VCO_2 als surrogaat variabele voor het energieverbruik van beademde patiënten

Koen Forschelen
Ventilation Practitioner i.o.
31 oktober 2018

Medisch begeleider: dr. Norbert Foudraine intensivist-internist
dr. Jos le Noble intensivist-internist
Medisch manager: dr. Jannet Mehagnoul intensivist-internist

VieCuri
medisch centrum

VieCuri Medisch Centrum Venlo

STZ-ziekenhuis

Bedden:

Ziekenhuis	360
IC	16

Opnames (2017):

Ziekenhuis	20.366
IC	1150

Inhoud

- Inleiding
- Methode
- Resultaten

- Discussie
- Conclusie
- Rol VP-er

- Dankwoord
- Literatuur

Inleiding

Intensive care – VieCuri Venlo

Level 2

Kern-IC

Team

- 7 intensivisten
- 7 ANIOS/AIOS
- 1 Physician assistant

Practitioners

- 3 VP-ers
- 2 CP-ers
- 1 RP-er
- 1 NP-er
- 55 IC-verpleegkundigen
- 6 MC-verpleegkundigen
- 9 leerling IC-verpleegkundigen

Intensive care VieCuri Venlo

Inleiding

Risico malnutritie

Ondervoeding

- Infecties
- Verhoogde morbiditeit en mortaliteit

Overvoeding

- Weaningsfalen
- Infecties
- Hyperlipidemie
- Hyperglycemie
- Refeeding-stoornissen
- Zuurbase-stoornissen
- Levertest afwijkingen

Inleiding (I)

VieCuri medisch centrum

Original Communication

Journal of Parenteral and Enteral Nutrition
Volume 33 Number 1
January/February 2009 27-36

10.1177/0148607108322399
http://jpen.sagepub.com
hosted at
http://online.sagepub.com

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]; and Robert N. Cooney, MD[3]

Financial disclosure: none declared.

N= 202

ORIGINAL ARTICLE

Measured *versus* calculated resting energy expenditure in critically ill adult patients. Do mathematics match the gold standard?

E. DE WAELE [1], T. OPSOMER [1], P. M. HONORÉ [1], M. DILTOER [1], S. MATTENS [2]
L. HUYGHENS [1], H. SPAPEN [1]

N= 279

Inleiding (II)

Oshima *et al. Critical Care* (2017) 21:13
DOI 10.1186/s13054-016-1595-8

Critical Care

N= 278

RESEARCH Open Access

Can calculation of energy expenditure based on CO_2 measurements replace indirect calorimetry?

Taku Oshima[1], Séverine Graf[1], Claudia-Paula Heidegger[2], Laurence Genton[1], Jérôme Pugin[2] and Claude Pichard[1]

Kagan *et al. Critical Care* (2018) 22:186
https://doi.org/10.1186/s13054-018-2108-8

