

Gas-exchange and resting energy expenditure measurement with indirect calorimetry in children supported with non-invasive ventilation

Dott. GIULIA CARLA IMMACOLATA SPOLIDORO (1), Dott. VERONICA D'ORIA (2), Dott. CARLO VIRGINIO AGOSTONI (1)(2), Dott. TIZIANA MARCHESI (2), Dott. STEFANO SCALIA CATENACCI (2), Dott. LUDOVICA UGHI (2), Dott. CINZIA MONTANI (2), Dott. GIOVANNA CHIDINI (2), Dott. THOMAS LANGER (1), Dott. EDOARDO CALDERINI (2)

(1) Università degli Studi di Milano, Milano, Italia.

(2) Fondazione IRCCS Ca' Granda, Ospedale Maggiore Policlinico, Milano, Italia.

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Introduction. Nutrition plays a fundamental role in critically ill children and personalized nutritional therapy requires the measurement of resting energy expenditure (REE) [1-2]. Indirect calorimetry (IC) is the gold standard for REE assessment and is based on $\dot{V}O_2$ and $\dot{V}CO_2$ measurements. Furthermore, IC provides information on carbohydrates/lipids consumption by defining the respiratory quotient (RQ). However, while IC is validated for spontaneously breathing and mechanically ventilated patients, it is not for patients undergoing non-invasive ventilation (NIV) [3].

Aim of the study is therefore to validate IC for children undergoing NIV by comparing IC results obtained during spontaneous breathing with data gathered during NIV-CPAP (continuous positive airway pressure).

Methods. Patients (age <6 years) admitted to our pediatric intensive care unit (PICU) and weaning from NIV-CPAP were enrolled. Two IC measurements (Canopy mode) were performed for 20 minutes in randomized order in the following conditions: 1) Spontaneous breathing (SB), 2) NIV-CPAP (performed by single-limb circuit and vented mask). Average values for $\dot{V}CO_2$, $\dot{V}O_2$, RQ and REE were obtained in the two conditions. Comparison between groups was performed via paired t-test. Agreement was assessed via Bland-Altman analysis. Statistical significance was defined as $p < 0.05$.

Results. Four patients (median age 8 months, median weight 8 kg) were enrolled. $\dot{V}CO_2$, $\dot{V}O_2$, RQ and REE did not differ significantly between groups. Limits of agreement (LOA) and BIAS indicate a good agreement between the two measures (**Table 1**).

Conclusions. Our preliminary data suggest that IC can be accurately performed in children undergoing NIV using a single limb circuit with intentional leaks. These results need to be confirmed on a broader cohort of critically ill children.

References

1. De Cosmi V et al. *Nutrients*. 2017, 18:9
2. Mehta NM et al. *Pediatr Crit Care Med*. 2017, 18:675-715
3. Taku Oshima et al. *Clinical Nutr* 2017; 36:651-662

Table 1. Agreement between IC data obtained during spontaneous breathing (SB) and NIV-CPAP.

	SB	NIV-CPAP	Paired t-test	Bland-Altman analysis		
			p-value	BIAS	Lower LOA	Upper LOA
$\dot{V}CO_2$ [ml/min/kg]	6.2 ± 1.2	5.3 ± 1.4	0.17	0.8	-1	2.6
$\dot{V}O_2$ [ml/min/kg]	8.1 ± 1.4	7.8 ± 1.6	0.68	0.27	-2	2.5
RQ	0.76 ± 0.08	0.68 ± 0.08	0.15	0.08	-0.08	0.24
REE (kcal/kg/die)	56 ± 10	52 ± 12	0.46	3	-12	19

Data are expressed as mean ± standard deviation.