XÁC ĐỊNH TIÊU HAO NĂNG LƯỢNG
BẰNG MÁY ĐO NĂNG LƯỢNG GIÁN TIẾP
TẠI TRUNG TÂM A9 BỆNH VIỆN BẠCH MAI

TS BS Nguyễn Hữu Quân

ICU A9 BV Bạch mai

Nội dung

1. Các phương pháp đánh giá nhu cầu dinh dưỡng ở bn ICU
2. Nguyên lý đo calo gián tiếp Indirect calometry
3. Ứng dụng đo calo gián tiếp trong thực hành lâm sang.

VẤN ĐỀ DINH DƯỠNG Ở BN NẶNG

- Tỉ lệ suy dinh dưỡng gặp ở bn nặng > 50%*
- Cung cấp quá nhiều mức năng lượng làm tăng đường huyết, tăng sản sinh CO2..kéo dài ngày thở máy, ngày nằm viện, tỉ lệ nhiễm trùng, nhu cầu insulin.
- Phải cân nhắc chặt đủ đúng nhu cầu của bệnh nhân

* Sriram, K., & Mizock, B. A. (2010). Critical care nutrition: Are the skeletons still in the closet?*. Critical care medicine, 38(2), 690-691.

Resting energy expenditure, calorie and protein consumption in critically ill patients: a retrospective cohort study

Critical Care (2016) 20:367

Oren Zusman[1*], Miriam Theilla[2,3], Jonathan Cohen[2,4], Ilya Kagan[2], Itai Bendavid[2] and Pierre Singer[2,4]

Background: Intense debate exists regarding the optimal energy and protein intake for intensive care unit (ICU) patients. However, most studies use predictive equations, demonstrated to be inaccurate to target energy intake. We sought to examine the outcome of a large cohort of ICU patients in relation to the percent of administered calories divided by resting energy expenditure (% AdCal/REE) obtained by indirect calorimetry (IC) and to protein intake.

Methods: Included patients were hospitalized from 2003 to 2015 at a 16-bed ICU at a university affiliated, tertiary care hospital, and had IC measurement to assess caloric targets. Data were drawn from a computerized system and included the % AdCal/REE and protein intake and other variables. A Cox proportional hazards model for 60-day mortality was used, with the % AdCal/REE modeled to accommodate non-linearity. Length of stay (LOS) and length of ventilation (LOV) were also assessed.

Results: A total of 1171 patients were included. The % AdCal/REE had a significant non-linear ($p < 0.01$) association with mortality after adjusting for other variables ($p < 0.01$). Increasing the percentage from zero to 70 % resulted in a hazard ratio (HR) of 0.98 (CI 0.97–0.99) pointing to reduced mortality, while increases above 70 % suggested an increase in mortality with a HR of 1.01 (CI 1.01–1.02). Increasing protein intake was also associated with decreased mortality (HR 0.99, CI 0.98–0.99, $p = 0.02$). An AdCal/REE >70 % was associated with an increased LOS and LOV.

Conclusions: The findings of this study suggest that both underfeeding and overfeeding appear to be harmful to critically ill patients, such that achieving an Adcal/REE of 70 % had a survival advantage. A higher caloric intake may also be associated with harm in the form of increased LOS and LOV. The optimal way to define caloric goals therefore requires an exact estimate, which is ideally performed using indirect calorimetry. These findings may provide a basis for future randomized controlled trials comparing specific nutritional regimens based on indirect calorimetry measurements.

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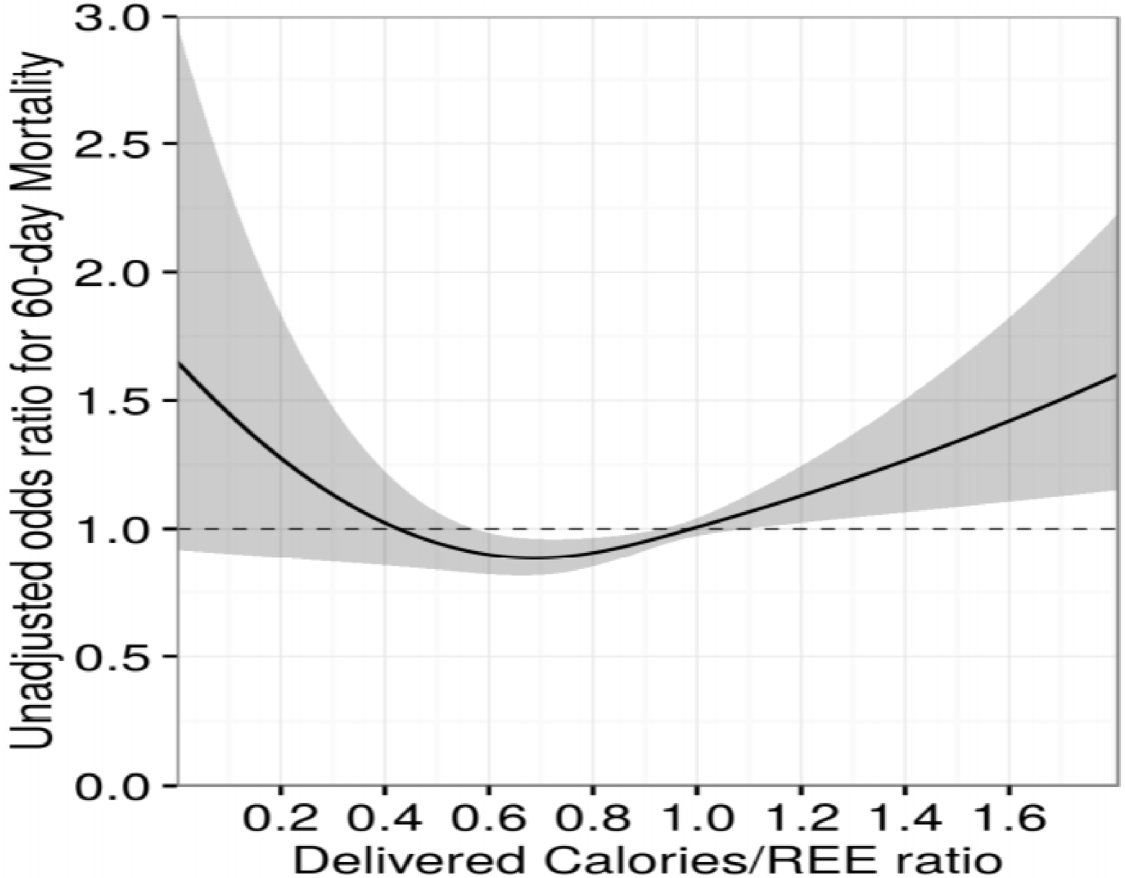


Yếu tố ảnh hưởng tới tiêu hao năng lượng tại ICU

- Tuổi
- Giới
- Thành phần cấu tạo cơ thể
- Bệnh lý
- Gen
- Nội tiết

- Bỏng
- Chế độ ăn
- Sốt/NT
- Tình trạng dinh dưỡng
- Thuốc
- Suy tạng
- Sepsis
- Mức độ nặng của bệnh
- Phẫu thuật
- Chấn thương
- Vết thương

Wooley, et al. *Nutr Clin Pract*. 2003; 18: 434-439.

