CHAPTER 2
EMERGENCY PROCEDURES

GENERAL

201. SCOPE

1. An emergency by definition is an unforeseen combination of circumstances or the resulting state that calls for immediate action. Because of the characteristics of the underwater environment, a situation that might only be annoying on the surface may assume life-or-death proportions for a diver.

2. By training and experience, the diver must be able to handle the wide range of actual and potential emergency situations that may be encountered. The diver must be able to separate the important from the trivial while at the same time recognizing the dangers that a seemingly minor symptom or event may foreshadow. The diver must be able to identify and properly react to the warning signals of various physiological disorders, whether affecting the diver or other divers. The diver must have a working knowledge of the most effective methods of handling physical emergencies (such as entrapment or malfunctioning equipment) as well as a basic knowledge of the correct steps to be taken in treating medical emergencies.

3. Most importantly, the diver must be able to work toward solving the emergency while under severe emotional and physical stress. Analysis of diving fatalities indicates that panic, or an inappropriate reaction to a relatively minor event such as a flooded mask, often triggers a sequence of events that leave the diver with a rapidly diminishing probability of survival. It is thus vital for divers to think through "what if" scenarios in advance. This will help to physically and mentally prepare them for an immediate and rational response.

4. Knowledge and training are vital. Individuals who are well-trained, well-rested, alert and confident can best cope with an emergency. An operation that is thoroughly planned, with a carefully paced workload and the prior organization of all necessary personnel, equipment and supplies, tends to be a safer operation. Finally, while the environment of the dive cannot be directly controlled, it can be understood and any hazardous elements accommodated with special training, equipment or scheduling.

5. This chapter does not cover every possible situation that may cause problems for a diver, nor will it serve as a text on basic first aid. Other chapters of this volume cover operational hazards, general work procedures including some which apply in emergency situations and other publications present sufficient material on general medical procedures that this information need not be repeated here.

6. This chapter specifically details those emergencies that:

   a. May be a matter of life or death;

b. Are unique to diving; and

c. May seriously interfere with the success of an operation.

7. The initial reporting shall be done IAW Diving Incident/Accident Initial Reporting Procedures section in this manual, and the subsequent investigation and report shall be completed IAW the B-GG-380-000/FP-009.

8. Further instructions that apply outside of Canada are contained in ADIVP1 (NAVY).

MEDICAL EMERGENCIES

202. IMMEDIATE ACTION

1. Divers who require emergency medical treatment fall into one of two categories:
ANNEX F
   a. Those who require recompression; and

   b. Those who do not require recompression.

2. All members of the diving team should be able to make this differentiation and should have sufficient knowledge and training to proceed with appropriate treatment or corrective action. It may well be that no treatment would be the most appropriate course of action, especially by non-medical personnel. The first rule of first aid is to do nothing that will harm the patient. However, there are four medical conditions that must be treated immediately and cannot wait for the arrival of medical personnel.

3. Four immediate actions that must be taken, in order of priority, are:

   a. Assure clear airway;

   b. Restore breathing;

   c. Assure heart function; and

   d. Stop massive bleeding.

4. Following these four steps, a more thorough diagnosis of the problem can be made and the assistance of more qualified personnel obtained. A severely injured individual will be best served if the person helping protects the injured from further harm and strives to maintain stable breathing, heartbeat and blood circulation. Other treatment such as recompression may be concurrent with these procedures.

5. Recompression treatment is covered in Volume 5 of the CAF Diving Manual.

6. In-water recompression treatment is covered in this Chapter. Refer to Article 228, Omitted Decompression.

203. MEDICAL EMERGENCY DURING A DIVE

1. In some serious situations (such as traumatic injuries occurring underwater) it may be necessary to bypass or delay normal decompression and risk decompression sickness in favor of rendering immediate first aid to the diver. Such serious situations can include:

   a. Cessation of breathing,

b. Cardiac arrest, and

c. Massive hemorrhage.

2. Loss of consciousness is a serious situation and a complicating factor in any diagnosis. It can be the result of near-drowning, inadequate oxygen, an oxygen convulsion or an excess of carbon dioxide in the blood. In diving, loss of consciousness must be considered to be a symptom of arterial gas embolism (AGE) or decompression sickness (DCS). Recompression should be given in almost every case of unconsciousness simply because it is seldom possible to be certain that it is not a result of AGE or DCS. If satisfied that recompression is not called for in a given case, then treatment can progress along other lines as outlined in the following sections.

204. TREATMENT FOR SHOCK

1. Emergency treatment for shock is needed occasionally with underwater incidents. The procedure is as follows:

a. Assure an open airway;

b. Control hemorrhaging; and

c. Control shock:

(1) Get the patient to relax in a comfortable position with the legs slightly elevated;

(2) Do NOT give pain-killing drugs or alcohol;

(3) Do NOT let the patient eat or drink if seriously injured, as this will increase the risk of vomiting if an operation is necessary; and

(4) Loosen constrictive clothing at the neck and waist and wrap the patient in blankets, to prevent a further loss of heat. The patient should be shaded from the sun and protected from breezes that may chill by evaporation. It is important not to overheat the patient by using heated blanket or hot water bottles. This will cause the superficial blood vessels to dilate and draw blood away from the body core.

d. Obtain medical assistance as soon as possible.

205. RESPIRATORY EMERGENCIES

1. All human life is directly dependent upon the quantity and quality of the breathing medium. Any deviations from established standards can result in a number of respiratory problems. In the underwater environment any such problem must be handled as an emergency.

2. Not all respiratory problems must result in termination of the dive. However, the need to ensure the safety of the diver will usually outweigh the operational requirement to complete the dive and the diver should be brought to the surface for treatment and thorough examination.

3. Every diver and every other member of the diving team must know the warning signs and symptoms for each of the following problems:

a. Oxygen deficiency (hypoxia/anoxia) (Refer to Article 207);

b. Oxygen poisoning (O_2 toxicity) (Refer to Article 208);

c. Carbon dioxide poisoning (Refer to Article 209);

d. Carbon monoxide poisoning (Refer to Article 210);

e. Asphyxia (Refer to A-MD-050-072/PW-001);

f. Strangulation (Refer to A-MD-050-072/PW-001);

g. Chemical irritants (Refer to A-MD-050-072/PW-001); and

h. Nitrogen narcosis (Refer to Article 211).

206. POST-TRAUMATIC STRESS DISORDER (PTSD)

1. PTSD may affect divers following any serious diving accident or death and must be taken into account.

SYMPTOMS AND TREATMENT OF RESPIRATORY DISORDERS

207. HYPOXIA AND ANOXIA (O2 DEFICIENCY)

1. **Definitions**:

a. **Hypoxia**. A shortage of oxygen.

b. **Anoxia**. A complete lack of oxygen.

c. Both are generally caused by wrongly prepared equipment or incorrect drills.

2. **Symptoms**:

a. The diver may experience no symptoms but an observer might notice the following:

(1) Change of behavior (diver becomes over-confident and nonchalant);

(2) Loss of judgment and efficiency;

(3) Dullness of senses;

(4) Restlessness and irritability;

(5) Loss of memory;

(6) Pallor of skin;

(7) Blueness of extremities;

(8) Increase of pulse rate; and/or

(9) Unconsciousness (with anoxia, a very rapid onset).

3. **Treatment**:

a. Treatment for either hypoxia or anoxia is as follows:

(1) Abort the dive.

(2) Surface slowly.

(3) Allow the patient to rest and breathe air or oxygen once out of the water.

(4) In serious cases administer artificial respiration.

