



Loss of Decompression Sickness Prevention with Interruption of Oxygen Pre-Breathe

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ABSTRACT

INTRODUCTION: Disabled submarine (DISSUB) survivors are expected to achieve saturation with inert gas. Oxygen pre-breathe (OPB) before simulated escape significantly reduces risk of DCS. In previous work, OPB of 45 minutes eliminated severe DCS. However, the effects of a delay from OPB to surfacing are unknown. We hypothesized a loss of OPB benefit following subsequent air periods in 70 kg swine.

MATERIALS AND METHODS: Adult Male Yorkshire Swine underwent dry chamber dives at 60 fsw; after 22h animals were treated with varying periods of OPB and air prior to rapid decompression to the surface (30fsw/min). Observers then entered the chamber and recorded signs of DCS for 2 h. Treatments were divided into five groups: OPB of 0 min (OPB0), OPB of 45 min (OPB45), OPB of 45 min followed by 30 min of Air (OPB45/Air30), OPB of 45 min followed by 60 min of Air (OPB45/Air60), OPB of 120 min followed by 60 min of air (OPB120/Air60).

RESULTS:

Group Characteristics:				DCS I		DCS II	
Group	N	Mwt	SE	N	Incid	N	Incid
OPB0	15	69.5	3.2	13	87%	12	80%
OPB45	10	67.3	1.8	1	10%	0	0%
OPB45/Air30	10	73.0	2.5	5	50%	2	20%
OPB45/Air60	10	71.0	4.9	5	50%	4	40%
OPB120/Air60	18	74.0	6.3	8	44%	2	11%

Relative Risk of DCS		DCS I		DCS II	
Comparison		RR	p	RR	p
OPB0 vs. OPB120/Air60	0.513	<0.05	0.139	<0.01	
OPB0 vs. OPB45/Air30	0.577	>0.1	0.25	<0.1	
OPB0 vs. OPB45/Air60	0.577	>0.1	0.5	>0.1	

CONCLUSIONS: This study demonstrates that decreases in serious DCS due to OPB are diminished with increasing durations of air interruption. These results support the potential of OPB with minimal air interruption as an alternative to staged decompression.

BACKGROUND

- Disabled submarine (DISSUB) survivors are expected to achieve saturation with inert gas.
- Due to the crew size in a DISSUB event local chamber resources could be overwhelmed
- In previous work, Oxygen Pre-Breathe of 45 minutes eliminated severe DCS.
- The effects of a delay from OPB to surfacing are unknown.
- We hypothesized a loss of OPB benefit following subsequent air periods in 70 kg swine.

METHODS

Animals

- 63 neutered male Yorkshire swine (*sus scrofa*)

Pre-dive Preparation

- Catheter inserted into left external jugular vein
- Custom designed fabric vest fitted around thorax and back secured and protected the catheter line and port
- After 24 h recovery animals lead into Plexiglas boxes within the Multiple Large Animal Chamber (MLAC)

Hyperbaric Exposure Protocol

- Animals compressed to 60 fsw (1.8 ATA) on air for 22 hours then
- Varying periods of 100% Oxygen (OPB) followed by varying periods of air
- After exposure period, dropout decompression to surface (30 fsw/min)
- Temperature maintained 26.7-29.4°C, humidity 50-75%, CO₂<0.3%

2h Surface Observations

- Cutis, Cardiopulmonary, Neurologic

Study Groups

- OPB of 0 min (OPB0)
- OPB of 45 min followed by 30 min of Air (OPB45/Air30)
- OPB of 45 min followed by 60 min of Air (OPB45/Air60)
- OPB of 120 min followed by 60 min of air (OPB120/Air60)

Table 1. Group Characteristics:

	N	Mwt.(kg) ¹	SE _{mwt} (kg) ²	
OPB ₀	15	69.5	3.2	
OPB ₄₅	10	67.3	1.8	
OPB ₄₅ /AIR ₃₀	10	73	2.5	
OPB ₄₅ /AIR ₆₀	10	71	4.9	1 = mean weight
OPB ₁₂₀ /AIR ₆₀	18	74	6.3	2 = standard error of the mean weight

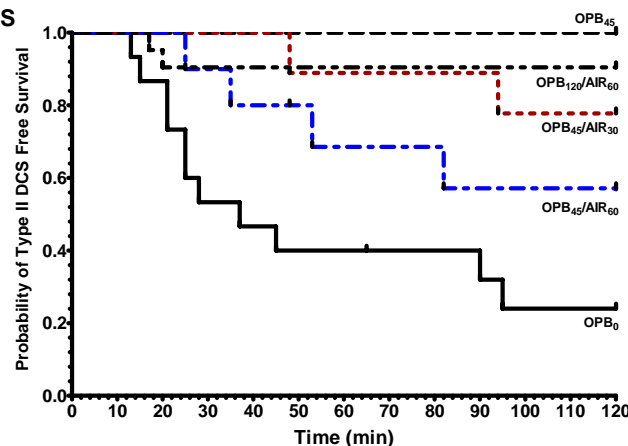
Table 2: DCS Incidence

	DCS Type I		DCS Type II	
	N	Incidence	N	Incidence
OPB ₀	13	87%	12	80%
OPB ₄₅	1	10%	0	0%
OPB ₄₅ /AIR ₃₀	5	50%	2	20%
OPB ₄₅ /AIR ₆₀	5	50%	4	40%
OPB ₁₂₀ /AIR ₆₀	8	44%	2	11%

Table 3: Relative Risk of Developing DCS

Comparison	DCS Type I		DCS Type II	
	Relative Risk	p	Relative Risk	P
OPB ₀ vs. OPB ₁₂₀ /Air ₆₀	0.513	<0.05	0.139	<0.01
OPB ₀ vs. OPB ₄₅ /Air ₃₀	0.577	>0.1	0.25	<0.1
OPB ₀ vs. OPB ₄₅ /Air ₆₀	0.577	>0.1	0.5	>0.1

RESULTS



CONCLUSIONS

- Reductions in Type II DCS due to Oxygen Pre-Breathe are lost with increasing periods of air interruption
- Oxygen Pre-Breathe has the potential as an alternative to staged decompression provided there is minimal air interruption prior to ascent
- Due to a lack of statistical significance between certain OPB/ air break pairings we are unable to determine and exact relationship between the length of OPB, air interruption and DCS incidence
- Conducting additional trials may allow for the generation of model that predict DCS incidence based on OPB time and duration of air interruption

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