding feature:				
Confusion	Headache		Rash	
Disorientation	Undue fatigue		Swelling	
Dizziness	Numbness		Itching	
Unconscious	Pins and needles		Chest pain	
Convulsions	Weakness		Abdomen pain	
Blurred vision	Difficulty standing		Arm pain R/L	
Double vision	Difficulty walking		Leg pain R/L	
Tunnel vision	Paralysis		Nausea	
Blindness	Speech problem		Vomiting	
Ringing in ears	Hoarseness		Coughing	
Deafness	Skin mottling		Coughing blood	
Ear pain	Squeeze		Breathless	
Bleeding	Minor	Moderate	Major	Site
Fractures				
Wounds				
Death	At bottom	On surface	Later	
Comments:				
FIRST AID GIVEN				
Mouth-to-mouth		CPR	Oxygen	
Oral fluids		IV Fluids	Drugs	
Position	Lying flat	Head down	Sitting	
Other first aid treatment:				

DIVING ACCIDENT REPORT FORM

Pg4

DEFINITIVE TREATMENT

Recompression therapy (Y/N):			
Site of chamber			
Type of chamber:	One man	Two man	Multi-place
Date recompression commenced:		Time commenced	
Delay between incident and recompression (days/hours):			
Therapeutic tables used:			
Chamber operator's name:			
Diving physician in charge of recompression:			
Results of recompression therapy:	Complete relief	Partial relief	No relief
Recurrence of symptoms after recompression: (Y/N):			
Repeat recompression therapy needed:(Y/N):			
Residual problems or defects after treatment (describe):			
Final result of therapy:	Full recovery	Partial	
Permanent disability		Death	
Other therapy			
Attending doctor's name(s):			
Hospital admission:			
Treatment received:			
Results of treatment:			
Comments:			
Dated at	this	day of	20
Name:			
Address/Tel no:			
Signature:			

DIVING EMERGENCIES

1.20 DAN Oxygen Provider Flow Chart

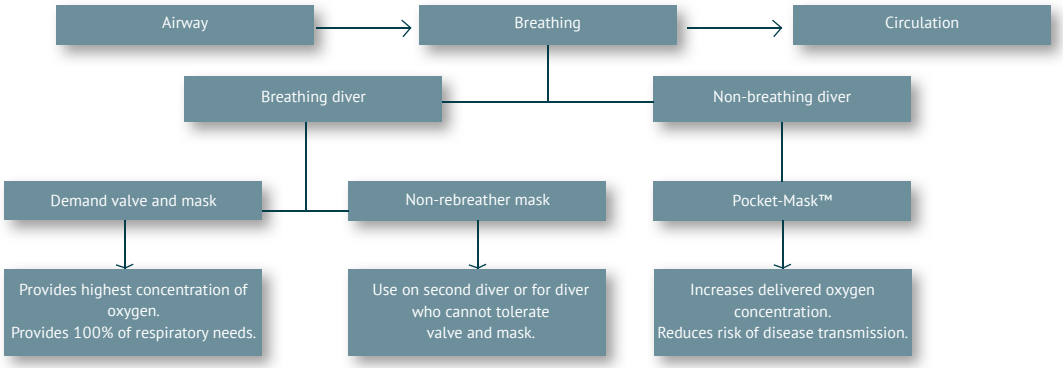
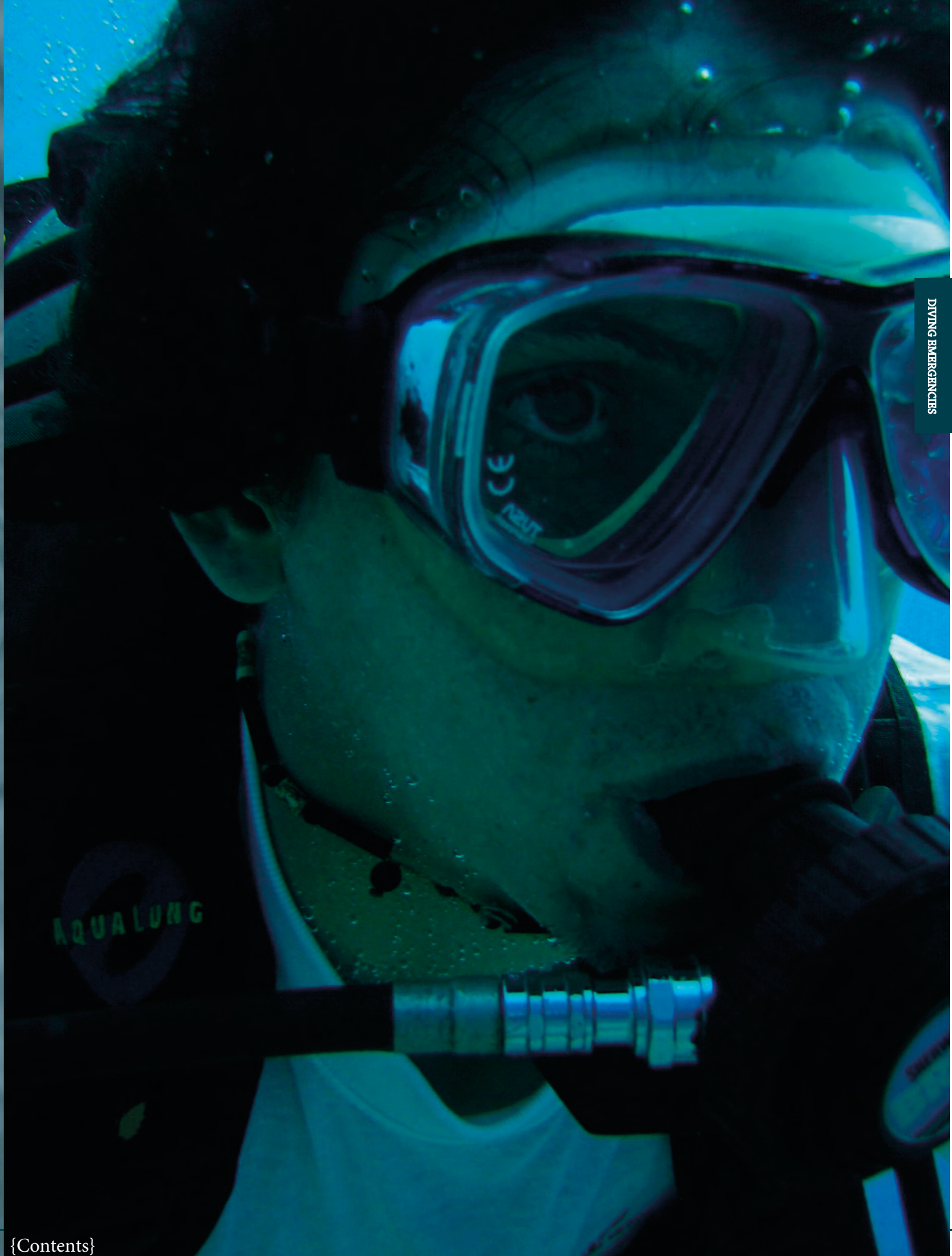


Figure 10: DAN oxygen provider flow chart

> A demand valve and mask provide the highest concentration of oxygen.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2.1 Ear Problems

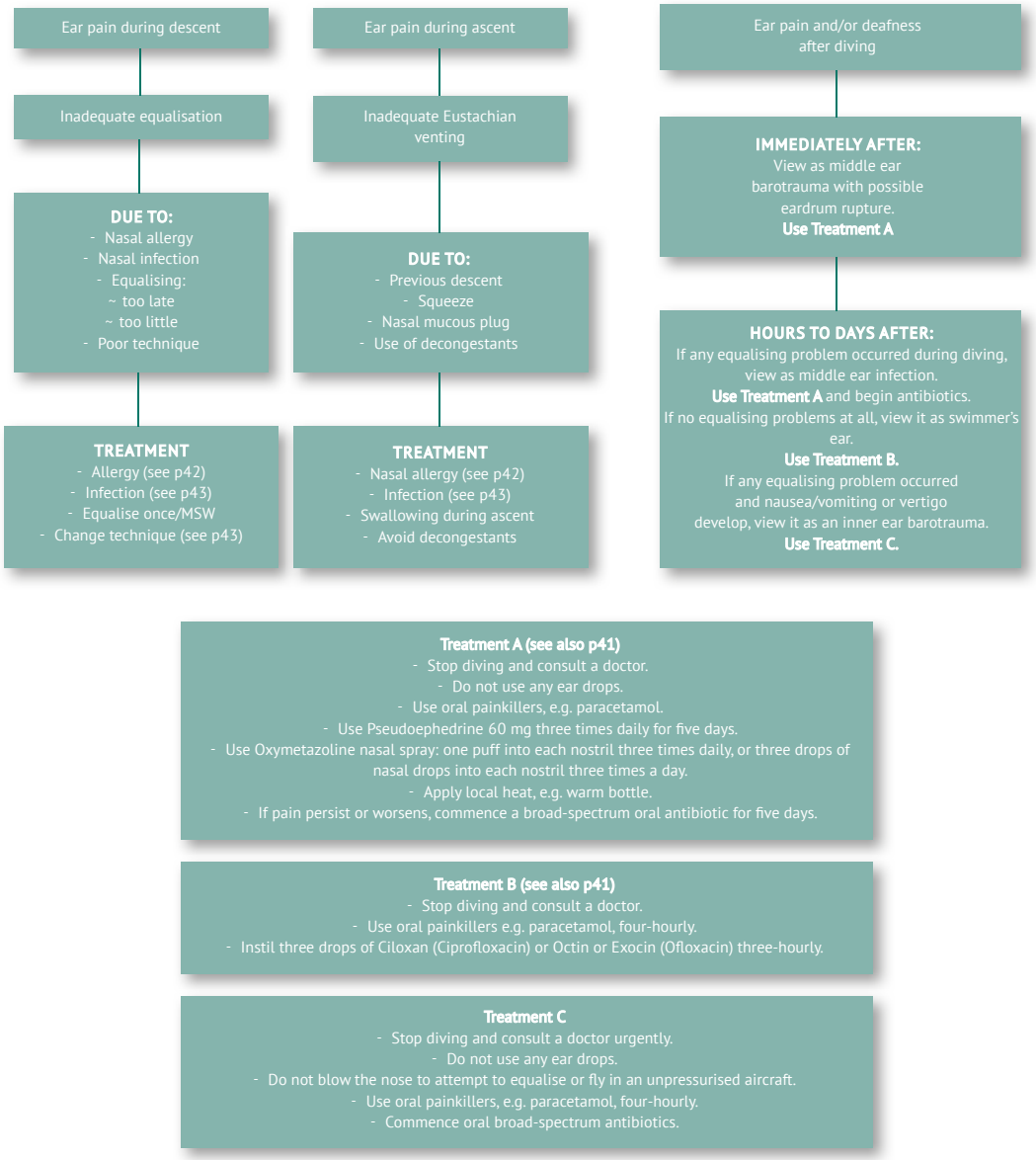


Figure 11: How to manage ear problems

> Earache and sometimes deafness within 24 to 48 hours of diving and often without any history of equalising difficulties.

2.2 Swimmer's Ear (Otitis Externa)

Causes

Bacterial infection of the canal between the external ear and the eardrum due to:

- Wax removal
- Damage to the lining of the canal by foreign bodies (including cotton buds)

Presentation

Earache and sometimes deafness within 24 to 48 hours of diving *and often without any history of equalising difficulties.*

Prevention

- Do not attempt to remove wax by using cotton buds or other foreign objects.
- Keep a plastic bottle of 3% saline in your dive bag. Using a clean dropper, rinse the ears with the solution to remove debris and organic contaminants after diving.
- Instil three drops of 5% glacial acetic acid in propylene glycol into one ear after diving. Wait five seconds, then allow the drops to drain from the ear. Repeat with the other ear.

