招請講演II

Decompression Tables and Evaluation of Decompression Risk

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Since the development of the first decompression tables in 1906 by J. S. Haldane, considerable research and effort have been expended in the development of safer and more rapid decompression procedures and tables. The approach taken by Haldane can be considered to be deterministic. Such an approach is governed by a fixed set of rules that defines the boundary between safe and unsafe dives. A model for gas exchange and an ascent criterion, such as gas supersaturation, are used to calculate the "safe" decompression depth. Most models of decompression that have been developed for generating decompression tables or for dive computers have taken this same approach. They are essentially empirical and not physiological models and provide "safe" decompression only over a limited range of depth and bottom times. Because decompression sickness (DCS) is considered a binary event, it becomes logistically and financially impossible to conduct enough dives, when validating dive tables, to show that a given dive profile is safe within statistical significance.

DCS should actually be considered as a probabilistic event. Decompression profiles are not just a case of being safe or unsafe. The time-depth dose is related to the risk of DCS. This concept leads to the statistical approach for developing probabilistic models of decompression for estimating or predicting the risk of DCS. A risk function is defined that consists of a gas exchange component and an ascent criterion. The ascent criterion can be based on supersaturation or bubble growth. To determine the risk function, a large data set of precise dive data, including time, depth, gas composition, and DCS outcome, must be available. The parameters of the risk model are calculated iteratively by comparing the predictions of DCS from the model with the observed data until the best fit is attained by the method of maximum likelihood. Not all dive data can be accepted as primary data. The problem of having to do so many tests on a single profile as in the deterministic approach can be overcome with the statistical method since data from widely varying dive profiles, with each individual profile constituting only a small number of human tests, can be combined and used to improve parameter estimates of the probabilistic model.

Probabilistic models of decompression can be used to analyze dive tables and procedures, compare different tables, and develop decompression tables with a given risk level. There are many paths to the surface, the obvious choice being the minimum decompression time for a given risk level. The probabilistic approach for decompression is a very powerful technique that opens up the potential for an entirely new concept in table design, analysis, and dive testing. Being able to investigate different risk criteria and gas kinetics should lead to a better insight into the physics and physiology of decompression.