Oro-Nasal Mask versus Two-Way Non-Rebreathing Valves for Maximal Aerobic Capacity Testing in Astronauts

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Abstract

INTRODUCTION. Astronauts complete maximal aerobic capacity (VO2peak) testing as part of their annual fitness assessment (AFA), which is an exercise test administered by the International Space Station (ISS) exercise physiologist. The protocol is known to vary considerably from pre-flight to in-flight. One of the main reasons is that the mask is used more frequently than the mouthpiece by doctors from all over Johnson Space Center who decided on items pertaining to crew health.

Purpose

To assess the reliability and validity of mask vs. mouthpiece by comparing submaximal VO2 and VO2peak data on the same astronauts within 1 year.

Methods

• Seventeen active astronauts (13 M: 2 F) completed a VO2peak test with the mouthpiece (first) and then a mask (second) for their AFA. These tests were conducted approximately one year apart.

• The VO2peak tests were conducted on a cycle ergometer with a TrueOne2400 metabolic cart (ParvoMedics, Sandy, UT).

• The nominal protocol starts with a 3 minute warm-up at 50 Watts (W) and increases 25W every minute until volitional fatigue (Light: 45W start; 15W increase).

• VO2peak and submaximal values were compared between tests.

• There were 447 data points in total across all 17 subjects. There are 2 data points per completed test (664 tests total).

• The VO2peak and submaximal values were compared between tests.

• VO2peak tests were separated the two tests. In one case, the time was 30 seconds less during the mask test.

• Most of the extreme under-estimates of VO2 at high workloads were seen in data from two of the subjects (379/447), with most of the discrepancies occurring at the highest workloads.

• VO2 data are plotted in Fig. 5. The VO2 data were separated into two test conditions (mouthpiece vs. mask). The VO2 data were separated into two test conditions (mouthpiece vs. mask).

• VO2pk values were more than 5% different, despite similar test times, between mouthpiece and mask.

• Under the assumption that the two methods (mask & mouthpiece) are equivalent, about 85% of the submaximal observations should lie between the limits of agreement. Overall, this percentage was 92.4%, with most of the discrepancies occurring at the highest workloads.

• Most of the extreme under-estimates of VO2 at high workloads were seen in data from two of the subjects.

• VO2peak data were separated into two test conditions. In one case, the time was 30 seconds less during the mask test.

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Conclusions

• This mask showed agreement with the mouthpiece at the lower loads (<300W), with discrepancies at the higher workloads (>300W).

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