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RELIABILITY OF BIOELECTRICAL IMPEDANCE ANALYSIS IN CRITICALLY ILL PATIENTS

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Bioelectrical impedance analysis (BIA) is a technique used to determine body composition in both healthy individuals and patients. BIA consists of the application of a low voltage current to measure Resistance and Reactance of the body tissues. OBJECTIVES: To determine if body composition varies significantly over time in critically ill patients or healthy volunteers. To determine if the variation in body composition over time differs significantly in critically ill patients versus healthy volunteers. DESIGN: Cohort Study. 46 critically ill patients and 46 volunteers matched by age and sex were measured sequentially for two days. Setting Intensive Care Unit (patients) and Research Facility of the Nutritional Support Service (volunteers), Royal University Hospital, Saskatoon, Saskatchewan, Canada. Main outcome measures. Resistance and Reactance measurement over time by BIA. Body composition was described by a 3 compartment model composed of Body Fat, Body Cell Mass and Extracellular Mass. RESULTS: There was no statistical significant difference in body composition measurements over time for either the critically ill group or the healthy volunteers. The variation in body composition over time between the two groups was not statistically significant. CONCLUSION: BIA is a useful clinical measure of body composition in critically ill patients.

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REE AND SUBSTRATE OXYDATION IN THE COPD PATIENTS: A CALORIMETRIC STUDY.

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Malnutrition is frequently seen in patients with severe cronic obstructive pulmonary disease (COPD) and is associated with increase of resting energy expenditure (REE) and decrease of fat oxydation. Several authorshave suggested that increased work of breathing in COPD patients may explain this hypercathabolic response and the alteration of lipid methabolism. The aim of this study was to compare REE obteined with indirect calorimetric study (CI) vs Harris Benedict (HB) formula and to calculate substrate oxydation in two groups of COPD patients: spontaneous breathing (SB) and machanically ventilated (MV).

METHODS. 16 COPD patients were studied. 10 of them were SB and 6 were MV. VO_2, VCO_2, RQ, REE, CHO%, LIP%, PROT% were determinate using an indirect calorimetric technique (Canopy System Deltatrac Datex ® for SB patients and Critical Care Menagement System Medical Graphics Corporation ® for MV patients). In both groups of patients REE was also calculated with HB formula. All studies were performed after midnight fast and in "steady state" (stable value of $PETCO_2$ for more than 45 minutes). All data was expressed as mean ± standard deviation (SD).

RESULTS.

Patients	REE (CI)	REE (HB)	CHO%	LIP%	QR
SB (n=10)	1420 *	1156	55	4,7	0,9
SD	±253	±203	±32	±32	±0,16
MV (n=6)	1535**	1299	76,5	3,0	0,9
SD	±414	±228	±45,4	±40	±0,12

REE (CI)/REE (HB) ratio using T test. *=p<0,05; **=p NS

CONCLUSIONS. In both groups studied REE (CI) was greater than REE (HB), but only in SB patients the difference was statistically significant. Lipid oxydation was impaired in both groups and carbohydrate was the preferential fuel. We may confirm from this study that the work of breathing in COPD patients induces hypermethabolism and that other factors (methabolic and endocrine) may impair lipid oxydation.

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ENERGY EXPENDITURE IN LIVER TRANSPLANT.

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The aim of the current study was to determine energy expenditure in patients who had undergone liver trasplant.

PATIENTS AND METHODS:

Nine patients submitted to an orthotopic liver trasnsplant were studied prospectively in the first 24 hours after the transplant. All were in a stable condition and the studies were done prior to starting nutritional support. The resting energy expenditure (REE), measured by indirect calorimetry (IC), was compared with the REE estimated from the Liggett modification of the Fick formula, and with the basal energy expenditure (BEE) using the Harris-Benedict formula (HBE). A "Med Graphics" metabolic monitor was used to realize the IC. The metabolic monitor, previously validated according to the Wasserman technic and the clinical correlation between calculated and measured oxygen consumption (VO2), was used for 30 minutes after a period of 15 minutes of equilibrium.

RESULTS:

Patient	REE (IC)	REE (Fick)	BEE (HBE)	Correction factor
1	2666	2013	1891	1.4
2	1696	1234	1128	1.5
3	1561	1802	1530	1.0
4	2897	1471	1633	1.7
5	1829	--	1236	1.4
6	1144	1477	1167	1.0
7	1125	2275	1417	1.5
8	2420	1890	1498	1.6
9	1874	1223	1223	1.5

- Correlation between REE (IC) and BEE (HBE): r=0.75, p=0.02
- No correlation was found between REE (IC) and REE (Fick) and between REE (Fick) and BEE (HBE).

