

C 47

Enriched-air/oxygen for pre-flight surface intervals

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Introduction/Background

Current guidelines for pre-flight surface intervals (PFSI) of 12-18 hours represent a delay if urgent medevac is required. This study seeks to investigate the potential use of enriched air mixtures and oxygen to decrease PFSI.

Materials and Methods

Simulated dive profiles assumed a descent rate of 30 meters/minute and an ascent rate of 10 meters/minute. Dive times included descent plus time at maximum depth. Six single dive profiles were selected, at three popular recreational diver certification depths: three profiles at or near the no-decompression time limits for those depths, and three with shorter times. Inert gas pressures at the end of the dives and at six, 12, 18 and 24 hours breathing air post-dive were estimated for ZH-L16B compartments using the R package 'scuba.' Then, still assuming the dives were made on air, surface interval times were estimated to reach equivalent (or less) pressures while breathing EANx32, EANx36, or 100% oxygen.

Results

Oxygen-rich gases accelerated removal of inert gas, at least halving the six-hour times with EANx32 (mean 2:59 vs 6:00 hours), and reducing the 24-hour PFSI across all tested dives to a mean of 1:07 hours with 100% O₂ (Table 1).

Table 1. Pre-flight surface interval (hr:mins) required while breathing either EANx32, EANx36 or O₂ before reaching equivalent tissue pressures as either 6, 12, 18 or 24 hours breathing normobaric air.



| Dive Profile D'(m)/ mins | EANx32 | | | | EANx36 | | | | 100% Oxygen | | | |
|-----------------------------|--------|-------|-------|-------|--------|-------|-------|-------|-------------|-------|-------|-------|
| | 6 hr | 12 hr | 18 hr | 24 hr | 6 hr | 12 hr | 18 hr | 24 hr | 6 hr | 12 hr | 18 hr | 24 hr |
| 40(12) / 60 | 2:54 | 4:15 | 4:51 | 5:21 | 2:28 | 3:20 | 3:54 | 4:15 | 0:45 | 0:55 | 0:59 | 1:02 |
| 40(12) / 120 | 3:41 | 5:47 | 7:12 | 8:15 | 3:15 | 4:55 | 6:00 | 6:45 | 1:11 | 1:31 | 1:42 | 1:48 |
| 60(18) / 20 | 2:05 | 2:42 | 3:01 | 3:14 | 1:43 | 2:09 | 2:22 | 2:30 | 0:28 | 0:31 | 0:33 | 0:33 |
| 60(18) / 40 | 3:07 | 4:11 | 4:55 | 5:25 | 2:31 | 3:29 | 2:58 | 4:19 | 0:48 | 0:56 | 1:00 | 1:03 |
| 60(18) / 55 | 3:21 | 4:57 | 5:57 | 6:40 | 2:55 | 4:09 | 4:53 | 5:23 | 1:00 | 1:12 | 1:19 | 1:22 |
| 100(30) / 20 | 2:46 | 3:49 | 4:24 | 4:48 | 2:11 | 3:06 | 3:31 | 3:47 | 0:43 | 0:50 | 0:53 | 0:54 |

Summary/Conclusions

The estimated PFSI from breathing EANx36 decreased to a mean of 42% the equivalent of six hours breathing air, and to a mean of 19% the equivalent time for 24 hours of post-dive breathing air. There was some variance with respect to the dive profile, with longer profiles showing less improvement due to greater saturation in slower tissues. This study presents PFSI time estimates for breathing various gases to reach equivalent estimated compartment pressures after six to 24 hours of breathing normobaric air. These estimated times do not take into account physiological factors such oxygen-induced vasoconstriction, exercise, hydration, and other factors; the results will need confirmation by actual human trial(s) before practical adoption.