HEART LUNG and VESSELS

Resting energy expenditures in haemodynamically compromised cardiac patients

The impetuous development of malnutrition due to increased catabolic requirements as a consequence of critical illness is a well-known clinical problem (1). Adequate energy provision in critically ill patients improves clinical outcomes (2, 3), decreases hospital costs (4), and recommended by international guidelines (5, 6). The aim of present pilot trial was to evaluate the actual resting energy expenditures (REE) among haemodynamically compromised cardiac patients.

Our study compared different methods for assessing REE. The resting energy expenditure was assessed using REE measured by indirect calorimetry (CCM Express, Medgraphics, St. Paul, MN, USA). The results of indirect calorimetry were compared with those determined by the Harris–Benedict formula and an empiric approach. REE was calculated using the empiric approach as follows: for patients with a body mass index 20-30, REE was set at 25 $kcal \cdot kg^{-1} \cdot d^{-1}$; for patients with a body mass index <20, REE was set at 25 kcal/kg ideal body weight; and for patients with a body mass index >30, REE was calculated as 25 kcal/kg ideal body weight + 30% (7, 8). Data presented as median (25-75 percentiles).

Forty patients operated on under cardiopulmonary bypass were included to the study. Measurements of REE were performed daily during the first 7 postoperative days and at the day of 14. The inclusion criteria were as follows:

1) signed informed consent from the patient or their next of kin;
2) age 18 years or older;
3) cardiopulmonary bypass surgery no more than 24 hours before eligibility assessment;
4) acute heart failure syndrome;
5) anticipated time of ventilation more than 48 hours.

Acute heart failure syndrome was defined as a vasoactive-inotropic score (VIS) >5 calculated as follows: VIS = dobutamine ($\mu g \cdot kg^{-1} \cdot min^{-1}$) + dopamine ($\mu g \cdot kg^{-1} \cdot min^{-1}$) + 100 × epinephrine ($\mu g \cdot kg^{-1} \cdot min^{-1}$) + 100 × norepinephrine ($\mu g \cdot kg^{-1} \cdot min^{-1}$) + 10 × phenylephrine ($\mu g \cdot kg^{-1} \cdot min - 1$).

The exclusion criteria were as follows:

1) increasing of VIS;
2) acidosis (pH <7.350 and/or serum lactate >4 mM);
3) hypoxia (arterial SpO_2 >60 mmHg);
4) bleeding;
5) cerebrovascular accident;
6) ileus;
7) diarrhoea (≥3 loose or liquid stools per day);
8) signs of mesenteric ischaemia.

The estimates of REE by indirect calorimetry were significantly higher than those calculated empirically and using the Harris–Benedict equation (both $p<0.05$) at all time points. The actual REE corresponded 31.4 (27.8-36.3) $kcal \cdot kg^{-1} \cdot d^{-1}$ and was an average of 6.8 and 7.5 $kcal \cdot kg^{-1} \cdot d^{-1}$ higher than the REE calculated using the Harris–Benedict equation and empiric approach, respectively (*Figures 1, 2*).

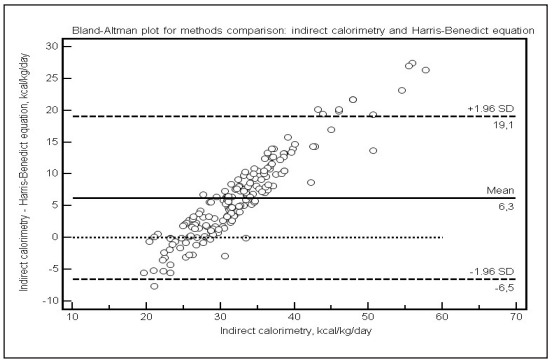

Figure 1 - *The Harris-Benedict equation underestimated resting energy expenditures by an average of 6.3 $kcal \cdot kg^{-1} \cdot d^{-1}$.*

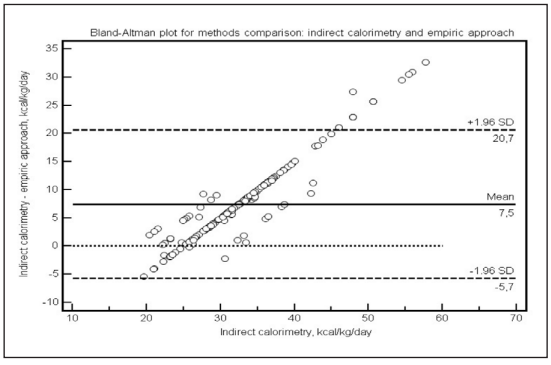

Figure 2 - *The empiric approach underestimated resting energy expenditures by an average of 7.5 $kcal \cdot kg^{-1} \cdot d^{-1}$.*

The present results show that the empiric approach is no better than the Harris–Benedict equation and underestimates the actual REE by a mean of 7.5 kcal·kg^{-1}·d^{-1}.

Different equations have been demonstrated to result in early significant errors for critically ill patients (9).

Therefore, indirect calorimetry is considered the gold standard, because no existing equations take into account circumstances that may significantly influence REE, such as shock, sedation, extracorporeal methods, diagnosis, and therapeutic manipulations. Previous studies set the REE to 25 kcal·kg^{-1}·d^{-1} (10), which was recommended for cardiac patients with acute heart failure syndrome on the basis of the authors' experience (11); this approach is currently used at the same patients category (12). However, based on our results, energy target of 25 kcal·kg^{-1}·d^{-1}may underestimate actual energy requirement and lead to underfeeding. Thus, we recommend additional studies to determine the most reliable equation for REE estimation in haemodynamically compromised patients.

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