Công thức Harris Benedict

sex. The most commonly used equations are based on the classical study by Harris and Benedict /36/made in 1919. The Harris-Benedict formulas for the basal energy expenditure (BEE) of males and females are as follows:

$$BEE\ (male) = (66 + 13.8W + 5H - 6.8A)\ kcal/24h \qquad (20)$$

$$BEE\ (female) = (655 + 9.6W + 1.8H - 4.7A)\ kcal/24h \qquad (21)$$

1919

Average BMI ~21

2010

Average BMI ~28

USA

Handbook of Gas Exchange and Indirect Calorimetry, J. Takala, P. Merilainen

Công thức Penstate1998

Dành cho bn thở máy

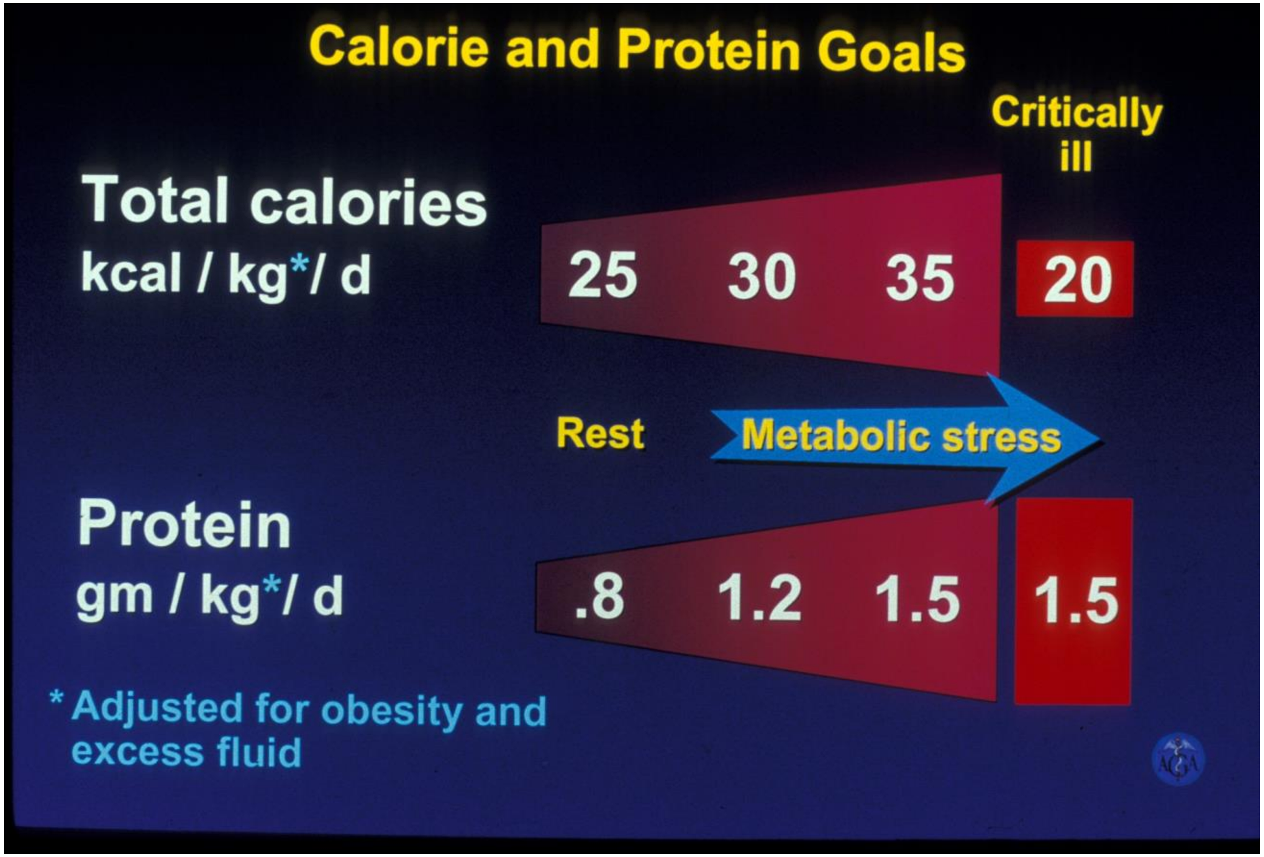
Penn State (1998)

1.1(HBE) + 140(Tmax) + 32(Ve) – 5340

- **Tmax: nhiệt độ cao nhất**
- **Ve: thông khí phút**

Tác giả Macdonald A.Nutrition 2003: độ chính xác 63%

- **American College of Chest Physician**



Hiệu chỉnh cân nặng

- BMI 16-25: sử dụng UBW
- BMI > 25: sử dụng cân nặng lý tưởng
- BMI < 16: sử dụng cân nặng thực trong 7-10 ngày sau đó sử dụng IBW
- Cân nặng hiệu chỉnh = IBW + 0,25(ABW-IBW)

Công thức Ireton Jones 1997

- EE = (5 x cân nặng) – (11 x tuổi) + (244 nếu nam giới) + (239 nếu chấn thương) + (840 nếu bỏng) + 1784

Các phương trình tính nhu cầu năng lượng có chính xác không??

Analysis of Estimation Methods for Resting Metabolic Rate in Critically Ill Adults

David C. Frankenfield, MS, RD, CNSD[1]
Abigail Coleman, MS, RD, CNSD[1]
Shoaib Alam, MD[2]
Robert N. Cooney, MD[3]

From the Departments of [1]Clinical Nutrition,[2] Pulmonary Medicine, and[3] Surgery, The Pennsylvania State University, College of Medicine, Hershey.

Methods: Standardized indirect calorimetry measurements were made in 202 ventilated, adult critical care patients, and resting metabolic rate was calculated using the following equations: Penn State equation, Faisy, Brandi, Swinamer, Ireton-Jones, Mifflin, Mifflinx1.25, Harris Benedict, Harris Benedictx1.25, Harris Benedict using adjusted weight for obesity, and each of the adjusted weight versions of Harris Benedictx1.25. The subjects were subgrouped by age and obesity status (young nonobese, young obese, elderly nonobese, elderly obese). Performance of each equation was assessed using bias, precision, and accuracy rate statistics.

Results: Accuracy rates in the study population ranged from 67% for the Penn State equation to 18% for the weight-adjusted Harris Benedict equation (without multiplication). Within subgroups, the highest accuracy rate was 77% in the elderly nonobese using the Penn State equation and the lowest was 0% for the weight-adjusted Harris Benedict equation. The Penn State equation was the only equation that was unbiased and precise across all subgroups. The obese elderly group was the most difficult to predict. Therefore, a separate regression was computed for this group: Mifflin(0.71)+Tmax(85)+Ve(64)-3085.

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Equation	Findings	Recommendation
Fick Method	Overestimate Imprecise	Not recommended
Harris-Benedict (HB) without added factors	Underestimate	Not recommended
HB with factors	Under AND overestimate Imprecise	Not recommended
Swinamer	Inaccurate	Limited data - inconclusive
Ireton-Jones (1992)	Inaccurate	Limited data - inconclusive
Ireton-Jones (1997)	Inaccurate	Not recommended
Penn State (2003)	Accurate in BMI < 30	Recommended in BMI < 30 Inconclusive

J Amer Dietet Assoc. 2007; 107: 1552-1561.