NOTE

During recovery the patient may have mild convulsions.

WARNING

Breath hold diving preceded by extensive hyperventilation may cause a form of hypoxia. Artificially lowering the blood's CO_2 level by hyperventilation can mask the need to draw breath, thus allowing the blood's oxygen level to fall below that necessary to sustain consciousness.

208. OXYGEN (O2) TOXICITY

1. **Cause**. Oxygen toxicity results from breathing oxygen at too high a partial pressure. Oxygen toxicity is highly unlikely in CABA at depths shallower than 60 msw, but may occur in RCC when breathing oxygen.

2. **Symptoms**:

a. Symptoms of oxygen toxicity tend to vary from day to day and between individuals. The most frequent symptom is a grand mal convulsion with loss of consciousness. Other symptoms include:

(1) Changes in vision such as blurring or narrowing of the visual field (tunnel vision);

(2) Ringing in the ears;

(3) Nausea/vomiting;

(4) Vertigo/dizziness;

(5) Twitching of the face and lips;

(6) Tremors of the arms and legs;

(7) Anxiety;

(8) Confusion;

(9) Malaise or excessive tiredness;

(10) Uncoordinated;

(11) Numbness or tingling of the fingers or toes;

(12) Fainting;

(13) Spasmodic breathing;

(14) Difficulty in taking a full breath or apparent resistance to breathing; an

(15) Convulsions.

3. **Treatment**:

a. Treat as follows:

(1) If in the RCC, switch to air;

(2) If in the water, do not change depth or surface during the rigid phase of convulsion (unless drowning);

(3) Remove the breathing apparatus and suit and place the patient in fresh air to recover; and

(4) During convulsions, stabilize the diver sufficiently to prevent self-injury.

209. CARBON DIOXIDE (CO2) TOXICITY

1. **Causes**:

a. Insufficient air being supplied to the diver;

b. Incorrect or shallow breathing by the diver;

c. Failure of the CO2 absorbent system (not applicable to CABA);

d. Contamination of breathing gases; and

e. Over-exertion. Over-exertion increases CO2 production and makes CO2 build-up more likely.

2. **Prevention**:

a. Ensure proper maintenance of equipment (regulator performance and air quality);

b. Ensure adequate ventilation;

c. Avoid over-exertion; and

d. Ensure that breathing is correct, i.e. long, deep breaths with all equipment.

3. **Symptoms**:

a. Breathlessness and panting;

b. Dizziness, nausea, headaches, anxiety;

c. General distress, sweating and palpitations;

d. Loss of consciousness; and/or

e. Death.

NOTE

What is an acceptable proportion of CO2 at atmospheric pressure can be lethal at depth. Loss of consciousness is often the initial symptom.

4. **Treatment**:

a. Treat as follows:

(1) On the bottom, relax and breathe deeply;

(2) Signal for more air according to the equipment in use. If this does not bring relief the diver must surface;

(3) Give the diver oxygen or fresh air; and

(4) Allow the diver to rest. Recovery should be rapid. If not, obtain medical attention.

NOTE

The after effect of carbon dioxide toxicity may be a headache.

210. CARBON MONOXIDE (CO) POISONING

1. **Cause**. Carbon monoxide poisoning results from breathing impure air most likely contaminated by exhaust fumes when the cylinder was being charged.

2. **Prevention**:

a. Adhering to the following can prevent carbon monoxide poisoning:

(1) Always ensure that air intakes are upwind of exhaust fumes;

(2) Avoid air intakes drawing air from inside compartments. Intakes should be sited out-side in the open; and

(3) If stored in cylinders, breathing air must be obtained from authorized reputable sources.

3. **Symptoms**:

a. Symptoms are similar to those of hypoxia, but also include:

(1) Exhaustion with breathlessness;

(2) A feeling of nausea;

(3) Increasing weakness;

(4) Dizziness and vertigo;

(5) A pink coloration, otherwise skin pallor; and/or

(6) Loss of consciousness.

4. **Treatment**:

a. Treat as follows:

(1) Allow the patient to breathe 100% oxygen or fresh air;

(2) Give artificial respiration if required; and

(3) An urgent consultation should be arranged with an ADMO or C/DM - or at any hyperbaric chamber.

211. NARCOSIS

1. Cause. Narcosis is caused because inert gases, especially nitrogen, become narcotic under pressure. The severity depends on depth (partial pressure).

2. Prevention:

a. Adhering to the following can prevent narcosis:

(1) Limit the depth of the dive.

(2) Deep divers should keep worked-up. This does not prevent narcosis but enables the diver to learn to partially control the effect.

(3) Dive using a less narcotic inert gas, such as helium (not applicable to CABA).

3. Symptoms

a. Slurred speech,

b. Irresponsibility,

c. Inability to concentrate and

d. Feeling of intense well-being.

4. Treatment

a. Decrease the depth of the dive.

b. In serious cases bring the diver to the surface.

NOTE

Symptoms are similar to those of drunkenness. There is no danger from the narcotic effect itself. What are dangerous are the diver's consequent actions that may lead to injury or drowning.

DIVING EMERGENCIES WITH DIRECT MEDICAL INVOLVEMENT

212. DISCUSSION

1. Emergencies discussed in this section are those which arise out of the nature of the diving environment: drowning, pressure imbalance and problems of low temperatures and heat loss leading to emergency conditions.

213. DROWNING/NEAR-DROWNING

1. Divers can drown because of over-exertion, panic, and an inability to cope with rough water, exhaustion and/or the effects of cold water or heat loss. The prevention of drowning is best ensured by the establishment of, and thorough training in, safe diving practices coupled with the careful selection of diving personnel. A physically fit and confident diver equipped with proper gear should not easily fall victim to drowning.

2. To treat near-drowning:

   a. Ensure airways are clear; if water is in mouth attempt to clear by rolling the casualty into recovery position and then back to supine.

   b. Restore breathing and heartbeat; follow the most current CPR procedures.

   c. Oxygenate; utilize the CAF Diving Team Resuscitator.

   d. Remove wet or constricting clothing, wet suits/dry suits, etc.

   e. Alert and seek assistance from qualified medical personnel.

   f. Transport casualty to the nearest medical facility, noting that a recompression chamber may well be necessary.

   g. Regardless of the mildness or severity of a near-drowning case, all victims must be hospitalized as quickly as possible; follow-on lung failure and infection is possible in every near-drowning case.

WARNING

Drowning victims, especially if they are hypothermic may survive for unexpectedly long periods of time without breathing or blood circulation. Also, the victim's response to resuscitation is sometimes very slow and difficult to identify. In these instances death can only be confidently diagnosed after prolonged failure of sophisticated management by medical personnel using specialized monitoring equipment. Therefore it is essential that all personnel involved in first aid to drowning victims

persevere with resuscitation - even when the situation appears hopeless - until the patient reaches definitive medical care.

WARNING

Regardless of the mildness or the severity of a near-drowning case, all victims should be hospitalized as quickly as possible. The occurrence of pulmonary edema (accumulation of fluids in the lungs), pneumonia and other complications may be delayed for many hours after the incident and proper medical observation is essential.

WARNING

While awaiting transportation to medical facilities the patient should be kept warm and comfortable.

