Title: Calibration of a bubble evolution model to observed bubble incidence in divers

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Abstract: The method of maximum likelihood was used to calibrate a probabilistic bubble evolution model against data of bubbles detected in divers. These data were obtained from a diverse set of 2,064 chamber man-dives involving air and heliox with and without oxygen decompression. Bubbles were measured with Doppler ultrasound and graded according to the Kisman-Masurel code from which a single maximum bubble grade (BG) per diver was compared to the maximum bubble radius (Rmax) predicted by the model. This comparison was accomplished using multinomial statistics by relating BG to Rmax through a series of probability functions. The model predicted the formation of the bubble according to the critical radius concept and its evolution was predicted by assuming a linear rate of inert gas exchange across the bubble boundary. Gas exchange between the model compartment and blood was assumed to be perfusion-limited. The most successful calibration of the model was found using a trinomial grouping of BG according to no bubbles, low, and high bubble activity, and by assuming a single tissue compartment. Parameter estimations converge to a tissue volume of 0.00036 cm3, a surface tension of 5.0 dyne.cm-1, respective time constants of 27.9 and 9.3 min for nitrogen and helium, and respective Ostwald tissue solubilities of 0.0438 and 0.0096. Although

not part of the calibration algorithm, the predicted evolution of bubble size compares reasonably well with the temporal recordings of BGs.

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