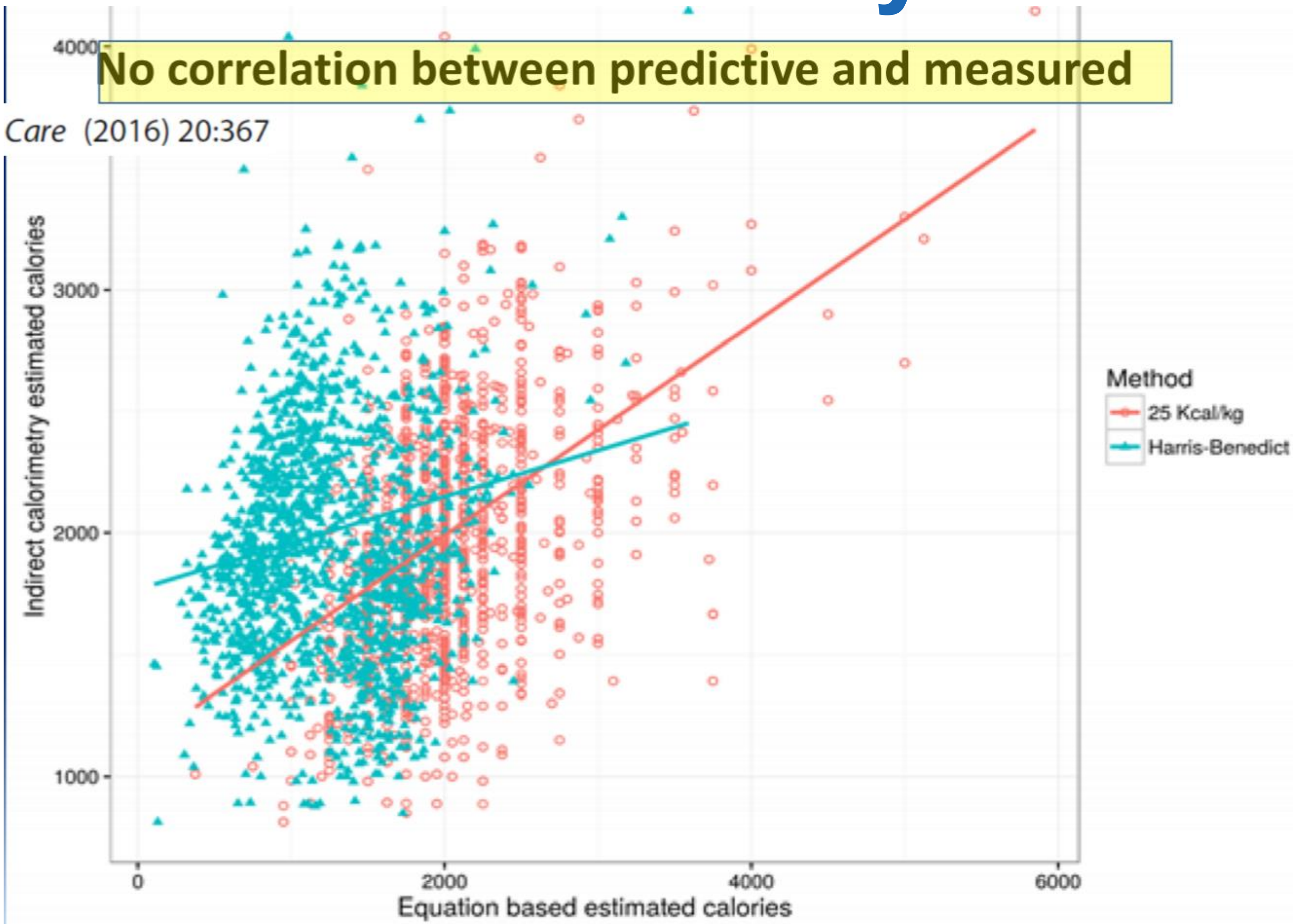
So sánh với Đo chuyển hóa IC

Predictive equations vs Indirect Calorimetry
Zusman O, et al: Clin Nutr 2018 (accepted).

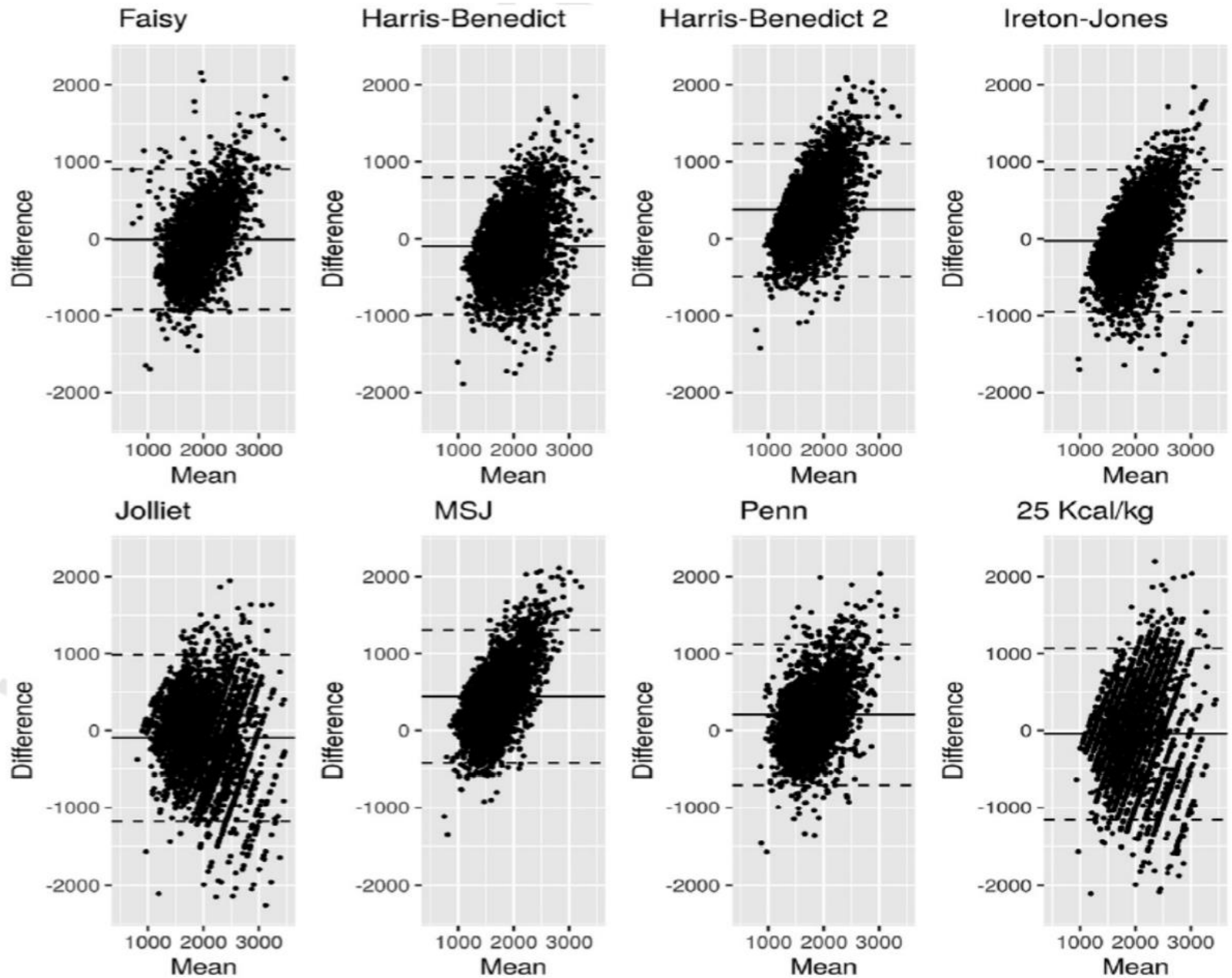
- The largest number of single center measurements published
- 5332 measurements from 1503 patients
- REE: Mean 1978 ± 530 kcal/d

- More than the half measured twice at least
- 171 patients more than 7 times

So sánh với Đo chuyển hóa IC



So sánh với Đo chuyển hóa IC



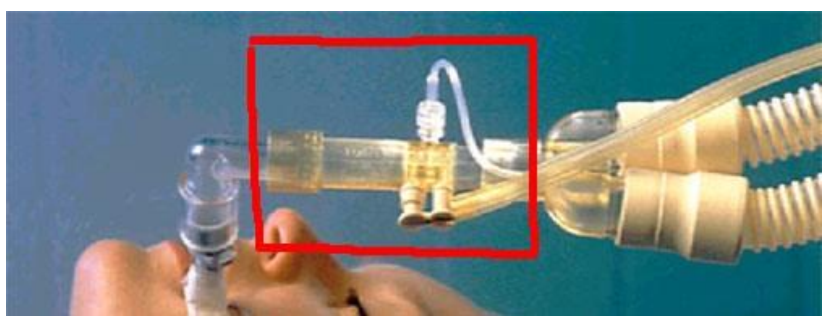
ĐO TIÊU HAO NĂNG LƯỢNG GIÁN TIẾP IC LÀ GÌ??