Critical Care

N= 80

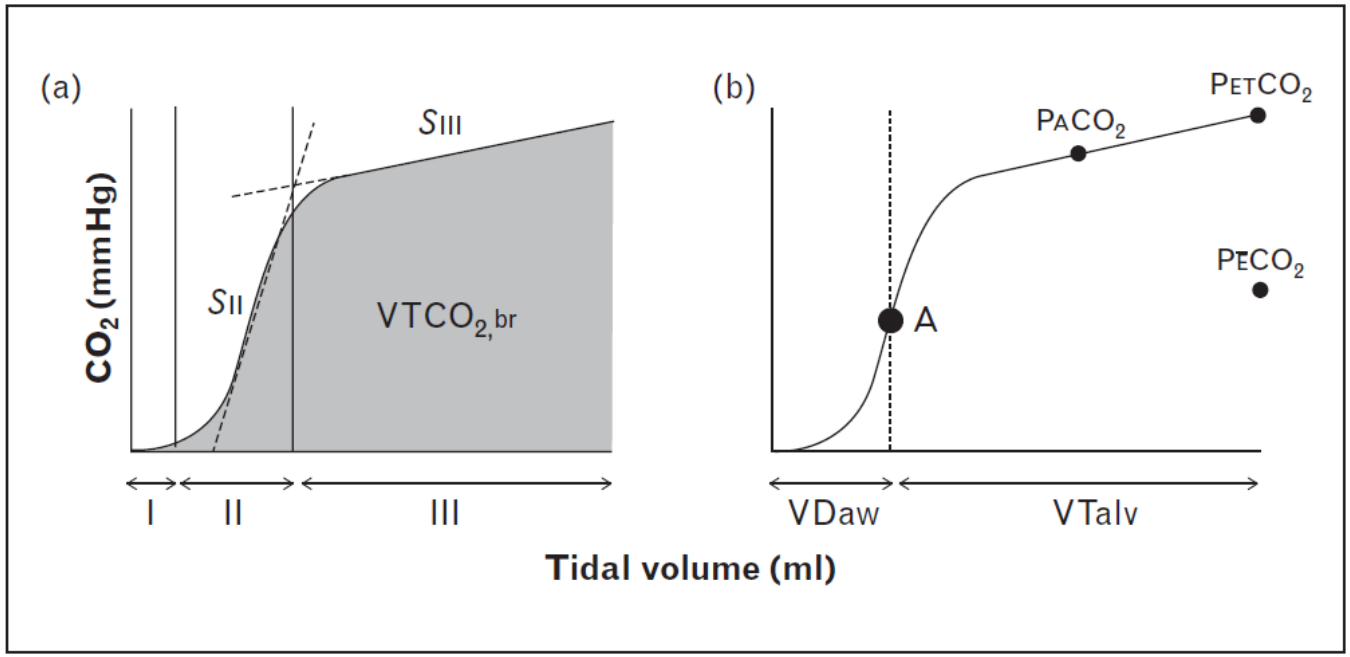
RESEARCH Open Access

Validation of carbon dioxide production (VCO_2) as a tool to calculate resting energy expenditure (REE) in mechanically ventilated critically ill patients: a retrospective observational study

I. Kagan[1], O. Zusman[2], I. Bendavid[1], M. Theilla[1,3], J. Cohen[1] and P. Singer[1]

VCO_2

Volumetrisch capnogram



Geeft belangrijke informatie over

- Metabolisme
- Circulatie
- CO_2 eliminatie door de long

Indirecte calorimetrie

Meet energy expenditure (EE)

Parameters

- VCO_2
- VO_2
- Respiratoiry quotiënt (RQ)

