ADVANCED DECOMPRESSION PHYSIOLOGY

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The class consists of illustrated lectures and is descriptive and of a non-mathematical nature. Examples from daily life are used to illustrate the concepts as they are applied to diving and decompression.

Introduction

Brief overview of the course content.

I. History of Diving

Why can't we just breathe underwater with a long tube to the surface? What methods were available to undersea workers centuries ago. How did naturalists come to recognize centuries ago that we live at the bottom of "an ocean of air?" What happened to compressed air workers in the last century, and what lessons does this hold for us today.

II. Techniques for Studying Decompression

Why is the gas phase difficult to study in decompression? What methods are available? How were employed by researchers to discover much of the material on decompression sickness (DCS) presented in this course? Additionally, there is a brief survey of decompression in aviation and space.

III. The Physical World As Applied To Diving

Presented is a review of the basic gas laws as they apply to diving. A description of different gases (e.g., helium, neon) employed for diving and a physical description of nitrogen narcosis.

IV. Physiology For Gas Exchange In Diving

A review of the role of the lungs, heart, microcirculatory system and fluid breathing as they apply to diving and decompression. A presentation of the basics of perfusion and diffusion of gases in tissues as applied to diving and dive tables.

V. Oxygen and Oxygen Toxicity

Oxygen as a toxic substance for plants and animals, and methods that organisms use for preventing oxygen toxicity in the body are discussed. Covered also are oxygen free radicals and their role in aging and cancer. Does oxygen “become toxic” at depth? Discussed is why it is impractical to prevent DCS by breathing pure oxygen underwater.

VI. Decompression Sickness (I). Gas Phase Nucleation and Growth

Covered is the concept of the tensile strength of water and the reason that it is difficult for scientists to understand why gas bubbles form in the body upon decompression. Musculoskeletal activity is presented and its relation to bubble formation. Rudiments of nucleation theory are discussed and the mechanisms for bubble formation with very small supersaturations. Discussed is how this helps to explain why dive tables can fail.

VII. Decompression Sickness (II), Pathophysiology of the In Vivo Gas Phase

The many faces of decompression sickness are presented. How do each of these arise from a single gas phase? Why is it incorrect to speak of the cause of DCS as "a bubble that lodged in my knee?" Presented are PFOs and their implication for recreational divers. Covered is the physiology of this form of neurological DCS. Why is delay of treatment often such a medical disaster? DCS pathophysiology is covered from the approach of bubble dynamics than tissue half times

VIII. The Haldane Method

Here we discuss the method used by John Scot Haldane to first calculated tables, and how he determined the quantitative factors necessary for the calculation of a practical decompression system that has survived almost untouched for one century. An initial presentation of some of the mathematical descriptions of dive table design.

IX. Surface Tension Effects

The role of surface tension in the growth of tissue micronuclei. Presented is the concpt of Laplace pressure and “the Laplace cutoff” for micronuclei growth.

X. Non-Haldane Methods

These are decompression methods based on tissue bubble dynamics models. Here we learn about the utility of nucleation theory in decompression calculations. This is an introduction to contemporary calculation algorithms.

XI. Control Of Nucleation

What information do we have about tissue micronuclei formation? What does the idea of the *in vivo* stable tissue gas phase mean for diving. Covered is the involvement of gas phase nucleation in the scuba diver

XII. Nuclei Resolution

How long do nuclei persist in the body? What con be done to control their formation to increase decompression safety?

XIII. Blood Flow

What is the qualitative and quantitative importance of blood flow in decompression? How is blood flow changed in NASA EVA operations and what is the meaning of this in a “one-tissue” model of gas loading?

XIV. Dive Computers and Diving Physiology

What do dive computers measure, and are they a significant departure from the tables that have been used for several decades? What is the relationship of the diving physiology presented in this course to the mathematical models in dive computers? Why is the body's free gas bubble load difficult to track in repetitive diving? What is the significance of “out of range” for recreational SCUBA divers.

XV. The Women Diver/ Diving and Pregnancy

What special requirements if any are needed by the woman diver? Discussed will be what scientists have discovered about the question of diving while pregnant.

XVI. Environmental Factors

Those last little topics that are in the catch-all basket. In particular are described speculations on “undeserved hits”

The course textbook, *Advanced Diving Physiology: A Syllabus* is provided within the course fee.