



The "Bends" or "Caisson disease" has been recognized since 1841 in association with "hard hat" divers or men working under pressurized conditions. By the end of WWI the possibility of decompression sickness in aviators was predicted and once high altitude balloon flights were undertaken the prediction was fulfilled. The cause of decompression sickness is the formation of gas bubbles in the body and the physical law was described by Henry. Henry's Law states that the quantity of gas that goes into solution at a given temperature is dependent upon its solubility characteristics and is proportional to the partial pressure of that gas over the surface of the liquid. Hence as the pressure falls, the amount of gas which can be held in solution is reduced.

Bubble Formation

The dominant gas in the atmosphere we breathe is nitrogen. It is inert and the body is saturated with it at ground level. During rapid ascent the reduction of barometric pressure creates a condition whereby the inert gas tension in the tissues is greater than the external barometric pressure. This condition is called super-saturation. At this point, in association with bubble nuclei produced by muscle shear forces or turbulent blood flow, bubbles of nitrogen can be formed in the tissues and in the body fluids. It is these bubbles which give rise to decompression sickness.

Symptoms

The symptoms of decompression sickness are described as the four "C's". These are Creeps, Cramps, Chokes and Collapse". "Creeps" is an unpleasant sensation as though tiny insects are moving underneath the skin. This "formication" is believed to be caused by the formation of tiny bubbles. "Cramps", usually described as "Bends", are manifested by pain which tends to be localized in and around the large joints of the body. Smaller joints may be affected and it is not uncommon to first notice the symptoms in joints which have previously been injured. The pain is deep and aching in character and varies from mild to severe. It is made worse by movement of the joints and is sometimes improved by pressure on the area. "Chokes" are rare, occurring in less than 2% of cases. It is a much more serious disorder caused by multiple pulmonary gas emboli. The subject complains of substernal chest pain, dyspnea and a dry, non-productive cough. He/she feels ill and usually appears anxious and distressed. If altitude is maintained "Collapse" will inevitably occur. The treatment is immediate descent which is generally effective.

Neurological Effects

Neurological decompression sickness is the most dangerous form and often has a very serious prognosis. It may be responsible for permanent neurological deficits particularly if hyperbaric treatment is not immediately available. It occurs in 5-7% of cases of decompression sickness, and, in altitude cases not relieved by returning to ground level, the central nervous system is involved 35-50% of the time. In the aviator brain injuries, although uncommon, are most frequent. In divers the spinal cord type is most frequent. The reason for this variance is not known.

In the brain type visual disturbances (scotoma, tunnel vision, diplopia etc.) are common together with headache and confusion. Physical signs are spotty and diffuse, both motor and sensory. The signs may be thought to be hysterical but collapse may occur. In the spinal cord the most common onset is of numbness or paraesthesia in the feet. This tends to spread upwards in the cord with ascending weakness and/or paralysis. A complete transverse spinal cord lesion may occur as bubbles obstruct the blood supply and infarct the cord.

Fortunately serious decompression sickness is uncommon in commercial aviation. Generally the altitude threshold is above 18,000 ft. although it rarely occurs below 25,000 ft. Above 26,000 ft. it is more common. It is much more often seen therefore in high altitude military pilots whose cockpit pressurization profiles are lower than those in commercial aircraft.

Provocative Factors

There are various factors which affect it. The incidence increases with age, there being a threefold increase between the 19-25 year old and the 40-45 year old age groups. Nitrogen is well dissolved in fat, so obesity is a factor. It is probably more common in women than men. It is more common with exercise at altitude, with rapid ascents, with re-exposure to altitude at frequent intervals and at low temperatures. The after effects of alcohol and intercurrent infection both increase the susceptibility.

Scuba Diving

It is important to keep in mind the relationship between scuba diving and decompression sickness in

aviators. Scuba divers use compressed air in their tanks and are often exposed to two or more atmospheres of pressure, supersaturating the tissues. If they fly within twelve hours of emerging from diving at standard depths, decompression sickness has been recorded at altitudes as low as 10,000 ft. Where they have been diving at depths which require decompression stops on the way to the surface, they should not fly for a minimum of 48 hours. Although serious problems are uncommon, it is necessary to be aware of the danger to recognize it, particularly with neurological symptoms.

Occasionally a medical emergency results when a diver ascends to the surface too rapidly, causing a bubble formation. In such cases the diver must be re-exposed to a greater pressure as quickly as possible and then brought back to the surface. Sometimes the diver is too ill to undertake another dive and must be transported to a hyperbaric chamber for treatment as quickly as possible. Pilots transporting such individuals should be cautioned that increases in altitude will worsen the patient's condition. If pressurized aircraft are not available, flights should be made at the lowest safe altitude. Recompression treatment tables are outlined in textbooks of Diving medicine.