

VENOUS GAS EMBOLI AND AMBULATION AT 4.3 PSIA

J. Conkin¹, N.W. Pollock², M.J. Natoli³, S.D. Martina², J.H. Wessel, III⁴, M.L. Gernhardt⁵

¹Universities Space Research Association, Houston, TX; ²Center for Hyperbaric Medicine and Environmental Physiology, Duke University Medical Center and Divers Alert Network, Durham, NC ; ³Center for Hyperbaric Medicine and Environmental Physiology, Duke University Medical Center, Durham, NC; ⁴Wyle Science, Technology & Engineering Group, Houston, TX; ⁵NASA Johnson Space Center, Houston, TX

INTRODUCTION: Ambulation imparts compressive and decompressive forces into the lower body, potentially creating quasi-stable micronuclei that influence the outcome of hypobaric depressurizations. *Hypotheses:* ambulation before the conclusion of a denitrogenation (prebreathe) protocol at 14.7 psia is not sufficient to increase the incidence of venous gas emboli (VGE) at 4.3 psia but is sufficient if performed after tissues become supersaturated with nitrogen at 4.3 psia. **METHODS:** VGE results from 45 subjects that performed exercise prebreathe without ambulation before or during a 4-hr exposure to 4.3 psia (Phase II control) are compared to 21 subjects that performed the same prebreathe but ambulated before and during the hypobaric exposure (Phase II-1) and to 30 subjects that only ambulated before the hypobaric exposure (Phase II-3). VGE in the pulmonary artery were detected at about 16 min intervals using precordial Doppler ultrasound (2.5 MHz) and assigned a Spencer 0 – IV grade. The highest grade assigned during the exposure is one metric, and Grade III or IV were combined as “high VGE grade”. We used Fisher’s exact directional χ^2 for VGE counts, evaluated survival curves for onset of high VGE grade using non-parametric Kaplan-Meier, and used logistic regression (LR). **RESULTS:** The incidence of high VGE grade for Phase II-1 (57%) was greater than Phase II (17%, $P = 0.001$) and Phase II-3 (16%, $P = 0.002$). Mean onset times for high VGE grade were similar for control (105 ± 72 min SD), II-1 (104 ± 55), and II-3 (102 ± 24) conditions. Differences among the three Kaplan-Meier survival curves were significant from log-rank tests ($P \leq 0.001$), but not just between II and II-3 ($P > 0.85$). Age and ambulation status from LR were needed to describe the probability of high VGE grade. **DISCUSSION:** VGE are increased by mild ambulation conducted under a supersaturated state (Phase II-1 vs II-3); however, no increase in VGE was observed with mild ambulation during the undersaturated state alone (Phase II control vs II-3).

Learning Objectives:

1. Lower body exercise is a consideration for hypobaric decompression sickness and bubble formation.