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Short Communication

Individualized nutritional therapy in a patient with chronic critical illness

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1. Introduction

Indirect calorimetry as a means of assessing a critically ill patient's energy expenditure is an important tool in precision, individualised medicine [1–3]. Both underfeeding and overfeeding in the critically ill patient, determined by calculating the ratio of delivered calories over resting energy expenditure, are associated with worse outcomes [1]. The cost of indirect calorimetry include the cost of the device, consumables, calibration gas and service [4]. At present funders in South Africa do not fund the use of indirect calorimetry in critically ill patients. We present a case, where indirect calorimetry-guided nutritional therapy enabled discharge of a patient from the intensive care unit. In this case the cost of prolonged ICU stay exceeded that of performing indirect calorimetry.

2. Case report

A 78-year-old female was admitted to hospital, from a long-term ventilation facility, for exchange of her tracheostomy tube. She had a preceding ten-month history of illness, during which she was initially admitted at another facility for pneumonia, complicated by multi-organ dysfunction. She had a protracted period of illness in the intensive care unit and after failure to wean from the ventilator, she was transferred to a long-term ventilation facility for further rehabilitation.

On re-admission to the intensive care unit, her weight was 54 kg (admission weight reported as 60 kg), height 160 cm and body mass index (BMI) 21 kg/m^2. While admitted, the patient was extensively investigated for metabolic, cardiovascular, neurological, and respiratory causes for failure to wean, but none were found. On admission she was receiving enteral nutrition through a percutaneous gastrostomy tube. This feeding tube was inserted during her initial ICU stay. Using weight-based calculations, and the rationale that she was in the “post-ICU” phase of her illness, she received a total energy of 30 kcal/kg/day (1620 kcal/day) and total protein of 1,5 g/kg/day (81g/day) [4].

We performed indirect calorimetry (IC), using the QNRG + metabolic monitor. IC was performed while the patient was receiving enteral nutrition, during morning rounds. The results are shown in Table 1 below, and with a respiratory quotient (RQ) of 1.01 it was clear that this patient was being over-fed.

The nutrition prescription was adjusted according to the indirect calorimetry data and was changed to an energy provision of 1350 kcal/day and 81 g of protein/day. With these adjustments the RQ improved to 0.83 (Table 1). A combination of targeted nutritional therapy, with ongoing physiotherapy and occupational therapy (continued throughout the admission at the long-term ventilation facility and the current hospital admission) were

Table 1
QNRG + metabolic monitor readings before and after adjusting nutrition therapy according to the RQ.

Parameter	Pre-adjustment	Post-adjustment
EE (kcal/day)	955	1247
RQ	1.01	0.83
EEkg (kcal/kg/day)	17.6	23
VO2(ml/min)	139	160
VCO2 (ml/min)	120	149
VE (l/min)	6.1	7.1

REE Resting energy expenditure. RQ respiratory quotient, EEkg energy expenditure per kg per day, VO2 oxygen consumption, VCO2 carbon dioxide production, VE minute ventilation.

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undertaken, and the patient was successfully weaned from mechanical ventilation.

3. Discussion

There is a wealth of literature supporting the use of indirect calorimetry in the acute phase of critical illness, but the there is little evidence to guide practice in chronic critical illness. It has been suggested that in the post-acute phase of intensive care caloric intake needs to be increased 125%–150 % of predictive equations to 30 kcal/kg/day and protein should be administered at 1.5–2 g/kg/day [4]. The importance of nutrition therapy in the chronic phase of critical illness should not be understated, and the case we present shows the importance of individualized medicine guided by measured physiological parameters.

Indirect calorimetry as a routine monitoring tool to guide nutrition therapy in the critically ill has been advocated [5], and a recent meta-analysis demonstrated a decrease in mortality if caloric provision is guided by indirect calorimetry [6]. Overfeeding may contribute to ICU-associated weakness [7] and difficulty in weaning patients from the ventilator [8]. In the case presented, we could find no other cause for failure to wean and once we adopted a targeted nutritional therapy approach, as part of a multidisciplinary intervention, the patient was successfully weaned.

One of the barriers to implementing routine use of indirect calorimetry in South Africa is cost. The newer model metabolic carts come at a reduced cost, and improved ease of use and time to obtain data, when compared with the older generation of metabolic monitors. At the time, the cost per measurement (including disposable sensor, ICU pack and filter) was calculated at R1 596.11 (approximately 81 Euro). Taking into consideration the average cost per day in the intensive care unit being R22 870 [9] (approximately 1157 Euro) the case presented recalls the proverb: “Penny wise, pound foolish.” The cost should be considered in the light of improved outcomes [6] and although the evidence to date is only for decreased mortality in individualised nutrition therapy, future studies will hopefully include functional outcomes and quality of life as metrics.

The case presented demonstrates the importance of individualised nutritional therapy, guided by indirect calorimetry in a patient with chronic critical illness. Underfeeding is often considered as a potential contributor for muscle weakness and failure to wean, but overfeeding should also be considered. In the context of health economics, it is important to weigh the cost of performing IC (one of the primary reason the practice is not standard of care in South Africa) against the cost of prolonged ICU stay. More research of cost analysis using indirect calorimetry in patients with chronic critical illness is required.

Author contribution

VU and EF contributed to preparation and editing of the manuscript.

Declaration of competing interest

The authors have no conflict of interest to declare.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.clnesp.2024.09.015.

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