DECOMPRESSION SICKNESS RISK REDUCED BY H₂ METABOLISM
OF NATIVE INTESTINAL FLORA IN PIGS DURING H₂ DIVES

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No correlation between DCS risk and depth. High coincidence between animals with DCS and those that released no methane during the final hour of the compression.

### Materials and Methods

**Animals:**
- Yorkshire pigs (*Sus scrofa*), castrated or uncastrated males, n = 17, body mass range 17.25 kg

**Dive Simulation:**
- H₂ dive simulated in a dry hyperbaric chamber (5660 L volume).
  - Chamber initially pressurized with He to 11 bar (to dilute O₂).
  - Chamber pressurized with H₂ to either 22.2, 24 or 25.5 bar for 3 h.
  - Final chamber [H₂] = 84 - 93% at each pressure; PO₂ = 0.3 - 0.5 bar.
  - Decompression rate 0.46 bar/min to 11 bar.
- Euthanized in chamber on confirmation of DCS or at end of hour.

**Measurements:**
- Chamber gases analyzed by gas chromatography for H₂, O₂, He, N₂ and CH₄.
- Chamber CH₄ release rate by pigs (µmol CH₄/min).
- Chamber CH₄ output concentration (ppm) was used as index of CH₄ release rate by pigs (µmol CH₄/min).
- DCS diagnosed as pigs walked on treadmill in chamber; symptoms of severe DCS include difficulty walking, falling, inability to stand, seizures.

### Data Summary

**Body Mass (kg)**
- 19.4 ± 0.4
- 18.8 ± 0.1
- 20.2 ± 1.9
- 20.0 ± 1.0
- 19.0 ± 0.1
- 20.7 ± 1.4

**% Risk of DCS**
- 35
- 25
- 30
- 0

**Sample Dive**

This pig released increasing amounts of methane throughout the exposure to hyperbaric H₂.

**Sample Dive**

This pig failed to make detectable quantities (> 0.5 ppm) of methane at any time during this exposure to hyperbaric H₂.

### How much H₂ was eliminated from the pigs via their release of methane?

Chamber gas volume is large (5660 L; 130 m), and sampling lines are relatively long (115 or 4011 m). Thus, >3 h are needed for the chamber to be completely flushed once with the sampling gas stream, and such a dynamic equilibrium between the input of methane from the pig and the output of methane from the chamber is measured. Chamber methane concentrations must therefore be corrected for the non-equilibrium conditions to which represent methane release into the chamber.

### Results

- DCS incidence did not increase with increasing dive pressure, as expected from general experience in diving.
- Pigs that released methane had a lower incidence of DCS (89%/121) than those that released no quantifiable amounts of methane (60%/3/5).

### Conclusions

- H₂-metabolizing microbes in the native intestinal flora of pigs can significantly reduce the tissue inert gas load during a simulated H₂ dive.
- We estimate that the microbes are removing H₂ at a rate that represents 4 - 8% of the rate at which H₂ is diffusing into the pigs.