PREVENTION OF HEAT EXPOSURE INJURIES

LEARNING OBJECTIVE:

Determine the steps needed to prevent heat exposure injuries.

The prevention of heat exposure injuries is a command responsibility, but the medical department plays a role in it by educating all hands about the medical dangers, monitoring environmental health, and advising the commanding officer.

On the individual level, prevention centers on water and salt replacement. Sweat must be replaced ounce for ounce; in a hot environment, water consumption must be drastically increased. Salt should be replaced by eating well-balanced meals, three times a day, salted to taste. In the field, "C" rations contain enough salt to sustain a person in most situations. DO NOT use salt tablets unless specified by a physician. DO NOT consume alcoholic beverages.

At the command level, prevention centers on an awareness of the environment. The Wet Bulb Globe Temperature (WBGT) must be monitored regularly, and the results interpreted with the Physiological Heat Exposure Limit (PHEL) chart before work assignments are made. In addition, unnecessary heat sources, especially steam leaks, must be eliminated, and vents and exhaust blowers must be checked for adequate circulation. The results will be a happier, healthier, and more productive crew.

COLD EXPOSURE INJURIES

LEARNING OBJECTIVE:

Describe the signs, symptoms, and emergency treatment of each type of cold exposure injury.

When the body is subjected to extremely cold temperatures, blood vessels constrict, and body heat is gradually lost. As the body temperature drops, tissues are easily damaged or destroyed.

The cold injuries resulting from inadequate response to the cold in military situations have spelled disaster for many armies such as those of Napoleon and Hitler in their Russian campaigns. The weather (i.e., temperature, humidity, precipitation, and wind) is the predominant influence in the development of cold injuries. Falling temperature interacting with high humidity, a wet environment, and rising wind accelerates the loss of body heat.

Other factors that influence the development of cold injuries are the individual's level of dehydration, the presence of other injuries (especially those causing a reduction in circulatory flow), and a previous cold injury which increases susceptibility by lowering resistance. In addition, the use of any drug (including alcohol) that modifies autonomic nervous system response or alters judgment ability can drastically reduce an individual's chance for survival in a cold environment.

Like heat exposure injuries, cold exposure injuries are preventable. Acclimatization, the availability of warm, layered clothing, and maintenance of good discipline and training standards are important factors. These are command not medical responsibilities, but the HM plays a crucial role as a monitor of nutritional intake and personal hygiene (with emphasis on foot care) and as an advisor to the commanding officer. The HM is also responsible for acquainting the troops with the dangers of cold exposure and with preventive measures.
Two major points must be stressed in the management of all cold injuries: Rapid re-warming is of primary importance, and all unnecessary manipulations of affected areas must be avoided. More will be said about these points later.

In military operations the treatment of cold injuries is influenced by the tactical situation, the facilities available for the evacuation of casualties, and the fact that most cold injuries are encountered in large numbers during periods of intense combat when many other wounded casualties appear. Highly individualized treatment under these circumstances may be impossible because examination and treatment of more life-endangering wounds must be given priority. In a high-casualty situation, shelter cold-injury casualties, and try to protect them from further injury until there is sufficient time to treat them.

All cold injuries are similar, varying only in the degree of tissue damage. Although the effects of cold can, in general, be divided into two types general cooling of the entire body and local cooling of parts of the body cold injuries are seldom strictly of one type or the other; rather, these injuries tend to be a combination of both types. Each type of cooling, however, will be discussed separately in the sections that follow.

GENERAL COOLING (HYPOTHERMIA)

General cooling of the whole body is caused by continued exposure to low or rapidly falling temperatures, cold moisture, snow, or ice. Those exposed to low temperatures for extended periods may suffer ill effects, even if they are well protected by clothing, because cold affects the body systems slowly, almost without notice.

As the body cools, there are several stages of progressive discomfort and disability. The first symptom is shivering, which is an attempt to generate heat by repeated contractions of surface muscles. This is followed by a feeling of listlessness, indifference, and drowsiness. Unconsciousness can follow quickly.

