Assessment of Resting Energy Expenditure (REE) in Mechanically Ventilated Patients

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By

Rania Othman Ibrahim Ibrahim
M.B, B.Ch

Under Supervision Of

Prof. Samiha Sayed Ahmad Ashmawi

Professor of Chest Diseases

Faculty of medicine – Ain Shams University

Dr. Nermine Mounir Riad Abd El Azim

Lecturer of Chest Diseases

Faculty of medicine – Ain Shams University

Faculty of Medicine
Ain Shams University
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تقييم الطاقة المستهلكة أثناء الراحة فى مرضى التنفس الصناعى

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الطبيبة / رانيا عثمان ابراهيم ابراهيم

بكالوريوس الطب والجراحة جامعة عين شمس

تحت إشراف

أ.د/ سميحة سيد أحمد عشماوى

أستاذ الأمراض الصدرية

كلية الطب- جامعة عين شمس

د/ نرمين منير رياض عبد العظيم

مدرس الأمراض الصدرية
كلية الطب- جامعة عين شمس

كلية الطب
جامعة عين شمس

Summary and Conclusion

Summary:

Metabolism is acutely modified by any form of severe disease. Resting energy expenditure is also influenced by malnutrition.

Malnutrition may be linked to higher morbidity and mortality rates and increased length of stay. Thus, caloric requirements & specific metabolism are essential components of the care of these patients.

So accurate determination of REE is necessary in ICU patient who are receiving nutritional support to ensure that their needs are met and to avoid complication of under or over feeding.

Vmax Encore Apparatus (indirect calorimetry) is still the gold standard method to obtain accurate, valid and reliable evaluation (measurement) of REE in both normal and overweight critically ill patients and to determine nutritional support in those patients, in comparison of H-B equation.

Despite that, Indirect calorimetry require metabolic, heamodynamic stability to obtain accurate measurement, trained personnel to perform it and time consuming, in addition; it's expensive specialized equipement that is not universally available.

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List of Abbreviations

2,3-DPG	2,3-diphosphoglycerate
ABG	Arterial blood gases
ADH	Antidiuretic hormones
AGA	American Gastroenterological Association
ANP	Atrial natriuretic peptide
ARDS	Adult respiratory distress syndrome
ASPEN	American Society for Parenteral and Enteral Nutrition
AT	Activity thermogenesis
ATP	Adenosine triphosphate
ATS	American Thoracic Society
BEE	Basel energy expenditure
BIA	Bioelectrical impedance analysis
BMI	Body mass index
BMR	Basal metabolic rate
C.B.C	Complete blood count
CA	Catecholamines
CF	Cystic fibrosis
CHO	Carbohydrates
CO	Cardiac output
CO2	Carbon dioxide
COPD	Chronic obstructive pulmonary disease
CPAP	Continuous positive airway pressure
CPIC	Clinical Pulmonary Infection Score

CR	Caloric restriction
CROP	Compliance, rate, oxygenation and maximal pressure integrated index
CVA	Central venous alimentation
CVP	Central venous pressure
DCH	Delayed cutaneous hypersensitivity
DEXA(DXA)	Dual x-ray absorptiometry
DIT	Diet-induced thermogenesis
DLW	Doubly-labeled water
DRIS	Dietary reference intakes
DVT	Deep venous thrombosis
EEA	Energy expenditure of activity
EEPA	Energy expended in physical activity
EER	Estimated energy requirement
EFA	Essential fatty acid
EN	Enteral nutrition
EPOC	Excess post exercise oxygen consumption
ESR	Erythrocyte sedimentation rate
FAO	Food and agriculture organization
FFM	Fat free mass
Fio2	Fraction of oxygen in inspired gas
FRC	Functional residual capacity
Ft	Feet
GIT	Gastrointestinal tract
GSK	Glasgow coma scale
HA	Hyper alimentation

