

O-10 DO PLASMA SURFACTANTS PLAY A ROLE IN DIVING? THE INTERRELATIONSHIPS BETWEEN PLASMA LIPIDS AND PROTEINS, SURFACE TENSION AND POST-DIVE VENOUS GAS EMBOLISM

Nico A.M. Schellart¹, Miroslav Rozložnik² and Costantino Balestra²

¹Biomedical Engineering and Physics, Academic Medical Centre, University of Amsterdam, Amsterdam, The Netherlands; n.a.schellart@amc.nl.

² Environmental and Occupational Physiology Laboratory, Haute Ecole "Paul Henri Spaak", Brussels, Belgium

Introduction/Aims

Decompression sickness (DCS) of divers is caused by bubbles of inert gas. When DCS occurs, most bubbles occur in the venous circulation; vascular gas bubbles (VGB). The classic surfactant theory states that bubbles are stabilized by low molecular weight surfactants, reducing the plasma-gas surface tension (γ). We hypothesize that proteins may also play a role. We studied the interrelations between VGB and γ , total protein, albumin, triglycerides, total cholesterol and free fatty acids (FFAs), measured before and after a dry (air-)dive simulation.

Methods

Of 52 divers executing 63 simulated dives (21msw/40min profile) VGB was determined 40, 80, 120 and 160 min after surfacing (precordial Doppler method) and recalculated to the logarithm of the Kisman Integrated Severity Score (logKISS). Total protein, albumin, lipids and γ (dynamic bubble method) were determined pre- and post-dive. To manipulate plasma composition half of the subjects obtained fat rich and half fat poor meals. Eleven subjects got both.

Results

Triglycerides and FFAs varied substantially both intra- and inter-subject and pre-versus-post simulation; proteins do not. In statistical analysis, including sub-group comparisons and (partial) correlations, a consistent pre-post behaviour of the compounds could not be established. Nor did VGB scores show correlation with the compounds and γ . Similar findings hold true for the paired differences between the double exposures of the 11 subjects. The difference between γ_{water} and γ_{plasma} was only about 15 mN/m.

Conclusions

Proteins, triglycerides, cholesterol and FFAs don't seem to modulate γ and hence they cannot play a predominant role in post-dive bubble formation. The measured γ_{plasma} suggests that proteins are possibly the main compounds that lower surface tension. Since these findings do not agree with the classic surfactant hypothesis, some rephrasing seems necessary.

Keywords

Diving, surface tension, surfactant, lipids and proteins, Doppler bubble score.

This study was partially supported by the Netherlands Society of Diving Medicine and an EU Marie Curie Programme (FRP/2007-2013/REA grant 264816).