NGUYÊN LÝ

ĐO CALO GIÁN TIẾP

calorimetry [kal″o-rim´ĕ-tre] đo sự mất nhiệt hay lưu trữ nhiệt trong bất kỳ hệ thống nào.
Phép đo calorie trực tiếp đo lượng nhiệt tạo ra bởi một đối tượng bao quanh trong một phòng nhỏ.
Phép đo calorie gián tiếp đo lượng nhiệt tạo ra bởi một đối tượng bằng cách xác định lượng oxy tiêu thụ và lượng carbon dioxide thải ra.

$$C_2H_5OH + 3*O_2 => 2*CO_2 + 3*H_2O$$

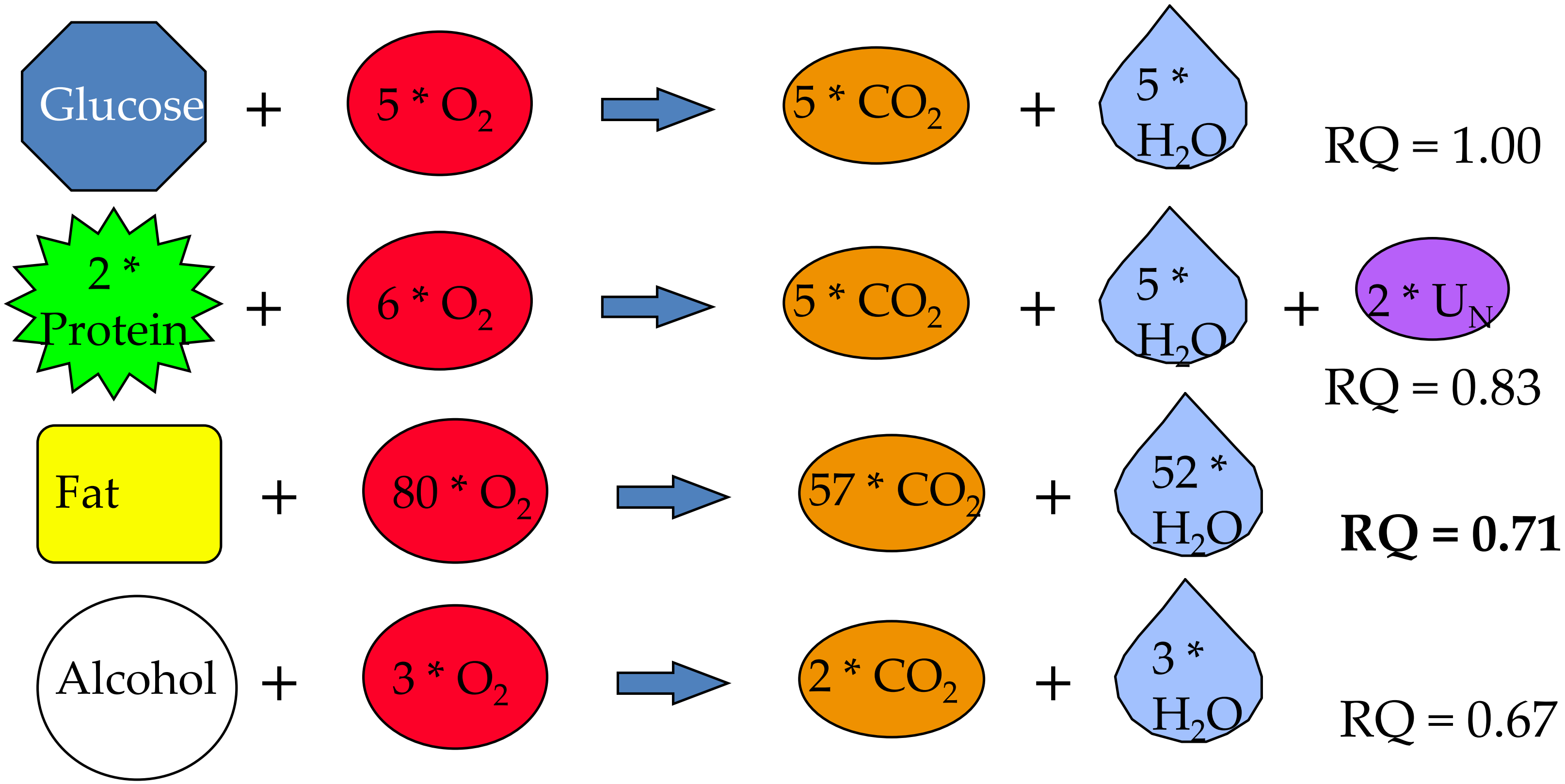


CÔNG THỨC WEIRD 1949

REE = Resting Energy Expenditure = <u>KCAL/day</u>

$$\left[\left(3.94 \times \underset{ml/min}{VO_2} + 1.11 \times \underset{ml/min}{VCO_2}\right) \times 1.44\right] - 2.17\ UUN$$

$$= \underline{Kcal/day}$$



Glucose + 5 * O_2 → 5 * CO_2 + 5 * H_2O
RQ = 1.00
2 * Protein + 6 * O_2 → 5 * CO_2 + 5 * H_2O + 2 * U_N
RQ = 0.83
Fat + 80 * O_2 → 57 * CO_2 + 52 * H_2O
RQ = 0.71
Alcohol + 3 * O_2 → 2 * CO_2 + 3 * H_2O
RQ = 0.67

THƯƠNG SỐ HÔ HẤP RQ

- Protein
  - $C_{72}H_{112}N_{18}O_{22}S + 77\ O_2 \rightarrow 63\ CO_2 + 38\ H_2O + SO_3 + 9\ CO(NH_2)_2$
  - RQ = $63\ CO_2 / 77 O_2 = 0.8$
- Lipid
  - $C_{16}H_{32}O_2 + 23\ O_2 \rightarrow 16\ CO_2 + 16\ H_2O$
  - RQ = $16\ CO_2 / 23\ O_2 = 0.696$
- Carbonhydrate
  - $C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$
  - RQ = $6\ CO_2 / 6\ O_2 = 1.0$

Chỉ số RQ – VCO2/VO2

- > 1.00 : Thừa dinh dưỡng, tăng thông khí, toan chuyển hóa, tích mỡ
- 0.9-1.00 : đốt đường
- 0.8-0.9 : đốt mỡ, protein và đường
- 0.7-0.8 : đốt mỡ và protein
- <0.7 : Thiếu dinh dưỡng, thiếu thông khí

ĐO CALO DỰA VÀO VCO2

- Khi RQ ở trạng thái ổn định
- RQ = VCO2/VO2
- EE_VCO2 = (3,9 x RQ + 1,1 X VCO2) x

  1,44 = VCO2 x 8,2

Ventilator-derived carbon dioxide production to assess energy expenditure in critically ill patients: proof of concept

Sandra N. Stapel[1,2,3*], Harm-Jan S. de Grooth[1,2,3], Hoda Alimohamad[1,2,3], Paul W G Elbers[1,2,3], Armand R J Girbes[1,2,3], Peter J M Weijs[1,2,3,4] and Heleen M. Oudemans-van Straaten[1,2,3]

Abstract

Introduction: Measurement of energy expenditure (EE) is recommended to guide nutrition in critically ill patients. Availability of a gold standard indirect calorimetry is limited, and continuous measurement is unfeasible. Equations used to predict EE are inaccurate. The purpose of this study was to provide proof of concept that EE can be accurately assessed on the basis of ventilator-derived carbon dioxide production (VCO_2) and to determine whether this method is more accurate than frequently used predictive equations.

Methods: In 84 mechanically ventilated critically ill patients, we performed 24-h indirect calorimetry to obtain a gold standard EE. Simultaneously, we collected 24-h ventilator-derived VCO_2, extracted the respiratory quotient of the administered nutrition, and calculated EE with a rewritten Weir formula. Bias, precision, and accuracy and inaccuracy rates were determined and compared with four predictive equations: the Harris–Benedict, Faisy, and Penn State University equations and the European Society for Clinical Nutrition and Metabolism (ESPEN) guideline equation of 25 kcal/kg/day.

Results: Mean 24-h indirect calorimetry EE was 1823 ± 408 kcal. EE from ventilator-derived VCO_2 was accurate (bias +141 ± 153 kcal/24 h; 7.7 % of gold standard) and more precise than the predictive equations (limits of agreement −166 to +447 kcal/24 h). The 10 % and 15 % accuracy rates were 61 % and 76 %, respectively, which were significantly higher than those of the Harris–Benedict, Faisy, and ESPEN guideline equations. Large errors of more than 30 % inaccuracy did not occur with EE derived from ventilator-derived VCO_2. This 30 % inaccuracy rate was significantly lower than that of the predictive equations.

