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VCO_2-derived energy expenditure: do not throw the baby out with the bath water!

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See related research by Oshima et al. http://ccforum.biomedcentral.com/articles/10.1186/s13054-016-1595-8

With great interest we read the retrospective study performed by Oshima et al. [1] evaluating whether VCO_2-based energy expenditure (EE-VCO_2) could be considered as an alternative to EE measured by indirect calorimetry. This study followed several prospective studies reporting good agreement between EE-VCO_2 and EE measured by indirect calorimetry [2, 3]. Indeed, in their retrospective cohort of 278 mechanically ventilated patients, the authors found a low bias of −48 kcal/day for EE-VCO_2, when calculated with a fixed respiratory quotient (RQ) of 0.85. They reported 5%-accuracy rates of 46% and 10%-accuracy rates of 77% for EE-VCO_2. This indicates that EE-VCO_2 is unreliable in some patients, likely due to extreme RQs or to high ventilator rates as observed in young children [4]. The weak spot of using EE-VCO_2 is that an RQ has to be assumed in order to derive the unknown oxygen consumption (VO_2) needed to calculate EE according to the Weir formula: $EE(kcal/day) = 1.44 \times (3.94 \times VO_2(mL/min) + 1.11 \times VCO_2(mL/min))$.

However, despite high 10%-accuracy rates, the authors considered a 10% difference in measured and calculated EE clinically unacceptable and concluded that EE-VCO_2 should not be considered as an alternative to EE measured by indirect calorimetry.

First and foremost, we agree with the authors that indirect calorimetry remains the gold standard for assessment of EE in mechanically ventilated patients. However, we regret that the authors failed to mention that EE-VCO_2 should be considered as the best alternative for clinicians not having access to indirect calorimetry. Unfortunately, few units have indirect calorimetry available and, more importantly, the most validated system (Deltatrac) is no longer being manufactured and new devices are not accurate [5]. Many ICU clinicians still rely on predictive equations that have repeatedly proven to be inaccurate, leading to deleterious over- and underfeeding. The results of the Oshima study underscore findings in prospective studies in ICU patients that EE-VCO_2 has good accuracy and is superior to predictive equations [2, 3]. Furthermore, when using built-in capnographs and flow meters, VCO_2 is available from the ventilator and EE-VCO_2 can be used to assess EE continuously. Continuous measurement is important because EE varies over the day and during ICU stay. This is an advantage of EE-VO_2 over the short-term EE measurements by indirect calorimetry.

Therefore, awaiting new, affordable, and accurate indirect calorimeters, EE-VCO_2 appears to be the best alternative in spite of its known limitations. Thus, the use of EE-VCO_2 assuming an RQ of 0.85, rather than applying predictive equations, is currently recommended to reduce over- and underfeeding.

Abbreviations

EE: Energy expenditure; EE-VCO_2: Carbon dioxide production based energy expenditure; ICU: Intensive care unit; RQ: respiratory quotient; VCO_2: Carbon dioxide production; VO_2: Oxygen consumption

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