

Abstract

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Title of Doctoral Thesis: **Indirect calorimetry application in two different insulin-resistant states – polytrauma and pregnancy**

Introduction and Objective: Indirect calorimetry is the gold standard for energy expenditure (EE) determination that is currently considered to be the best indicator of individual energy requirements – both in health and in illness. Although polytrauma and pregnancy could seem as two physiologically different states, they are quite similar in metabolic terms. Both in polytrauma and in late pregnancy, catabolism increases energy expenditure and insulin resistance occurs. Not only common characteristics mentioned above distinguish these two groups from healthy individuals and non-pregnant women. The aim of this dissertation was to describe the metabolism of polytrauma patients and healthy pregnant women together with the factors that affect it. Besides energy expenditure, this work focuses on respiratory quotient (RQ; in polytrauma also in relation to indirect prognostic markers), which characterizes nutritional substrate oxidations. In pregnant women, the dissertation is also focused on the relationship between the metabolic and anthropometric parameters of mother and the new-born babies birth parameters and on the verification of the predictive equation for the resting energy expenditure (REE) determination in pregnancy (Hronek et al., 2009).

Methods: By indirect calorimetry, oxygen consumption (VO_2) and carbon dioxide production (VCO_2) were measured. From these parameters, (resting) energy expenditure, respiratory quotient, non-protein respiratory quotient (npRQ) and nutritional substrate oxidations were calculated using the indirect calorimeter software. By this method, 22 polytrauma patients from surgical intensive care unit (ICU-1) at University Hospital Hradec Kralove were examined. If possible, four examinations of every patient were performed. The first one was performed after at least 4 h of fasting (about the fourth day after ICU admission), the second one after at least 4 h of hypocaloric nutritional support administration (18.0 ± 5.7 kcal/kg/d of energy), the third one after at least 18 h

of normocaloric hyperproteic nutritional support administration (25.8 ± 8.5 kcal/kg/d of energy, 1.8 ± 0.4 g/kg/d of protein) and finally the fourth examination was done approximately one week after the first examination (the nutritional support composition had not almost changed since the third examination). At the same time, 22 healthy individuals with similar anthropometric parameters were examined as a control group. A total of 45 pregnant women participated in the second study. These women were examined in three different periods of pregnancy – during the second (23.41 ± 2.17 weeks of gestation), the third (31.04 ± 1.14 weeks of gestation), and the late third trimester (37.41 ± 0.72 weeks of gestation).

Results: The first study showed that while the severe polytrauma patients without nutritional support had significantly lower RQ and npRQ than fasting control group, the resting energy expenditure of these two groups did not differ significantly. On the other hand, the patients with any kind of nutritional support had significantly higher EE (expressed on the body surface area) when compared to REE of fasting controls and very similar RQ and npRQ values. What is more, respiratory quotient and non-protein respiratory quotient in patients with hypocaloric nutritional support determined about the 4th day of hospitalization inversely correlated with the clinical outcomes such as ICU length of stay or duration of mechanical ventilation. In pregnancy, the REE, VO_2 , VCO_2 , RQ and npRQ values were increasing with the increasing length of pregnancy (the closer the delivery was, the higher the parameters were too). The respiratory quotients changes indicated an increasing proportion of carbohydrate oxidation. The study also showed that the lipid and protein oxidation determined about the 37th week of gestation related to the newborns birth weight (independently of maternal anthropometric parameters). After almost 10 years, this study finally re-verified the predictive equation for the REE determination in pregnancy.

Conclusion: Due to a results variability and their changes during the observation time (either because of time itself or because of measurement conditions), we can conclude that the indirect calorimetry is an important tool for metabolic requirements determination in both observed states. Based on the results we obtained it can be assumed that this method could be clinically used in more different ways in the future – as a marker of ICU length of stay and duration of mechanical ventilation or as a marker of approaching childbirth.