Conclusions: In critically ill mechanically ventilated patients, assessment of EE based on ventilator-derived VCO_2 is accurate and more precise than frequently used predictive equations. It allows for continuous monitoring and is the best alternative to indirect calorimetry.

EVIDENCE

KHUYẾN CÁO ASPEN 2016

tality) than patients at low nutrition risk. While widespread use and supportive evidence are somewhat lacking to date, improvement in these scoring systems may increase their applicability in the future by providing guidance as to the role of EN and PN in the ICU.

Question: What is the best method for determining energy needs in the critically ill adult patient?

A3a. We suggest that indirect calorimetry (IC) be used to determine energy requirements, when available and

in the absence of variables that affect the accuracy of measurement.

[Quality of Evidence: Very Low]

A3b. Based on expert consensus, in the absence of IC, we suggest that a published predictive equation or a simplistic weight-based equation (25–30 kcal/kg/d) be used to determine energy requirements. (See section Q for obesity recommendations.)

but traditional outcome parameters were not evaluated.[38] A second study in general ICU patients used both EN and PN to meet target energy goals determined by IC measurement or a weight-based predictive equation (25 kcal/kg/d).[39] While the IC-directed energy goal was no different from the value obtained by predictive equation (1976 ± 468 vs 1838 ± 468 kcal/d, respectively; $P = .60$), only study patients were monitored vigilantly by an ICU dietitian, while controls were managed by standard of care (less frequent ICU dietitian monitoring), which led to significantly more energy and protein per day in the study patients. The trend toward reduced mortality in study patients compared with con-

KHUYẾN CÁO ESPEN 2019

Recommendation 15

In critically ill mechanically ventilated patients, EE should be determined by using indirect calorimetry.

Grade of recommendation: B – strong consensus (95% agreement)

Statement 2

If calorimetry is not available, using VO_2 (oxygen consumption) from pulmonary arterial catheter or VCO_2 (carbon dioxide production) derived from the ventilator will give a better evaluation on EE than predictive equations.

Consensus (82% agreement)

Commentary to recommendation 15 and statement 2

KHUYẾN CÁO ESPEN

The weakness of predictive equations and the use of indirect calorimetry have been subject to multiple evaluations and recommendations from ESPEN [2] and ASPEN [41], both preferring the use of indirect calorimetry to evaluate ICU patient needs (rated a very weak recommendation by ASPEN). The predictive equations are associated with significant inaccuracy (up to 60%), leading to over or under evaluation of the needs and inducing over or underfeeding [118]. Numerous meta-analyses have demonstrated the poor value of predictive equations [119,120], variability that is increased because body weight remains a value difficult to accurately assess [121]. If indirect calorimetry is not available, calculation of REE from VCO_2 only obtained from ventilators ($REE = VCO_2 \times 8.19$) has been demonstrated to be more accurate than equations [122] but less than indirect calorimetry [123]. VO_2 calculated from pulmonary artery catheter can also be used. In the absence of indirect calorimetry, VO_2 or VCO_2 measurements, use of simple weight-based equations (such as 20–25 kcal/kg/d) [1,2,41]: the simplest option may be preferred.

KHUYẾN CÁO ESPEN 2019

Hypocaloric nutrition (not exceeding 70% of EE) should be administered in the early phase of acute illness.

Grade of recommendation: B – strong consensus (100% agreement)

Recommendation 18

After day 3, caloric delivery can be increased up to 80-100% of measured EE.

Grade of recommendation: 0 – strong consensus (95% agreement)

TICACOS

Tight Calorie Control in geriatric patients following hip fracture decreases complications: A randomized, controlled study☆

R. Anbar[a,d], Y. Beloosesky[b], J. Cohen[c], Z. Madar[d], A. Weiss[b], M. Theilla[c], T. Koren Hakim[a], S. Frishman[a], P. Singer[c,*]

Table 2
Summary of energy and protein parameters during the study period.

Parameter	Study group ($n = 22$)	Control group ($n = 28$)	p-Value
REE measurement – day 1(kcal/day)	1292.2 ± 255.9	1262.3 ± 246.1	0.90
Mean REE during study	1274 ± 262.9	1346 ± 309.1	0.96
Mean energy delivered/day (kcal/day)	1121.3 ± 299.1	777.1 ± 301.2	0.001
Mean enterally and ONS delivered energy/day (kcal/day)	220.3 ± 147.2	94.6 ± 233.8[a]	0.845
Preoperative days of fast	1.7 ± 0.5	1.4 ± 0.7	0.635
Mean protein delivered/day (g/day)	55.9 ± 18.1	37.4 ± 12.4	0.001
Mean daily energy balance (kcal)	−176.9 ± 273.2	−490.7 ± 355.2	0.104
Cumulative energy balance (kcal)	−1229.9 ± 1763	−4975.5 ± 4368	0.001

Table 3
Primary outcomes: complications and duration of hospital stay.

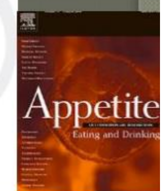
Variable	Study group ($n = 22$)	Control group ($n = 28$)	p-Value
Duration of hospital stay (days)	10.1 ± 3.2	12.5 ± 5.5	0.061
Total number of patients who developed complications	6 (27.3%)	18 (64.3%)	0.012
Infectious complications (n)	3 (13.6%)	14 (50%)	0.008
Pneumonia (n)	0	9	
Urinary tract infections (n)	3	5	
New pressure ulcers (%)	0	2 (7.1%)	0.497
Surgical complications (%)	1 (4.5%)	1 (3.6%)	0.691
Cardiovascular complications	0	2 (7.1%)	0.497
Gastrointestinal complications	0	4 (14.3%)	0.089
Delirium	1 (4.8%)	2 (7.1%)	1.00
Other	1 (4.8%)	0	

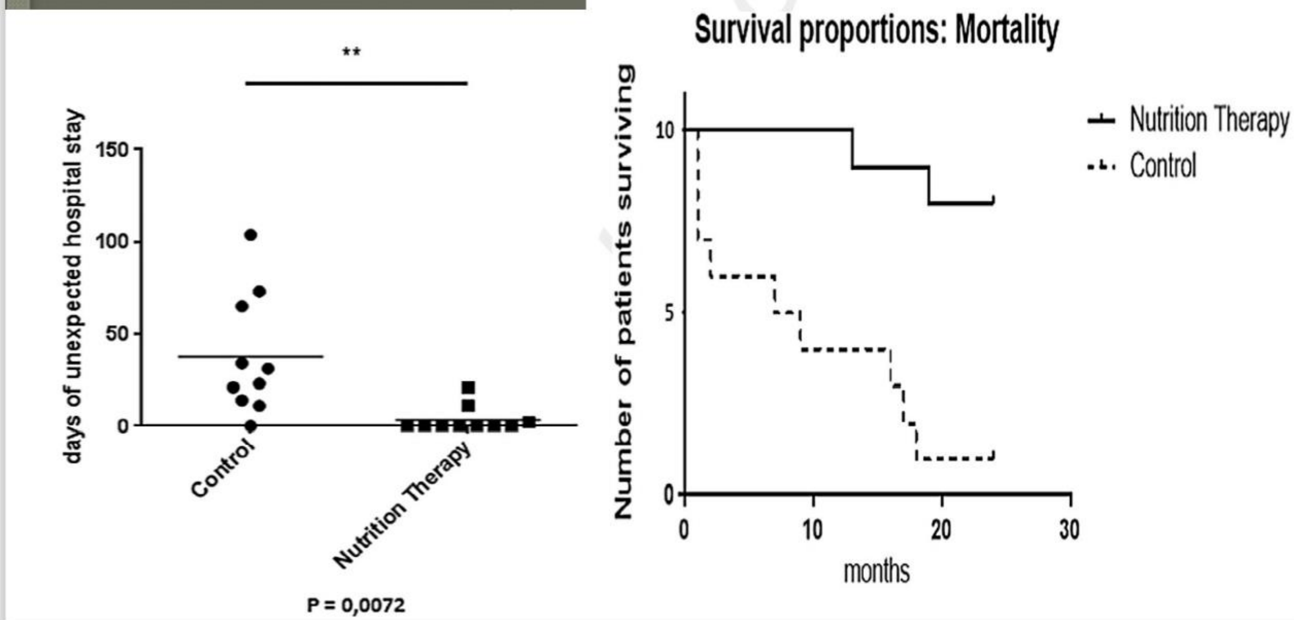
**TICACOS & Co
Decrease in
infections**

TICACO

Nutrition therapy in cachectic cancer patients. The Tight Caloric Control (TiCaCo) pilot trial ☆