214. SQUEEZE

1. Squeeze (barotrauma) is caused by a lack of pressure equalization between the gas spaces in the body or between the body and the diving equipment. It normally occurs during descent. Squeeze may be categorized by location and cause as follows:

a. **Facemask Squeeze**. This is caused by a failure to equalize air in the mask by nasal exhalation. The eyes and eye socket tissues can be seriously affected.

b. **External Ear Squeeze**. May be caused by a hood or piece of equipment covering the outer ear, thus blocking the outer ear canal.

c. **Middle Ear Squeeze**. This is caused by a blocked Eustachian tube, increasing middle ear pressure relative to ambient pressure and bowing the eardrum, causing pain. This over-pressure can rupture the eardrum.

d. **Suit Squeeze**. This normally occurs in stiff dry suits in which a pocket of gas becomes trapped under a fold or fitting and pulls the skin into the fold area. Lack of suit inflation gas may lead to suit squeeze.

e. **Body Squeeze**. This is caused by a failure of the gas supply to balance ambient pressure and helmet pressure when wearing a surface-supplied helmet. It can be precipitated by a fall into water of greater depth or by the malfunction or maladjustment of helmet supply and/or exhaust valves.

2. Squeeze may be relieved by the following procedures:

a. Stop descent.

b. If efforts to equalize pressure fail, ascend to shallower depth.

c. If further efforts to equalize pressure fail, abort the dive.

3. If an eardrum rupture is suspected, send down the standby diver to assist. Dizziness and disorientation caused by a ruptured eardrum may expose the diver to further hazards, such as vertigo, vomiting, aspiration and in the worst case, panic ascent leading to death.

4. If a diver suffers any physical injury, the diver must notify the Diving Supervisor and report to a Medical Officer for appropriate treatment.

215. HYPOTHERMIA

1. Immersion hypothermia (significant loss of body heat) is a potential hazard whenever diving operations take place in cool to cold waters. Hypothermia can be prevented by providing insulating garments, by limiting the duration of cold water dives and by re-warming the diver completely between dives. Adequate thermal support for divers is a necessity if operations are to proceed safely. A chilled diver must be brought out of the water before serious complications arise. Heat losses must be restored. Also refer to Article 143.

2. Immersion in cold water may be immediately painful and distracting even before significant heat is lost. The hypothermic diver loses muscle strength and the ability to concentrate. The diver may be irrational or confused. Continued chilling can result in collapse, unconsciousness or death.

3. Diagnosis of hypothermia is easy if the condition is suspected but may be complicated by additional diving injuries. If the skin is cold the diver may shiver violently, and with severe hypothermia shivering may be replaced by muscle rigidity. Profound hypothermia may so depress heartbeat and respiration that the victim appears dead.

4. The treatment for hypothermia is re-warming. In mild cases when the diver is only chilled, treatment is still important if diving operations are to continue. Hypothermia severe enough to cause confusion or unconsciousness is a medical emergency. Do NOT wait on medical assistance before beginning re-warming. In profound hypothermia, even when it appears that breathing has stopped and there is no cardiac action, re-warming should be attempted only under specialist medical supervision.

5. The quickest and most efficient way to re-warm a conscious diver is with warm water, either in a bath or directly under the diver's wet suit. Rapid re-warming, if necessary, is best accomplished using water heated to 37 to 40°C. If hot water is not available, the next alternative is to dry the diver and provide warm clothes or blankets and a warm room or heat from another source.

6. A diver should be completely re-warmed before attempting a repetitive dive in cold water. Studies have shown that individuals suffering from heat loss invariably report feeling warm again very soon after they stop shivering, when re-warming is less than half complete. A simple indication that re-warming has been carried on long enough is the onset of sweating. In

repetitive diving with exposure to cold, the operation should be planned so that the diver is re-warmed to the point of sweating before the next dive.

216. HYPERTHERMIA

1. Divers may easily succumb to hyperthermia (over-heating). Hyperthermia is potentially fatal, very difficult for the diver to detect and can lead to confusion and unconsciousness. Refer to Article 145.

2. Some measures to prevent hyperthermia are:

   a. Good hydration,

   b. Rest,

   c. Minimize exposure,

   d. Positive cooling measures and

   e. Selection of diving equipment.

3. Improved preventive procedures will be promulgated when available.

217. GAS EXPANSION

1. Occasionally a diver may experience various types of internal gas expansions. For example, in rare instances, a middle ear or sinus that has equalized pressure on descent may block on ascent, trapping a pocket of gas. Slowing the rate of ascent will usually permit the gas to escape without additional complications.

2. A more common condition results from the generation of gas in the intestines during a dive or from swallowing air that becomes trapped in the stomach. These pockets of gas will usually work their way out of the system through the natural vents. If not, and if the pain begins to pass the stage of mild discomfort, ascent should be halted and the diver should descend slightly until the pain is relieved. The diver should release the gas anally or attempt to belch, with the following caution: overzealous attempts to belch may result in swallowing more air.

3. Most intestinal gas expansion can be avoided by a few simple precautions: do not dive with an upset stomach or bowel, avoid eating foods that are likely to produce intestinal gas and avoid swallowing air during a dive.

218. BLOW-UP

1. Blow-up is defined as an uncontrolled rapid ascent caused by excessive positive buoyancy (usually due to over inflation of the diver's dry suit or BC). A diver should be aware that blow-up can lead to a number of serious problems, including gas embolism, decompression

sickness and physical injury from collision with surface objects. Additionally, should the dry suit rupture from the high internal pressure, the diver can fall back to depth and be exposed to squeeze or drowning.

2. A diver should be particularly wary of the possibilities of blow-up when executing any maneuver that requires an increase in buoyancy, particularly if trying to free from a muddy bottom or in a similar situation where the diver is likely to break free suddenly.

3. The possibility of blow-up is also high when engaging in underwater jetting or tunneling while using a dry suit. Stirred up silt or sand can clog the dry suit's exhaust valve resulting in a gradual and often unnoticed build-up of air in the suit. It is good practice to operate the exhaust valve at regular intervals to ensure that it is clear and working properly.

4. If caught in a blow-up, the diver must:

   a. Breathe normally or exhale continuously to avoid embolism.

   b. Attempt to vent air using the BC's manual dump valve or by using the dry suit exhaust valve.

5. When reaching the surface, vent enough air to prevent rupture of either the dry suit or buoyancy compensator while at the same time maintaining positive buoyancy. The attendant should take in any slack in the lifeline, get the diver out of the water and quickly examine the diver for signs of serious injury.

6. If the dive did not require decompression stops and the diver appears to be uninjured, ensure that the diver is closely watched and kept within one hour's travelling time of a hyperbaric chamber for a period of four hours.

7. If the dive required decompression stops that were omitted or if the diver shows any signs of decompression sickness or embolism, recompress the diver in a hyperbaric chamber at once.

8. If an RCC is not immediately available, transport the diver to the nearest chamber immediately using prescribed emergency procedures. Also refer to, Omitted Decompression.

219. FOULING AND ENTRAPMENT

1. Divers must be particularly careful to watch not only their own lines but also those of other divers. Fouling and entrapment are more common with surface-supplied gear than with CABA because umbilical’s can easily become entangled. Although the surface-supplied diver may become fouled more easily, the surface-supplied diver will also usually have an ample air supply while working to get free. This is not the case with the CABA diver.

2. If the diver is trapped, the possibility of running out of air before working free must be faced. If attempts to unfoul fail, the CABA diver should consider cutting/disconnecting a fouled life-line. Ditch weights if required. Ditching gear and making a free ascent is a last resort.

3. The first and most important thing for a trapped diver to do is to stop and think. Remain calm, analyze the situation and carefully try to work out of it. Panic and over-exertion are the greatest dangers to the trapped diver and if a simple effort will not resolve the situation, GET HELP. Always keep in mind that the CABA diver can be given a new apparatus or be furnished with air by a buddy or the standby diver.