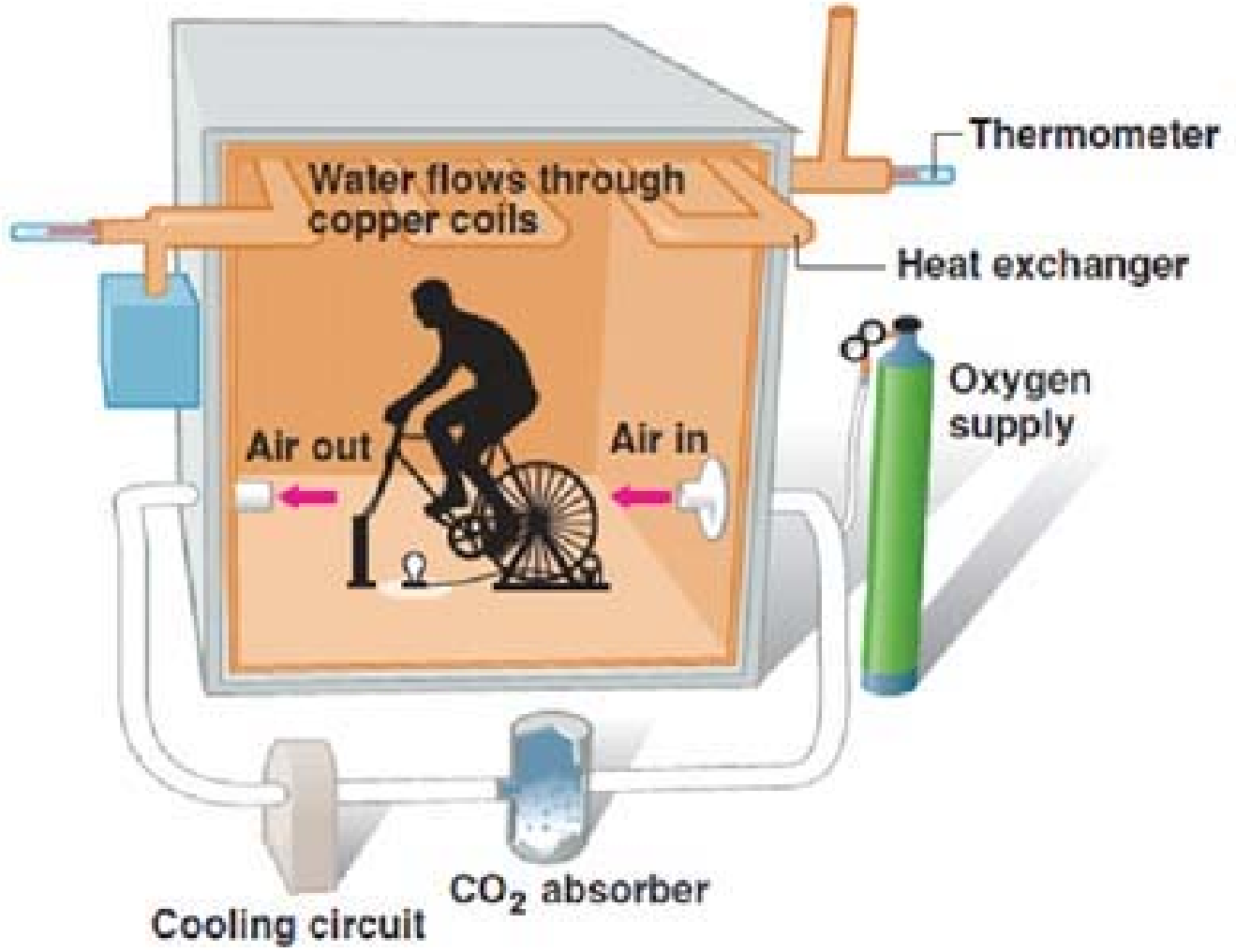
Medgraphic CCM expres®

WEIR formule

EE=3.941xVO_2 (L/min) /Nutritional RQ +1.11 x VCO_2(L/min) x1440= 24 hr KCAL.[3]

Normaalwaarden RQ: 0.7-1.0

Directe calorimetrie



Capnografie Servo-i

VieCuri medisch centrum

Mainstream capnograaf

Parameter

- VCO_2

Aangepaste WEIR formule

EE= 8.19 x VCO_2 (ml/ min).(1)

Stapel *et al. Critical Care* (2015) 19:370
DOI 10.1186/s13054-015-1087-2

CRITICAL CARE

RESEARCH Open Access

Ventilator-derived carbon dioxide production to assess energy expenditure in critically ill patients: proof of concept N= 84

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[1,3,4] and Heleen M. Oudemans-van Straaten[1,2,3]

Getinge Group

Probleem en doelstelling

Probleemstelling

- Bij onze patiënten vaak sprake van ondervoeding
- Harris-Benedict gebruikt

Doel van de studie

- Betrouwbaarheid metingen/berekeningen
- Procesverbetering

Vraagstelling

Onderzoeksvraag

Is VCO_2 afgeleid uit de Servo-i® betrouwbaar om energy expenditure mee te berekenen in verhouding tot indirecte calorimetrie en de standaard gebruikte berekeningen?

Methode

In- en exclusie criteria

Inclusiecriteria

- Invasief beademde patiënt
- 18 jaar en ouder

Exclusie criteria

- FiO_2 >0.6
- PEEP >15 cmH_2O
- Luchtlekkage en patiënt bewegingen

Primaire en secundaire outcome

Primair EEVCO$_2$ vs EE metabole monitor

- Correlatie
- Significantie
- Conclusie

Secundair voorspellende formules vs EE metabole monitor

- Correlatie
- Significantie
- Conclusie

Patiënt en methode (I)

Prospectief observationele studie N=101

Methoden energy expenditure per patiënt

Metingen

Indirecte calorimetrie

- 30 minuten metingen

medgraphic CCM express®

VCO_2 beademingsmachine

- 30 minuten metingen mean

servo-i®

Patiënt en methode (II)

Voorspellende formules

Harris-Benedict

Man: 88.362 + 13.397 x weight(kg) + 4.799 x height (cm) -5.677 x age(y)
Vrouw: 447.593 + 9.247 x weight(kg) + 3.098 x height(cm) – 4.33 x age (y)

Esp25 (european society for clinical nutrition and metabolism guideline)

25 kcal/kg/day

Penn State University

Mifflin – St Jeor x0.96 T max x 167 + Ve x 31 -6212

Mifflin – St Jeor:
Man: 10 x weight (kg) + 6.25 x height (cm) -5 x age (y) +5
Vrouw: 10 x weight (kg) + 6.25 x height (cm) -5 x age (y) -161

Faisy

8 x weight (kg) +14 x height (cm) + 32 x Ve (L/ min) +94 x T-4834

Studieopzet (II)

Tijdsframe

- Studie: mei 2017 tot en met juli 2018

Goedkeuring

- Niet WMO plichtig
- Medisch ethische commissie
- Wetenschapsbureau
- Afdelingsmanager

Data en analyse en presentatie gegevens

- IBM SPSS statistics®
- Tabellen demografische gegevens
- Lineaire regressie grafieken
- Bland-Altman grafieken
- P waarden

