Updates in Decompression Illness

Neal W. Pollock, PhD[a,b,c,*], Dominique Buteau, MD[c,d]

KEYWORDS

• Decompression sickness • Arterial gas embolism • High-fraction oxygen
• Hyperbaric

KEY POINTS

- Decompression sickness (DCS) is a disease resulting from an ascent profile not allowing the orderly elimination of excess gas that was accumulated in tissues during exposure to elevated pressure.
- Decompression sickness (DCS) can present idiosyncratically, affecting a wide range of systems with a variable degree of insult. Masking of important symptoms by chief complaint is possible.
- Arterial gas embolism (AGE) is a disease of frank gas in the arterial systemic circulation following a reduction of ambient pressure so rapid that expanding gases cause pulmonary tissue rupture.
- The first aid for decompression illness (collectively, DCS and AGE) is high fraction oxygen; the definitive treatment is hyperbaric oxygen therapy.
- There are currently no diagnostic tests to confirm decompression sickness.

INTRODUCTION

Diving is a popular recreational pastime, as well as an activity with numerous applications in the scientific, commercial, military, and exploration realms. Although diving can be done safely, the underwater environment is unforgiving. Problems may arise during a dive due to insufficient medical or physical fitness, improper use of equipment, or inadequate management of the high-pressure environment.

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[a] Department of Kinesiology, Université Laval, PEPS Building, 2300 rue de la Terrasse, Quebec City, Quebec G1V 0A6, Canada; [b] Department of Medical Research, Divers Alert Network, 6 West colony place, Durham, NC 27705, USA; [c] CISSS Chaudière-Appalaches (CHAU-Hôtel-Dieu de Lévis), Hyperbaric Medicine Unit, Emergency Department, 143 rue Wolfe, Lévis, Quebec G6V 3Z1, Canada; [d] Family Medicine and Emergency Medicine Department, School of Medicine, Université Laval, Quebec City, Quebec, G1V 0A6 Canada
* Corresponding author. Université Laval, Quebec City, Quebec G1V 0A6, Canada.
E-mail address: neal.pollock@kin.ulaval.ca

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Decompression illness (DCI) is a term used to encompass injuries due to arterial gas embolism (AGE) and decompression sickness (DCS). AGE typically results from pulmonary barotrauma-induced damage to the alveolar wall and introduction of gas into the systemic arterial circulation. DCS, colloquially known as the bends, results from the uncontrolled release of gas from tissues during or after surfacing with inadequate time for equilibration (decompression).

DIVING PHYSICS

The concentration, or tension, of dissolved inert gas within body tissues is a function of ambient pressure. Inert gases normally exist in equilibrium with the ambient environment, effectively a saturated state. When pressure differences (gradients) are created, molecules flow from the area of higher to lower concentration until equilibrium is re-established.

The pressure range of the diving environment is much greater than the pressure range of the air environment. The pressure exerted at sea level by the entire 100 km (62 mi) atmospheric column of gas is 1 atm absolute (ATA), equal to 101.3 kPa or 14.7 psi. In contrast, water pressure increases by 1 atm for every 10 m (33 ft) of seawater and for every 10.4 m (34 ft) of freshwater (Fig. 1).

The lungs play a primary role in gas uptake and elimination and, ultimately, decompression stress. When exposed to increased pressure underwater, the gas in the lungs is compressed. This creates an inflow gradient from concentrated lung gas to the bloodstream and, subsequently, from the bloodstream into tissues as they are perfused. Tissues take up inert gas until saturation is achieved. At the point of saturation, staying longer does not further increase the subsequent decompression obligation.

PREDICTING GAS UPTAKE AND ELIMINATION

Gas uptake and elimination generally follows roughly exponential patterns. The technology is not yet available to measure tissue status directly, so the norm is to rely on

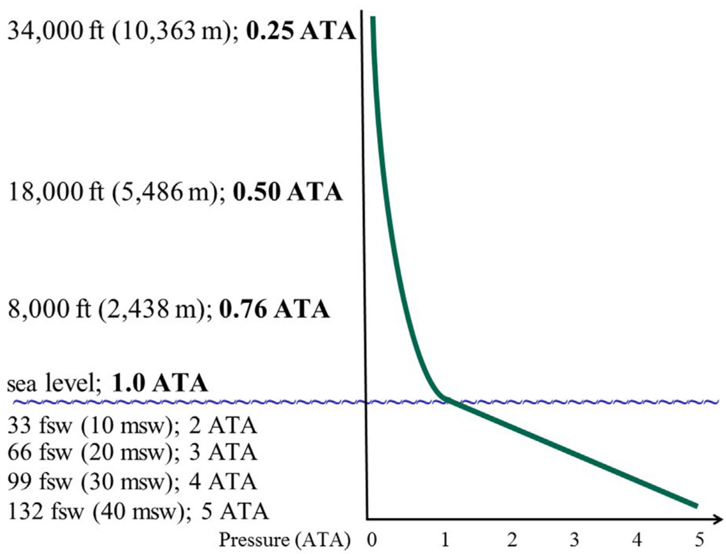

Fig. 1. Air pressure increases slowly from zero at the boundary of space to 1 atm (14.7 psi) at sea level. Water pressure increases much more dramatically, adding 1 atm of pressure for every 10 m of seawater. fsw, feet of seawater; msw, meters of seawater.