Comparison of Measured Versus Calculated Maximum Voluntary Ventilation for Determining Ventilatory Limitation in Veterans with Unexplained Dyspnea

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Introduction: Current guidelines from professional societies recommend directly measuring maximum voluntary ventilation (MVV) prior to cardiopulmonary exercise testing to assess the presence of ventilatory limitation. In practice, calculated MVV (cMVV; FEV₁ x 40) is frequently used instead of measured MVV (mMVV) for practical or other reasons. The objective of our study was to compare indices of ventilatory limitation using either mMVV or cMVV among dyspneic veterans. Methods: Data from deployed veterans referred to our center for unexplained dyspnea were retrospectively reviewed. Veterans who did not undergo exercise testing or who had unacceptable spirometry were excluded. Three commonly used indices of ventilatory limitation were calculated using both mMVV and cMVV: 1) ratio of peak exercise ventilation (VEmax) to MVV (VEmax/MVV), 2) breathing reserve (BR = 1 - VEmax/MVV), and 3) absolute difference (MVV - VEmax). Ventilatory limitation was defined as: 1) VEmax/MVV ≥ 0.80, 2) BR ≤ 0.15, and MVV - VEmax < 11 L. Bland-Altman method comparison analysis was performed to assess agreement between cMVV and mMVV across indices.

Results: 147 veterans (90.5% male) were included for analysis and had the following characteristics ([Median (IQR)]; age: 44 (35, 51) years, BMI: 31.1 (27.9, 34.0) kg/m², smoking history: 0.0 (0.0, 5.0) pack-years, and post-deployment length: 10.5 (6.4, 21.0) years). VEmax (87.3 [68.9, 102.2] L•min⁻¹), mMVV (107.0 [86.4, 130.2] L•min⁻¹), and cMVV (145.2 [123.6, 166.4] L•min⁻¹) were used for ventilatory limitation indices. The frequency of ventilatory limitation were as follows (mMVV vs. cMVV): VE/MVV: 50.3% vs. 9.7%, BR: 43.8% vs. 5.5%, and MVV-VEmax: 34.2% vs. 9.5%. For each method comparing mMVV and cMVV, the bias and 95% limits of agreement are reported as follows: 1) VE/MVV: 0.22 [-0.18, 0.63], 2) BR: -0.22 [-0.64, 0.21], and 3) MVV-VEmax: -35.8 [-92.6, 21.0]. Bland-Altman plots are shown in Figure. Conclusions: Among our sample, there was poor agreement and considerable variability for ventilatory limitation indices when using either mMVV or cMVV for calculation. Notably, these findings raise concerns regarding current guidelines to detect ventilatory limitation using mMVV. Future studies are necessary to identify sources of this poor agreement as well as optimal indices for assessing ventilatory limitation to exercise in this population.

This abstract is funded by: N/A

Am J Respir Crit Care Med 2020;201:A3244
Internet address: www.atsjournals.org