DECOMPRESSION SICKNESS AFTER AIR BREAK IN PREBREATHE DESCRIBED WITH A SURVIVAL MODEL

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BACKGROUND: Data from Brooks City-Base show the decompression sickness (DCS) and venous gas emboli (VGE) consequences of air breaks in a resting 100% O₂ prebreathe (PB) prior to a hypobaric exposure. METHODS: DCS and VGE survival times from 95 controls for a 60 min PB prior to 2-hr or 4-hr exposures to 4.37 psia are statistically compared to 3 break in PB conditions: a 10 min (n=40), 20 min (n=40), or 60 min break (n=32) 30 min into the PB followed by 30 min of PB. Ascent rate was 1,524 meters / min and all exposures included light exercise and 4 min of VGE monitoring of heart chambers at 16 min intervals. DCS survival time for combined control and air breaks were described with an accelerated log logistic model where exponential N₂ washin during air break was described with a 10 min half-time and washout during PB with a 60 min half-time.

RESULTS: There was no difference in VGE or DCS survival times among 3 different air breaks, or when air breaks were compared to control VGE times. However, 10, 20, and 60 min air breaks had significantly earlier survival times compared to control DCS times, certainly early in the exposures. CONCLUSION: Air breaks of 10, 20, and 60 min after 30 min of a 60 min PB reduced DCS survival time. The survival model combined discrete comparisons into a global description mechanistically linked to asymmetrical N₂ washin and washout kinetics based on inspired pN₂. Our unvalidated regression is used to compute additional PB time needed to compensate for an air break in PB within the range of tested conditions.
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ABSTRACT

BACKGROUND: Data from Brooks City-Base show the decompression sickness (DCS) incidence and venous gas embolism (VGE) consequences for 100% O2 prebreath (PB) prior to a hypoxic exposure. METHODS: DCS and VGE survival times from 95 controls for a 60 min PB prior to 2-hr or 4-hr exposures to 4.37 psia to 25 psia are statistically compared to 3 break in PB conditions: a 10 min, 20 min, or 60 min PB reduction of DCS survival times. The survival model combined discrete comparisons into a global description mechanistically linked to asymmetrical N2 washout and washin kinetics based on inspired pN2. Our univariate regression is used to compute additional PB time needed to compensate for an air break in PB within the range of tested conditions.

RESULTS

Table 1. Model results to describe DCS survival times

<table>
<thead>
<tr>
<th>Condition</th>
<th>Survival time (hrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>50.2</td>
</tr>
<tr>
<td>10 min</td>
<td>42.8</td>
</tr>
<tr>
<td>20 min</td>
<td>35.2</td>
</tr>
<tr>
<td>60 min</td>
<td>20.0</td>
</tr>
</tbody>
</table>

CONCLUSIONS / DISCUSSION

A logistic model that maximized the model fit for these data required very short times. This is perplexing since very high DCS incidence is associated with very low computed tissue N2 pressure, so the model is incomplete, but uncertain over a narrow range of test conditions.

Our approach to compute O2 payback time is not appropriate outside the range of tested conditions. The control data are from an "effective PB" of 60 min, and our model computes an effective PB of 50 min for the 10-min air break, 43 min for the 20-min air break, and 60 min for the 60-min air break.

Our regression model has not been prospectively validated, so our conclusions are hypotheses rather than operational recommendations.

REFERENCES