Treatment

- Stop diving for one week.
  ~ Consult a doctor.

WARNING!
If failure to equalise occurred before the onset of earache, do not proceed with the following treatment. *Permanent deafness may result from a ruptured eardrum.* Proceed with the management of middle ear barotrauma as described below.

  ~ If the diver is in a remote area and there is no history of any equalising difficulty causing possible rupture of the eardrum, instil three drops of Ciloxan (Ciprofloxacin) or Octin or Exocin (Ofloxacin) drops three-hourly for a week.
  ~ If earache is severe, use benzocaine ear drops. The drops should be warmed by immersing the closed bottle in warm water, taking care not to allow any water into the bottle. Instil five to 10 drops two-hourly and plug the ear with cotton wool.
- If the condition remains unresponsive to treatment, medical attention is necessary.

2.3 Middle Ear Infection (Otitis Media)

Causes

Bacterial infection of the middle ear:

- via the Eustachian tubes by equalising with a nasal infection
- via a perforated eardrum

Presentation

Throbbing earache hours to one day after diving.

Prevention

- Do not dive with an upper respiratory infection.
- The use of decongestants is not wise. They assist in driving nasal bacteria into the middle ear. If they wear off during the dive, reverse block on ascent may occur.

Treatment

- Stop diving.
- Consult a doctor.
- Use broad-spectrum antibiotics, e.g. Suprapen, Augmentin or Cefadrox.
- Use oral painkillers.
- Ear drops will not help.

2.4 Middle Ear Pressure Injury (Barotrauma)

Cause

Failure to equalise air pressure in the middle ear during descent, resulting in any combination of middle ear swelling, bleeding and/or perforation.

Presentation

- Nasal congestion before diving
- Equalising difficulty during descent
- Acute ear pain during descent
- Sudden noise or squealing sound in the ear
- Vertigo due to eardrum perforation during diving
- Deaf feeling after surfacing
- Bleeding from the nose or ear

Prevention

- Stopping smoking often cures equalising problems.
- Surgical straightening of the septum restores normal air flow.
- Treating nasal allergy

Treatment

- Mild squeeze relieved by ascent and successful equalising should be allowed eight hours before diving again.
- Severe squeeze with bleeding from the nose and/or a blocked feeling in the ear should bar diving for two to four weeks and medical opinion must be sought to exclude a perforation.
- Use pseudoephedrine 60 mg three times a day for five days.
- Use two puffs of oxymetazoline nasal spray in each nostril three times a day for five days maximum.

NOTE

Ear drops are of no use whatsoever either in preventing middle ear squeeze or after experiencing equalising difficulties during a dive. The problem is not in the outer ear canal – it is behind the eardrum in the middle ear and Eustachian tube. Ear drops can cause permanent deafness, if an eardrum perforation is present. A perforated eardrum takes an average of two to four weeks to heal and this must be confirmed by a doctor.

2.5 Dental Barotrauma

Prevention

- Divers must take care of their teeth. All fillings must be firm and healthy.
- Inform your dentist that you scuba dive. He or she will then pay particular attention to potential trouble.

Treatment

This is directed at pain relief before seeing a dentist.

- Oral painkillers should be used.
- If pain is very severe, pressing a small wad of cotton wool soaked with alcohol on the tooth may help. You can use whiskey or other spirits.
- Oil of cloves is also useful. Grip a small wad of cotton wool soaked in the oil between the jaws at the site of the affected tooth.
- If available, lignocaine spray (two sprays every three hours) onto the tooth will provide some relief.

2.6 Nasal Allergy

The following management is useful, provided it is approved by a doctor to ensure no contraindications in a particular diver. If possible, it should be begun one month before diving and is recommended for adults only.

- Douche both nostrils with a mixture of half a teaspoon of salt and half a teaspoon of bicarbonate of soda dissolved in 300 mℓ of warm water three times a day and just before bed. Douching washes away sticky mucus, clears the nose of particles of pollen, dust, etc., and provides better exposure of the membranes to nasal medication. Douche the nose just before using a nasal spray.
- Inhale steam through the nose from a bowl of hot (not boiling) water medicated with menthol and eucalyptus three times a day.
- Use two sprays of fluticasone in each nostril once a day, two sprays of budesonide in each nostril twice a day or two sprays of flunisolide in each nostril twice a day.
- Take one 10 mg tablet of loratidine, cetirizine or astemizole once a day as a single evening dose.
- One week before the trip add pseudoephedrine (available in tablet combination with the above or as separate tablets) in two to three divided doses. The total dose per day should be 180 mg to 240 mg.
- Stop *all* tablets the day before diving begins.
- Continue regular nasal steaming, douching and steroid sprays during the holiday.

> Divers must take care of their teeth. All fillings must be firm and healthy.

2.7 Nasal Infection

Cause
Viral (e.g. common cold) or bacterial infection of the lining membrane of the nose.

Presentation
- Nasal stuffiness, streaming, stinging or redness
- Clear, yellow or green mucus in the nose

Treatment
- Do not dive with a cold or nasal infection.
- For a cold:
  - ~ Use pseudoephedrine 60 mg three times a day for five days.
  - ~ Use two puffs of oxymetazoline nasal spray in each nostril twice a day for five days maximum.
  - ~ Use two tablets of paracetamol four-hourly for pain relief.
  - ~ Take 1 000 mg of vitamin C daily.
  - ~ Drink lots of fluids.
- For a bacterial infection:
  - ~ Apply mupirocin (Bactroban) ointment into the nostrils twice a day or neomycin and chlorhexidine cream (Naseptin) into the nostrils two to four times a day.

2.8 Equalise the Ears

Rules for equalising
DO
- Equalise immediately after you submerge.
- Equalise at least once per metre.
- Descend feet first to bottom depth.
- Halt the descent and ascend 2 m immediately if any ear pressure is felt. *Do not wait for ear pain – damage has then already occurred!*

DON'T
- Forget about your ears while fiddling with buoyancy and gauges.
- Wait for ear pressure, let alone pain, before equalising – at a depth of only 2 MSW you are already much too deep.
- Dive with congestion due to allergy, irritation or infection.
- Continue to dive if equalising difficulty has caused any deafness, bleeding or vertigo. See a doctor first – further diving will be more and more difficult and will only cause more damage.
- Descend horizontally or, even worse, head-down until you are sure your new equalising technique works well and reliably for you. It is much more difficult to equalise when inverted.

Techniques
Beance Tubaire Voluntaire
A few divers can voluntarily wiggle the Eustachian cushions by moving the jaws from side to side or forwards and backwards to equalise. This method is a knack and not teachable.

Valsalva manoeuvre
This is the most commonly used method.
- Clamp off the nostrils with the index finger and thumb of one hand.
- Press the tongue firmly against the roof of the mouth.
- Attempt to blow the nose.

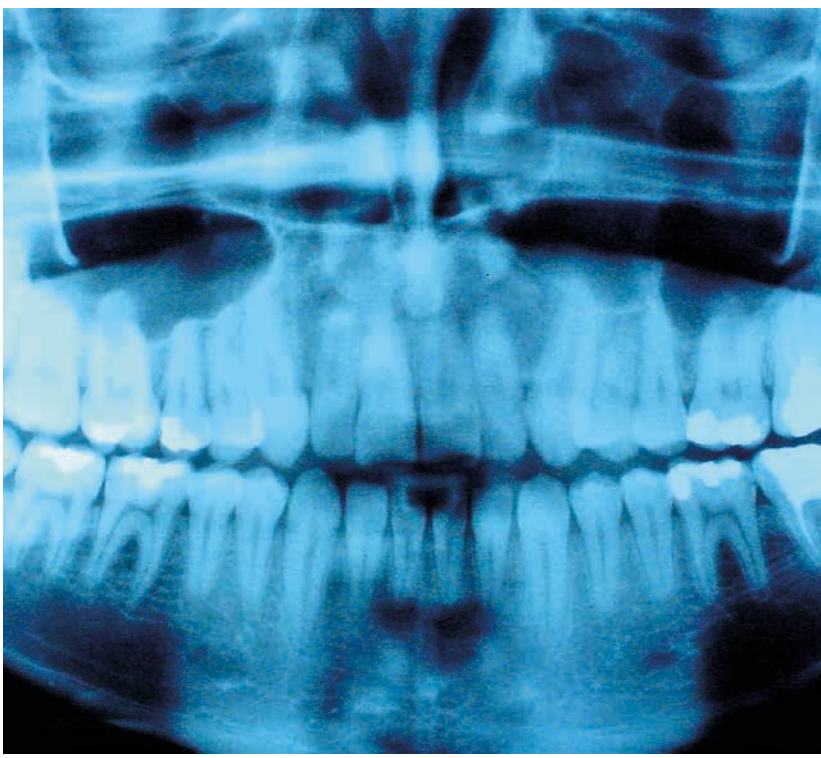
Toynbee manoeuvre
This is the second most commonly used method.
- Clamp off the nostrils with the index finger and thumb of one hand.
- Swallow.

Frenzel manoeuvre
- Clamp off the nostrils with the index finger and thumb of one hand.
- Press the tip of the tongue hard against the lower front teeth.
- Say "hick" from the back of the throat and simultaneously try to blow the nose.

Lowry technique
This technique often works where all others have failed.
- Clamp off the nostrils with the index finger and thumb of one hand.
- Press the tongue firmly against the roof of the mouth.
- Blow and swallow simultaneously.

Edmonds technique
- Thrust the lower jaw forward.
- Perform a Valsalva or Frenzel manoeuvre.

TIP
The Lowry technique often works where all others have failed.



2.9 Nose Bleeds (Epistaxis)

- Sit erect with the head tilted *forward* onto the chest.
- Compress the nostrils between two fingers for 10 minutes.
- If bleeding persists, plug the nose with oxycellulose nasal plugs, a nasal gauze or moistened cotton wool drawn into a plug.
- Feed the plug straight back *parallel* to the roof of the mouth.
- Try to ensure that the nostril is packed as firmly as possible.
- Continue nasal compression between two fingers.
- Keep the nose plugged for 12 hours.
- Remove the plug slowly and gently to avoid causing sneezing which may restart the bleeding.
- Do not blow the nose!
- If bleeding persists or recurs, consult a doctor.

2.10 Sinus Allergy

The following management is useful, provided it is approved by a doctor to ensure no contraindications in a particular diver. If possible, it should be begun one month before diving and is recommended only for adults.

- Douche both nostrils with a mixture of half a teaspoon of salt and half a teaspoon of bicarbonate of soda dissolved in 300 mℓ of warm water three times a day and just before bed. Douching washes away sticky mucus, clears the nose of particles of pollen, dust, etc., and provides better exposure of the membranes to nasal medication. Douche the nose just before using a nasal spray.
- Inhale steam through the nose from a bowl of hot (not boiling) water medicated with menthol and eucalyptus three times a day.
- Use two sprays of fluticasone in each nostril once a day, or two sprays of budesonide in each nostril twice a day, or two sprays of flunisolide in each nostril twice a day.
- Take one 10 mg tablet of loratidine, cetirizine or astemizole once a day as a single evening dose.
- One week before the trip, add pseudoephedrine (available in tablet combination with the above or as separate tablets) in two to three divided doses. The total dose per day should be 180 mg to 240 mg.
- Stop all tablets the day before diving begins.
- Continue regular nasal steaming, douching and steroid sprays during the holiday.

2.11 Sinusitis

Cause

Bacterial infection of the nasal sinuses, commonly following a nasal and sinus allergy.

Presentation

- Acute pain over the cheekbones, above or behind the eyes, or referred to the back of the head
- Nasal allergy or congestion
- Discoloured mucous discharge from the nose or as a post-nasal drip

Prevention

Adequate management of nasal and sinus allergy.