Elisabeth De Waele [a,1], Sabrina Mattens [b], Patrick Honoré [a,1], Herbert Spapen [a,1], Jacques De Grève [c,1], Joeri J. Pen [d,*,1]





Resting energy expenditure, calorie and protein consumption in critically ill patients: a retrospective cohort study

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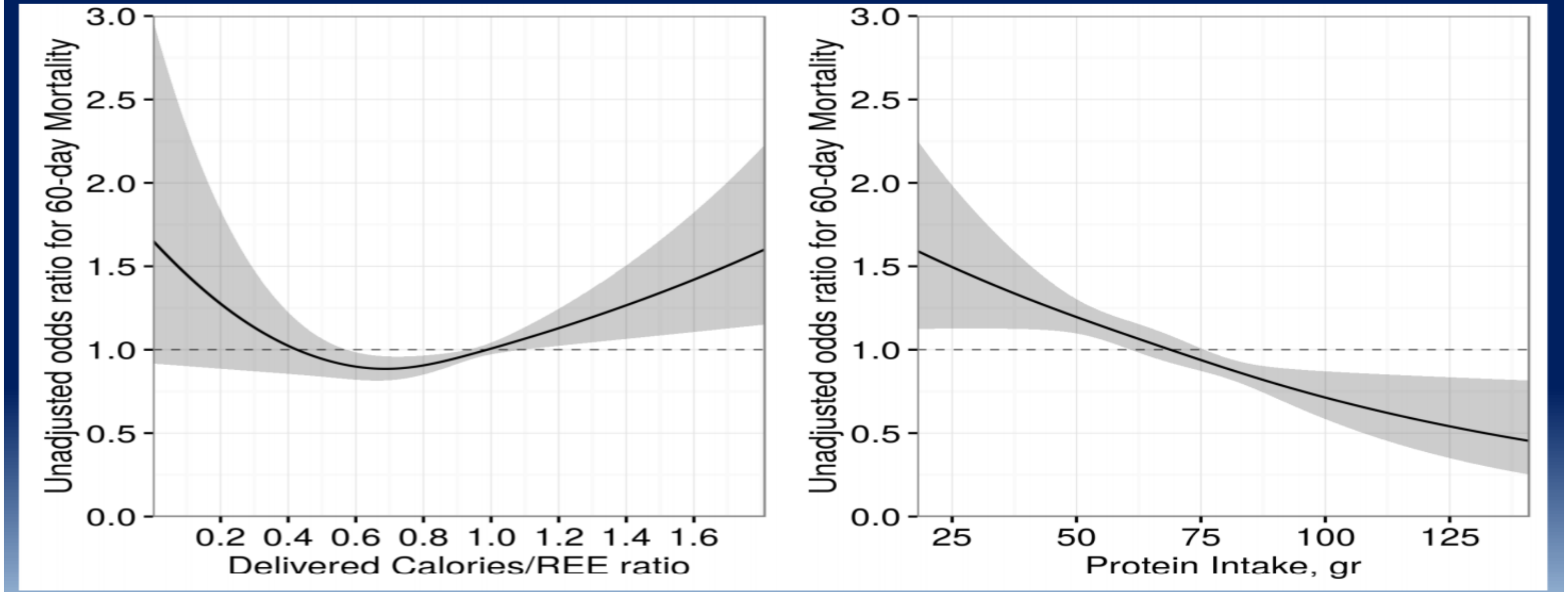
Oren Zusman[1*], Miriam Theilla[2,3], Jonathan Cohen[2,4], Ilya Kagan[2], Itai Bendavid[2] and Pierre Singer[2,4]

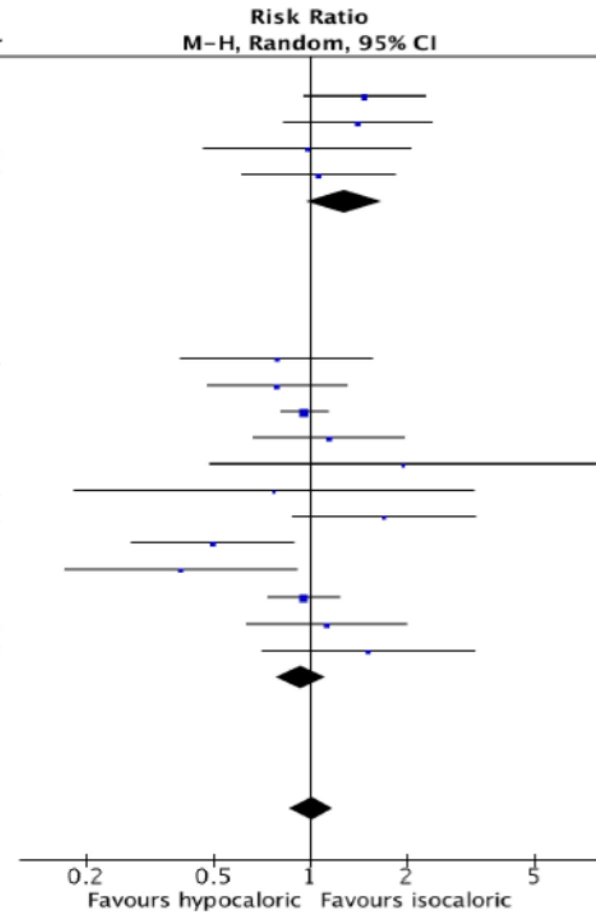
6 patients incomplete background data
243 not full filling length of stay follow up criteria

Prescribe 80 to 100% of the REE



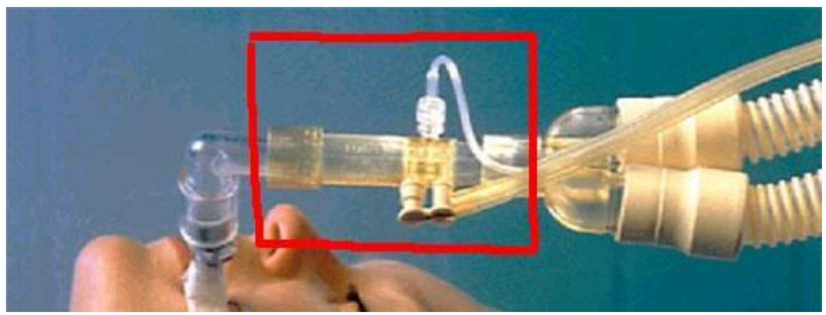
PICO 7, Figure 1: Short-term mortality (Includes Meta 7A and 7B)

