

Application of interconnected and parallel decompression models to PDE data

Saul Goldman and Sam Campbell

Department of Chemistry, University of Guelph, Guelph, Ontario, Canada

Introduction: DAN’s “Project Dive Exploration” (PDE), involves collecting recreational dive profiles, together with their outcomes (1). The purpose of this study was to apply current decompression models to these profiles, to determine how well these models predicted the observed outcomes.

METHODS: Two pre-existing interconnected three-compartment models (3cm, 3cmb), a basic two-compartment independent parallel model (2cp), and the LE1 model were used. These models and their calibration (by “Maximum Likelihood”) were all described in detail previously (2, 3). The models were used to predict the mean probability of decompression sickness per profile, and there-from the expected number of hits, for the air and nitrox profiles in the dataset. The dataset used contained 102,642 and 6,933 air and nitrox individual dive profiles, respectively. Both single and repetitive dives were considered. A “cut-off” time is needed to define the beginning/end of a repetitive dive profile. We used a cut-off time of 12 hours, resulting in 40,008 and 3,262 air and nitrox repetitive profiles, respectively.

OBSERVED AND PREDICTED NUMBERS OF HITS IN PDE DATASET FOR SINGLE DIVES

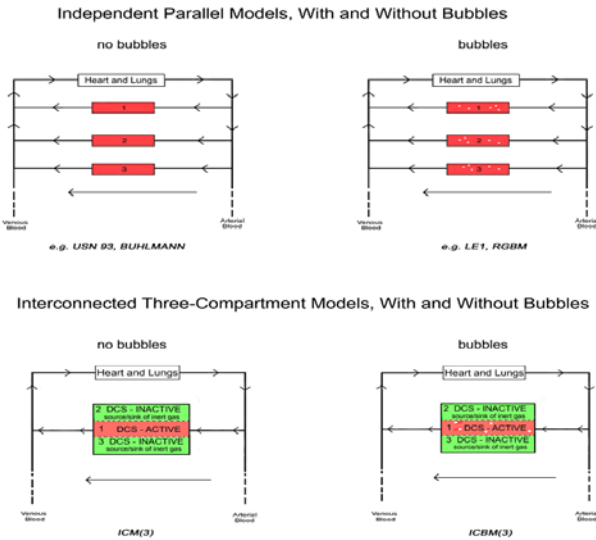
MODEL	AIR		NITROX ^(A)	
	PREDICTED	OBSERVED ^(B)	PREDICTED	OBSERVED ^(C)
2CP	1485	32.4 (22-46)	72.9	1 (.03-5.6)
LE1	352	32.4 (22-46)	9.8	1 (.03-5.6)
3CM	67.8	32.4 (22-46)	0.64	1 (.03-5.6)
3CMB	43.4	32.4 (22-46)	0.26	1 (.03-5.6)

^(A) MOSTLY (32-36) % O₂.
^(B) BASED ON 102,642 SINGLE DIVE PROFILES (DEFINED USING A CUT-OFF TIME = SURFACE INTERVAL). MARGINALS WEIGHTED AS 0.1 HITS.
^(C) BASED ON 6,933 SINGLE DIVE PROFILES (DEFINED USING A CUT-OFF TIME = SURFACE INTERVAL). MARGINALS WEIGHTED AS 0.1 HITS.

OBSERVED AND PREDICTED NUMBERS OF HITS IN PDE DATASET FOR REPETITIVE DIVES

MODEL	AIR		NITROX ^(A)	
	PREDICTED	OBSERVED ^(B)	PREDICTED	OBSERVED ^(C)
2CP	502	32.4 (22-46)	27.8	1 (.03-5.6)
LE1	134	32.4 (22-46)	4.4	1 (.03-5.6)
3CM	29.0	32.4 (22-46)	0.39	1 (.03-5.6)
3CMB	18.9	32.4 (22-46)	0.16	1 (.03-5.6)

^(A) MOSTLY (32-36) % O₂.
^(B) BASED ON 102,642 SINGLE DIVE PROFILES, COLLECTED TO FORM 40,008 REPETITIVE DIVE PROFILES (DEFINED USING A CUT-OFF TIME OF 12 HOURS). MARGINALS WEIGHTED AS 0.1 HITS.
^(C) BASED ON 6,933 SINGLE DIVE PROFILES, COLLECTED TO FORM 3,262 REPETITIVE DIVE PROFILES (DEFINED USING A CUT-OFF TIME OF 12 HOURS). MARGINALS WEIGHTED AS 0.1 HITS.



CONCLUSIONS. Both interconnected models, on balance, are significantly more accurate in predicting the observed number of hits, than both parallel models, which (with the exception of the LE1 model for repetitive nitrox dives) predicted too many hits for both air and nitrox.

Acknowledgements: The authors are grateful to the Natural Sciences and Engineering Research Council of Canada (NSERC) for financial support in the form of a Discovery Grant to one of us (SG), and to Drs. Dick Vann, Petar Denoble, and Richard Dunford for a copy of the current PDE dataset for air and nitrox.

REFERENCES:

(1) Dunford. UHM **38**:465 (2011)
(2) Goldman. J APPL PHYSIOL **103**:484 (2007); UHM **34**:229 (2007); UHM **36**:249 (2009).
(3) Thalmann. UHM **24**:255. (1997); Howle. COMP BIOL MED doi: 10.1016 (2009).