Hb	Haemoglobin
H-B	Harris Benedict
HCO3	Bicarbonate
HIV/AIDS	Human immune deficiency virus
HR	Heart rate
Ib	Pound
IBW	Ideal body weight
ICP	Increased Intracranial pressure
ICU	Intensive care unit
Ins	inches
J	Joule
K	Potassium
K Pa	kilopascal
Kcal	Kilocalorie
KJ	Kilo joule
mEq	Milliequivalents
MIP	Maximal inspiratory airway pressure
MV	Mechanical ventilation
Na	Sodium
NEAT	Non exercise activity thermogenesis
NO	Nitric oxide
NPPV	Non invasive positive pressure ventilation
PaCO2	Partial pressure of carbon dioxide in blood
PaO2	Partial pressure of oxygen in blood
PCO2	Partial pressure of carbon dioxide
PEEP	Positive end expiratory pressure
PEG	Percutaneous endoscopic gastrostomy

PH	Power of hydrogen
PIP	Peak inspiratory pressure
PMR	Resting metabolic rate
PPD	Purified protein derivative
PS	Pressure support
PSL	Pascal
PT	Prothrombin time
PTT	Partial thromboplastin time
PVA	Peripheral venous alimentation
QOL	Quality of life
RDA	Recommended dietary allowance
REE	Resting energy expenditure
REI	Recommended energy intake
RICU	Respiratory Intensive Care Unit
RMR	Resting metabolic rate
RQ	Respiratory quotient
RR	Respiratory rate
RSBI	Rapid shallow breathing index
RVR	Respiratory rate / tidal volume ratio
SaO2	Arterial oxygen saturation
SDA	Specific dynamic action
SEF	Specific effect of food
SFA	Skin fold anthropometry
SGA	Subjective global assessment
SKSD	Streptokinase streptodornase
SPSS	Statistical Package of Social Science

SVo2	Mixed venous oxygen saturation
TBW	Total body water
TEA	Thermic effect of activity
TEE	Total energy expenditure
TEF	Thermic effect of food
TG	Triglycerides
TLC	Total leucocytic count
TPN	Total parenteral nutrition
TSH	Thyroid stimulating hormones
U.S	United states
UUN	Urine urea nitrogen
VA	Alveolar volume
V-A/C	Volume assist/control
VAP	Ventilator associated pneumonia
VC	Vital capacity
VCo2	Carbon dioxide production
VE	Minute ventilation
VO2	Oxygen consumption
V-SIMV	Volume synchronized intermittent mandatory ventilation
VT	Tidal volume
W	Weight
WBC	White blood cell
WHO	World health organization
WOB	Work of breathing

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Introduction

Mechanical ventilation is a life saver. Proper ventilation restores levels of oxygen and carbon dioxide in the blood, improving sleep at night and increasing the ability to engage in activities during the day. When combined with proper respiratory hygiene, it can prolong life considerably ***(Robinson et al., 2003).***

Metabolism is acutely modified by any form of severe disease. Resting energy expenditure (REE) is influenced by malnutrition ***(Roza et al., 2003).***

Malnutrition affected 40-50% of the patients in intensive care unit (ICU) ***(Giner et al., 1996).***

Malnutrition may be linked to higher morbidity and mortality rates and increased length of stay ***(Giner et al., 1996).***

Thus, caloric requirements and specific metabolism are essential component of the care of these patients.

The fundamental goal of nutritional support is to provide individual patients with their daily nutritional requirements and to determine energy needs of each patient in ICU ***(Dark et al., 1993).***

Indirect calorimetry is a non invasive technique that assesses REE by estimating the heat liberated during metabolic

oxidative processes by measuring oxygen consumption (VO2) and carbon dioxide production (VCO2) ***(Schutz et al., 1995).***

Few previous studies have compared REE measured by indirect calorimetry with REE calculated by using Harris-Benedict predictive equations ***(Harris et al., 1919)*** an old method detecting REE for adult patients requiring respiratory assistance.

Weissman showed that the difference between measured and calculated REE is substantial from 30% to 49% ***(Weissman et al., 2003).***

Also, Weissman suggested that; REE estimated by indirect calorimetry on the basis of body weight, height, minute ventilation and body temperature is clinically more relevant than are the predictive equations for metabolically stable and mechanically ventilated patients ***(Weissman et al., 2003).***