Shock becomes evident as the casualty’s eyes assume a glassy stare, respiration becomes slow and shallow, and the pulse is weak or absent. As the body temperature drops even lower, peripheral circulation decreases and the extremities become susceptible to freezing. Finally, death results as the core temperature of the body approaches 80°F.

The steps for treatment of hypothermia are as follows:

1. Carefully observe respiratory effort and heart beat; CPR may be required while the warming process is underway.

2. Re-warm the casualty as soon as possible.
   a. It may be necessary to treat other injuries before the casualty can be moved to a warmer place.
   b. Severe bleeding must be controlled and fractures splinted over clothing before the casualty is moved.

3. Replace wet or frozen clothing and remove anything that constricts the casualty’s arms, legs, or fingers, interfering with circulation.

4. If the casualty is inside a warm place and is conscious, the most effective method of warming is immersion in a tub of warm (100 to 105 °F or 38 to 41 °C) water.
   a. The water should be warm to the elbow never hot.
   b. Observe closely for signs of respiratory failure and cardiac arrest (re-warming shock).
   c. Re-warming shock can be minimized by warming the body trunk before the limbs to prevent vasodilatation in the extremities with subsequent shock due to blood volume shifts.
5. If a tub is not available, apply external heat to both sides of the casualty.
   a. Natural body heat (skin to skin) from two rescuers is the best method. This is called "buddy warming."
   b. If this is not practical, use hot water bottles or an electric re-warming blanket.
      i. Do not place the blanket or bottles next to bare skin.
      ii. Monitor the temperature of the artificial heat source, since the casualty is very susceptible to burn injury.
   c. Because the casualty is unable to generate adequate body heat, placement under a blanket or in a sleeping bag is not sufficient treatment.

6. If the casualty is conscious, give warm liquids to drink. Never give alcoholic beverages or allow the casualty to smoke.

7. Dry the casualty thoroughly if water is used for re-warming.

8. As soon as possible, transfer the casualty to a definitive care facility. Be alert for the signs of respiratory and cardiac arrest during transfer, and keep the casualty warm.

LOCAL COOLING

Local cooling injuries, affecting individual parts of the body, fall into two categories: freezing and nonfreezing injuries. In the order of increasing seriousness, they include chilblain, immersion foot, superficial frostbite, and deep frostbite. The areas most commonly affected are the face and extremities.

Chilblain

*Chilblain* is a mild cold injury caused by prolonged and repeated exposure for several hours to air temperatures from above freezing 32°F (0°C) to as high as 60°F (16°C). Chilblain is characterized by redness, swelling, tingling, and pain to the affected skin area.

Injuries of this nature require no specific treatment except warming of the affected part (if possible use water bath of 90°F to 105°F), keeping it dry, and preventing further exposure.

Immersion Foot

*Immersion foot*, which also may occur in the hands, results from prolonged exposure to wet cold at temperatures ranging from just above freezing to 50°F (10°C). Immersion foot is typically seen in connection with limited motion of the extremities and water-soaked protective clothing.

Signs and symptoms of immersion foot are tingling and numbness of the affected areas; swelling of the legs, feet, or hands; bluish discoloration of the skin; and painful blisters. Gangrene may occur. General treatment for immersion foot is as follows:

1. Get the casualty off his or her feet as soon as possible.
2. Remove wet shoes, socks, and gloves to improve circulation.
3. Expose the affected area to warm, dry air.
4. Keep the casualty warm.
5. Do not rupture blisters or apply salves and ointments.
6. If the skin is not broken or loose, the injured part may be left exposed; however, if it is necessary to transport the casualty, cover the injured area with loosely wrapped fluff bandages of sterile gauze.
7. If the skin is broken, place a sterile sheet under the extremity and gently wrap it to protect the sensitive tissue from pressure and additional injury.
8. Transport the casualty as soon as possible to a medical treatment facility as a litter patient.
Frostbite

Frostbite occurs when ice crystals form in the skin or deeper tissues after exposure to a temperature of 32°F (0°C) or lower. Depending upon the temperature, altitude, and wind speed, the exposure time necessary to produce frostbite varies from a few minutes to several hours. The areas most commonly affected are the face and extremities.

