- **Drowning** – asphyxiation resulting from submersion in liquid with death occurring within 24 hours of submersion.

- **Near Drowning** – an incident of potentially fatal submersion in liquid that did not result in death or in which death occurred more than 24 hours after submersion.
Other medical conditions can be associated with near drowning

- Possible trauma (caused before or during)
- Hypothermia
- Hypoxia
Dry drowning – a simulated laryngospasm (airway obstruction) prevents large amounts of water from entering the lungs.

Wet Drowning – no simulated laryngospasm occurs, resulting in the lungs filling with water.
Although the pathophysiology of fresh-water and salt water drownings differs, there is no difference in the end result or in prehospital management.
Mammalian diving reflex – resulting from the submersion of the face and nose in water, a complex cardiovascular reflex that constricts blood flow everywhere except the brain.

A cold-water drowning patient is not dead until they are warm and dead!
- Remove patient from the water as soon as possible (this should be done by a trained rescue swimmer)

- Initiate ventilation while patient is still in the water. Rescue personnel should wear protective clothing in water less than 70 degrees F. In addition, attach a safety line to the rescue swimmer. In fast water, it is ESSENTIAL to use personnel trained for this type of rescue.

- Suspect head and neck injury if the patient experienced a fall or was diving. Rapidly place the victim on a long backboard and remove them from the water. Use C-spine precautions throughout care.

- Protect the patient from heat loss. Avoid laying the patient on a cold surface. Remove wet clothing and cover body to the best extent possible.

**Treatment for Near Drowning**
Examine the patient for airway patency, breathing, and pulse. If indicated, begin CPR and defibrillation.

Manage the airway using proper suctioning and airway adjuncts

Administer oxygen at 100% concentration

Use respiratory rewarming, if available, and if transport time is longer than 15 minutes

Establish an IV of lactated Ringer's solution or normal saline for venous access and run at 75 mL/hr. If indicated, carry out defibrillation

Follow ACLS protocols if the patient is normothermic. If the patient is hypothermic, treat according to the hypothermic protocol.

Treatment for Near Drowning
All near-drowning patients should be admitted to the hospital for observation since complications may not appear for 24 hours.

- Adult respiratory distress syndrome (ARDS) – a severe complication resulting from fluid leaking from the lungs into the alveoli.
- **Scuba Diving** – self contained underwater breathing apparatus that allows divers to breathe underwater.

- Scuba diving emergencies can occur before, during, and after a dive.

- More serious emergencies usually occur following a dive.
• Injuries on the Surface
  - Entanglement of lines or kelp fields
  - Cold water causing shivering or blackout
  - Boat collision

Diving Injuries
• Injuries during Descent
  - Barotrauma – injuries caused by changes in pressure. It can occur if the diver cannot equilibrate the pressure between the nasopharynx and the middle ear.
  - Diver may experience middle ear pain, dizziness, ringing of the ears, hearing loss, and severe headache
Injuries on the Bottom

- Nitrogen Narcosis – a state of stupor that develops during deep dives due to nitrogen's effect on cerebral function (diver may appear intoxicated)
- Diver runs low or out of air
Injuries during Ascent

- Barotrauma injuries
- Decompression illness – development of nitrogen bubbles within the tissue due to rapid reduction of air pressure when a diver returns to the surface
- Pulmonary over-pressure – expansion of air held in the lungs during ascent. If not exhaled, the expanded air may cause injury to the lungs and surrounding structures.
  - Arterial gas embolism (AGE) – an air bubble that enters the circulatory system from a damaged lung
  - Pneumomediastinum – the presence of air in the mediastinum
  - Pneumothorax – a collection of air in the pleural space.
- Time at which the signs and symptoms occurred
- Type of breathing apparatus utilized
- Type of hypothermia protective gear worn
- Parameters of the dive
  - Depth
  - Number
  - Duration
- Aircraft travel following a dive

General Assessment of Diving Emergencies
• Rate of ascent
• Associated panic forcing rapid ascent
• Experience of diver
• Properly functioning depth gauge
• Previous medical diseases
• Use of medications
• Use of alcohol

General Assessment of Diving Emergencies
• **Decompression Illness** – develops in divers subjected to rapid reduction of air pressure after ascending to the surface.
Signs and Symptoms

- Joint and abdominal pain
- Fatigue
- Paresthesias
- CNS disturbances

Treatment

- Recompression – resubmission of a person to a greater pressure so that gradual decompression can be achieved
- Hyperbaric oxygen chamber – recompression chamber used to treat patients suffering from barotrauma
Prehospital management

- Assess the patients ABC's
- Administer CPR if required
- Administer O2 at 100% concentration. An unconscious diver should be intubated
- Keep patient in supine position
- Protect patient from excessive heat, cold, wetness, or noxious fumes
- Give the conscious patient nonalcoholic liquids such as fruit juices or oral bland salt solutions
Prehospital Management

- Evaluate and stabilize the patient at the nearest emergency department prior to transport to a recompression chamber. Begin IV fluid replacement with electrolyte solutions for unconscious or seriously injured patients.
- If there is evidence of CNS involvement, administer dexamethasone, heparin, or Valium as ordered by medical direction.
- If air evacuation is used, do not expose the patient to decreased barometric pressure. Cabin pressure must be maintained at sea level, or fly at lowest, safe altitude possible.
- Send the patient's diving equipment with the patient for examination.

Decompression Illness
- Arterial Gas Embolism (AGE) – air bubble or air embolism that enters the circulatory system from a damaged lung

- Pulmonary Over-Pressure Accidents - Lung overinflation due to rapid ascent can cause a number of emergencies
Signs and Symptoms

- Sharp, tearing pain
- Confusion
- Vertigo
- Visual disturbances
- Loss of consciousness

Treatment

- Assess the patients ABC's
- Administer oxygen by nonrebreather mask at 100%
- Place the patient in supine position
- Monitor vital signs frequently
- Administer IV fluids at a TKO rate
- Administer a corticosteroid agent
- Transport to a recompression chamber as rapidly as possible

Arterial Gas Embolism