Resultaten (I)

Kenmerken	±SD
Patiënten *n* (%)	*101 (100.0)*
Man	*77 (76.2)*
Vrouw	*24 (23.8)*
Leeftijd, jaren	*68 ±(12.9)*
Lengte, cm	*172 ± (9)*
Anamnestisch lichaams gewicht, kg	*83 ± (19.5)*
Body mass index	*28 ± (5.6)*
Voor meting:	
Length of ICU stay, dagen	*17 ± (11.8)*
Beademingsduur invasief, uren	*264 ± (234)*
Opname diagnose *n* (%)	
Sepsis	*10 ± (9.9)*
Trauma	*6 ± (5.9)*
Neurologie	*5 ± (5.0)*
Respiratoir falen	*34 ± (33.7)*
Post chirurgie	*12 ± (11.9)*
Gastro intestinaal	*10 ± (9.9)*
Cardiaal falen	*5 ± (5.0)*
Post cardiac arrest	*13 ± (12.9)*
Cardiovasculair	*6 ± (5.9)*

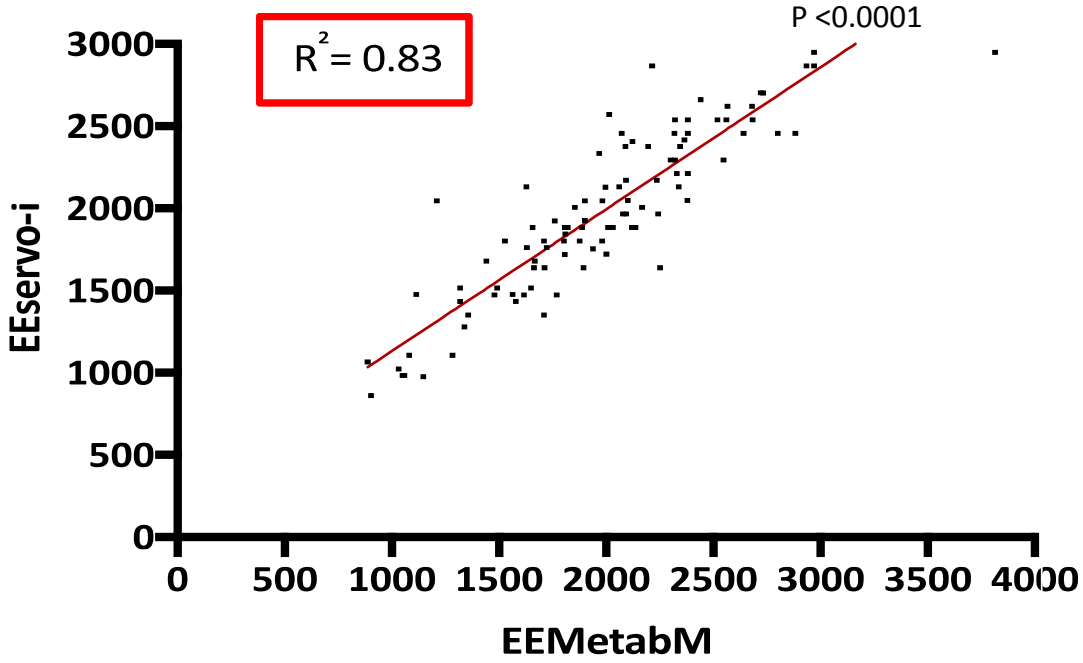
Resultaten (II)