The symptoms of frostbite are progressive. Casualties generally incur this injury without being acutely aware of it. Initially, the affected skin reddens and there is an uncomfortable coldness. With continued heat loss, there is a numbness of the affected area due to reduced circulation. As ice crystals form, the frozen extremity appears white, yellow-white, or mottled blue-white, and is cold, hard, and insensitive to touch or pressure. Frostbite is classified as superficial or deep, depending on the extent of tissue involvement.

SUPERFICIAL FROSTBITE.—In superficial frostbite the surface of the skin will feel hard, but the underlying tissue will be soft, allowing it to move over bony ridges. This is evidence that only the skin and the region just below it are involved. General treatment for superficial frostbite is as follows:

1. Take the casualty indoors.
2. Re-warm hands by placing them under the armpits, against the abdomen, or between the legs.
3. Re-warm feet by placing them in the armpit or against the abdomen of the buddy.
4. Gradually re-warm the affected area by warm water immersion, skin-to-skin contact, or hot water bottles.
5. Never rub a frostbite area.

DEEP FROSTBITE.—In deep frostbite, the freezing reaches into the deep tissue layers. There are ice crystals in the entire thickness of the extremity. The skin will not move over bony ridges and will feel hard and solid.

The objectives of treatment are to protect the frozen areas from further injury, to rapidly thaw the affected area, and to be prepared to respond to circulatory or respiratory difficulties.

1. Carefully assess and treat any other injuries first. Constantly monitor the casualty's pulse and breathing since respiratory and heart problems can develop rapidly. Be prepared to administer CPR if necessary.

2. Do not attempt to thaw the frostbitten area if there is a possibility of refreezing. It is better to leave the part frozen until the casualty arrives at a medical treatment facility equipped for long-term care. Refreezing of a thawed extremity causes severe and disabling damage.

3. Treat all casualties with injuries to the feet or legs as litter patients. When this is not possible, the casualty may walk on the frozen limb, since it has been proven that walking will not lessen the chances of successful treatment as long as the limb has not thawed out.

4. When adequate protection from further cold exposure is available, prepare the casualty for re-warming by removing all constricting clothing such as gloves, boots, and socks. Boots and clothing frozen on the body should be thawed by warm-water immersion before removal.

5. Rapidly re-warm frozen areas by immersion in water at 100°F to 105°F (38°C to 41°C). Keep the water warm by adding fresh hot water, but do not pour the water directly on the injured area. Ensure that the frozen area is completely surrounded by water; do not let it rest on the side or bottom of the tub.
6. After re-warming has been completed, pat the area dry with a soft towel. Later it will swell, sting, and burn.
   a. Blisters may develop. These should be protected from breaking.
   b. Avoid pressure, rubbing, or constriction of the injured area.
   c. Keep the skin dry with sterile dressings and place cotton between the toes and fingers to prevent their sticking together.

7. Protect the tissue from additional injury and keep it as clean as possible (use sterile dressings and linen).

8. Try to improve the general morale and comfort of the casualty by giving hot, stimulating fluids such as tea or coffee. Do not allow the casualty to smoke or use alcoholic beverages while being treated.

Transfer to a medical treatment facility as soon as possible. During transportation, slightly elevate the frostbitten area and keep the casualty and the injured area warm. Do not allow the injured area to be exposed to the cold.

LATER MANAGEMENT OF COLD INJURIES

LEARNING OBJECTIVE:

Determine the steps needed for the later management of cold-exposure injuries.

When the patient reaches a hospital or a facility for definitive care, the following treatment should be employed:

1. Maintain continued vigilance to avoid further damage to the injured tissue. In general, this is accomplished by keeping the patient at bed rest with the injured part elevated (on surgically clean sheets) and with sterile pieces of cotton separating the toes or fingers.
   a. Expose all lesions to the air at normal room temperature.
   b. Weight bearing on injured tissue must be avoided.