Treatment

- Stop diving.
- Douche both nostrils with a mixture of half a teaspoon of salt and half a teaspoon of bicarbonate of soda dissolved in 300 mℓ of warm water three times a day and just before bed. Douching washes away sticky mucus, clears the nose of particles of pollen, dust, etc., and provides better exposure of the membranes to nasal medication. Douche the nose just before using a nasal spray.
- Inhale steam through the nose from a bowl of hot (not boiling) water medicated with menthol and eucalyptus three times a day.
- Use pseudoephedrine 60 mg three times a day for five days.
- Use two puffs of oxymetaxoline nasal spray in each nostril twice a day for five days maximum.
- Use two tablets of paracetamol four-hourly for pain relief.
- Drink lots of fluids.
- If medical help is unavailable, use a broad spectrum antibiotic, e.g. Suprapen, Augmentin or Cefadrox.

TIP

Douching washes away sticky mucus, clears the nose of particles of pollen, dust, etc., and provides better exposure of the membranes to nasal medication.

> If bleeding persists or recurs, consult a doctor.

3.1 Vertigo in Divers

Vertigo is a hallucination of directional movement – to the left or right, upwards, downwards, or round and round. It can render a diver totally incapable of any safe, or even life-saving, reaction.

CAUSES IN DIVERS	MANAGEMENT
SEASICKNESS	See p 49
COLD WATER (CALORIC VERTIGO)	
- A partial obstruction of one ear canal while descending in the 30° head-down position. It may be due to: ~ a wax plug ~ a foreign body or ear plug ~ the bony canal thickening ~ swimmer's ear ~ a tight hood - Perforated eardrum due to failure to equalise on descent. Cold water suddenly enters the middle ear. - Unequal sensitivity of the ears to cold water. Vertigo suddenly occurs five to 10 minutes into the dive without any equalising problem.	Assume the vertical position underwater. Have excess wax removed. Ensure clear canals. May require surgery. Treat as per p41. Perforate hood at ears. Vertigo passes quickly as water in middle ear warms. Ascend. Stop diving until eardrum is confirmed to be healed. It is usually prevented by wearing a hood.
BAROTRAUMA	
- Total obstruction of one ear canal. It may be due to: ~ a wax plug ~ a foreign body or ear plug ~ the bony canal thickening ~ swimmer's ear ~ a tight hood - Failure to equalise causing uneven pressures in the middle/inner ears - Damage to the inner ear by a very forceful equalising attempt - Unequal venting of the Eustachian tubes during ascent (alternobaric vertigo)	Have excess wax removed. Ensure clear canals. May require surgery. Treat as per p41. Perforate hood at ears. Ensure adequate equalising technique (p43). Treat nasal congestion (p42). Stop diving. Contact a doctor urgently. Halt ascent until vertigo passes. Ascend very slowly.
DISORIENTATION	
- Poor or zero visibility - Anxiety/hyperventilation	Orientate on direction of bubbles, dangling gear or shotline. Discuss with instructor.
INHALED GAS PROBLEMS	
- Nitrogen narcosis - Hypoxia - Oxygen toxicity - Carbon dioxide toxicity - Carbon monoxide toxicity	Signal for help. Begin an assisted ascent. Check that air supply or gas mix is correct and pure
INNER EAR DECOMPRESSION ILLNESS	
- Very rare among sport divers. - Occurs more commonly with mixed gas diving on changing breathing mixtures with ascent.	Requires recompression therapy.

Table 17: How to manage vertigo in divers

A maximum depth of 30 MSW must not be exceeded if any anti-seasickness medication is used.

3.2 Seasickness

Cause

Seasickness is caused by disruption of orienting sensory information to the brain. It has been suggested that it may be a variant of temporal lobe epilepsy.

Predisposing factors

- Alcohol
- Overeating
- Age – youth
- Females – probably due to less boat exposure
- Sensory confusion of inner ear sensors
- Psychological factors

Prevention

- Eat lightly and do not drink alcohol the night before diving.
- Ensure that all your equipment is placed in a logical and orderly fashion next to you on the dive boat.
- Concentrate on factors that will assist the brain in orientating acceptably. The eyes and body should actively fix on steady bearings.
  - ~ Keep the head upright and steady.
  - ~ Stare at the horizon.
  - ~ Do not look down at the deck or water.
  - ~ Do not try to read. This removes eye reference and makes things worse.
- Anti-seasickness drugs act by preventing seasickness rather than treating it, so it is logical that they be taken before seasickness starts.

A maximum depth of 30 MSW must not be exceeded if any anti-seasickness medication is used.

ANTI-SEASICKNESS DRUG	DOSAGE	NOTES
Hyoscine (Scopalamine) Scopaderm TTS	0.3 to 0.6 mg by mouth	May lead to: - blurred vision - dry mouth - drowsiness *Do not combine with any other medication.*
Dramamine	50 mg six-hourly	No prescription required.
Valoid	50 mg four-hourly	No prescription required.
Maxolon	10 mg six-hourly	Prescription required.
Stugeron together with motilium	25 mg six-hourly and 10 mg six-hourly	Prescription required.
Epanutin (phenytoin sodium)	5 mg per kg body mass taken as a single dose each night before diving or as a twice daily divided dose (am and pm)	Prescription required.

Table 18: Anti-seasickness drugs and dosages

> Vertigo is a hallucination of directional movement.

NOTE

Epanutin is not officially registered as an anti-seasickness preparation. In this author's experience, it is the most effective anti-seasickness preparation, but its use must be discussed with a doctor as there are significant potential dangers and contraindications in certain people.

4.1 Oxygen Deficiency (Hypoxia)

Cause

Failure of oxygen supply to tissues.

SITE OF BREAKDOWN	CAUSES
Gas supply	- Breathhold diving - Exhaustion of air supply - Wrong mix, e.g. 2% oxygen instead of 20% - Equipment failure, e.g. faulty regulator - Too low flow rate in a rebreather
Airway (mouth, larynx, trachea, bronchi, bronchioles)	- Inhaled dentures - Laryngospasm - Inhaled foreign material, e.g. vomiting under water
Alveoli	- Water in alveoli: drowning - Collapsed alveoli, e.g. pneumothorax
Lung capillaries	- Obstruction with bubbles: "chokes" - Compressed capillaries due to pulmonary barotrauma
Arterial blood	- Failure of circulation of blood, e.g. arterial gas embolism, shock, heart failure or hypothermia - Failure of oxygen carriage, e.g. carbon monoxide - Failure of enough blood, e.g. haemorrhage
Tissue capillaries	- Failure of capillary circulation, e.g. inert gas bubbles or arterial gas embolism in vessels
Tissues	- Poisoning of oxygen uptake, e.g. carbon monoxide

Table 19: Causes of oxygen deficiency

Presentation of hypoxia

- The brain is affected first! With severe hypoxia, sudden unconsciousness occurs, e.g. ascent after breath hold diving. With lesser hypoxia, confusion, headache, fatigue, apathy, overconfidence, blurred vision, slurred speech, vertigo, stupor, etc. may occur.
- The diver becomes blue.

Treatment under water

- Stop swimming and relax (less oxygen use).
- Signal to the buddy that something is wrong (unconsciousness may occur at any moment).
- Begin the ascent.
- At the surface, hyperventilate atmospheric air.
- If a diver sees an unconscious buddy, perform a deep diver rescue.

> With severe hypoxia, sudden unconsciousness occurs

Treatment at the Surface

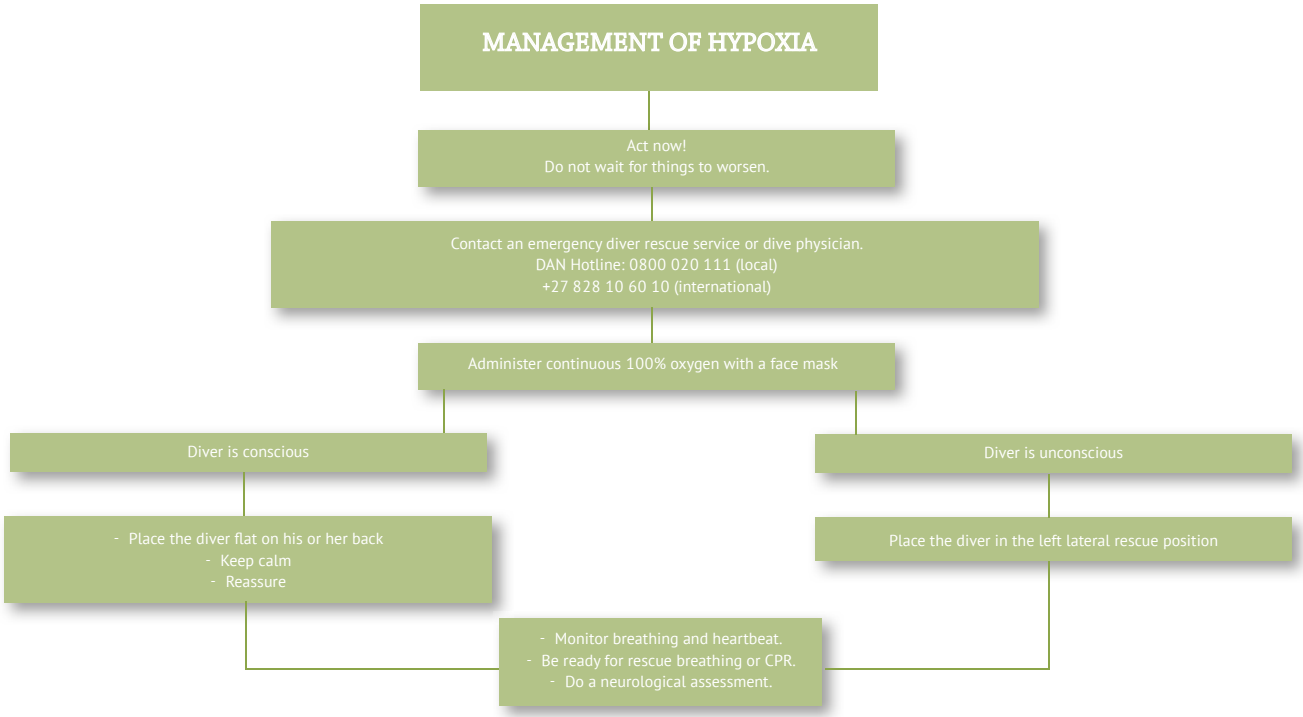


Figure 12: Management of hypoxia

4.2 Oxygen Toxicity

Causes

Oxygen toxicity in sport divers is rare. It is caused by a high partial pressure of oxygen in the inspired gas supply.

- Pure oxygen rebreathers
- High percentage oxygen mixes including enhanced air mixes

Presentation

- Changes in higher cerebral function (e.g. anxious, confused, agitated or coma)
- Changes in the senses (vision, hearing, touch, taste or smell)
- Changes in motor ability (e.g. weakness, tremor or paralysis)
- Twitching, especially of the face, is common
- Pallor of the skin. An oxygen toxic diver is pale
- Vertigo and nausea
- Convulsions

Treatment

From a scuba-diving point of view, this refers almost entirely to sport divers who decide to use an oxygen enriched breathing supply. A deep diver rescue must be performed.

4.3 Nitrogen Narcosis

Nitrogen narcosis occurs when the partial pressure of nitrogen in the inhaled air is above 2.8 ATA. It increases with depth, limits sport diving to 50 MSW and is aggravated by cold, alcohol, drugs, fatigue and anxiety.