Study or Subgroup	Hypocaloric nutrition Events	Hypocaloric nutrition Total	Isocaloric nutrition Events	Isocaloric nutrition Total	Weight	Risk Ratio M-H, Random, 95% CI	Year
2.1.1 Studies using indirect calorimetry							
Singer 2011	31	65	21	65	8.4%	1.48 [0.96, 2.28]	2011
Heidegger 2013	28	152	20	153	6.4%	1.41 [0.83, 2.39]	2013
Petros 2016	10	46	12	54	3.7%	[illegible]	2016
Allingstrup 2017	21	99	20	100	6.1%	1.06 [0.61, 1.83]	2017
Subtotal (95% CI)		**362**		**372**	**24.5%**	**1.28 [0.98, 1.67]**	
Total events	90		73				
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 1.51$, df = 3 (P = 0.68); $I^2 = 0\%$							
Test for overall effect: Z = 1.80 (P = 0.07)							
2.1.2 Studies without indirect calorimetry							
Desachy 2008	11	50	14	50	4.2%	0.79 [0.40, 1.56]	2008
Arabi 2011	22	120	28	120	6.9%	0.79 [0.48, 1.29]	2011
Casaer 2011	242	2328	251	2312	18.7%	0.96 [0.81, 1.13]	2011
Rice 2011	22	98	20	102	6.2%	1.14 [0.67, 1.96]	2011
Rugles 2013	5	53	3	62	1.2%	1.95 [0.49, 7.78]	2013
Charles 2014	3	41	4	42	1.1%	0.77 [0.18, 3.22]	2014
Peake 2014	18	55	11	57	4.6%	1.70 [0.88, 3.26]	2014
Doig 2015	15	166	30	165	5.5%	0.50 [0.28, 0.89]	2015
Braunschweig 2015	6	38	16	40	3.1%	0.39 [0.17, 0.90]	2015
Arabi 2015	93	447	97	444	14.6%	0.95 [0.74, 1.23]	2015
Rugles 2016	18	60	16	60	5.7%	1.13 [0.64, 1.99]	2016
Wischmeyer 2017	17	73	8	52	3.6%	1.51 [0.71, 3.24]	2017
Subtotal (95% CI)		**3529**		**3506**	**75.5%**	**0.94 [0.78, 1.12]**	
Total events	472		498				
Heterogeneity: $Tau^2 = 0.03$; $Chi^2 = 16.36$, df = 11 (P = 0.13); $I^2 = 33\%$							
Test for overall effect: Z = 0.73 (P = 0.47)							
Total (95% CI)		**3891**		**3878**	**100.0%**	**1.01 [0.86, 1.18]**	
Total events	562		571				
Heterogeneity: $Tau^2 = 0.03$; $Chi^2 = 22.06$, df = 15 (P = 0.11); $I^2 = 32\%$							
Test for overall effect: Z = 0.09 (P = 0.93)							
Test for subgroup differences: $Chi^2 = 3.62$, df = 1 (P = 0.06), $I^2 = 72.4\%$							



THỰC HÀNH ĐO TIÊU HAO NĂNG LƯỢNG Ở BN TKNT

PHƯƠNG TIỆN



BỘ ĐO CHUYỂN HÓA

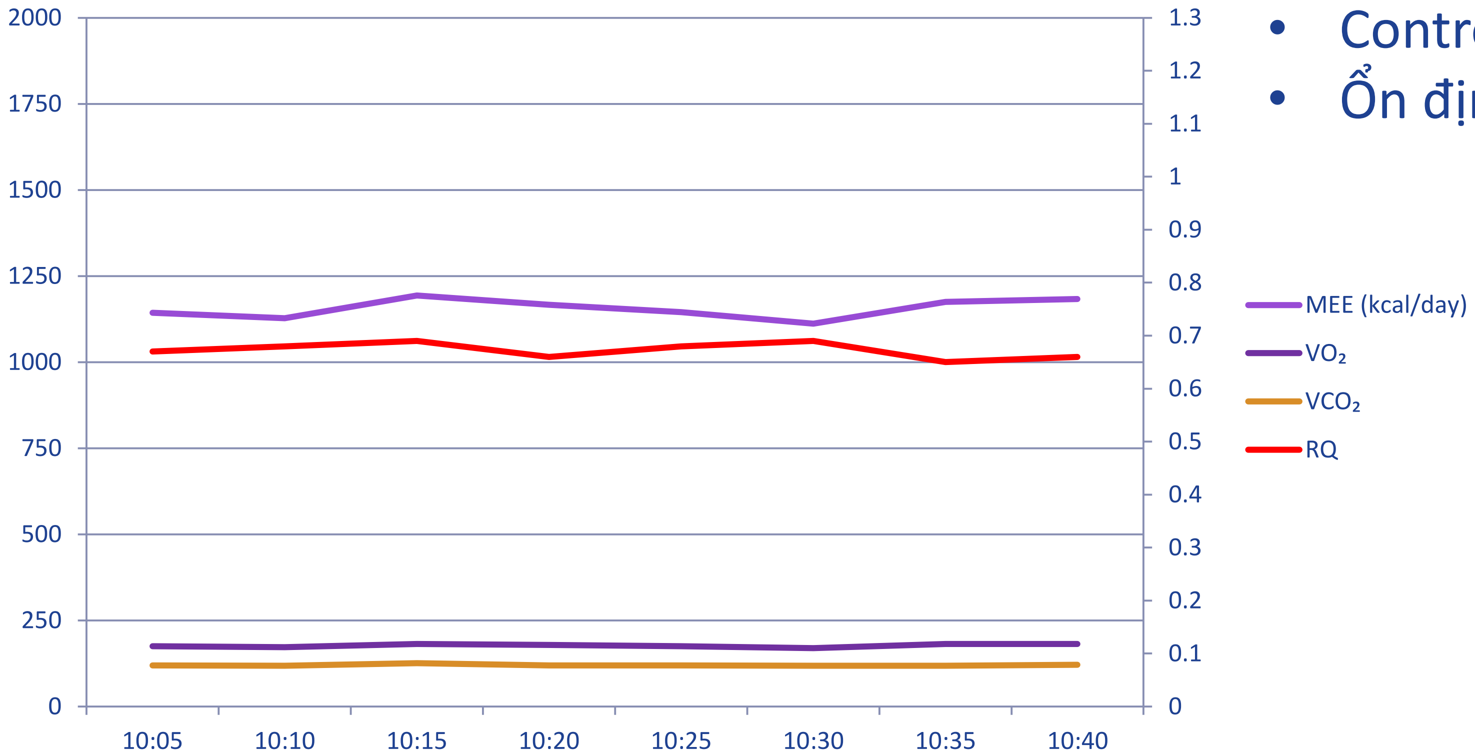
Cảm biến D-lite
Ống đo Spirometry
Bẫy nước
Dây lấy mẫu khí

Điều kiện đo

1. Máy phải làm warm up 30 phút
2. Bn ở trạng thái ổn định, chuẩn độ
3. FiO2 < 60 và nồng độ oxy ổn định
4. PEEP < 12
5. Không dò khí, dẫn lưu phổi, fistula
6. Không lọc máu, huyết động ổn định, To ổn định
7. Không ECMO, không iNO
8. Không thay đổi cài đặt máy thở 1-2h trước đo