2. Whirlpool baths, twice daily at 98.6°F (37°C) with surgical soap added, assist in superficial debridement, reduce superficial bacterial contamination, and make range of motion exercises more tolerable.

3. Analgesics may be required in the early post-thaw days but will soon become unnecessary in uncomplicated cases.

4. Encourage the patient to take a nutritious diet with adequate fluid intake to maintain hydration.

5. Perform superficial debridement of ruptured blebs, and remove suppurative scabs and partially detached nails.

DIVING RELATED DISORDERS

LEARNING OBJECTIVES:

Explain the basic laws associated with diving related disorders.

Identify signs and symptoms of common diving related disorders.

Identify treatment methods for common diving related disorders.

Introduction

A general approach to the medical aspects of diving and altitude injuries would be to say it is literally “medicine under pressure.” The physiological insult is by definition “pressure related.” The solution to most dive and altitude related injuries is to reintroduce the patient to pressure. Additionally, the vague and often misleading presentation a diving patient presents adds its own unique pressure in medicine.

“Caissons Disease”

The word caisson is a French word meaning “big boxes.” Caissons were developed to allow workers a dry environment in which they could work on the bottom. They used these boxes to excavate bridge footings and build tunnels under water.
As the use of caissons increased, a new and unexplained illness began to affect the workers. Upon returning to the surface the workers often experienced dizziness, difficulty breathing and sharp pains in their joints and abdomen. The workers usually recovered but not always completely. The caisson workers often noted that they felt better while on the bottom in the caissons. The malady was logically called, caissons disease. However, workers on the Brooklyn bridge project in New York gave the malady a more descriptive name “the bends.” The “bends” is a slang term used for Decompression Sickness (DCS).

This demonstrates the importance that all medical personnel have a basic understanding of the effects of pressure on the human body. Whether stationed at a diving command or a high mountain airstrip; understanding pressure related emergencies can make the difference by knowing the mechanisms of injury and the presentation with an elevated index of suspicion. Injuries specific to diving are the result of exposure to increased pressure over and above what bodies are normally exposed to at the earth’s surface. The three principle categories for injuries are barotraumas, toxicities, and decompression sickness.

**Pressure**

Pressure is defined as force acting upon a particular area of matter. While diving there are two factors to consider: the weight of the water over the diver and the weight of the atmosphere above the water. In the field of aviation the effects of pressure must be considered, due to the weight of the atmosphere. The weight of the atmosphere (from sea-level up to the ozone layer) exerts 14.7 psi on the human body. This pressure of the “atmosphere” is constantly exerted on our bodies. Due to the atmosphere being made up of gases and gases having the characteristic of compressing, if people travel to a higher altitude they find air is less dense, therefore weights less per square inch. Inversely as they descend through the water, more weight is applied causing the gas to be denser.

1 atmosphere = 14.7

1 foot sea water = .445 psi

33 feet sea water = 14.7 psi

Measuring pressure while descending the water column (going deeper) there will be an increase of .445 psi for every foot of seawater descended into. This is known as “hydrostatic pressure.” At 33 feet of seawater (fsw) the amount of pressure on the diver’s body doubles from the surface. This increase remains .445psi/fsw no matter how deep because water does not compress (Fig. 21-12). The deeper a diver descends the more water that is over the diver, the more weight that is acting on the diver.

![Diagram](image)

**Figure 21-12.—Atmosphere and Pressure Relationship**

33 fsw = 14.7 psi = 1 atm

*1 square inch of air 20-30 miles high = 1 square inch of water 33 feet high.*

Pressure increases linearly, gas volume changes exponentially.
Barotrauma (Boyle’s Gas Law)

Boyle’s Law (Fig. 21-13) – For any gas at a constant temperature, pressure, and volume are inversely related. Boyle’s Law predicts gas changes in volume. As a bubble descends the water column, increasing pressure will act on it causing it to compress and shrink in size. Inversely, as it ascends the water column, pressure decreases thereby allowing it to expand/enlarge.