4. Once the diver has been freed and returns to the surface, examine and treat the diver with the following considerations in mind:

a. The diver will probably be over-tired and emotionally exhausted.

b. The diver may be suffering from, or approaching, hypothermia.

c. The diver may have some physical injury.

d. Decompression may have been omitted in which case recompression will be required.

220. EQUIPMENT FAILURE

1. Operational failure will rarely be a problem with good equipment that has been well maintained and thoroughly inspected and tested before each dive. When a failure does occur the correct procedure will depend upon the nature of the equipment and the dive. As with most emergencies, the training and experience of the diver and the diving team will be the most important factor in safely resolving the situation.

221. LOSS OF AIR SUPPLY

1. A CABA diver without air or with malfunctioning breathing apparatus should make a free ascent, remembering to exhale. If with a buddy, buddy breathe and ascend. Ascending while buddy breathing must be conducted with care since the possibility of embolism (due to breath holding) is increased.

2. Air Sharing (Buddy Breathing). This is to be used only in an emergency when the diver cannot surface immediately and a new air supply is not readily available or is delayed. The out of air diver signals and swims toward the buddy (Stby) diver. The buddy (Stby) diver will face the out of air diver and provide the secondary air supply regulator (octopus) fitted to the BC. While the out of air diver breathes from the octopus, the buddy (Stby) diver takes positive control of the out of air diver by grasping the BC. Both divers should begin a controlled ascent to the surface to prevent injuries.

222. LOSS OF COMMUNICATION

1. Loss of communication between diver and attendant can be the first sign of serious problems. Additionally, because co-ordination between divers or between a diver and an attendant is interrupted, dangerous situations can rapidly develop, particularly when working with underwater tools and equipment.

2. Correct procedures for the loss of communication are:

   a. Re-try line pull/diver recall/through-water signals at once, but keep in mind that because of depth, current, bottom or worksite conditions they may not always work.

   b. Check the diver's rising bubbles of air. Look for a cessation or marked diminishing which could be a sign of trouble.

   c. Send down the standby diver.

223. LOST DIVER

1. In planning for an operation using CABA, "lost diver" procedures must be included and understood by all personnel. ATP-10(C), Search and Rescue, Chapter 6 contains pertinent graphs, diagrams and tables for calculating such factors as surface current caused by wind, efficient search methods and the probable area of the victim's location.

2. The first stage of a "lost diver" situation occurs when communications have been lost. The Diving Supervisor must IMMEDIATELY mark the position with the lost diver marker (refer to Article 433) and institute search procedures. At the same time, medical personnel should be notified and the hyperbaric chamber brought to IMMEDIATE NOTICE.

3. If the lost diver has become trapped or injured and the visibility is good, the diver should not be difficult to locate and assist. If visibility is poor the difficulty is greatly increased. This is one reason for the requirement that CABA divers be equipped with a buddy line or a surface-tended lifeline.

4. A lost diver is often one who has lost bearings and moved out of the operating area. The diver may be suffering from narcosis or a problem with the breathing mixture. This can result in mental confusion, disorientation, anxiety or panic. Unknowingly, a diver could harm those attempting rescue. When located, rescuers should approach cautiously to avoid being harmed while assessing the stricken diver's condition.

5. If the diver is unconscious when found bring the diver to the surface IMMEDIATELY.

   a. If possible, ensure the diver's head is held back to keep the airway open.

b. Ascend SLOWLY. Rescuers should always remember the risk of embolism during ascent.

224. IMMERSION PULMONARY EDEMA

1. Immersion pulmonary edema (IPE) is the inappropriate accumulation of fluid in the lungs as result of immersion in water. The exact cause is unknown, but is likely due to the shift of blood from the limbs to the body core with immersion in susceptible individuals. Constriction of peripheral blood vessels due to cold or stress may further accentuate this shift. Additional contributing factors may include overhydration, negative pressure breathing (e.g. resistance from diving equipment), increased breathing rate, overtight diving suit, cold water, and heavy exercise. Diseases affecting the cardiovascular or respiratory systems may predispose to IPE. Reporting mechanisms suggest that occurrence of IPE in CAF diving is infrequent. However, minor occurrences are likely under reported as they may resolve quickly post-immersion and be misattributed to shortness of breath from dive-related exercise. It may even occur in a seasoned diver.

2. Several steps should be taken to reduce the risk of IPE in the diver. First, divers must be aware that anyone immersed in water for diving or swimming may experience IPE regardless of past diving history. Second, certain risk factors can be modified before immersion, such as avoiding overhydration that puts extra strain on the circulatory system. Aim for lack of thirst and clear urine as a guide for neutral hydration status. Further preventive measures include: adequate insulation for the water temperature conditions; ensure diving suit is not overtight; and, avoid negative pressure breathing.

3. Recognition of IPE is important. Unlike decompression illness, IPE can occur anywhere in the water column from surface to bottom. IPE is associated with symptoms such as cough, shortness of breath, and production of frothy or bloody sputum. If these symptoms occur, abort the dive, place the diver on supplemental oxygen, and activate a medical response including ADMO consultation. Most cases of IPE resolve soon after removal from water, removal of dive equipment, warming, placement on oxygen, and rest. At times, more advanced medical intervention is necessary and a monitoring period is always required with medical personnel. Patients with IPE must not receive hyperbaric oxygen therapy.

4. If a diver experiences IPE they will be deemed unfit to dive until CDSM and specialist evaluations are obtained to assess future fitness to dive.

DIVING EMERGENCY PROCEDURES

NOTES

(1) Always remain calm.

(2) **DIVER**: Continuously communicate (if possible) with topside or with buddy.

(3) If ever in doubt, send down the standby diver.

(4) **TOPSIDE**: Prepare for emergency recompression.

(5) Check surfaced diver for injury.

NOTE

These following procedures are recommended as basic rules only. Not all situations will be the same.

Cause	Affected Personnel	Action
Fouling	**Diver**	1. Move slowly and carefully. 2. Retrace steps to source of fouling. 3. If on lifeline, signal surface of condition and what you are attempting to do. 4. Consider cutting/disconnecting lifeline, ditching weights and conducting a free ascent. 5. For ULSSDS: Attempt to clear. If unable to clear, then signal surface, ditch weights, harness, mouthpiece / AGA maskand conduct a free ascent.
	STBY diver	1. At Supervisor's direction, check to see if the diver is all right. 2. If the diver conducts a free ascent, assist the diver. 3. Provide standby breathing assistance to the diver on ascent if the diver's equipment has been ditched.
	Supervisor	Prepare for recompression after medical check.
Traumatic injury while in-water	**Diver**	Reduce blood loss by applying pressure.
	STBY diver	1. Improvise pressure dressing. 2. Assist diver in controlled ascent. 3. Be prepared to handle diver in shock.
	Supervisor	Treat diver for shock and blood loss.
Lost communication or lost diver	**Diver**	If separated from buddy or swim line, surface and indicate position.
	STBY diver	1. If diver's air bubbles are visible, follow them. 2. If visibility allows, upon finding diver use hand signals to determine condition. 3. Assist diver to the surface.
	Supervisor	1. If an attendant reports loss of communication, re-try available comms (line pulls/diver recall/through-water comms). 2. Mark area immediately with Lost Diver Marker. 3. Send standby diver out to trace diver's bubbles if visible. If not, follow diver's lifeline and mark area for search. 4. Fix location by all available navigational means and record data.