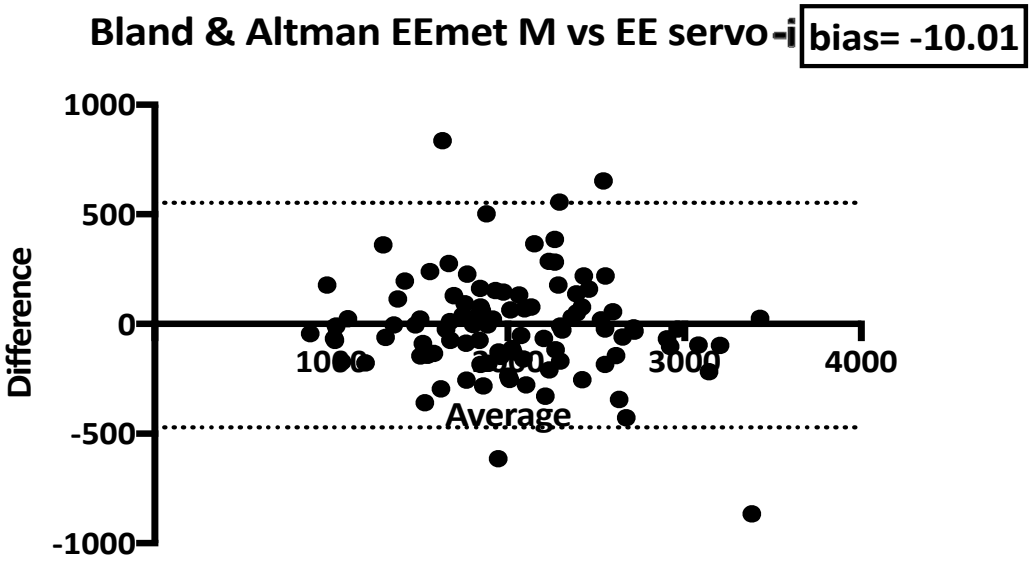
Kenmerken	±SD
Patiënten *n*	*101*
Glasgow Coma Scale	*6 ± (3.8)*
Sedation-Agitation Scale	*-3 ± (1.7)*
Lichaamstemperatuur, °C	*37.6± (0.9)*
FiO_2, %	*36.5 ± (9.4)*
PEEP cmH_2O	*10.3 ± (3.4)*
Ademminuutvolume, L/min	*11 ± (3.5)*
Indirecte calorimetrie	
VCO_2, mL/min	*236 ± (65.3)*
Respiratory quotient	*0.82 ± (0.1)*
Energy expenditure, kcal/day	*2033 ± (573)*
APACHE II score	*23 ± (6.9)*
APACHE IV score	*84 ± (24.3)*
SAPS II	*52 ± (14.2)*
ICU mortaliteit %	*33*

Resultaten (III)

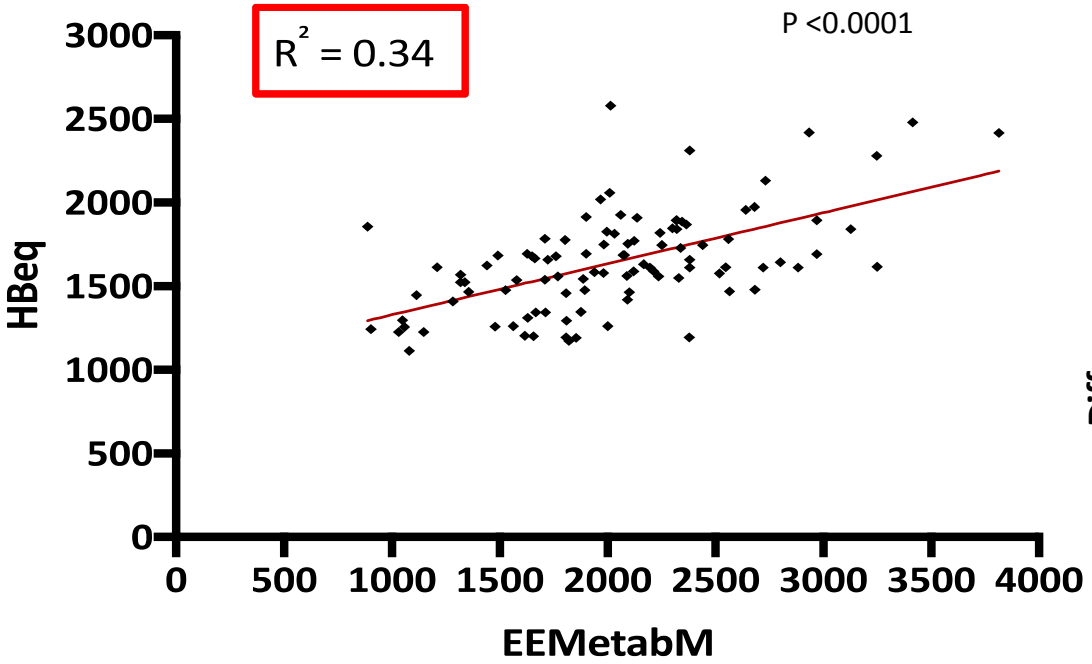
Kenmerken	Mean ±SD
VCO_2 (ml/min)	
EEmetabM	*237±65.3*
EEServo-I	*247±65.9*
RQ	*0.82±0.1*
Energy Expenditure (kcal/24uur)	
EEmetabM	*2033±573*
VCO_2 Servo-I	*2022±542.7*
HB	*1644±300*
HB+20%	*1973±360*
ESP25	*2078±486*
PSU(Mifstjeor)	*1573±242*
Faisy	*2126±8*