Barotrauma is defined as damage to tissues caused by a change in ambient pressure. The human body has gas filled, semi rigid cavities that are subject to changes in volume due to changes in pressure – lungs, sinuses, and middle ear for example. A diver must equalize for this volume change otherwise barotrauma will occur. This is also known as a squeeze on descent and reverse squeeze on ascent.

The most common type of squeeze, “middle ear squeeze,” can be experienced by simply jumping in a swimming pool and swimming to the bottom – pressure increases, the volume of gas in the middle ear decreases resulting in pain. If not corrected/equalized by forcing more gas into the middle ear (valsalva), barotrauma will occur. The space inside the middle ear is enclosed. As a diver descends in the water, pressure is increasing and compressing that space, if the diver does not valsalva and equalize the pressure inside the middle ear to match the pressure being applied outside, damage will occur.

General Treatment for middle ear squeeze: Upon surfacing after a middle ear squeeze, the diver may complain of pain, fullness in the ear, hearing loss, or even mild vertigo. Occasionally, the diver may have a bloody nose, the result of blood being forced out of the middle ear space and into the nasal cavity through the eustachian tube.

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Figure 21-13.—Diving Laws and Associated Complications
Treatment consists of decongestants, NSAID's for pain and inflammation as needed, and discontinue diving until healed. Three days to several weeks depending on severity. If the eardrum is ruptured antibiotics may be prescribed as well. Never administer medication directly into the external ear canal if a ruptured eardrum is suspected or confirmed without consulting an ear, nose, and throat (ENT) specialist.

General Types of Squeezes/Barotrauma – Outer Ear, Middle Ear, Inner Ear, Sinus, Tooth, Dry Suit, Mask, POIS, etc. As noted above, that which affects the middle ear affects other gas-filled, semi-rigid areas as well. Of particular concern are the pulmonary over inflation syndrome (POIS) injuries which are discussed below.

Pulmonary Over Inflation Syndrome (POIS) is barotrauma of the lung. Expanding gas if trapped in the lung(s) and not allowed to escape can result in tearing at the alveolar sacs. This can result in one or several types of POIS - Mediastinal Emphysema, Subcutaneous Emphysema, Pneumothorax, and Arterial Gas Embolism.

Mediastinal Emphysema is the tearing of the lung with air leaking out and remaining inside the chest cavity. Symptoms are mild with a substernal burning sensation or pain on deep inspiration. This is enough air to cause discomfort yet not enough to cause the lung to collapse.

Subcutaneous Emphysema tearing of the lung with air leaking out of the lung then migrating up and out of the chest cavity and stopping at the base of the neck. Air bubbles can be felt beneath the skin.

Pneumothorax is the tearing of the lung with air leaking out and collapsing the lung.

Arterial Gas Embolism (AGE) capillaries on the alveolar sacs at the location of a tear in the lung draw gas into the blood stream. These gas bubbles will follow the circulatory system traveling from the lung to the heart then out to the body via arterial flow. The bubble continues until it becomes lodged ultimately resulting in decreased blood flow and hypoxia downstream from its location, acting like a blood clot.

Severity of symptoms depends on the location of the bubble. The brain and heart are the two most serious locations for AGE to occur with stroke and heart attack symptoms presenting respectively. Due to the obstruction occurring on the arterial side of the circulatory system, symptoms present rapidly. The general rule is “Any neurological deficit within 10 minutes of a diver reaching the surface is considered AGE^4.”

Given the mechanism of injury for POIS it is entirely possible to have all 4 types of injury at the same time. Any time a diver presents with any POIS symptoms, a neurological exam must be completed to rule out AGE.

Toxicities: Dalton’s Law – increasing partial pressure

As a gas descends in the water column it is exposed to increased pressure and becomes more concentrated (Fig. 21-13). The ratio or percentage of gas (21% oxygen/79% nitrogen in air for example) remains the same, but because gasses compress, the number of molecules that fit in a given volume increases. Take human lungs for instance. Tidal Volume at rest is 500ml. At a depth of 33 fsw the body still requires 500ml of Tidal Volume, however, because gases compress twice the amount of nitrogen and oxygen is received in a single breath compared to what is normally received at surface. This is what’s known as “partial pressure”, gas becomes “concentrated” under pressure. This “concentration” relative to atmospheres increases linearly: 33fsw x 2, 66fsw x 3, and 99fsw x 4. At 99fsw the diver is at 4 atmospheres absolute (3 water + 1 surface).
Higher partial pressures/concentrations of gasses have adverse and toxic effects on the body.