Causes

- Diving below 30 MSW while breathing air
- Rapid descent

Presentation

- Changes in higher brain function – commonly a feeling of well-being and overconfidence and impaired memory, learning and concentration. At greater depths mental function becomes impaired and hallucinations, sleepiness, stupor, coma and death can occur
- Changes in the senses, most commonly tunnel vision
- Changes in motor ability with awkward, unco-ordinated and, finally, ineffectual movements
- Nitrogen narcosis disappears rapidly during the ascent

Management

- Narcosis disappears with ascent.
- It can be prevented by the addition of helium to the gas supply.

4.4 Carbon Dioxide Toxicity

Causes

- Contamination of the gas supply with carbon dioxide
- Failure of absorbent in scrubbers
- Poor ventilation flow in helmets and decompression chambers
- Breath-hold diving
- Inhaled foreign material – dentures, vomit or water
- Laryngospasm
- Insufficient breathing due to tight wetsuits, harnesses or BCs
- Failure of circulation due to shock, hypothermia, heart failure or haemorrhage

NOTE
In most cases, carbon dioxide toxicity and hypoxia develop together. Using oxygen enriched nitrox mixes, carbon dioxide toxicity and oxygen toxicity can occur simultaneously. A convulsion is almost inevitable.

Presentation

- Changes in higher brain function (e.g. anxious, confused, agitated or coma)
- Changes in the senses (vision, hearing, touch, taste or smell)
- Changes in motor ability (e.g. weakness, tremor or paralysis)
- Rapid, deep breathing
- Flushing and sweating
- Throbbing headache
- Unconsciousness or convulsions – carbon dioxide narcosis

The flushing and sweating will not be noticed under water. The diver may think that the increased depth and rate of breathing are due to the exertions of diving and may then convulse, stop breathing or lose consciousness under water *without any further warning.*

Prevention

- Paying meticulous attention to scrubbers
- Constantly taking care to ensure an adequate free flow volume
- Monitoring carbon dioxide levels in chambers, bells and habitats
- Ensuring no contamination of the air mix with carbon dioxide
- Avoiding restraining equipment and dense mixes

Treatment under water

- Stop swimming and relax (less carbon dioxide production and oxygen use).
- Signal to your buddy that something is wrong (unconsciousness may occur at any moment).
- Begin the ascent.
- At the surface, hyperventilate atmospheric air.
- If a diver sees an unconscious buddy, perform a deep diver rescue.

"If a diver sees an unconscious buddy, perform a deep diver rescue.

Treatment at the Surface

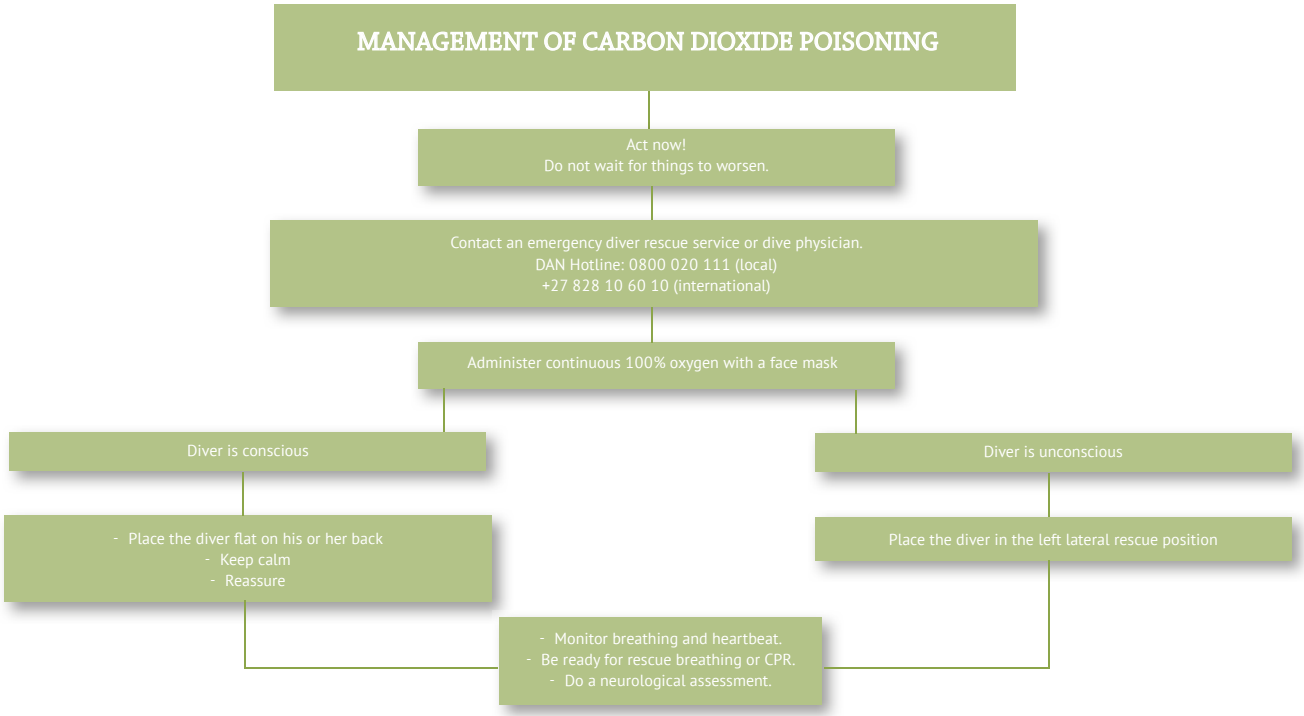


Figure 13: Management of carbon dioxide poisoning

4.5 Carbon Monoxide Poisoning

Causes

- Carbon monoxide contamination of the compressor air intake
- Carbon monoxide formed in the compressor by flashing of oil

Presentation

- The features of hypoxia are evident in:
  - ~ changes in higher cerebral function (e.g. anxious, confused, agitated or coma)
  - ~ changes in the senses (vision, hearing, touch, taste or smell)
  - ~ changes in motor ability (e.g. weakness, tremor or paralysis)
- Bright red lips and flushed cheeks. This is not a reliable sign, however, and its absence need not mean the absence of carbon monoxide poisoning.

Prevention

- Ensure that the compressor air intake is upwind of petrol and diesel exhausts.
- Ensure that the compressor is serviceable.
- Regularly test the purity of the compressed air.

> Regularly test the purity of the compressed air.

