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) and various gas embolism (GVE) conditions occurring in a mix of 100% O2 prebreathe (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 describe DCS outcome. Add the additional O2 PB in the table to the balance of the required 60 min PB.

RESULTS

4.0 3.0 2.0 3.0 1.0 3.5 2.5 0.5 3.0 2.0 1.5 2.0 0.5

Fig. 2. Cumulative O2 PB with 10, 20, and 60 min breaks at 40 min into a 60 min 100% O2 PB. The hazard function for the control data is the same as that for curve C, and 5.320 for D.

Twelve subjects were exposed to an O2 PB of 60 min. The effect of each air break was compared to control VGE survival times. 15% of those with DCS had no VGE (21/140), 16% with VGE had no DCS (23/140), 7% had DCS with no VGE and 57% had both (82/140). Details about survival models and maximum likelihood optimization are available elsewhere (4-7).

CONCLUSIONS: Air breaks of 10, 20, and 60 min after 30 min of a 60 min PB result in a significant decrease in DCS survival times, certainly early in the exposures. CONCLUSION: Air breaks of 10, 20, or 60 min after 30 min of a 60 min PB reduce DCS survival times. The survival model combines data into a global description mechanically linked to asymmetrical N2 washout and washin kinetics based on inspired pN2. Our cumulative regression is used to compute additional PB time needed to compensate for an air break in PB within the range of tested conditions.

METHODS

We used an accelerated log logistic survival model for asymmetrical N2 washout and washin to describe DCS survival times in data where (0,30,30,150) 30 min, or 60 min air breaks occurred at 30 min into a 60 min PB, including a six min ascent on 100% O2. RESULTS. There was no difference in VGE or DCS survival times among the three air breaks, or when air breaks were compared to control VGE survival times. CONCLUSION: Air breaks of 10, 20, or 60 min after 30 min of a 60 min PB reduce DCS survival times. The survival model combines data into a global description mechanically linked to asymmetrical N2 washout and washin kinetics based on inspired pN2. Our cumulative regression is used to compute additional PB time needed to compensate for an air break in PB within the range of tested conditions.

INTRODUCTION

Few data are available to understand the DCS and VGE consequences of an air break in an otherwise normal resting 100% O2 PB, and none are available after PB that includes exercise. Few data are available to understand the DCS and VGE consequences of an air break in an otherwise normal resting 100% O2 PB, and none are available after PB that includes exercise. Few data are available to understand the DCS and VGE consequences of an air break in an otherwise normal resting 100% O2 PB, and none are available after PB that includes exercise. Few data are available to understand the DCS and VGE consequences of an air break in an otherwise normal resting 100% O2 PB, and none are available after PB that includes exercise. Few data are available to understand the DCS and VGE consequences of an air break in an otherwise normal resting 100% O2 PB, and none are available after PB that includes exercise. Few data are available to understand the DCS and VGE consequences of an air break in an otherwise normal resting 100% O2 PB, and none are available after PB that includes exercise. Few data are available to understand the DCS and VGE consequences of an air break in an otherwise normal resting 100% O2 PB, and none are available after PB that includes exercise. Few data are available to understand the DCS and VGE consequences of an air break in an otherwise normal resting 100% O2 PB, and none are available after PB that includes exercise. Few data are available to understand the DCS and VGE consequences of an air break in an otherwise normal resting 100% O2 PB, and none are available after PB that includes exercise. Few data are available to understand the DCS and VGE consequences of an air break in an otherwise normal resting 100% O2 PB, and none are available after PB that includes exercise. Few data are available to understand the DCS and VGE consequences of an air break in an otherwise normal resting 100% O2 PB, and none are available after PB that includes exercise. Few data are available to understand the DCS and VGE consequences of an air break in an otherwise normal resting 100% O2 PB, and none are available after PB that includes exercise. Few data are available to understand the DCS and VGE consequences of an air break in an otherwise normal resting 100% O2 PB, and none are available after PB that includes exercise. Few data are available to understand the DCS and VGE consequences of an air break in an otherwise normal resting 100% O2 PB, and none are available after PB that includes exercise. Few data are available to understand the DCS and VGE consequences of an air break in an otherwise normal resting 100% O2 PB, and none are available after PB that includes exercise. Few data are available to understand the DCS and VGE consequences of an air break in an otherwise normal resting 100% O2 PB, and none are available after PB that includes exercise.

CONCLUSIONS / DISCUSSION

A N2 pressure model that maximized the clinical difference in these data required very short times. Our approach to compute O2 PB payback time is not appropriate outside the range of tested conditions.

The control data are from an “effective PB” of 66 min, and our model computes an effective PB of 50 min for the 10 min air break. The hazard function for the control data is the same as that for curve C, and 5.320 for D.

Fig. 7. Cumulative O2 PB with 10, 20, and 60 min breaks at 40 min into a 60 min 100% O2 PB. The hazard function for the control data is the same as that for curve C, and 5.320 for D.

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

REFERENCES