Nitrogen Narcosis at depths greater than 99 fsw, Nitrogen exerts a progressive depression of the central nervous system (CNS). Nitrogen Narcosis doesn’t cause damage but, its greatest hazard is gross lack of judgment which can cause a diver to make life threatening mistakes at depth.

CNS Oxygen Toxicity at partial pressures greater than 1.3, oxygen has a toxic effect on the CNS. Prolonged exposure to oxygen can irritate the tissues of the respiratory tract and lungs resulting in a burning sensation, also called Pulmonary Oxygen Toxicity.

Carbon Dioxide Toxicity build up is the waste product of respiration. Hyperbaric environment (increased pp) not required but due to the nature of work diving and ventilation limitations of diving apparatus make this the most common toxicity encountered in diving.

Carbon Monoxide Toxicity Carbon Monoxide binds to hemoglobin 200 times faster than oxygen, thereby causing a state of hypoxia. Breathing medium (tanks) contaminated by exhaust from internal combustion engines is the main cause for this toxicity. Hyperbaric environment not required, but increased pressure exacerbates effects of carbon monoxide.

Decompression Sickness: Henry’s Law – absorption/saturation

The amount of gas which will dissolve in a liquid is proportional to the partial pressure of that gas above the liquid (Fig. 21-13). Take a closed container half filled with water, half with air, increase the pressure inside the chamber by adding more air – air is going to dissolve into the water. Now rapidly open the container reducing the pressure – the air will come back out of the liquid in the form of bubbles. This is the same action as shaking a carbonated beverage prior to opening, it explodes when opened because the pressure is decreased and the gas is forced out of the liquid.

Our bodies are 85% water and on the surface the body is at equilibrium (balance) with the inert gases in breathing air. Tissues are “saturated” to the 14.7 psi of 1 atmosphere of pressure.

Air is 79% Nitrogen, 21% Oxygen. There is about 1% of other trace elements, but not in high enough concentration to have an effect. Our bodies metabolize the oxygen. When the pO2 falls below the surface equivalent of 16% signs of decreased mental status and function present themselves. Nitrogen is not necessary for anything, it is not metabolized. It is an “inert gas.” It basically provides a buffer or vehicle for oxygen. During a dive, pressure increases due to the weight of water over the diver causing the inert gas to become more concentrated. Thus at depth, because the pressure on the diver has increased, the amount of inert gas dissolved in the diver’s tissue also increases.

Then what happens to this gas on ascent to the surface? The external ambient pressure reduces on ascent, so the partial pressure of inert gas in the breathing mix decreases. Correspondingly, per Henry’s Law, the amount of inert gas dissolved in tissues drops.

When a diver maintains a normal ascent rate from the bottom to the surface, the inert gases have time to “off gas” or come out of solution at a controlled rate where the body can naturally dispose of the gas through the normal process of respiration. If ascent is too rapid the diver’s body exceeds the capacity for dissolved inert gas in its tissues, then the excess gas dissolved in tissues has nowhere else to go except to form bubbles in the body.

Essentially, DCS (decompression sickness) is the formation of bubbles in tissues. Where these bubbles form determines the type and severity of DCS. By following rules for decompression, such as a controlled rate of ascent and limiting time at depth will prevent significant bubble formation and reduce the risk of DCS.
Decompression Sickness Type I

Pain – Dull aching pain localized to a joint, normally not made worse with movement. It can progress from a dull ache to a deep ache and typically results from bubble formation in joint tissue. This is the most common manifestation of DCS Type I.