Treatment

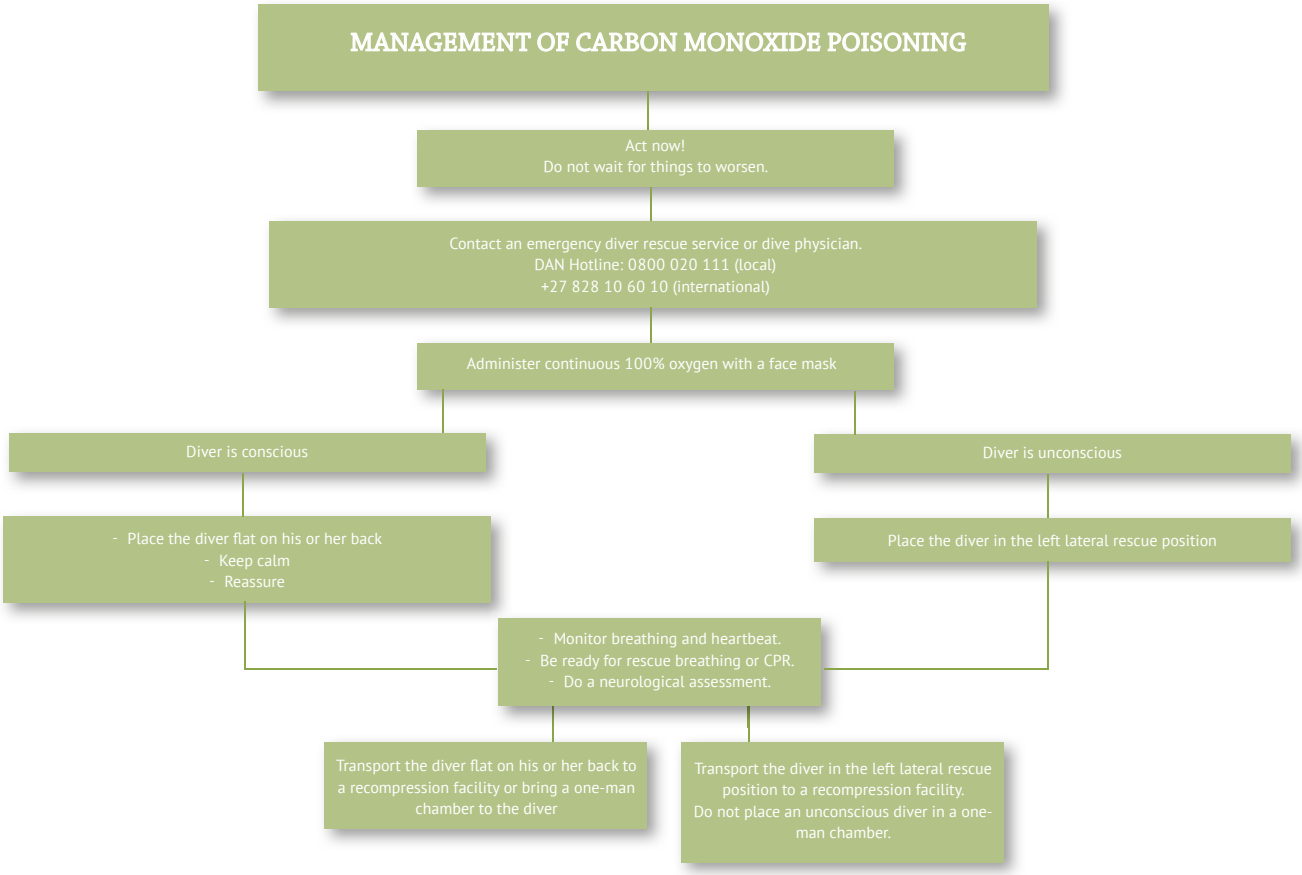


Figure 14: How to manage carbon monoxide poisoning

5.1 Abdominal Pain

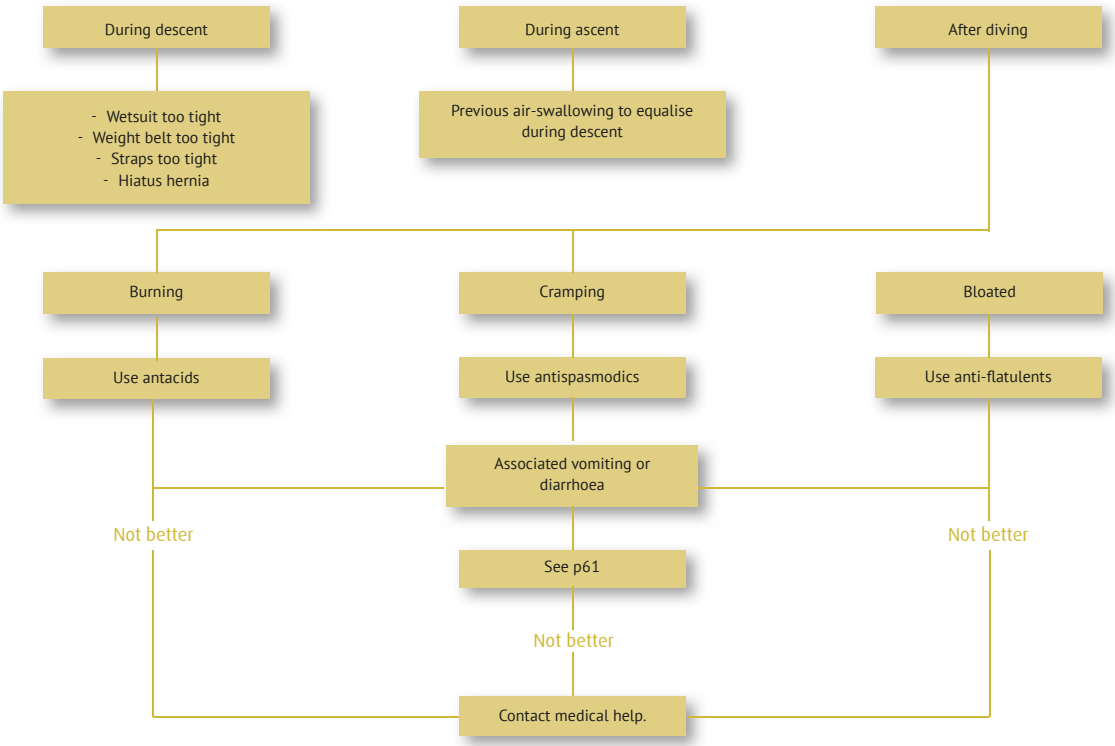
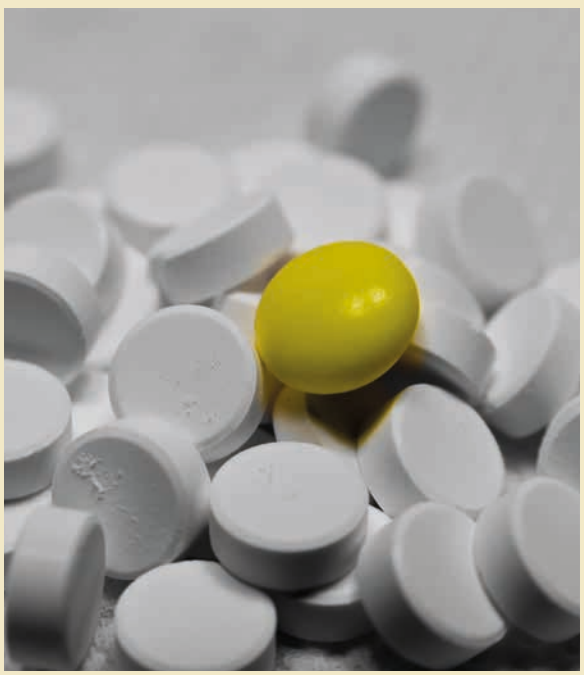


Figure 15: How to manage abdominal pain



5.2 Vomiting and Diarrhoea

Prevention

- Try to determine whether any particular bacterial dysentery is currently prevalent in the area before embarking on the trip.
- Speak to your doctor about the advisability of taking suitable antibiotic therapy, such as norfloxacin, with you on the trip.
- Avoid eating dubious foods, possibly contaminated fruits and vegetables and drinking local water in areas with primitive sanitation.
- Ensure an adequate supply of bottled water or boil all water for 20 minutes before drinking it.
- Avoid diving in areas contaminated by sewage. Swallowing water contaminated by sewage can cause a host of illnesses including bacterial gastroenteritis, amoebic dysentery, cholera, typhoid and paratyphoid.

Treatment

- Stop all diving.
- Stop any dairy product intake or fatty food consumption. All food should be bland and boiled, baked or lightly grilled. Boiled chicken, fish, rice, pumpkin and potatoes and thin soup are examples of suitable foods.
- Encourage fluid intake. Replacement of lost body fluids is the cornerstone of treatment. Water, weak black tea, soda and fruit juice diluted 1:1 with water are examples.
- If nausea or vomiting persists, anti-emetics are required, e.g. Valoid or Stemetil. If vomiting is the major feature, oral use of these drugs may be ineffective as they will be rejected almost as soon as they are swallowed. Rectal suppositories may then help. If frequent diarrhoea makes this impractical, an intramuscular injection, by a doctor, of an anti-emetic may be required.
- Abdominal cramps are commonly handled by the use of antispasmodics such as Buscopan, hyoscine and atropine sulphate.
- Diarrhoea can usually be controlled by dietary restriction and adequate fluid intake. If persistent, Imodium, Lomotil or Kantrexil is usually effective. Binding agents containing the clay kaolin, apple pectin and milk of bismuth may also help.
- If blood and mucus are present in the stool and a doctor is unavailable, oral norfloxacin 400 mg twice a day for three days generally provides cover against all bacterial dysenteries. Previous discussion with and permission from a doctor is necessary and norfloxacin must not be used before puberty. Kantrexil, three tablets three-hourly for three days, is often useful for diarrhoea in adults.
- In severe cases, hospitalisation is required for intravenous replacement of fluid and electrolytes, such as Ringer's lactate plus added potassium chloride, to combat dehydration and electrolyte loss.

TIP
Avoid eating dubious foods, possibly contaminated fruits and vegetables and drinking local water in areas with primitive sanitation.

> Encourage fluid intake. Replacement of lost body fluids is the cornerstone of treatment.

6.1 Athlete's Foot

Cause
Fungal infection of the skin of the feet, following barefoot exposure to contaminated wet areas such as showers and decks or sharing rubber diving booties.

Presentation
The skin, commonly between the toes, becomes very white and soggy. Small blisters appear which later burst and are followed by skin ulcers and peeling. Pain is usually not a feature, unless secondary bacterial infection occurs in the broken skin.

Treatment
- Keep the skin dry.
- Exposure to sunlight dries out the blisters.
- Bathe the feet in 0.05% potassium permanganate (about one third teaspoon in 5ℓ water) solution twice a day.
- Dry carefully with paper towels.
- Apply topical antifungals such as ketoconazole, zinc undecanoate acid, tolnaftate or miconazole for three to four weeks.
- Secondary bacterial infection causing pain, redness and swelling requires the use of oral antibiotics such as broad-spectrum penicillin or tetracycline.

6.2 Tinea Versicolor

Cause
Superficial fungal infection of the skin caused by the fungus *Malassezia furfur*.

Presentation
Many brownish spots over the body, especially the chest and back. It is usually very mild and is only noticed after sunbathing, when the skin becomes tanned everywhere except for untanned paler spots affected by the fungus.

Treatment
- Applying half-strength Whitfield's Ointment, 15% sodium thiosulphate solution, or 5% salicylic acid in alcohol for three to four weeks cures the condition.
- The conazole group of antifungal creams are also effective.

TIP
Skin wounds do not heal well if diving is continued.

6.3 Coral Abrasions and Cuts

Cause
Skin contact with hard corals results in skin nicks and grazes. Infection is almost invariable if coral fragments, nematocysts or contaminating bacteria are not thoroughly removed from the wound.

Presentation
Infection becomes apparent after a few days with local swelling, redness, pain and heat which spreads to surrounding normal tissues.

Prevention
- Avoid contact with coral – maintain neutral (not negative) buoyancy, keep finning under control and ensure a hands-off approach.
- Skin wounds do not do well if diving is continued. Repeated wetting removes antiseptic or antibiotic creams, reinfects the wound and causes bogginess of the skin. Under these conditions, healing can be very delayed.

Treatment
- If possible, consult a doctor
- Wash any coral injury thoroughly with antiseptic solution such as cetrimide and chlorhexidine.
- Ensure that all foreign debris has been removed.
- Apply an antiseptic cream, e.g. povidone iodine, or an antibiotic cream such as neomycin, mupirocin or fusidate.
- If infection spreads as evidenced by increasing pain, swelling and redness, an oral antibiotic such as a broad-spectrum penicillin or tetracycline is necessary.
- Treat any non-diving related cut or blister with frequent applications of an antibiotic or antiseptic cream. Any diving or immersion in water may also aggravate these injuries.

> Infection is almost invariable if contaminants are not removed from the wound.

6.4 Eye Irritations or Infections

Cause

Exposure of the eyes to chlorinated water or seawater may result in chemical irritation or infective conjunctivitis (pink eye).

Presentation

- Chemical or allergic irritation presents with red, burning or itchy eyes. Swelling of the eyelids is common.
- Infection presents with redness, pain and a sticky discharge which gums the eyelashes together.

Treatment

- Allergic or chemical irritation is rapidly relieved by the use of 0.9% saline eye baths followed by antihistaminic drops containing antazoline, oxymetazoline or phenylephrine. Levocabastine (Livostin Eye Drops) is also effective in allergic conjunctivitis.
- Infective conjunctivitis requires antibiotic therapy. A doctor should be consulted, if possible, before these are used. Numerous preparations are available, containing antibiotics such as neomycin, chloromycetin, fusidic acid, gentamycin, ciprofloxacin, polymixin and sulphacetamide.
- Eye preparations containing cortisone derivatives should never be used without medical opinion, as corneal ulceration and scarring can occur with viral eye infections.

6.5 Tick-Bite Fever

Causes

Divers camping in African and Mediterranean countries may be bitten by ticks harbouring *Rickettsia conori,* the causative organism of tick-bite fever. After a few days, a black sore develops at the site of the tick bite, followed by the painful enlargement of nearby lymph glands. Fever, severe headaches and a spotted rash appear. The disease is self-limiting, even without treatment, and is rarely fatal.

Prevention

- Adequate precautions must be taken to avoid being bitten, including full-length trousers tucked into the socks when walking in grassy areas and the use of insect repellents.
- Any ticks found on the skin must be removed. Do not pull off the tick. It usually breaks in two, leaving the head embedded in the diver's skin. Apply a drop of petrol, paraffin or diesel on to the tick. This will induce it to let go. It can then be removed using tweezers.
- Not all ticks carry tick-bite fever and most tick bites simply heal. Only if the tick itself is harbouring the organism will a black sore develop and the disease occur.

Treatment

- If possible, consult a doctor.
- If a black sore at the site of the bite develops, accompanied by the painful swelling of lymph glands in the area, a rash and a splitting headache, tetracycline in a dose of 500 mg three times a day for five days should be used. Tetracycline should not be given to children under 13 years, as staining and damage to unerupted teeth can occur.

> Adequate precautions must be taken to avoid being bitten.

6.6 Malaria

Cause

Malaria is carried by the female *Anopheles* mosquito and infection occurs following a mosquito bite and the injection of the insect's saliva containing the malaria parasite into the wound. The disease occurs in many parts of the world and is caused by a parasite called *Plasmodium*. There are four species of *Plasmodium*, the most dangerous of these being *Plasmodium falciparum*.

Presentation

Malaria usually presents initially with flu-like symptoms: headaches, muscle and joint aches, and fever. Severe shivering attacks (rigors) and high fever then occur and recur in a cyclical pattern every third or fourth day. In severe cases of *Plasmodium falciparum* malaria, the urine may become bloody (blackwater fever) or the brain may be affected with unconsciousness and convulsions (cerebral malaria).

Prevention

No drug provides 100% cover against malarial infection. Prophylaxis must involve both mosquito avoidance and antimalarial drugs.

Mosquito avoidance involves:

- meticulous application of insect repellent to exposed skin and clothing. The repellent of choice is N,N-diethyltoluamide (e.g. Peaceful Sleep, Mylol and Tabard lotions and sticks)
- wearing long-sleeved shirts or blouses, slacks and socks between sunset and sunrise (the feeding time of the *Anopheles* mosquito)
- moving continuously when outdoors at night (mosquitoes prefer a static meal)
- mosquito screening on all doors and windows
- spraying insecticide inside living quarters every day at dusk
- burning insecticide coils in the sleeping quarters at night
- sleeping under insecticide-impregnated mosquito nets tucked under the mattress.

Antimalarial drugs

The drug of choice depends on the area visited, the presence or absence of drug-resistant *P. falciparum* malaria, personal allergies and idiosyncrasies to antimalarial medication, drug interaction with any maintenance medication a diver may be using, pregnancy, age, health and the availability of the drug. Consult your doctor to determine the best choice of medication and to ensure that no untoward side effects or contraindications are present.