Figure 2-1 (Sheet 1 of 3) Diving Emergency Procedures

Cause	Affected Personnel	Action
Unconscious diver	**Diver**	Diver unconscious
	STBY diver	1. Assist diver to the surface, removing weights if necessary. Support diver in head back position. 2. Inflate diver's BC.
	Supervisor	1. Transport and recompress as soon as possible. 2. Monitor the diver for signs and symptoms.
Emergency ascent	**Diver**	1. Ditch weights. 2. Inflate BC if necessary. 3. Make controlled ascent, exhaling continuously during ascent. 4. Activate day/night distress flare upon surfacing.
	STBY diver	Assist as directed.
	Supervisor	1. If on lifeline, have attendant take up slack as diver ascends, but do not pull up the diver unless signaled for assistance. 2. Monitor the diver for signs and symptoms. 3. Prepare for recompression as required.
Delay or unplanned decompression	**Diver**	Ascend to pre-planned stop.
	STBY diver	Assist as directed.
	Supervisor	1. Provide pre-planned stop depths. 2. Monitor dive profile. 3. Rig shot/lazy shot. Provide alternative air supply at pre- planned stops. 4. Prepare for recompression as required.

Figure 2-1 (Sheet 2 of 3) Diving Emergency Procedures

Cause	Affected Personnel	Action
Loss of air supply in ULSSD	**Diver**	1. Ensure umbilical is clear. 2. Activate reserve. 3. Ditch weights if necessary. 4. Inflate BC or dry suit to give positive buoyancy but do not over- inflate. 5. Make a controlled ascent.
	STBY diver	1. Assist as directed. 2. Provide breathing assistance as required.
	Supervisor	1. Direct standby diver to assist if necessary. 2. Have attendant take up umbilical slack as diver ascends. 3. Monitor the diver for signs and symptoms. 4. Prepare for recompression as required.

Figure 2-1 (Sheet 3 of 3) Diving Emergency Procedures

MEDICAL EMERGENCIES REQUIRING RECOMPRESSION

225. GENERAL

1. This section does not cover every possible situation that may cause problems for a diver, nor does it serve as a text on first aid. Volume 1 of the CAF Diving Manual covers diving physiology. Medical Emergencies, to provide information on first-aid, resuscitation techniques and control of bleeding.

2. This section specifically details the diagnosis of those emergencies that may require recompression treatment.

3. **IF IN DOUBT, SEEK DIVING MEDICAL ASSISTANCE**.

226. ANCILLARY AND FOLLOW-UP TREATMENT

1. Divers who require recompression may or may not require emergency medical treatment. All divers should be able to make this differentiation and should have sufficient knowledge and training to proceed with appropriate treatment or corrective action. Refer to, Immediate Action, for generic emergency treatment of divers. These procedures can be followed while preparing for a recompression treatment or may be performed in the hyperbaric chamber.

2. Before returning to fit diving status following a medical restriction or hyperbaric treatment, the diver must be assessed by a medical authority as described below:

a. Non-pulmonary Barotrauma. Cleared to dive by a PA or above and fit to return to diving when able to clear ears.

b. Pinhole Tympanic Membrane Perforation. Unfit for diving for a minimum of two weeks; must be cleared to dive by a hyperbaric-qualified PA, or a DMO or an ADMO.

c. Major Tympanic Membrane Injury. Unfit for diving until cleared to dive by an ENT specialist.

d. DCS Type I. Unfit for flying for 3 days; unfit for diving for a minimum of 7 days; must be cleared to dive by an ADMO or equivalent prior to diving.

e. DCS Type II with Complete Resolution of Symptoms on First Treatment. Unfit for flying for 7 days; unfit for diving a minimum of 30 days; must be cleared to dive by ADMO or equivalent prior to diving.

f. DCS Type II with Residual Symptoms, or Requiring More Than One Hyperbaric Treatment. Unfit for flying for 10 days; unfit for diving until case has been reviewed by DRDC Toronto/ Consultant in Diving and Hyperbaric Medicine

(CDHM), after which clearance to dive must be given by an ADMO once DRDC Toronto/CDHM has concluded any necessary review or board.

g. AGE with Complete Resolution of Symptoms. Unfit for flying for 7 days; unfit for diving until case has been reviewed by CDM (Consultant in Diving Medicine) or AUMB (Aerospace and Underwater Medical Board). Prior to resuming diving, the diver must be cleared by an ADMO once the review IAW paragraph 2.f is concluded.

h. AGE Requiring Two or More Hyperbaric Treatments. Unfit for flying for 10 days; unfit for diving until case review IAW paragraph 2.f is concluded.

3. All determinations of medical fitness to dive must be recorded in the member's medical records. If necessary, the diver's personal log (CF 849) should also be annotated on the appropriate medical or dental exam page.

227. EMERGENCIES REQUIRING RECOMPRESSION

1. There are three general classes of diving medical emergency requiring treatment by recompression:

a. Arterial Gas Embolism (AGE),

b. Decompression Sickness (DCS), and

c. Omitted Decompression ("Omitted-D").

2. Arterial Gas Embolism (AGE) is the most dangerous of the three and must be treated as an extreme emergency. It can occur during a brief, shallow dive, even a dive made in a swimming pool with breathing equipment. It develops rapidly and must be treated immediately.

3. Decompression sickness can be just as serious, but may develop quite gradually - up to 24 hours after the completion of a seemingly routine and uneventful dive. However, statistics indicate that most cases will occur within 6 hours of surfacing.

4. Omitted decompression results from failing to observe the appropriate decompression schedule, possibly as a result of serious injury to the diver in the water or an emergency at the dive station. In some cases, using one of the CAF Air Diving Tables may prevent decompression sickness. Otherwise, a therapeutic treatment table must be followed (refer to B-GG-380-000/FP-005, CAF Diving Manual, Vol. 5).

228. OMITTED DECOMPRESSION AND ARTERIAL GAS EMBOLISM, GENERAL

1. This Article deals with the two diving emergencies usually requiring the fastest reaction from the diving team: omitted decompression and arterial gas embolism.

a. **Omitted Decompression**. Omitted decompression ("Omitted-D") may range from minor to major decompression deficits. For the purposes of the CAF Air Diving Tables "omitted decompression" is defined as "the time omitted from in-water decompression as calculated from the appropriate CAF Air Diving Table".

b. **Pulmonary Over inflation Syndrome (POS)**.POS is a general term used to describe the result of the expansion of gas which has been taken into the lungs while breathing under pressure and held in the lungs during a reduction in pressure, normally during ascent. The gas might have been retained in the lungs by choice (voluntary breath holding) or by accident (blocked air passages). The diver, reacting with panic to a difficult situation, may breath-hold without thought. This is a panic-induced involuntary reaction. Gas can also be trapped in a portion of a lung as a result of damage from previous disease or accident, active infection (e.g. pneumonia, bronchitis) or asthma.

2. When the lungs are overinflated and the alveoli rupture, gas can go to four locations:

a. **Arterial Gas Embolism (AGE)**. Gas enters the capillaries surrounding the alveoli, travels back to the heart in the pulmonary veins, and is carried by the blood throughout the body.

b. **Pneumothorax**. Gas goes to the potential space between the lung and the chest wall causing collapse of the lung. This is rare in healthy individuals since the membrane covering is very tough and seldom ruptures.

c. **Mediastinal Emphysema**. Gas travels along the veins, arteries and bronchioles from the site of rupture in the periphery of the lung to surround the heart, great vessels and root of the lungs in the center of the chest (mediastinum) and

d. **Subcutaneous Emphysema**. Gas travels up from the mediastinum to lie under the skin in the area above the clavicles at the base of the neck.