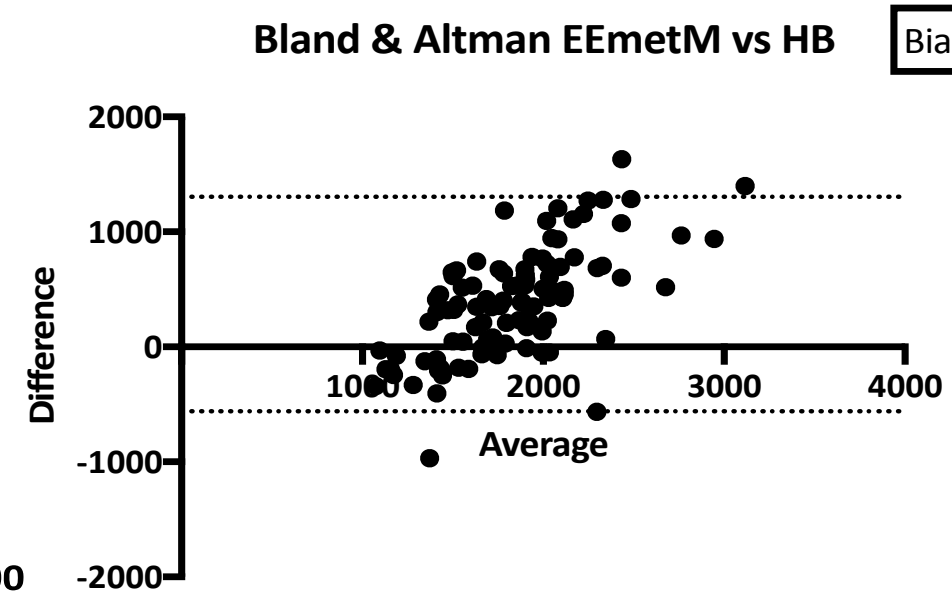
Resultaten $EEVCO_2$



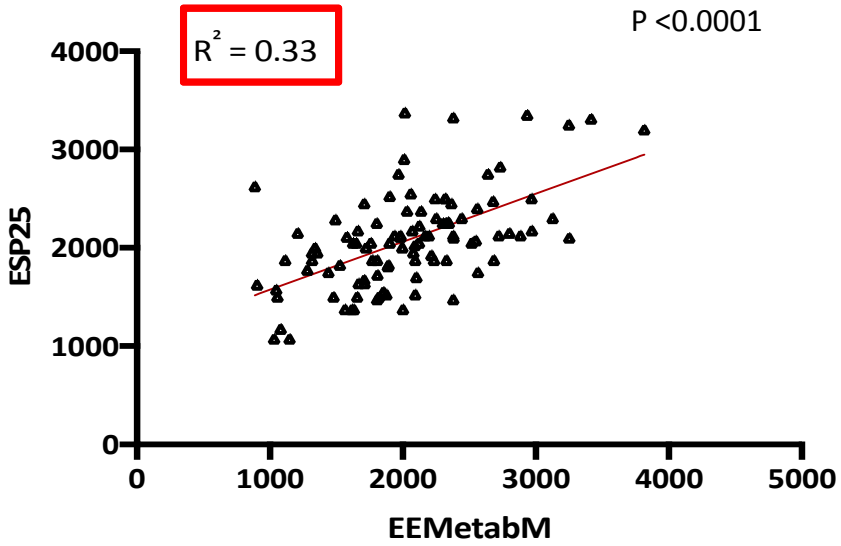


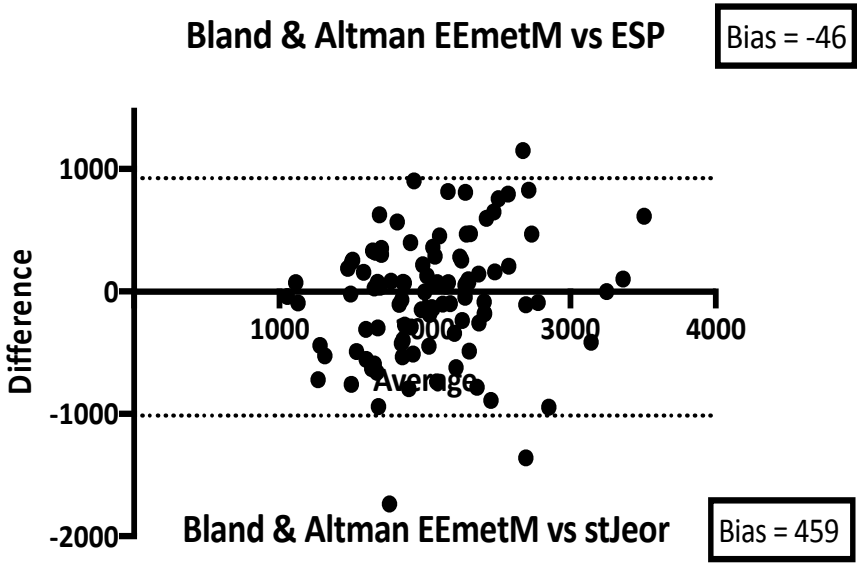
Resultaten voorspellende formules (I)

