EXPLOITING AEROBIC FITNESS TO REDUCE RISK OF HYPOBARIC DECOMPRESSION SICKNESS

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INTRODUCTION
Decompression sickness (DCS) is similar in nature. But we hypothesize that an aerobically fit person is less likely to experience hypobaric DCS than an "unfit" person given that fitness is exploited as part of the denitrogenation (prebreathe, PB) process prior to ascent in an altitude chamber. Aerobic fitness is peak oxygen uptake (VO2pk, ml/kg/min). We evaluated dichotomous DCS outcomes and venous gas emboli (VGE) outcome detected in the pulmonary artery with Doppler ultrasound associated with VO2pk for two classes of experiments: 1) those with no PB or prebreathe, and 2) those with PB that included exercise for some or all subjects during PB. Separate VO2pk and PB protocols were used over 15 years to determine aerobic fitness in 165 cases of DCS with 25 cases of DCS in the first protocol class and 172 cases of DCS pk with 25 cases of DCS in the second. Similar incidence of the DCS (15.2% vs. 14.5%) and VGE (45.5% vs. 44.8%) between the two classes indicates that decompression stress was similar. The relationship between VO2pk and DCS outcome was explored using univariate logistic regression. RESULTS: An inverse relationship between the DCS outcome and VO2pk was evident, but the relationship was stronger when exercise was done as part of the PB (exercise PB, coef. = -0.058, p = 0.07; rest or no PB, coef. = -0.005, p = 0.86). There was no relationship between VGE outcome and VO2pk (exercise PB, coef. = 0.003; rest or no PB, coef. = 0.004, p = 0.93). CONCLUSIONS: A significant change in probability of DCS was associated with fitness only when exercise was included in the denitrogenation process. We believe a fit person that exercises during PB efficiently eliminates dissolved nitrogen from tissues.

RESULTS

The VO2pk for subjects who perform no PB or resting PB has no bearing on the P(DCS) outcome as seen in Fig. 1, the slope is essentially zero. P(DCS) outcome is not associated with fitness unless fitness is exploited as part of the denitrogenation process (exercise PB, coef. = -0.058, p = 0.07; rest or no PB, coef. = -0.005, p = 0.86).

CONCLUSIONS / DISCUSSION

Exercise is a necessary condition for a fit and unfit person to reduce their risk of DCS. However, for the unfit person a greater percentage of VO2pk must be prescribed in the same PB interval, or more PB time is needed at the lower percentage of VO2pk, or some combination if both fit and unfit persons are to have comparable DCS risk.

Example: Based on a statistical model that relates exercise to a change in half-time compartment for nitrogen washout (2), a fit (80 ml O2/kg/min) and unfit (30 ml O2/kg/min) non-ambulating person doses are exercises PB of 60% while breathing 100% O2 from a mask and then ascends to 4.3 psi (30.500 feet) for a 4 hr exposure.

PB Time

<table>
<thead>
<tr>
<th>VO2 consumption rate (ml / kg / min)</th>
<th>P(DCS)*</th>
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</thead>
<tbody>
<tr>
<td>0 - 90</td>
<td>2.3%</td>
</tr>
<tr>
<td>90 - 105</td>
<td>2.3%</td>
</tr>
<tr>
<td>105 - 120</td>
<td>2.3%</td>
</tr>
<tr>
<td>120 - 140</td>
<td>2.3%</td>
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</tbody>
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We believe that a fit person is better able to eliminate dissolved nitrogen from tissues associated with "pain-only" DCS during PB when exercise as a percentage of PB time is included.

REFERENCES