3. In AGE the gas bubbles in the blood may lodge in the arteries of the spinal cord or the brain, cutting off circulation causing paralysis, unconsciousness or death. If the brain is involved the term cerebral gas embolism may be used.

4. Pneumothorax, mediastinal and subcutaneous emphysema are generally not as life threatening as arterial gas embolism but must still be dealt with swiftly. Recompression is not indicated for pneumothorax, mediastinal/ subcutaneous emphysema and treatment should be at the discretion of an Advanced Diving Medical Officer.

5. If gas in the lungs is not expelled, an ascent of only 1 meter can cause rupture of the alveoli. This is a more significant concern near the surface where expansion of the gas is greatest. Symptoms of AGE will normally be evident within minutes of surfacing. Speedy diagnosis treatment and recompression are essential if permanent injury or death is to be avoided.

229. OMITTED DECOMPRESSION

1. Omitted-D may range from a minor to a major decompression deficit.

2. Certain emergencies may interrupt or prevent planned decompression. Blow-up, an exhausted air supply or bodily injury constitute such emergencies. If the diver shows any symptoms of decompression sickness or gas embolism, immediate treatment using the appropriate oxygen treatment table is essential. Even if the diver shows no symptoms or ill effects (i.e. is asymptomatic), omitted decompression must be treated by recompression to reduce the risk of DCS.

3. The preferred action is to transport the diver to a recompression chamber (RCC) for treatment. The diver should receive 100% oxygen via a double-seal oral-nasal mask while en-route to the RCC.

4. When an RCC is immediately available, omitted decompression should be managed IAW B-GG-380-000/ FP-003, B-GG-380-000/FP-004 and B-GG-380-000/FP-005 (Vols. 3, 4 and 5, CAF Diving Manual).

5. When transit to an RCC is not feasible, and the diver is asymptomatic (refer to Article 235 to 238), the Diving Supervisor may:

   a. Return the diver to a depth one stop deeper than where the omission occurred, repeat this stop and continue decompression IAW the original schedule, or

   b. If the omission occurred at the first stop, return the diver to a depth one stop deeper and remain there for the time scheduled for the first stop. Continue decompression IAW the original schedule.

6. While conducting a Sur-D, if for any reason the Sur-D procedure cannot be completed, the diver must be treated using emergency procedures IAW B-GG-380-000/FP-003 and B-GG-380-000/FP-004, Vol 3 and 5, CAF Diving Manuals).

7. If a diver omits decompression and violated the seven-minute Surface Interval, use Treatment Table protocol found in B-GG-380-000/FP-003 and B-GG-380-000/FP-005 (Vols. 3 and 5, CAF Diving Manual).

NOTE

All CAF Treatment Tables are found in B-GG-380-000/FP-005.

230. ARTERIAL GAS EMBOLISM (AGE)

1. Arterial gas embolism must be diagnosed quickly and correctly. The supply of blood to the brain is almost always involved and unless promptly and properly treated (by

recompression), gas embolism is likely to result in permanent disability or death. The circulation time from the heart to the brain is only a few seconds and neurological symptoms such as unconsciousness will normally occur within a few minutes of reaching the surface.

2. Any central nervous system (CNS) symptom that develops more than ten minutes after surfacing is rarely the result of gas embolism. CNS symptoms are described in Article 237.

3. Any diver who may have obtained a breath from any source at depth and who loses consciousness or exhibits any neurological symptom within ten minutes after reaching the surface must be assumed to be suffering from arterial gas embolism. Recompression treatment must be started immediately.

4. Other factors to consider in diagnosing arterial gas embolism are:

a. The onset is usually sudden and dramatic, often occurring within seconds after arrival on the surface or even before reaching the surface. The signs and symptoms may include:

(1) Bloody, frothy sputum, dizziness, paralysis, weakness, respiratory failure, disturbance of vision or convulsions. The diver may have noticed chest pain or a sensation like a blow to the chest during ascent.

(2) It is common for the first symptom to be convulsion or loss of consciousness.

b. A diver suffering from decompression sickness may also experience some of these symptoms but the time of onset is normally later.

c. If the dive has been to a depth of less than 9 msw, decompression sickness is unlikely and arterial gas embolism must be assumed.

d. If the only symptom is pain, AGE is unlikely. Decompression sickness or one of the other conditions resulting from a burst lung should be assumed.

e. The dive profile will usually provide clues to the correct diagnosis (i.e. uncontrolled or rapid ascent).

5. Some symptoms may be masked by environmental factors or by other less significant symptoms. A diver who is chilled may not be concerned with numbness in an arm. Pain from any source may divert attention from other symptoms. The natural anxiety that would accompany the failure of the air supply, for example, might mask anxiety or a state of confusion that is actually being caused by AGE affecting the brain. A diver who is coughing up blood or bloody froth may be showing signs of ruptured lung tissue or may have merely bitten his or her tongue.

6. Ambiguities of this sort will usually be quickly resolved by the appearance of more severe symptoms. However, once the diver is in the hyperbaric chamber it may be difficult to evaluate symptoms.

7. Pneumothorax, mediastinal and/or subcutaneous emphysema may accompany AGE. Therefore, a very careful neurological examination must always be performed and if there are any neurological signs or symptoms, immediate treatment for AGE must be initiated.

8. The treatment for arterial gas embolism is usually longer and more aggressive than treatment of other diving injuries because the risk of permanent brain damage is much greater.

9. IF THERE IS ANY DOUBT REGARDING THE CORRECT DIAGNOSIS, IT MUST BE RESOLVED IN FAVOR OF THE DIVER. ASSUME ARTERIAL GAS EMBOLISM AND TREAT ACCORDINGLY.

231. PNEUMOTHORAX

1. Chest pain and the coughing up of blood or bloody froth frequently accompany pneumothorax. Shallow, rapid breathing, an increased pulse rate, cyanosis and/or subcutaneous emphysema may also be present. Pneumothorax may be detected by listening to both sides of the chest. Chamber venting and other noises will need to be suppressed to do this effectively. Breath sounds will be decreased or inaudible over the site where a significant pneumothorax exists.

232. MEDIASTINAL EMPHYSEMA

1. The symptoms of mediastinal emphysema may include discomfort or pain under the breastbone, shortness of breath and faintness. These latter two would be the result of the trapped gas pressing against the lungs, heart and large blood vessels, thereby interfering with breathing and/or circulation. This might also be evidenced by blueness (cyanosis) of the skin, lips or fingernails.

233. SUBCUTANEOUS EMPHYSEMA

1. The victim (except in an extreme case) may not notice subcutaneous emphysema, although the diver might experience a feeling of fullness around the neck and have difficulty swallowing. The sound of the diver's voice may change and an observer may note a marked swelling or inflation of the diver's neck. Movement of the skin near the collarbone may produce a crackling or crunching sound (crepitation).

234. DECOMPRESSION SICKNESS

1. Decompression sickness (DCS) is caused by inadequate decompression. Occasionally, DCS occurs even when normal decompression procedures are followed. Certain factors increase the likelihood of DCS, even when following standard procedures. These predisposing factors

must be taken into account by increasing decompression time when necessary or by avoiding or minimizing the predisposing factor.

235. PREDISPOSING FACTORS FOR DECOMPRESSION SICKNESS

1. The likelihood of DCS increases when one or more of the following factors are involved:

   a. Injury (previously injured sites might be more prone to develop DCS),

   b. Obesity,

   c. Hangover (after alcohol consumption),

   d. Age (risk increases with age),

   e. Strenuous physical exercise (before, during or after diving),

   f. Dehydration from any cause (e.g. hangover),

   g. Poor physical fitness,

   h. Cold (especially during decompression),

   i. Mental stress (unfamiliarity with diving, fear or anxiety),

   j. Fatigue, and

   k. Infection.

