Decompression Sickness and Arterial Gas Embolism in Sports Scuba Divers

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Summary

Diving underwater with breathing apparatus is an increasingly popular sport. Consequently, the number of diving-related accidents, including both decompression sickness and arterial gas embolism, have increased. Though both involve bubbles, decompression sickness is a disease which involves gas bubbles forming in tissues and venous blood, while arterial gas embolism results from the introduction of gas bubbles directly into the arterial circulation. Although the pathologies and natural histories of decompression sickness and arterial gas embolism are different, the treatment of these conditions is essentially the same. Compression in a recompression chamber is the definitive treatment of both decompression sickness and arterial gas embolism, and any delay before treatment must be minimised if a good outcome is desired.
During the last decade there has been a considerable increase in the popularity of all forms of sports diving. This includes snorkel diving, underwater hockey, breath-hold diving, and self-contained underwater breathing apparatus (scuba) diving. The total number of trained sports scuba divers has increased in the USA from 220,000 in 1978 to 395,000 in 1985; and in Japan from 23,995 in 1978 to 151,168 in 1985 and to 202,113 in 1986 (Cummins 1988). The Australian Scuba Council estimates that there are about 400,000 sports divers in Australia (2.5% of the total population), and the New Zealand Underwater Association estimates there to be between 100,000 and 150,000 sports divers in New Zealand (between 3 and 5% of the country's population).

Fortunately, with the possible exception of the United Kingdom (Pearson 1988), although there has been a global increase in the number of diving-related accidents, the diving accident rate (accidents per 100,000 divers) amongst sports divers has almost certainly decreased (Cummins 1988). An increased reliance on diver-worn decompression meters in the United Kingdom may be responsible for a local increase in the rate of decompression sickness in sports divers (episodes per 100,000 divers) (Pearson 1988).

Like most other sports, there are health-risks associated with diving that can be significantly reduced, but not eliminated, by 'safe' practice. These risks include problems related to any pressure exposure (e.g. decompression sickness, arterial gas embolism, pulmonary and other barotrauma, and inert gas narcosis) and those due to the environment (e.g. drowning, hypothermia, and marine animal injuries).

This paper will briefly review decompression sickness and arterial gas embolism in the context of sports scuba diving, and will describe methods of appropriate first-aid and treatment.

1. Disease Definitions
   1.1 Decompression Sickness

Decompression sickness is brought about by the formation of bubbles in tissues and venous blood. During a scuba-air dive, the inspired nitrogen tension is higher than normal, and extra nitrogen dissolves into body fluids. When the diver returns to the surface of the water, that is decompress, the excess nitrogen diffuses from the tissues into venous blood, is carried to the alveoli and is expired by the lungs. If this process of elimination does not ensure that the tissue nitrogen tension remains below the ambient (surrounding) pressure, bubbles will form in the tissues and venous blood; and if the size of these bubbles reaches a critical volume, decompression sickness will occur (Hills 1977). Fortunately, the lungs normally act as a filter to prevent these venous gas bubbles from reaching the arteries (Butler & Hills 1985).

1.2 Arterial Gas Embolism

Arterial gas embolism refers to the direct introduction of gas bubbles into the arteries, which in scuba diving is thought to occur as a result of lung overinflation during the ascent to the surface (Catron et al. 1984). This has occurred even after very brief dives to only 1 metre of sea water, when bubbles due to decompression sickness would not be present (Weathersby et al. 1986).

2. Aetiology and Epidemiology

Though it is believed that most scuba dives deeper than 7 metres of sea water (msw) cause the formation of bubbles in the diver's tissues and venous blood, the reported occurrence of decompression sickness is much less common (Hills 1977). In 1987 more than 300 divers in the USA, almost 200 divers in Australia and over 50 in New Zealand were treated for either decompression sickness or arterial gas embolism in a recompression chamber (Bond et al. 1988). Approximately 90% of these divers had decompression sickness.

2.1 Decompression Sickness

Conventional wisdom accepts that the predispositions to decompression sickness include (Edmonds et al. 1983; Ward et al. 1987): being female;