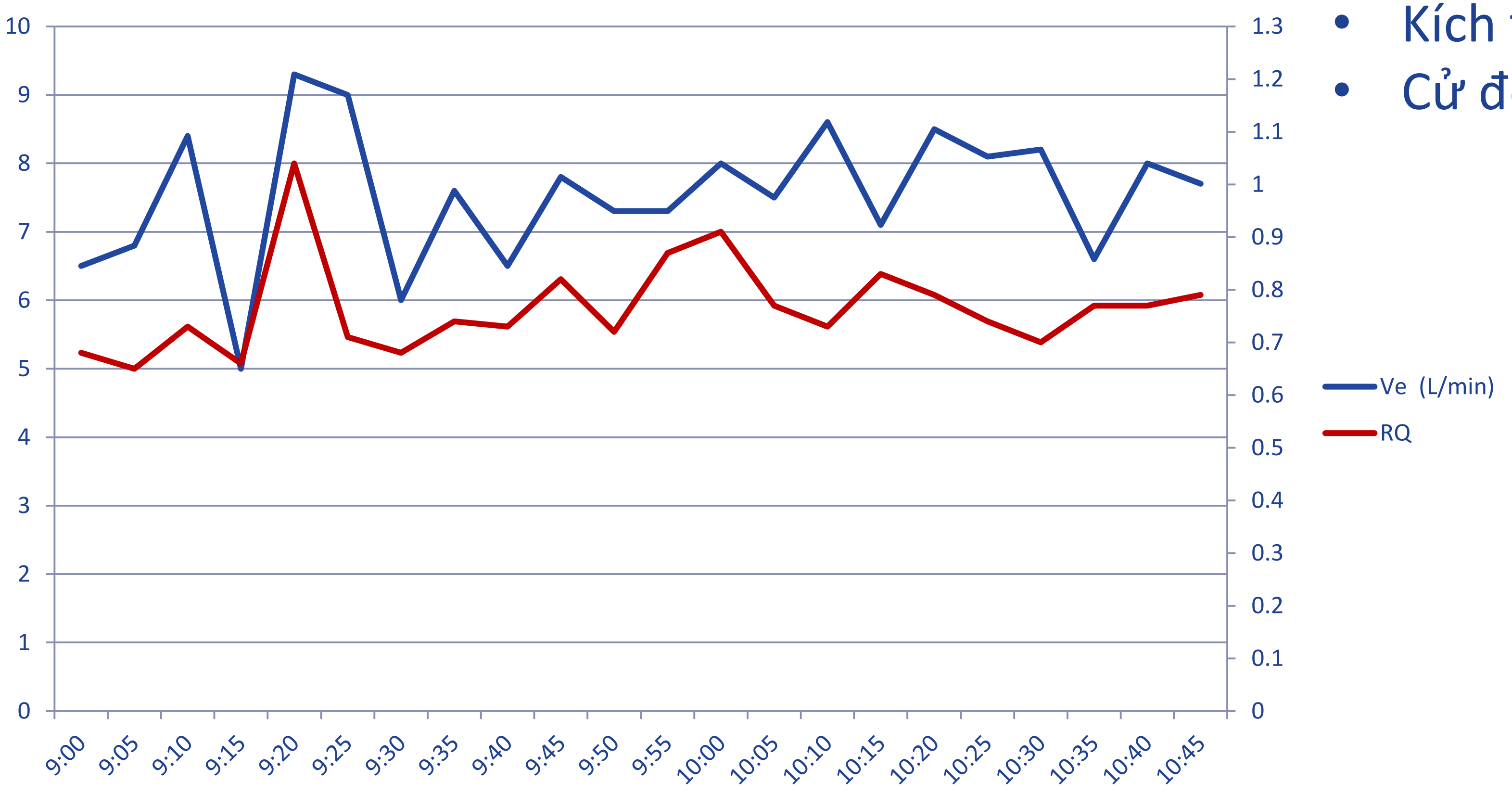
Trạng thái ổn định

- An thần
- Control Mode
- Ổn định



TRẠNG THÁI KHÔNG ỔN ĐỊNH

- CPAP/PSV
- TỉNH
- Kích thích
- Cử động



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ĐO CHUYỂN HÓA IC

Tìm trạng thái ổn định

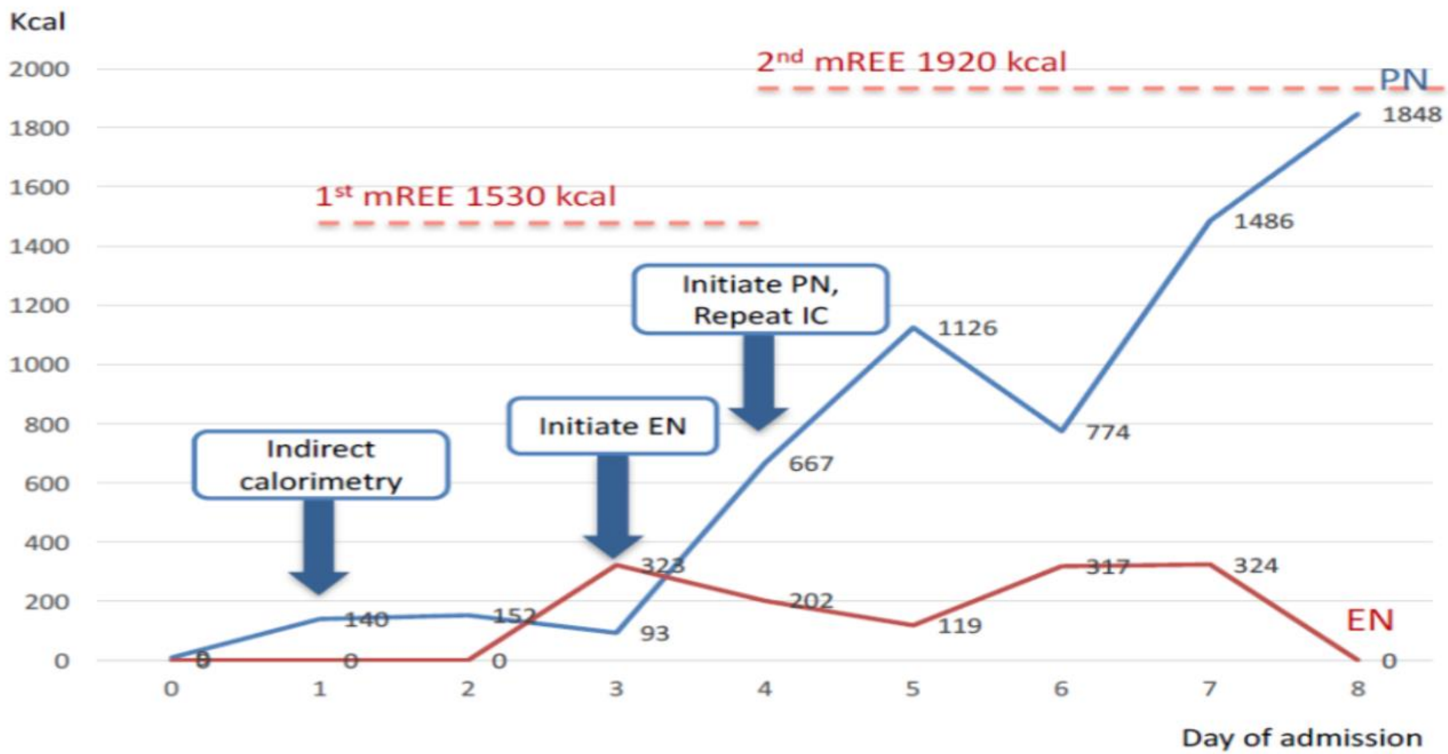
Chọn thời gian 30 phút đến 1 giờ

"Chọn cửa sổ xanh vào vùng ổn định": 5 phút tới 2 giờ

- Hiển thị kết quả cột bên phải
- Chọn hệ số biến thiên < 5%


Menu
Adult
Alarms 6
MVexp low
Alarm Setup
Insp Hold
Exp Hold
Manual Breath
MVexp
l/min
04-Mar 11:27
04-Mar 17:27
04-Mar 23:27
05-Mar 05:27
30 min
Metabolics
Avg VCO2 162 ml/min
VCO2 CV 2.6 %
Avg VO2 227 ml/min
VO2 CV 1.9 %
Avg RQ 0.71
Avg EE 1506 kcal/d
Avg EE/m2 1091 kcal/d/m2
Avg EE/kg 41 kcal/d/kg
BSA 1.38 m2
Weight 37 kg
Paw
cmH2O
Pmax
Ppeak
PEEP
VTexp 431 ml
FiO2 101 %
VCO2
ml/min
VO2
ml/min
RQ
EE
kcal/d
5 min
05-Mar 10:07
05-Mar 10:27
05-Mar 10:37
Oxygenation
01:16
SBT
FRC
11:27
Current Mode
A/C PRVC
FiO2 100 %
VT 400 ml
Rate 12 /min
I:E 1:2
PEEP 5 cmH2O
Pmin 2 cmH2O
STANDBY
CARESCAPE R860

Caloric titration



ıREE measured resting energy expenditure, IC indirect calorimetry

Message home

Tiêu chuẩn vàng

- Indirect calometry: VO_2 + VCO_2

hoặc

- VCO_2 x 8,2 nếu chỉ đo được VCO_2

Xin trân trọng cảm ơn