2. Whenever possible, the complete history of the dive and any predisposing factors should be taken into account when diagnosing DCS.

236. DIAGNOSIS OF DECOMPRESSION SICKNESS

1. Decompression sickness usually causes symptoms within a short time following the dive or pressure exposure. If the required decompression has been severely shortened or completely omitted, the diver could suffer decompression sickness before reaching the surface. In general, the time of occurrence for the onset of the first symptom after surfacing is as follows:

   a. 70% of first symptoms occur within 1 hour after surfacing,

   b. 90% of first symptoms occur within 6 hours after surfacing and

   c. 99% of first symptoms occur within 24 hours after surfacing.

2. When the first symptom occurs more than 24 hours following a dive, other causes should be suspected before decompression sickness, acknowledging that divers may experience a symptom and not report it right away.

3. Factors to be considered in evaluating symptoms include the depth and duration of the dive, the decompression table used, and the stress of the dive (e.g. cold, hard work) and the probability of other conditions such as gas embolism. The best-qualified person available should make a presumptive diagnosis. This must not be delayed while awaiting the arrival of a better-qualified person.

4. A wide range of symptoms may signal the onset of decompression sickness and some will be so obvious that the diagnosis will not be in doubt. Subtle symptoms may not be detected if a complete examination of the patient is not performed.

5. Symptoms of decompression sickness among professional divers have been found to occur with the following frequency:

a. **Pain Only**. 80%. Pain is a symptom in over 90% of all cases.

b. **Neurologic**. 15%.

c. **Vestibular**. Less than 1%.

d. **Pulmonary (Chokes)**. Less than 1%.

e. **Other**. 3% to 5%.

f. **Fatigue**. A common symptom in all cases of DCS.

6. Eighty percent of recreational divers with decompression sickness who are treated at a hyperbaric chamber have neurologic symptoms. The reason that pain as the only symptom is less commonly reported among recreational divers is probably because many sport divers with pain do not have easy access to hyperbaric treatment and tend not to report it. CAF Divers are well supported by hyperbaric facilities and are to report post dive pain without delay.

7. **IF IN DOUBT, SEEK DIVING MEDICAL ASSISTANCE**.

237. DECOMPRESSION SICKNESS - MILD (DCS TYPE I)

1. Pain is the most common symptom of decompression sickness in professional divers. The pain is usually slight when first noticed, but may grow progressively worse until it becomes unbearable. It may seem to come from deep in a bone and will often be near a joint. It is easy to misinterpret pain as being due to a sprain or a bruise. Pain should not be treated with drugs in an effort to make the patient more comfortable because pain is often the only way to measure the effectiveness of the treatment.

2. Abdominal pain may signal involvement of the spinal cord and therefore should be regarded as a potentially serious symptom. The diver should be carefully examined for other signs or symptoms of DCS and treated accordingly. A diver with abdominal pain after a dive should at the very least be carefully observed for the development of decompression sickness for several hours after surfacing.

3. "Niggles" or short duration aches and pains may be signs of decompression stress, but if there is any doubt as to the origin of the pain, then assume that the diver is suffering from decompression sickness and treat accordingly.

4. Lymphatic DCS results from blockage of the lymphatic ducts by bubbles. The subsequent buildup of fluid in the tissues causes localized swelling and edema. Recompression treatment should be initiated.

5. "Skin bends" refers to decompression sickness caused by blockage of the circulation in the skin by bubbles. It presents as a swollen, red or mottled tender area of skin. A DMO may prescribe recompression treatment.

6. Other skin symptoms that are frequently observed after a dive include a painless rash, itching and pricking. These symptoms are usually due to gas dissolving directly in the skin and occur after dives in which the skin is exposed to gas (chamber, dry suit) and not after wet suit or hot water suit dives. This is not decompression sickness and does not require treatment.

7. Symptoms of localized pain, edema and/or an area of tender, red or mottled, raised skin are to be diagnosed as mild, Type I DCS and should be treated with the appropriate oxygen treatment table.

8. **IF IN DOUBT, SEEK DIVING MEDICAL ASSISTANCE**.

238. DECOMPRESSION SICKNESS - SERIOUS (DCS TYPE II)

1. Central nervous system (CNS) and/or spinal cord involvement is a serious problem requiring prompt treatment. In severe cases (e.g. blow-up, unconscious diver or life-threatening symptom) immediate recompression is essential. A short delay is acceptable to allow surface examination by diving medical personnel, preferably an Advanced Diving Medical Officer.

2. The examination may be completed in the chamber at treatment pressure; however, at greater depths this will prove difficult owing to noise, heat and narcosis.

3. Since treatment for serious, Type II DCS is designed to treat the "worst case", any less serious symptoms that may go unnoticed will be appropriately treated.

4. The symptoms of serious, Type II DCS, in order of frequency, include:

   a. Numbness,

   b. Dizziness or vertigo,

c. Nausea or vomiting,

d. Visual disturbances,

e. Paralysis,

f. Headache (severe),

g. Unconsciousness,

h. Urinary disturbances,

i. Shortness of breath (chokes),

j. Personality change,

k. Agitation or restlessness,

l. Fatigue (severe),

m. Muscular twitching,

n. Confusion,

o. Lack of coordination, and

p. Balance problems.

NOTE

Many of these symptoms are easily over-looked or passed off by the victim as being of no consequence. For this reason, watch for these symptoms during the immediate post- dive activities of the divers, who may only think that they have been working too hard. The foregoing types of symptoms are categorized as serious, Type II DCS.

5. **IF IN DOUBT, SEEK DIVING MEDICAL ASSISTANCE**.

239. RAPID NEUROLOGICAL EXAMINATIONS

1. All divers responsible for supervising should be able to perform a rapid assessment of neurologically-related symptoms. The diagnosis of DCS may depend upon the detection of subtle or deceptive signs (see Figure 2-2).

2. A detailed examination performed by qualified personnel may be conducted IAW Diving Incident/Accident Report Forms 5(1) and 5(2) contained in Chapter 1, Annex A.

RAPID NEUROLOGICAL EXAMINATION

Patient's Name _____ Place _____

Date _____ Time _____

Normal	Abnormal	Head and neck
_____	_____	Orientation (time, person, place)
_____	_____	Visual acuity (count fingers, ask about double vision)
_____	_____	Visual fields (bring fingers from behind patient's head)
_____	_____	Pupils equal and reactive to light
_____	_____	Eye movement ("H" pattern; nystagmus)
_____	_____	Sensation of forehead, cheeks, lower jaw
_____	_____	Clench teeth (check jaw muscles)
_____	_____	Furrow brow
_____	_____	Shut eyes tight (check muscles above/below eyes)
_____	_____	Smile or grimace
_____	_____	Check hearing/noises
_____	_____	Swallow
_____	_____	Shrug shoulders (apply force to shoulders, check resistance)
_____	_____	Protrude tongue (check for deviation to one side)
		SENSATION
_____	_____	Ask about any unusual sensation
_____	_____	Check sensation of arms, back, trunk, legs
_____	_____	Ask if the sensation is the same on both sides
		MOTOR FUNCTION
_____	_____	Finger squeezes bilaterally
_____	_____	Thumbs up, resisting pushing arms apart and thumbs down, resisting pushing arms together.
_____	_____	Check flexion and extension of hip, knee and ankle
_____	_____	Plantar reflex (toes down = normal)

NOTE

Add explanatory note for all abnormalities.