Chloroquine 150 mg tablet: In South Africa, with the exception of the Ingwavuma and Ubombo districts, all species of malaria are, to date, chloroquine sensitive. Preventative treatment should begin 24 hours before entering an endemic area. In adults and children over 12 years, two tablets are taken initially, repeated weekly on the same day while in the area, and then weekly for four weeks after leaving the area. Children aged six to 12 years take one tablet; aged one to five years take half a tablet (or 10 mℓ syrup); aged six weeks to 12 months take 5 mℓ syrup.

In areas where drug-resistant *P. falciparum* prevails (South-East Asia including Philippines, Thailand, Burma and China; Gabon and most of sub-Saharan Africa including the Comores and Madagascar; Sodwana; and the Ingwavuma and Ubombo districts of South Africa), other antimalarial drugs are required. These are tabulated on p67.

Treatment

- A doctor must always be consulted, if at all possible.
- *Self-treatment of malaria:* Divers in remote malarial areas and without access to immediate medical treatment may be faced with the problem of an unexplained fever, headache, body aching and rigors. Self-treatment is potentially very dangerous. If malaria is suspected and there is absolutely no professional help available use:
  - ~ *Coartem (artemether 20 mg, lumefantrine 120 mg) tablets. Take with food/fluids. Repeat dose if vomiting occurs within one hour of administration. An intensive three-day course is recommended. The dose depends on body mass. Children of 10-15 kg: one tablet initially, repeat after eight hours; thereafter one tablet twice a day for the following two days (total: six tablets). Children of 15-25 kg: initially two tablets as a single dose; repeat two tablets after eight hours and thereafter two tablets twice a day for the following two days (total: 12 tablets). Children of 25-35 kg: initially three tablets as a single dose, repeated after eight hours; thereafter three tablets twice a day for the following two days (total: 18 tablets). Persons of 35-65 kg: initially four tablets as a single dose, repeated after eight hours; thereafter four tablets twice a day for the following two days (total: 24 tablets). For persons over 65 kg, the same dose (total: 24 tablets) is recommended. With new or recrudescent infections, a second course is recommended.*
  - ~ *Fansidar (pyrimethamine/sulphadoxine)* as a single dose (three tablets for adults, two tablets for ages nine to 14, one tablet for ages four to eight; half a tablet for ages under four).

Coartem and Fansidar are temporary measures only and a doctor must then be found and consulted urgently.

NOTE

Safety in pregnancy and lactation has not been established. Side effects have been reported and special precautions do exist. If at all possible, contact a doctor before using the treatment.

TIP

Malaria usually presents initially with flu-like symptoms.

DRUGS RECOMMENDED IN THE PREVENTION OF RESISTANT *P. FALCIPARUM* MALARIA		
PREVENTATIVE DRUG	DOSE IN ADULTS	DOSE IN CHILDREN
MEFLOQUINE Trade names: - Lariam - Mefliam	Take 250 mg each week on the same day. Start one week before entering the area and continue for four weeks after leaving the area. *It can cause vertigo and divers should not use it.* Do not exceed three months.	*Do not use in children under 15 kg.* 5 mg/kg body mass per week, at the same time intervals as adults. *Contraindicated in pregnancy and breastfeeding.*
CHLOROQUINE Trade names: - Nivaquine - Plasmoquine - Daramel - Mirquin syrup	Take 400 mg each week on the same day. Start one week before entering the area and continue for six weeks after leaving the area. *Usually taken in combination with Proguanil.*	Take 5 mg/kg body mass per week, at the same time intervals as adults. *Safe in pregnancy.*
PROGUANIL Trade names: - Paludrine	Take 200 mg daily. Start 48 hours before entering the area and continue on a daily basis for six weeks after leaving the area. *Must only be taken together with chloroquine.*	Under one year: 25 mg/day One to four years: 50 mg/day Five to eight years: 100 mg/day Nine to14 years: 150 mg/day *Safe in pregnancy.*
ATAVOQUONE AND PROGUANIL Trade names: - Malanil	Atavoquone 250 mg and Proguanil 100 mg: Take one tablet on the day before arrival and one tablet per day during your stay. One tablet per day for one week after leaving.	*May only be used in persons above 40 kg.* *Contraindicated in pregnancy and lactation.* *Not available in endemic South African areas.*
DOXYCYCLINE Trade names: - Cyclidox - Doxycyl - Doximal - Doxitab - Dumoxin - Doxyhexal - Randoclin	Take 100 mg daily. Start 48 hours before entering the area and continue on a daily basis for four weeks after leaving the area. *Skin sensitisation and severe sunburn may occur.*	Do not use in children under eight years. Ages eight to 15 years: 3 mg/kg daily as for adults. *Contraindicated in pregnancy and breastfeeding.*

Table 20: Drugs recommended in the prevention of resistant P. Falciparum *malaria*

7.1 Avoiding HIV from Blood Contact with Divers

Methods of spread of HIV

- Vaginal, anal or oral sexual contact with an infected partner
- Sharing contaminated needles among drug abusers
- Blood transfusions with HIV-infected blood
- Infection of a newborn by an HIV-positive mother
- Tattoos, acupuncture, etc. with contaminated needles
- Needle-stick or scalpel injury in medical staff working with HIV-positive patients
- Giving CPR to an HIV-positive victim with blood in his or her airway

The disease is only spread by infected blood or sexual contact. Mosquitoes have not been shown to carry the HIV-virus. Kissing or saliva contact does not cause infection (unless there is blood in the saliva). Sweat and urine contact also do not spread the disease. Touching, sneezing, coughing, working together, sharing food utensils, towels and combs, etc., cannot cause the spread of HIV.

Prevention

- HIV-positive persons should probably not dive, at least not without informing their buddies of the situation. There is a moral obligation to do so because a rescuer may have to resuscitate a bleeding HIV victim. Ideally this should also mean wearing a medic-alert necklace informing an unknown rescuer that the victim is HIV-positive and that precautions are necessary, but the ethical, personal and social ramifications of having the HIV disease are still raging in most countries.
- Use a non-contact, non-return mouth-to-mouth airway with CPR.
- Keep a suitable airway on hand at all times – on the dive boat, at the shore base and in your BC pocket.
- Have a suitable kit containing gloves, plastic aprons and goggles.

TIP
When performing CPR on an HIV-positive person, use a non-contact, non-return mouth-to-mouth airway.

7.2 Protocol for Diabetic Scuba Divers

The following diabetics must not scuba dive:

- Those with a history of loss of consciousness or requiring the assistance of others within the last 12 months
- Those with complications of diabetes, i.e involvement of the eyes, kidneys, peripheral nerves or arteries or the coronary arteries
- Those individuals who cannot "feel" that their blood sugar is low (hypoglycaemic unawareness). A coma may be the first presenting feature
- Those who have poor or inadequate control of their diabetes.

Needs of the diabetic diver

- The diabetic diver must be fit, well educated about diabetes and well controlled on either insulin or an oral treatment.
- This control must be regularly monitored by a diabetes specialist.
- An annual medical must be undertaken by a diving doctor.
- Two diabetics must not form a buddy pair.

Needs of the buddy, instructor, dive marshal and boatsperson

- These persons must be taught about diabetes and notified immediately should any problems occur after diving.
- They must be shown how to use and read a glucometer.
- They must be taught what to do in the event of hypoglycaemia.

- They must be informed of the dive plan and the plan must be strictly adhered to – "plan the dive and dive the plan".

Actions to take before diving

- Both the diabetic and the buddy must be well hydrated by drinking 500 mℓ water before the dive.
- Ensure some carbohydrate intake and monitor the blood glucose before the dive. It must be slightly elevated at about 8 mmol/ℓ.
- Ensure that mask oxygen is available *on the boat* .
- Ensure that a supply of oral glucose is available *on the boat* .
- Ensure that two injectable glucagon kits are available on the boat. They should be kept in a cool place out of the sun, but do not require refrigeration.
- Carry a supply of glucose tablets in a sealed collapsible plastic container in a pocket of the BC in case of a "lost diver" situation.
- Carry a flare, flag or other method of attracting attention.
- Seasick diabetics *must not dive* or must abort their dive. Vomiting rejects food reserves and predisposes him or her to hypoglycaemia after insulin.

Actions to take during the dive

- Be alert for any signs or symptoms of impending hypoglycaemia. This will usually present as peculiar or uncharacteristic behaviour. *The dive must then be aborted.*
- Diabetic divers should not dive deeper than 30 MSW.

Actions to take after diving

Any unusual symptoms or signs must not be ignored after diving.

- Measure the blood glucose on the boat immediately after diving. If it is low, take oral glucose and inhale 100% oxygen by mask.
- Do not give oral glucose to a confused or comatose individual. The chances of inhalation and choking are enormous.
- Place the diver in the left lateral coma position.
- Administer continuous 100% oxygen by mask. Be ready for CPR.
- Monitor the blood glucose. If below 3.5 mmol/ℓ, take the following steps:
  - ~ if a trained person is at hand, inject 1 mg glucagon or give 50 mℓ of 50% glucose solution intravenously.
  - ~ if no trained help is available, inject 1 mg glucagon into the deltoid muscle of the shoulder or into the outer upper quadrant of the buttock muscle.
  - ~ monitor the blood glucose after 10 minutes. If no improvement in consciousness has occurred *and the blood glucose is still low*, inject another 1 mg of glucagon.
  - ~ Be alert for sudden vomiting and possible inhalation of vomit.
  - ~ Notify an emergency rescue service and hyperbaric centre (see p5-7).

TIP

Do not give oral glucose to a confused or comatose individual. The chances of inhalation and choking are enormous.

> Any unusual symptoms or signs must not be ignored after diving.

8.1 When Confronted by a Shark

- Remain submerged if possible.
- Use slow, soft, purposeful movements as panicky and erratic movements will excite the shark. Avoid any sudden positional changes.
- Do not attempt to swim away. Stay calm – sharks can somehow sense fear. Keep facing the shark and try to get a reef or wreck at your back. This at least ensures a frontal attack.
- Try to fend off the shark with something in your hand, be it a rock, your camera, a piece of wreckage or your spear. A shark billy (equipped with points or short nails at its end to avoid sliding off the shark's skin) is best, but use it only to fend off the animal and ensure a distance between you and the shark. Do not strike at the shark.
- Prodding it on the snout, eyes or gills is best.
- Try not to wound it – it may become angry.
- Avoid using your bare hands if possible – the animal's skin will tear your skin and the bleeding will compound problems by exciting it.
- Ensure that the shark has an escape open to it. Putting it in a position where escape is via yourself is very unwise.
- Powerheads can be used if the situation is right. This requires expertise in their use as well as accuracy, and is only effective against a single shark. Using a powerhead in a school can easily precipitate a frenzy.

TIP

Ensure that the shark has an escape open to it. Putting it in a position where escape is via yourself is very unwise.

8.2 Sea-Stingers: A General Approach

- If the stinger has spines (starfish, urchin or fish), there will be a puncture wound: use hot water to inactivate the venom.
- If the stinger has no spines (jellyfish or blue-bottles), there will be welts or a rash: use vinegar or alcohol.

8.3 Jellyfish and Blue-Bottle Stings

- Get the victim out of the water as fast as possible.
- If the stinger is the sea-wasp jellyfish (*Chironex fleckeri*), apply a tourniquet, rope, string or any ligature above the sting if it is on an arm or leg.
- Do not use a tourniquet for other jellyfish or blue-bottles.
- If available, an aluminium sulphate solution spray (e.g. Stingos) is helpful in alleviating pain.
- Pour vinegar over the stings and pieces of tentacles. If unavailable, alcohol or any spirits will help. This inactivates the venom and must be done before any attempt is made to remove the tentacles, which are still loaded with active nematocysts, which will worsen the condition of the diver and even poison the rescuer.
- Scrape off the inactivated tentacles with a knife. Drying them with powder makes this easier.
- Apply more vinegar to the area as a poultice.
- Summon medical aid if the stinger was a sea-wasp jellyfish or if there is no rapid improvement after vinegar treatment.
- Be alert for the development of respiratory failure. Rescue breathing or CPR must be given if needed (see p26).
- Transfer the diver to hospital when shock is stabilised.
- Do not forget to release the tourniquet (maximum two hours).

