Title:	Prediction of decompression illness using bubble models
Authors:	Tikuisis, P Gault, KA Nishi, RY
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Abstract:	The method of maximum likelihood was applied to models of bubble formation and evolution against data involving decompression illness (DCI). Equilibrium and non-equilibrium gas kinetic models were tested under the constraint of a finite tissue volume. The equilibrium model (leq), where the internal gas of a bubble is in partial pressure and mechanical equilibrium with the gas dissolved in tissue, assumed formation of a bubble upon any gas supersaturation. The non-equilibrium model (neq), where mechanical equilibrium is maintained but the exchange of gas between the bubble and the tissue is governed by a rate constant, assumed formation of a bubble at the metastable equilibrium state which requires a specific degree of gas supersaturation. In addition, another version of bubble evolution based on the diffusivity of gas in tissue (vl) was tested under similar finite volume constraints. Model parameters included liquid surface tension, the gas exchange rate constant, gas solubility, and the tissue time constant. The risk of DCI was based on the bubble radius (R) raised to powers ranging from 0 to 6. The data included 2,023 man-dives in 630 different dive profiles of air and nitrox gas mixtures with depth ranging from 1.75 to 7.09 bar and bottom time ranging from 2.8 to 300.2 min. There were 97 occurrences of DCI and 27 occurrences of marginal symptoms. Predictions of the neq and vl models were quite similar and suggested that the tissue primarily responsible

for bubble formation leading to DCI in the present analysis has a perfusion rate of about 4.0 ml blood.100 ml-1.min-1. The best fit of the data for a single compartment of 10(-4) ml vol was obtained with the leq model and a risk based on R4, and an estimated time constant of 95.6 +/- 9.8 min.

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