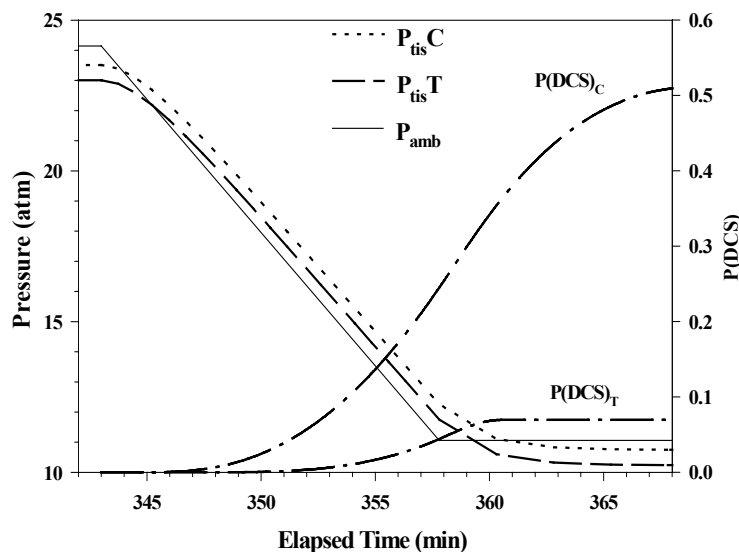


**ON THE LIKELIHOOD OF DECOMPRESSION SICKNESS DURING H<sub>2</sub> BIOCHEMICAL DECOMPRESSION IN PIGS.** Fahlman, A, Tikuisis, P, Himm, JF, Weathersby, PK and Kayar, SR. Environmental Physiology Department, Naval Medical Research Center, Silver Spring, MD USA and Defence and Civil Institute of Environmental Medicine, Toronto, ONT, Canada.

The risk of decompression sickness (DCS) in pigs following hyperbaric exposures to H<sub>2</sub> was modulated by a process called biochemical decompression. In this process, intestinal H<sub>2</sub>-metabolizing microbes eliminated some of the H<sub>2</sub> stored in the tissues of animals. Experimental conditions were intended to mimic ultra-deep dives to 200 – 600 m (20 - 60 atm). At these pressures, H<sub>2</sub> may be a more suitable breathing gas for humans than He or N<sub>2</sub> because its lower density reduces lung ventilatory effort. Conventional decompression from such great pressures requires many days; biochemical decompression may shorten this time with lower risk of DCS.

Pigs (*Sus scrofa*, 19.5 ± 1.3 kg) were either controls (C; n = 80) or surgically treated with intestinal injections of H<sub>2</sub>-metabolizing microbes (*Methanobrevibacter smithii*) (T; n = 29). Animals were placed in a dry hyperbaric chamber and compressed to 22.3-25.7 atm for 30-1440 min. Chamber gases were monitored by gas chromatography. Final gas composition was 86-96% H<sub>2</sub>, 2-12% He, 2% O<sub>2</sub>, < 1% N<sub>2</sub>. The rate at which pigs released methane (CH<sub>4</sub>) was monitored as an index of microbial H<sub>2</sub> metabolism. Animals were decompressed at 0.45-1.80 atm/min to 11 atm, and observed for 1 h for signs of DCS. Among the 109 exposures, 53 DCS cases were observed.

A probabilistic model was used to predict DCS outcome in C and T pigs. Single exponential kinetics described the tissue partial pressures (P<sub>tis</sub>) of H<sub>2</sub> and He:  $P_{tis} = \int (P_{amb} - P_{tis}) \cdot \tau^{-1} dt$ , where P<sub>amb</sub> is ambient pressure and τ the exponential time constant. Probability of DCS [P(DCS)] was predicted using the risk function:  $P(DCS) = 1 - e^{-r}$ , where  $r = \int (P_{tis}H_2 + P_{tis}He - P_{amb}) \cdot P_{amb}^{-1} dt$ . To estimate the effect of H<sub>2</sub> metabolism on P(DCS), a term (A) corresponding to the rate of H<sub>2</sub> removal by the microbes was added into the calculation of  $P_{tis}H_2 = \int (P_{amb} - A - P_{tis}H_2) \cdot \tau^{-1} dt$ .



Inclusion of A significantly improved the prediction of P(DCS). Accordingly, the model predicted that by removing 5% of the total burden of H<sub>2</sub> in tissues by microbial H<sub>2</sub> metabolism, P(DCS) could be reduced by 50% during H<sub>2</sub> biochemical decompression.