Penetration of the stinging spine causes pain on contact.

8.4 Fire Coral Stings

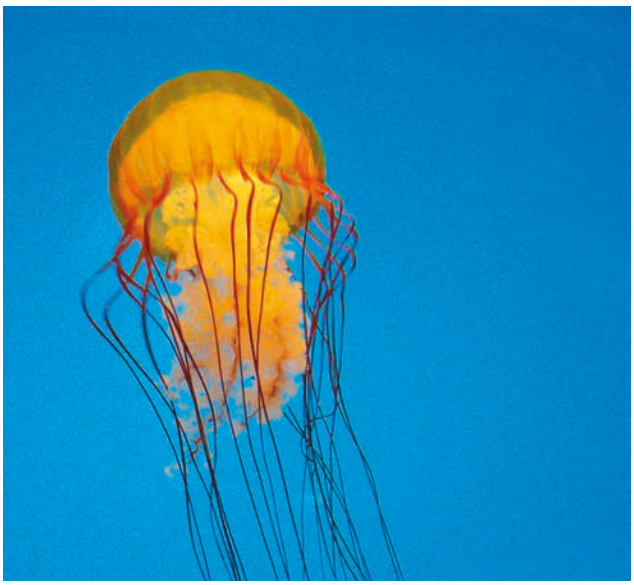
- Get the victim out of the water.
- If available, aluminium sulphate solution spray (e.g. Stingos) is helpful in alleviating pain.
- Pour vinegar over the stung area.
- Apply more vinegar to the area as a poultice for 20 minutes.
- Clean the wound thoroughly with a diluted antiseptic solution.
- Apply local antibiotic ointment e.g. Fucidin twice a day for five days.
- Keep the wound dry. Further diving always results in spreading the infection or abscess formation.

8.5 Cone Shell and *Octopus maculosus* Bites

- Locally, the bite may be painless, numb, burning or very painful.
- Generally, the numbness and tingling start at the wound and then spread over the whole body after 10 minutes. The lips and mouth are particularly numb. Paralysis of muscles may occur, ranging from mild weakness to total body paralysis. Speech and swallowing become difficult. In severe cases, paralysis of the breathing muscles causes death. If the victim lives for six hours, survival is probable. After 24 hours the diver will be better.

Treatment

- There are no antivenoms for the molluscs.
- The emphasis is on artificial respiration to keep the victim alive for the first hours. This means rescue breathing for extended periods if in a remote area or until the victim can be placed on a hospital respirator (see p24).



8.6 Sea-Urchin Injuries

Sea-urchin injuries involve both penetrating urchin spines and, in some species, venom effects.

- Local effects are immediate: severe burning pain and spines are seen in the skin. The area around the wound becomes numb. Infection is common and a spreading inflammation then occurs around the site with pain and aching.
- General effects are absent with most species. If the urchin has venomous pedicellariae, a nerve poison will be involved, so be alert for paralysis. The local burning pain is followed by generalised weakness, faintness and numbness, with progressive muscular paralysis. Speech and swallowing become difficult and progression to respiratory paralysis may lead to death. The pain usually disappears after about one hour, but paralysis may last for over six hours. Note that this sequence of events is very similar to the effects from sea-wasp, blue-ringed octopus and conus stings.

Treatment

- Spines in the skin are best left alone. They are very brittle and difficult to remove, break off very easily and will usually be absorbed by the body within a few weeks anyway. Removal by a doctor is usually only required if the spines penetrate into a joint.
- If available, unripe papaw milk is effective in alleviating pain. Cut into the skin of a small unripe papaw and allow the milk to drip on to the stung area.
- Heating is the most effective way of destroying the venom. Treat the sting with water at 50°C for 10 minutes. Do not scald the victim.
- Alcohol may now be applied. It is an antiseptic and also inactivates pedicellariae, which can now be removed if seen.
- Clean the wound with a diluted antiseptic solution once the pain has passed. Sometimes the wounds become infected and medical help and antibiotics will then be needed.
- Oral antihistamines may provide some relief and painkillers by mouth can assist with pain.
- Any signs of paralysis or difficulty with breathing may mean that rescue breathing will be needed, *so keep a watchful lookout* (see p29).

> Sea-urchin injuries involve penetrating urchin spines and venom effects.

8.7 Annelid (Segmented Worm) Stings

Presentation

Annelids inflict injury in two ways:

- The bite is inflicted using biting jaws.
- The sting is inflicted using bristles on the segments.

A painful local reaction occurs, with redness and swelling at the site.

Treatment

- Apply hot water (at 50°C) to the site for 10 minutes.
- Clean the wound with a diluted antiseptic solution.
- Painkillers can be given orally if required.
- Bristles embedded in the skin can be removed using sellotape or adhesive tape.

8.8 Stinging Fish Injuries

Causes

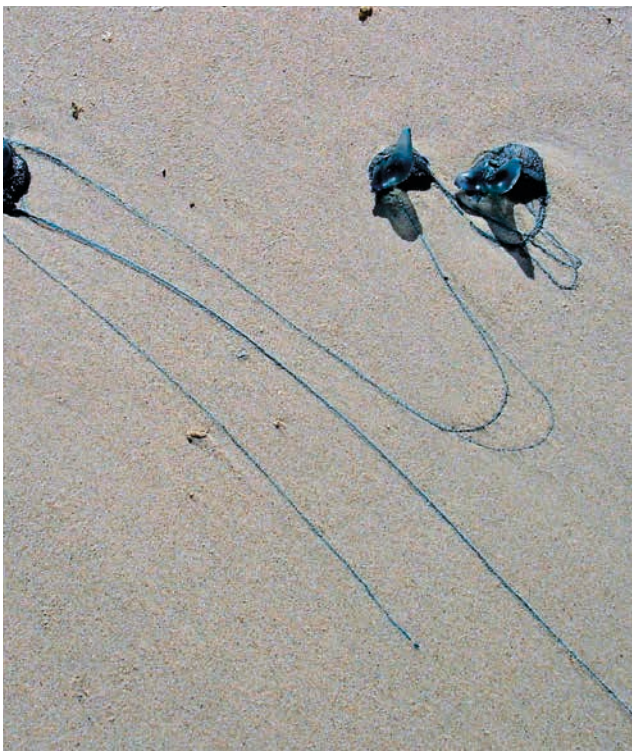
Stinging fish injuries are most commonly caused by stingrays and various scorpionfish (lionfish, scorpionfish proper or stonefish).

Presentation

- Penetration of the stinging spine causes intense pain on contact.
- The venoms are toxic to muscle, causing paralysis of limbs, then the breathing muscles and then the heart.
- If the victim survives, infection and gangrene can occur.

Treatment

- Management of venomous fish stings relies on three aspects:
  - ~ Control of pain
  - ~ Control of venom effects
  - ~ Control of infection
- Rescue the victim from the water.
- Lay the victim flat on the ground.
- Remember that the victim is frightened and in very great pain and distress. Be calm and reassuring.
- Call for medical help.
- Irrigate the wound with cold seawater (or a saline solution if available) to rinse out some of the poison.
- Heat fresh water to 50°C as quickly as possible.
- Immerse the limb in hot water (as hot as bearable without scalding) for 30 to 60 minutes. Additional hot water must be added as the water cools. The addition of Epsom salt to the wound has been reported to be useful.
- Wounds on the head and trunk should be treated with hot-water compresses for one hour.
- Injection of local anaesthetic (2% lignocaine or xylocaine) into the area around the wound may help for the pain.
- Keep a sharp lookout for respiratory and cardiac failure.
- If necessary, rescue breathing or CPR must be done (see p26).
- Then:
  - ~ The wound must be properly cleaned and dressed.
  - ~ Lacerated wounds may need suturing.
  - ~ Broad-spectrum antibiotics should be given.
  - ~ In severe cases, hospitalisation is required.
  - ~ Stonefish antivenin, if available, should be given to all cases of stonefish stings.



TIP
Remember that the victim is frightened and in very great pain and distress. Be calm and reassuring.

8.9 Sea-Snake Bites

Presentation

A sea-snake bite causes:

- nervous system poisoning with paralysis
- muscle tissue breakdown
- blood cell destruction

There is a period of time, from 10 minutes to hours before anything is noted. Then the victim becomes restless and a little excitable. The tongue becomes "thick" and generalised body aches and stiffness appear. Drooping of the eyelids is an early sign and spasm of the jaw muscles or lockjaw occurs. The nerve toxin then causes an ascending paralysis, starting in the legs and working up to the neck. Speech becomes difficult, swallowing an effort and vomiting may occur. The blood toxin causes breakdown of red blood cells with progressive shock. The destruction of muscle cells and red blood cells causes the urine to become red-pink and kidney failure can occur. Finally convulsions, coma, cardiac failure and respiratory failure lead to death.

Treatment

- The victim must lie down and remain absolutely quiet.
- Splint the limb, if the bite is on an arm or leg.
- Apply a tourniquet above a limb puncture wound. It must be released after two hours.
- Obtain medical help urgently.
- Give rescue breathing or CPR as needed.
- Sea-snake antivenin should be used if available, or else polyvalent serum with krait (*Elapidae*) fraction must be used.

NOTE
Adrenaline and hydrocortisone are emergency life-saving drugs and may only be considered when it is impossible to obtain any trained help. These medications are being given without expert opinion and offer only a hope of success in extreme circumstances.

8.10 Acute Shellfish Allergy

Cause

People who have previously eaten shellfish may develop an acute allergic reaction on their second or subsequent meals.

Presentation

It can be present:

- as a violent itchy and spreading red rash with large welts
- as an acute episode of asthma
- as a sudden episode of collapse due to circulatory shock

Treatment

- Itching and rashes can generally be controlled by the use of antihistamines.
- Acute breathing difficulties due to sudden severe asthma or sudden circulatory collapse and shock are medical emergencies. *A doctor or emergency paramedic service must be summoned .*
- *If the diver is in a remote place with no recourse to any medical help*: Inject adrenaline 1:1 000 subcutaneously at a dose of 0.1 mℓ/kg body mass, *very slowly over five minutes.* Draw back on the syringe before injecting to ensure that a blood vessel has not been entered by the needle. *Do not inject adrenaline into a blood vessel!* Automatic adrenaline injection kits are available (e.g. Epipen).
- Monitor the pulse continuously. It will become forceful and accelerate as the injection is given. If it rises above 120 beats per minute, stop injecting and wait until the pulse settles.
- Watch the diver's face. It will become extremely pale due to the vasoconstrictive effect of adrenaline.
- Monitor respiration continuously. Be prepared for CPR (see p26).
- Inject 2 000 mg of hydrocortisone intramuscularly into the upper outer quadrant of the buttock muscle.
- Administer CPR if breathing and heart function fail.

8.11 Paralytic Shellfish Poisoning

Cause

This is a potentially lethal disease during red tides which are caused by the sudden and massive proliferation of tiny plankton dinoflagellates, commonly *Alexandrium catanella* and *Alexandrium tamarensis*.

Fish eating these organisms may die, causing a mass death of fish. Molluscs, however, simply store the contaminating *Alexandrium* and pass it on to the person who eats them. This can cause an epidemic of paralytic shellfish poisoning at the time of the red tide and even for some time afterwards, as the poison may be retained by the molluscs for several months after a flush of red tide.

Presentation

The poison is a nerve toxin (saxitoxin) and, like so many marine venoms, causes a progressive paralysis which can affect the respiratory muscles and lead to death by suffocation.