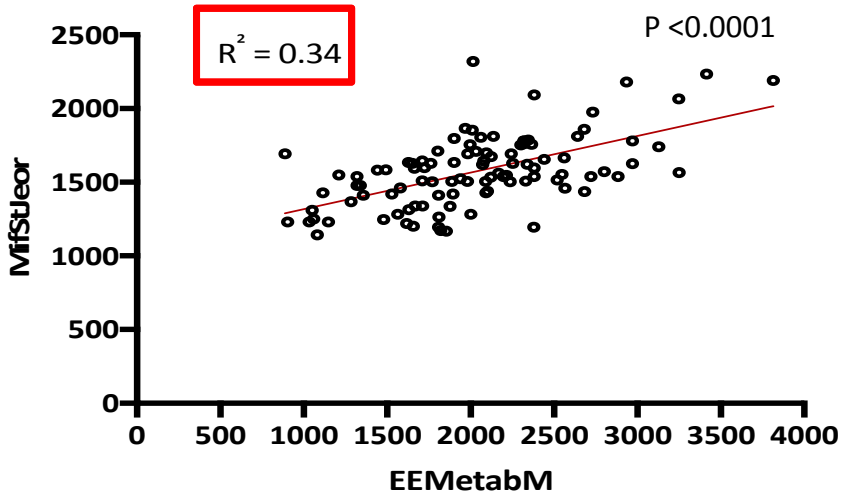


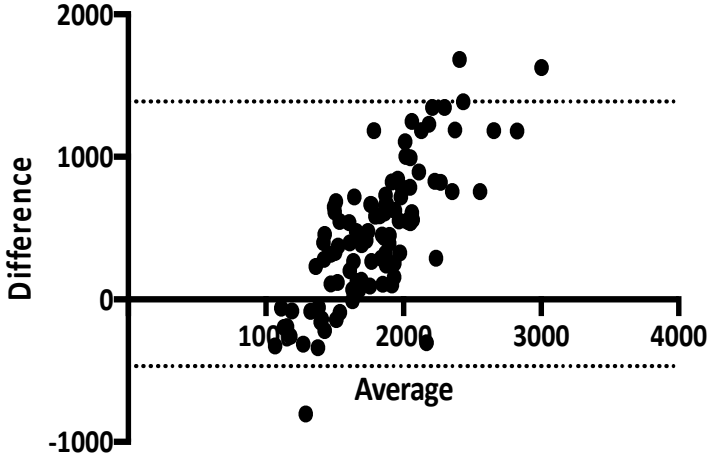


Resultaten voorspellende formules (II)

