Body fat does not *influence* venous bubble formation after air dives: nitrogen load models and experiments

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Study questions

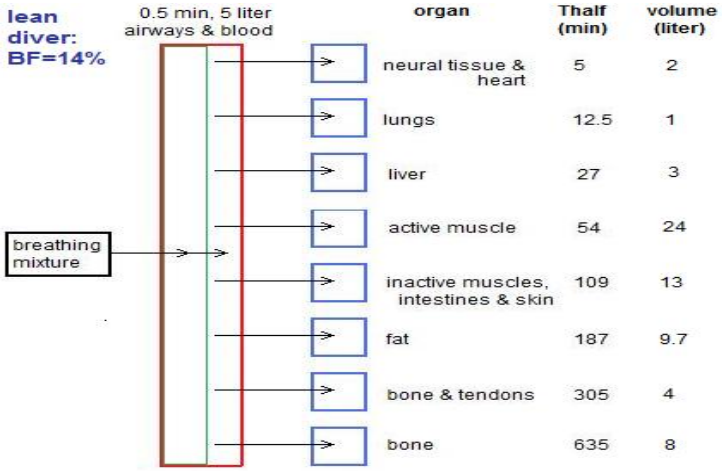
A. Is it theoretically possible that body fat (BF) affects venous gas bubble grade (VGB)?

B. Shows a Doppler experiment with subjects with a wide range of body fat but with (about) the same age VO_{2max} and gender (to negate multicollinearity) an influence of BF?

To simulate N_2-loads of lean and fat divers a series-parallel model was developed.

Novelty: 1. **blood compartment** (airways&circulation) precedes all **//compartments;**

2. **//compartments** have halftimes and **volumes**



Material and methods

Modeling principle: every time interval PN_{2blood} is corrected by summed ΔN_2-load$_{//comp}$ via Henry's law. Next, PN_{2blood} recalculated with $PN_{2ambient}$, then $PN_{2//comp}$ from new PN_{2blood} and new summed ΔN_2-load$_{//comp}$, etc.

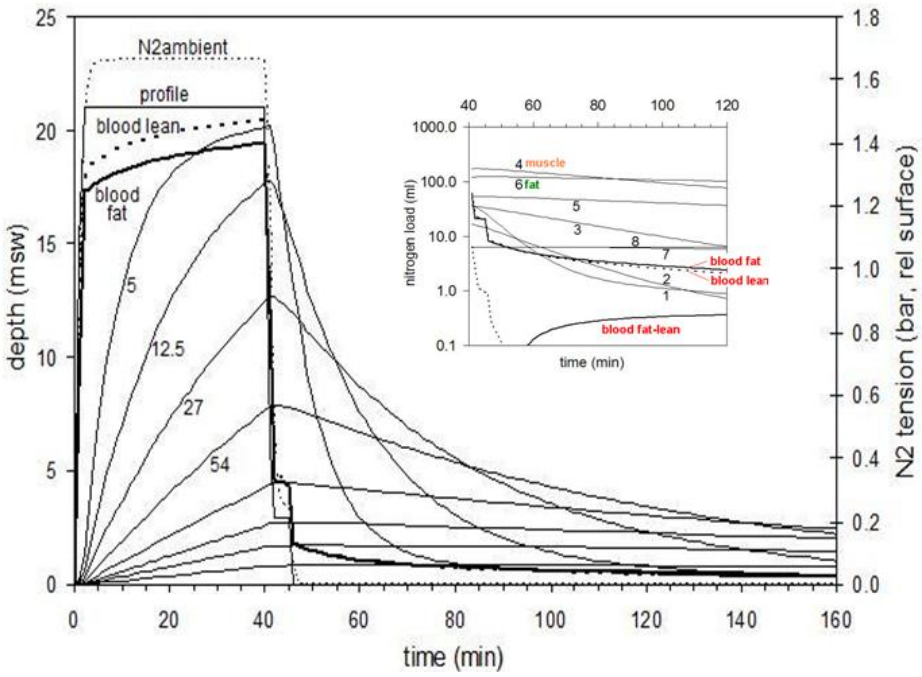
Precordial Dopplers (KM) were taken at 40, 80, 120, and 160 min. Profile 40 min/3.1 bar(a); 53 male divers. KM values transformed to logKISS and to log{#bubbles/cm^2} (logB). Independent test variables: BF, age, VO_{2max}.

Results

The model shows strongly delayed N_2 uptake and especially release (see graph; //compartments of lean diver). One hour after surfacing, a 14 to 28% increase of BF gives a whole body increase of 51%, but only 15% in the blood (see inset) → only a. 0.01 KM 'units' increase (near KM = I.)

Substantial changes in T_{half}'s, compartment volumes, profiles (saturation) and changes of T_{half}'s, after surfacing do not matter. The long supersaturation of blood compartment allows bubble grow (critical diameter concept).

All statistical outcomes of partial correlations between VGB data and BF are non-significant (P-values about 0.50), supporting the model outcomes.



CONCLUSIONS

1 The robust series//-N_2-load model shows a much slower uptake and release than Haldanian models. This promotes bubble grow (d^{crit} concept).

2. The model shows that BF is irrelevant for VGB, even for saturation exposures (caisson work).

3. Experiments and former experimental studies (Schellart et al. ASEM 2012, reanalysis of Carturan et al. 2002) indicate that BF does not affect VGB.

Schellart et al., JAP, 2013:114;602-10.