Figure 2-2 Rapid Neurological Examinations

RECOMPRESSION TREATMENT

240. GENERAL PROCEDURE

1. When a diver has received inadequate decompression or has an air embolism, the first treatment procedure is to return the diver to a pressurized environment where the expanded gases will be recompressed. This should reduce any localized pain caused by gas bubbles, may restore normal blood flow and will frequently relieve the patient of many if not all of the subjective symptoms. After recompression treatment is underway additional treatment may be administered.

2. In all cases involving recompression treatment, a qualified Clearance Diving Supervisor is to take charge of the hyperbaric chamber and be responsible for the chamber operation. In the absence of a Medical Officer qualified and current in diving medicine, the Clearance Diving Supervisor shall choose the treatment table to be used.

3. When contacted, an Advanced Diving Medical Officer (ADMO) will assume complete control and responsibility for the well-being of the patient. The ADMO will diagnose diving ailments and have control of all aspects of treatment of the patient. Only an ADMO may order a deviation from the standard treatment tables published in the CAF Diving Manual. The ADMO must be prepared to justify such deviation to a possible BOI. Any deviation must be clearly communicated to the Diving Officer/Chamber Supervisor by the ADMO. The deviation and the reason for the deviation are to be recorded on the Treatment Dive Record.

4. Certain facets of recompression treatment have been previously mentioned but they are so important that they cannot be overstressed:

a. Treat promptly and adequately. Do NOT delay treatment by waiting for the arrival of medical personnel. The longer the time between the onset of symptoms and the initiation of treatment, the less effective the treatment.

b. Do NOT ignore seemingly minor symptoms. They can quickly become major.

c. Follow the selected treatment table accurately and completely. If a symptom or group of symptoms seems to be relieved, do not assume that the treatment is finished. Follow the tables to completion.

d. Keep the diver in the immediate vicinity of the chamber or the diving station for at least 6 hours following the recompression. Keep the diver within 1 hour travel time to the chamber for a period of 24 hours.

e. Careful attention should be paid to the dive partner; the dive partner should accompany the Diving Supervisor and the patient.

5. Following the completion of the treatment table and after a surface interval sufficient to allow complete medical evaluation, hyperbaric oxygenation treatment may be continued when recommended by the ADMO.

6. See Figure 2-3 for mandatory restrictions on diving or flying after recompression treatment.

7. Advice on diving medical problems may be obtained from the senior Diving Medical Officer at DRDC - Toronto. Emergency consultation is available on a 24-hour basis.

Diver treated for	Restrictions following Treatment
DCS Type I (pain-only)	a. Unfit for diving for 7 days. b. Unfit for flying for 3 days.
DCS Type II or Gas Embolism	a. Unfit for diving for 30 days. b. Unfit for flying for 7 days. c. If there were residual symptoms or if repeated treatments were required, the patient is unfit for flying for 10 days and unfit for diving until the case has been reviewed by Central Medical Board (Diving) at DRDC - Toronto and a decision made on the patient's fitness to dive.
Asymptomatic Omitted Decompression	A diver who has been treated for asymptomatic omitted decompression will have been treated on either a TT5 or TT6. Owing to the amount of oxygen breathed and the elimination of inert gasses, no restrictions for flying or diving are required.

Figure 2-3 Restrictions on Diving or Flying After Recompression Treatment

241. HYPERBARIC CHAMBER

1. If there is no hyperbaric chamber on site, the Diving Supervisor has two alternatives:

   a. If recompression of the patient is not immediately necessary, transport the patient to the nearest hyperbaric chamber for treatment.

   b. If a transportable two man chamber is available and the situation permits, the diver may be transported under pressure to the nearest full size chamber.

      (1) CAF Diving Manual, Volume 5 covers the use of transportable chambers.

2. Also refer to Article 228, Omitted Decompression, for instructions for in-water recompression for omitted decompression when transport to an RCC is not feasible.

3. The location of the nearest hyperbaric chamber must be included in the data collected during the planning phase of the dive.

242. TRANSPORTING THE PATIENT

1. Not all patients will require immediate recompression; a certain delay may be acceptable while the patient is being transported to a hyperbaric chamber.

WARNING

While preparing a patient for recompression (when a delay is necessary) and while moving the patient to a chamber, the patient should be kept lying down in a horizontal position, on either side, and given oxygen if available.

WARNING

Additionally, the patient should be kept warm and his/her condition constantly monitored for signs of a blocked airway, fainting, cardiac arrest, cessation of breathing or sudden massive internal bleeding.

WARNING

Always keep in mind that the most obvious symptoms may not actually be related to the most serious problem and that a number of conditions may well exist at the same time. For example, the victim may be suffering from both decompression sickness and severe internal injuries.

2. If the patient must be transported, the initial arrangement will have been made well in advance of the actual diving operation. These arrangements, which would include an "alert" notification to the hyperbaric chamber staff and a determination of the most effective means of transportation, are set out in the emergency assistance checklist for instant reference, CAF Diving Emergency Planning and Task Definition Grid).

3. The patient should be accompanied by the Diving Supervisor who was in charge of the diving operation, the diving partner and if available, an ADMO. If it is not possible for the Diving Supervisor to attend, another diver who knows the full details of the case must accompany the patient. In all cases the Diving Incident/Accident Report Forms shall be completed as far as is practicable and shall accompany the patient in transit.

4. If a civilian-manned chamber is to be used, the Diving Supervisor must accompany the patient and if appropriately qualified be responsible for treatment.

5. If the patient is moved by air, the helicopter or other aircraft should be flown as low as possible consistent with aircraft safety. Otherwise, a further reduction in external pressure may

result in worsening symptoms or additional complications. While in transit, oxygen (if available) should be administered to the patient.

6. If communications can be established while in transit, obtain consultation with the ADMO at the hyperbaric chamber.

7. Therapeutic recompression in the water should never be attempted except in the case of omitted decompression when an RCC is not immediately available (refer to Article 228, Omitted Decompression).

243. TREATMENT TABLES

1. Standard, modified and alternate treatment tables are set out in B-GG-380-000/FP-005, Canadian Armed Forces Diving Manual Vol. 5, Hyperbaric Chamber - Operation and Treatment Procedures. Extensive research and field experience has shown the therapeutic value of oxygen administered during recompression treatment.

244. GENERAL RESTRICTIONS AFTER RECOMPRESSION TREATMENT

1. After surfacing the patient should be kept under observation for 1 hour and then re-examined for residual symptoms.

2. During the 24-hour period following any treatment the patient must remain within 1 hour travel time of the chamber.

3. Restrictions beyond 24 hours are laid down in Volume 5.

4. See also Figure 2-3, Restrictions on Diving or Flying after Recompression Treatment.

245. HYPERBARIC CHAMBERS - OTHER USES

1. In addition to their use for the treatment of decompression sickness and surface decompression, hyperbaric chambers are also used for administering pressure tolerance tests to divers and prospective divers. In other than diving applications, hyperbaric chambers are used for medical treatment (both routine and emergency) of various disorders, notably gas gangrene. Chambers may also be located in research laboratories and in military and commercial aviation schools and operating facilities. Chambers used to create less than atmospheric pressures are called hypobaric chambers.

2. Diving team supervisors must always know the location, availability and type of the nearest chamber before commencing diving operations.

3. When hyperbaric chambers are used for treatment of ailments other than those related to diving, the attending medical officer or physician is solely responsible for the choice and control of the treatment. The Diving Supervisor is responsible for the safe operation of the chamber.