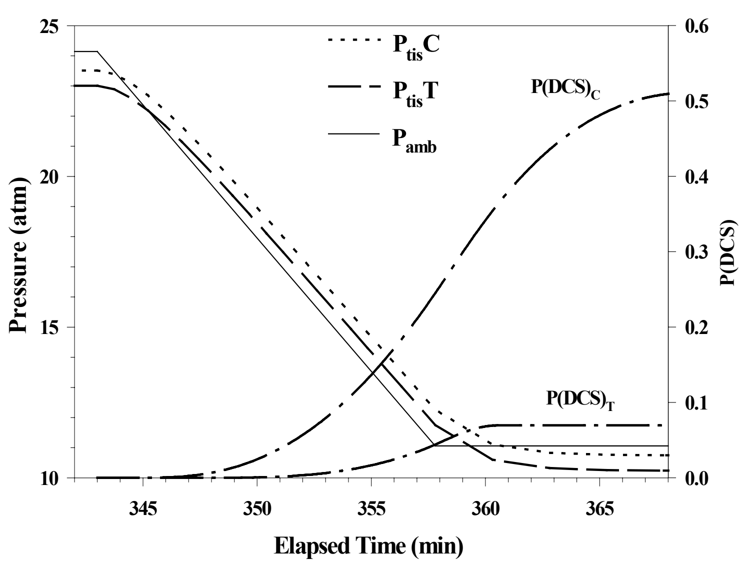
ON THE LIKELIHOOD OF DECOMPRESSION SICKNESS DURING H_2 BIOCHEMICAL DECOMPRESSION IN PIGS. Fahlman, A, Tikuisis, P, Himm, JF, Weathersby, PK and Kayar, SR. Environmental Physiology Department, Naval Medical Research Center, Silver Spring, MD USA and Defence and Civil Institute of Environmental Medicine, Toronto, ONT, Canada.

The risk of decompression sickness (DCS) in pigs following hyperbaric exposures to H_2 was modulated by a process called biochemical decompression. In this process, intestinal H_2-metabolizing microbes eliminated some of the H_2 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_2 may be a more suitable breathing gas for humans than He or N_2 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_2-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_2, 2-12% He, 2% O_2, < 1% N_2. The rate at which pigs released methane (CH_4) was monitored as an index of microbial H_2 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_{tis}) of H_2 and He: $P_{tis} = \int (P_{amb} - P_{tis}) \bullet \tau^{-1}\, dt$, where P_{amb} 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 $r = \int (P_{tis}H_2 + P_{tis}He - P_{amb}) \bullet P_{amb}^{-1}\, dt$. To estimate the effect of H_2 metabolism on P(DCS), a term (A) corresponding to the rate of H_2 removal by the microbes was added into the calculation of $P_{tis}H_2 = \int (P_{amb} - A - P_{tis}H_2) \bullet \tau^{-1}\, dt$.



Inclusion of A significantly improved the prediction of P(DCS). Accordingly, the model predicted that by removing 5% of the total burden of H_2 in tissues by microbial H_2 metabolism, P(DCS) could be reduced by 50% during H_2 biochemical decompression.

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