Marbling – When a bubble forms “in” the skin, the dermis and or epidermis, it results in a condition known as Calis Marmorata. This is a mottling or marbling of the skin or a popular or plaque like violet colored rash. This is often accompanied by an itching or burning sensation. On rare occasions, skin has an orange-peel appearance. This condition is often called “skin bends.” This is not to be confused with Subcutaneous Emphysema; they are two different disease processes.

Swelling – When a bubble forms in the lymphatic system it will cause swelling of the affected lymph nodes. The most commonly involved lymph nodes are in the inguinal and axillary areas. The affected nodes are usually painful and swollen.

Decompression Sickness Type II

Central Nervous System (CNS) – When a bubble forms within the CNS it will produce a neurological deficit. Some examples include weakness, decreased sensation, paralysis, confusion, memory loss, visual disturbances, or extreme fatigue. The onset of symptoms takes place 10 minutes after surfacing from a dive up to 48 hours post dive. Any neurological symptom within the first 10 minutes after surfacing from a dive is considered an Arterial Gas Embolism.

Pain – This is a different type of pain from that of Type I DCS. If the pain is radiating such as radicular truck pain, pain that follows a dermatome, is an indication of Type 2 DCS.

Lungs – When a bubble forms in the lungs it results in Pulmonary DCS (the chokes). This is characterized by burning, substernal discomfort on inspiration, non-productive coughing that can become paroxysmal, and severe respiratory distress. Symptoms can start up to 12 hours after a dive and persist for 12 to 48 hours.

Inner Ears – When a bubble forms within the inner ears, it results in Inner Ear DCS (staggers). It is characterized by tinnitus (ringing in the ears), hearing loss, vertigo, dizziness, nausea, and vomiting. The affected person will have difficulty walking, hence the name staggers.

Aviation Bends

DCS caused by rapid decompression of an aircraft cabin or a rapid vertical climb; typically seen in fighter jets, either of them can produce similar mechanics of surfacing too rapidly in the water. Symptoms will present as Type I or II DCS and are treated accordingly.

General rules

DCS Types I and II, and AGE can progress to permanent or life threatening conditions. Recompression in a hyperbaric chamber is the only definitive treatment for DCS and AGE.

Pain alone is not AGE. A Neurological deficit would need to be present for it to be true AGE and present within the first 10 minutes.

Other POIS may be present. Recompression therapy is not indicated for pneumothorax or mediastinal and subcutaneous emphysema unless considered severe.
Treatment

ABCs.

- 100% O2 by mask
- Obtain dive history
  - Depth of dive
  - Time spent on dive
  - Time the diver reached the surface
  - What are the symptoms
  - When did they start
  - Have they improved or worsened
  - Does anything make them better or worse
  - Were any other dives prior to last dive, if so depth and time of dive and time spent on surface between dives
  - Are there any prior diving related injuries
- If diving related injury is suspected contact closest recompression facility, Dive Medical Technician (DMT), and or dive medical officer (DMO)
- Upon recommendation transport patient flat on O2 – do not elevate feet or head. If aircraft used maintain cabin pressure / altitude < 1000 feet above sea level
- Start a large bore IV (16 or 18 gauge) at 75cc/hr or KVO as indicated

**CAUTION:**
Do NOT give medications as they will mask the symptoms.

Differences between AGE and DCS

Neurological deficit on surface post dive <10 min AGE, >10 DCS Type II

Neurological Deficits: Unconsciousness, disorientation, memory loss, incoordination (ataxia), decreased mental function/reasoning, numbness, tingling, weakness, paralysis, deficits in sight, hearing, smell, and any deficit in motor or sensory function.

AGE can occur in as shallow as a few feet of water. DCS requires depth with improper off gassing, excessive time at depth, or both. Get a thorough history!

**SUMMARY**

A medical emergency can occur at anytime. HMs must be prepared to act expeditiously and confidently, whether in a combat situation, on board a naval vessel, or at the Navy Exchange. This chapter covers the preliminary steps that should be followed when managing sick or injured patients. The preliminary emergency steps include triage, patient assessment, and, when needed, basic life support. Other related topics covered in this chapter are breathing aids, shock, diagnosis and emergency treatment procedures for medical conditions and injuries, and other emergencies.