TOWARDS PROBABILISTIC ASSESSMENT OF HYPOBARIC DECOMPRESSION SICKNESS TREATMENT

J. Conkin[1], A.F. Abercromby[2], A.H. Feiveson[3], M.L. Gernhardt[3], J.R. Norcross[2], R. Ploutz-Snyder[1], J.H. Wessel, III[2]

[1]Universities Space Research Association, 3600 Bay Area Blvd., Houston, TX 77058, johnny.conkin-1@nasa.gov, [2]Wyle Science, Technology & Engineering Group, 1290 Hercules, Houston, TX 77058, [3]NASA Johnson Space Center, 2100 NASA Parkway, Houston, TX 77058.

INTRODUCTION: Pressure, oxygen (O_2), and time are the pillars to effective treatment of decompression sickness (DCS). The NASA DCS Treatment Model links a decrease in computed bubble volume to the resolution of a symptom. The decrease in volume is realized in two stages: a) during the Boyle's Law compression and b) during subsequent dissolution of the gas phase by the O_2 window. **METHODS**: The cumulative distribution of 154 symptoms that resolved during repressurization was described with a log-logistic density function of pressure difference (ΔP as psid) associated with symptom resolution and two other explanatory variables. The 154 symptoms originated from 119 cases of DCS during 969 exposures in 47 different altitude tests. **RESULTS**: The probability of symptom resolution [P(symptom resolution)] = 1 / (1+exp(-(ln(ΔP) – 1.682 + 1.089×AMB - 0.00395×SYMPTOM TIME) / 0.633)), where AMB is 1 when the subject ambulated as part of the altitude exposure or else 0 and SYMPTOM TIME is the elapsed time in min from start of the altitude exposure to recognition of a DCS symptom. The P(symptom resolution) was estimated from computed ΔP from the Tissue Bubble Dynamics Model based on the "effective" Boyle's Law change: $P_2 – P_1$ (ΔP, psid) = $P_1 \times V_1/V_2 – P_1$, where V_1 is the computed volume of a spherical bubble in a unit volume of tissue at low pressure P_1 and V_2 is computed volume after a change to a higher pressure P_2. V_2 continues to decrease through time at P_2, at a faster rate if 100% ground level O_2 was breathed. The computed ΔP is the effective treatment pressure at any point in time as if the entire ΔP was just from Boyle's Law compression. **DISCUSSION**: Given the low probability of DCS during extravehicular activity and the prompt treatment of a symptom with options through the model it is likely that the symptom and gas phase will resolve with minimum resources and minimal impact on astronaut health, safety, and productivity.