Treatment

- Induce vomiting with emetics such as ipecacuanha, drinking a glass of strong salt water or using a finger in the throat. Vomiting will reduce the amount of toxin absorbed.
- When signs develop, urgent medical help must be sought.
- Mouth-to-mouth respiration (rescue breathing) is necessary if breathing stops. *This may have to be continued for hours* (see p27).
- Monitor the pulse and heartbeat continuously. Be ready to administer CPR (see p26).
- Remember that the victim is often conscious and aware of what you are doing. Reassurance is extremely important.

TIP

Induce vomiting with emetics such as ipecacuanha, drinking a glass of strong salt water or using a finger in the throat. Vomiting will reduce the amount of toxin absorbed.

8.12 Ciguatera Poisoning

Cause

This disease is transmitted to man by eating fish products tainted with the dinoflagellate *Gambierdiscus toxicus*. *Gambierdiscus* lives on brown seaweed. Herbivorous fish eat the seaweed and become contaminated. These fish may then be caught by man and eaten, so passing on the disease, or the herbivorous fish may be eaten by carnivorous fish which then become contaminated. Netting and eating these carnivorous fish will also cause the disease in man. The fish themselves are unaffected.

Most commonly, reef fish (including filefish, groupers, parrotfish, surgeonfish, triggerfish, trunkfish and wrasse) are the carriers. Moray eels are particularly poisonous when affected. The real problem arises when commonly eaten fish suddenly become poisonous. These include anchovies, herrings, barracuda and shad.

Presentation

The disease starts within 12 hours of eating contaminated fish.

- Skin symptoms are typical:
  - ~ Cold feels hot and hot feels cold.
  - ~ Redness, itching, burning and blistering of the skin may occur.
- Flu-like symptoms appear with muscle pains, aching joints and headaches.
- The muscle pains progress to severe weakness, tremors and paralysis.
- Diarrhoea and vomiting can occur.
- Eventually, convulsions, coma and death occur in up to 10% of cases.
- Survival is a lengthy, painful process taking up to a year. Alcohol can cause the features to reappear.

Prevention

Do not eat reef fish, especially their gonads and guts.

Treatment

- Induce vomiting with emetics such as ipecacuanha, drinking a glass of strong salt water or using a finger in the throat. Vomiting will reduce the amount of toxin absorbed.
- When signs develop, urgent medical help must be sought.
- Mouth-to-mouth respiration (see p26) is necessary if breathing stops. *This may have to be continued for hours* (see p26).
- Monitor the pulse and heartbeat continuously. Be ready to administer CPR.
- Remember that the victim is often conscious and aware of what you are doing. Reassurance is *extremely* important.

8.13 Pufferfish (Tetrodotoxin) Poisoning

Cause

Puffers, porcupinefish and ocean sunfish contain a deadly poison called tetrodotoxin in their skin, liver, gonads and guts. It is a potent nerve poison.

Presentation

- Poisoning commences with numbness around the mouth.
- Numbness spreads to involve the whole body.
- Twitching, progressive paralysis, difficulty with speech and swallowing, and convulsions occur.
- Consciousness is usually present.
- Severe respiratory distress with a hypoxic blue colour and bleeding into the skin can occur.
- About 60% of victims die.

Treatment

- Induce vomiting with emetics such as ipecacuanha, drinking a glass of strong salt water or using a finger in the throat. Vomiting will reduce the amount of toxin absorbed.
- When signs develop, urgent medical help must be sought.
- Mouth-to-mouth respiration (rescue breathing) is necessary if breathing stops. *This may have to be continued for hours* (see p27).
- Monitor the pulse and heartbeat continuously. Be ready to administer CPR (see p26).
- Remember that the victim is often conscious and aware of what you are doing. Reassurance is *extremely* important.

TIP
Do not inject adrenalin directly into the bloodstream.

NOTE
Adrenaline and hydrocortisone are emergency life-saving drugs and may only be considered when it is impossible to obtain any trained help. These medications are being given without expert opinion and offer only a hope of success in extreme circumstances.

8.14 Scombroid Poisoning

Cause

Scombroid poisoning follows eating contaminated fish of the scombroid family and includes mackerel, tuna, albacore, swordfish and bonito. The muscle of all these fish is rich in the amino acid histidine. Contamination due to improper preservation or canning allows bacteria entrance to the flesh of the fish. These bacteria break the histidine down to a poisonous amine called saurine, which has many of the properties of histamine.

Presentation

- The affected fish has a characteristic sharp, peppery taste and must be discarded immediately.
- A mixture of allergic-type reactions occurs following ingestion:
  ~ Migraine
  ~ Urticaria
  ~ Asthma
  ~ Gut irritation
- The victim develops an intense headache, with nausea and vomiting, an intensely itchy spreading rash, tightness of the chest with wheezing, palpitations, abdominal pain and diarrhoea; and circulatory shock can occur.

Prevention

The condition can be avoided by prompt freezing or eating the fish after catching it. Do not allow your mackerel or tuna catch to stand in the sun all day.

Treatment

- Induce vomiting as soon as possible unless the diver has already vomited or is very agitated by severe breathing difficulty. Emetics include ipecacuanha, drinking a glass of strong salt water or simply using a finger in the throat. Vomiting will reduce the amount of toxin absorbed.
- Obtain medical help urgently.
- Antihistamines must be given, preferably by injection.
- Acute breathing difficulties due to sudden severe asthma or sudden circulatory collapse and shock are medical emergencies. *A doctor or emergency paramedic service must be summoned.*
- *If the diver is in a remote place with no recourse to any medical help*: inject adrenaline 1:1 000 *subcutaneously* at a dose of 0.1 mℓ/kg body mass, *very slowly over five minutes.* Draw back on the syringe before injecting to ensure that a blood vessel has not been entered by the needle. *Do not inject adrenaline directly into a blood vessel!* Automatic adrenaline injection kits are available (e.g. Epipen).
- Monitor the pulse continuously. It will become forceful and accelerate as the injection is given. If it rises above 120 beats per minute, stop injecting and wait until the pulse settles.
- Watch the diver's face. It will become extremely pale due to the vasoconstrictive effect of adrenaline.
- Monitor respiration continuously. Be prepared for CPR (see p26).
- Inject 2 000 mg of hydrocortisone intramuscularly into the upper outer quadrant of the buttock muscle.
- Administer CPR if breathing and heart function fail.

A first aid certificate is essential for any diver and a diver rescue qualification is of immense value in times of need. Depending on the remoteness of the area, available professional medical help and facilities, and the type of injury or disease, the requirements of medical kits vary.

9.1 Dive Bag Medical Kit

One waterproof container with:

- One bottle of sun barrier cream
- One bottle of post-dive ear drops, e.g. 5% glacial acetic acid in propylene glycol and a dropper
- One small pack of paracetamol tablets
- One small pack of adhesive bandages
- One small bottle of 10% cetrimide solution
- One small pack of cotton wool
- One bottle of anti-seasickness tablets

9.2 Small Dive Boat Medical Kit

This is for when you are a maximum of 30 minutes from qualified medical help.

- One small oxygen bottle with regulator, face mask and tubing
- One waterproof container with:
  - ~ Three small standard dressings (no. 7)
  - ~ Three large standard dressings (no. 9)
  - ~ Two triangular bandages
  - ~ Two 15 cm crepe bandages
  - ~ One pack of 75 mm x 75 mm gauze squares (individually wrapped)
  - ~ Four medium safety pins
  - ~ One roll of adhesive plaster
  - ~ One small pack of adhesive bandages
  - ~ One pair of scissors
  - ~ One pair of tweezers
  - ~ One tourniquet (Esmarch)
  - ~ One 500 mℓ bottle vinegar or anti-sting solution or spray
  - ~ One bottle of sun barrier cream
  - ~ One bottle of post-dive ear drops, e.g. 5% glacial acetic acid in propylene glycol and a dropper
  - ~ One small pack of paracetamol tablets
  - ~ One bottle of antihistamine tablets
  - ~ One bottle of anti-seasickness tablets
  - ~ One tube of antihistamine ointment
  - ~ One bottle of mercurochrome, iodine or antiseptic ointment
  - ~ One small bottle of 10% cetrimide solution
  - ~ One small pack of cotton wool
  - ~ One pair of rubber gloves
  - ~ One pair of goggles
  - ~ One disposable plastic non-return airway for CPR
  - ~ One standard thermometer
  - ~ One low-reading thermometer

TIP
Before leaving on a remote diving expedition, determine whether a doctor is available in the area.

9.3 Medical Equipment for Diving Expeditions in Remote Areas

Before leaving on a remote diving expedition:

- determine whether a doctor is available in the area.
- obtain the doctor's name, address and telephone number.
- contact and inform the doctor about the expedition and request any special information relevant to the area (malaria, dysentery, medical facilities, etc.). Ensure immunisation against diseases such as cholera and typhoid if these are locally prevalent.
- choose an expedition medical leader before leaving. One member of the team should ideally have emergency medical assistance training. See your own doctor before leaving and discuss the expedition.
- ensure available radio or telephone contact with a diver rescue service and a diving doctor in case of serious problems.

9.4 Emergency Medical Box

The complexity and range of a medical kit in remote areas depends upon the medical training of the members in the group and on local endemic diseases. Intravenous infusions and injections, and the use of drugs such as adrenaline, morphine and atropine require special knowledge and training. If members of the group are medically or paramedically trained, the onus of providing and using advanced life-support equipment and drugs must rest with them and the level of their protocol training. In addition to the dive bag and small boat medical kits, provision should be made for the following items:

Oxygen

- At least two large cylinders of oxygen and administration sets are required on board or at the shore base. Until trained emergency help can arrive or be reached, oxygen is the mainstay of treatment in acute decompression illness, severe trauma and shock.

Trauma pack

- An adequate supply of equipment is necessary in case of major trauma. A kit such as one recommended for shark attacks is advised (see p15).

Oral medicines

- The indications and use of oral medicines must be discussed with a doctor and a prescription obtained. A supply adequate for the group size must be provided and purchasing enough for 20% of the people in a large group is a reasonable working number. In small groups, each diver should provide his or her own. In general, oral medicines should include the following:
  - ~ Painkiller tablets
  - ~ Anti-emetics
  - ~ Antidiarrhoeals
  - ~ Antispasmodics
  - ~ Antacid suspension
  - ~ Antibiotics (prior instruction in their use is essential)

Ear/Eye drops

Antiseptic and antibiotic drops.

> The complexity and range of a medical kit in remote areas depends upon the medical training of the members in the group and on local endemic diseases.

HOW TO MANAGE DIVING PROBLEMS

How to Manage Diving Problems is an e-book for the average sport scuba diver. It is not a textbook of diving problems. Rather, it is a quick-fix approach to both major emergencies and minor ailments.

It is intentionally put into electronic format so that it can always be easily on hand. There is no index, but all necessary information is provided in the contents pages, so that time is not wasted in an emergency. Emergency telephone numbers are included as well as step-by-step notes, additional help pages and clearly set-out flow charts.

This is a book for your electronic device. Don't set off on your diving trip without it!

Allan Kayle is the author of *Salvage of the Birkenhead* and *Safe Diving: A Medical Handbook for Scuba Divers*. Dr Kayle was the medical journalist for *Divestyle* magazine, he is a past-president of the Southern African Undersea and Hyperbaric Medical Association, an approved diving physician for the Department of Labour, and on the board of DAN-SA. In 1999, he participated in a CSIR: MININGTEK hyperbaric assessment of toxic gas pollutants in ultra-deep mining. In 2001, he wrote the occupational diving section in *Handbook of Occupational Health Practice in the South African Mining Industry* edited by R.Guild *et al.* and commissioned by the Safety in Mines Research Advisory Committee (SIMRAC). His first novel, *A Match for Doctor Koekentapp*, was published in 2011.

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