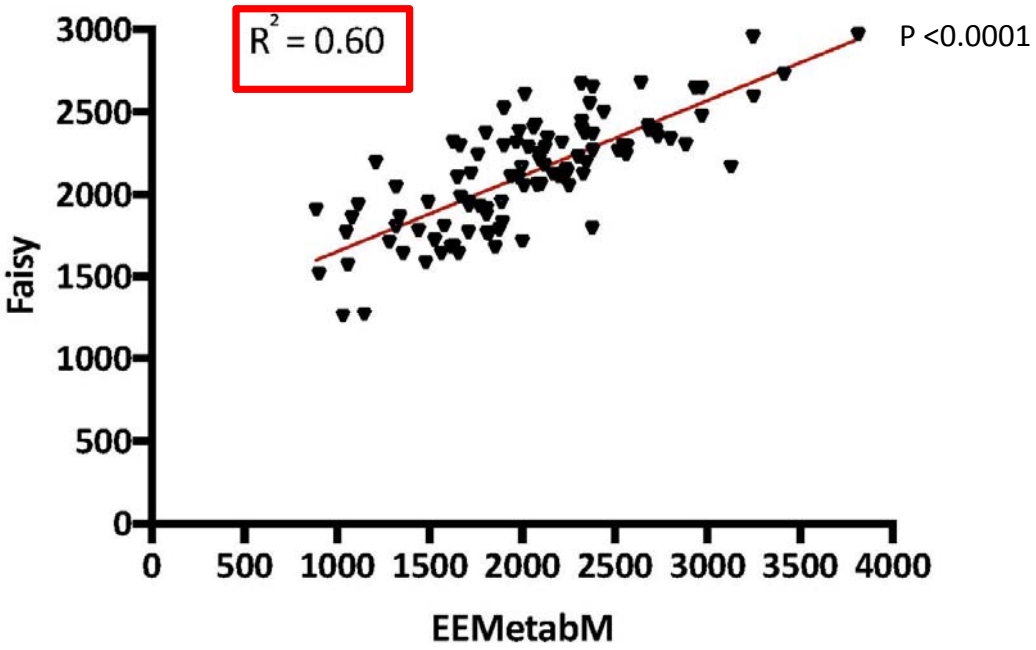


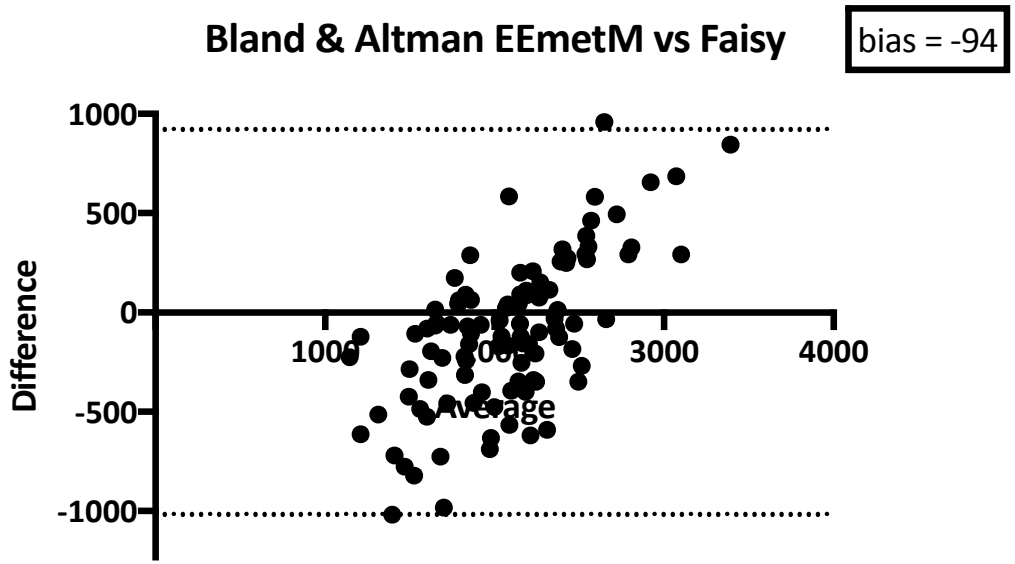






Resultaten voorspellende formules (III)





Samenvatting

- $EEVCO_2$ heeft beste correlatie met indirecte calorimetrie (R^2 =0,83), P< 0.0001

  Mean RQ 0.82±0.1

- Voorspellende formules grote discrepantie

- EEfaisey beste correlatie voorspellende formules

- BMI patiëntengroep

Discussie

- Slechts 30 minuten metingen in studie
- Tijdstip metingen
- Goede meting EE gevoelig door veel factoren
- Enteraal parenteraal voeden niet vergeleken
- Oorzaak slechtere score voorspellende formules

Conclusie

1. $EEVCO_2$ afgeleid uit de beademingsmachine is accuraat en betrouwbaarder dan de voorspellende formules

2. $EEVCO_2$ uitstekend alternatief voor indirecte calorimetrie P <0,0001, bias van -10

3. Voorspellende formules niet accuraat genoeg ter vervanging voor indirecte calorimetrie

Aanbevelingen

- Dagelijkse bijsturing EE bij $EEVCO_2$ mogelijk

- $EEVCO_2$ mogelijk kosteneffectief
- Meer onderzoek voor ontwikkeling en verbetering van betere metabole monitoren is nodig
- Grotere studies voor outcome mortaliteit zijn nodig

Rol als Ventilation Practitioner

Dankwoord

- Jantien (vriendin)
- Dr. Norbert Foudraine, intensivist-internist (supervisor)
- Dr. Jos le Noble, intensivist-internist (supervisor)
- Dr. Jannet Mehagnoul intensivist-internist (medisch manager)
- Alle collega's van IC in VieCuri Venlo
- Hans Sloot (managing director)

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Vragen