CONCLUSIONS:

The current study suggest that, taking IC as the reference method, the HBE seems more reliable than the Fick modified method to evaluate energy balance. Beacause of the differences found in the individual patients after liver transplant, we were not able to quantify a correction factor between BEE and REE. IC seems to be the best method to determine energy expenditure.

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ENERGY METABOLISM IN ACUTE HEPATIC FAILURE

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The purpose of this study was to invastigate energy metabolism in patients with acute liver failure. Resting energy expenditure and substrate oxidation rates for fat, glucose and protein were evaluated by indirect calorimetry (Beckman metabolic measurement cart Horizon, Sensor Medics, Anaheim, CA) in 9 patients with acute liver failure and in 22 sex and age matched healthy individuals. The diagnoses in acute hepatic failure were hepatitis in four,Amanita phalloides intoxication in two, and Non-A Non-B hepatitis in three patients. In healthy controls and three patients studies were done in the postabsorptive state after an overnight fast, in the remaining 6 patients glucose has do be administered at an rate of 0.08 mg/kg.min to prevent hypoglycemia. Measured resting energy expenditure was increased in patients as compared to healthy subjects (5.2±0.13 kJ/min/1.73m² v.s. 3.97±0.08 kJ/min/1.73m²; mean±SEM; p<0.001) and compared to the basal metabolic rate calculated with the Harris-Benedict equation (4.4±0.07 kJ/min/1.73m²; p<0.001). Respiratory quotient and oxidation rates of major fuels were not different between patients and controls. However, if considering the patients without glucose supply separately, percentages of total calories derived from fat (median: 77%; range: 66%-81%) were higher and from carbohydrate (medain:12%; range: 9%-23%) lower than in healthy controls (fat: 40±4%; carbohydrate: 43±4%; mean±SEM) and patients with glucose supply (fat: 38%±6%; carbohydrate: 44±6%).

We conclude that energy expenditure is markedly increased in patients with acute hepatic failure. The altered substrate oxidation rates in fasting patients seem to be the result of a limited glucose availability by the liver.

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HIGH BLOOD LACTATE LEVEL AND LOW O2 EXTRACTION RATIO AS A MARKER OF LIVER RETRANSPLANTATION

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Early graft dysfunction after liver transplantation (OLT) is often difficult to assess when only based on liver enzymes levels and bile production. High lactate level was evaluated as a marker of poor graft function. In 29 pts undergoing OLT simultaneous measurement (mes) of blood lactate levels, mVO2 (indirect calorimetry-Deltatrac®, Datex), DO2 (thermodilution) and O2 extraction ratio (EO2r) were performed within the first 48 postoperative hours. The pts were divided in 3 groups (G) according to their clinical evolution. GI (19 pts-28mes) : no postoperative hemorrhage (H), good graft function (GF) ; GII (5pts-8mes) : acute postoperative H, GF ; GIII (5pts-9mes); no H, G dysfunction and early retransplantation (RT). Mean values of VO2, DO2, EO2r and lactates (L) are reported on the Table.

	n mes	VO2 ml/min/m²	DO2 ml/min/m²	EO2r %	L mmol/L
GI	28	152	783	20	1
GII	8	158	596*	28.3*	2.21*
GIII	9	158	759°	21.2°	3.29°

* GI compared to GII ; ° GII compared to GIII ; $p<0.05$.

In GII high L levels with elevated EO2r indicates a relative tissue hypoxia due to reduced DO2 secondary to hemorrhage. In GIII, high L levels with EO2r<25% indicates graft dysfunction.

Conclusion : Simultaneous low EO2r (<25%) and high L (>2mmol/L) when present after the first 48 postoperative hours are specific and early markers of graft dysfunction. Normalization of EO2 (adequate DO2) is necessary to avoid the influence of tissue hypoxia on L levels. Residual hyperlactacidemia could be an early indication of retransplantation.

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PASSIVE STRETCHING EFFECTS THE WASTING OF MUSCLE IN THE CRITICALLY-ILL

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This study examines whether the muscle wasting in the catabolic intensive care patient can be prevented by passive stretching alone in the absence of any contractile activity. Five critically ill patients (2F:3M, ages 28-61) who required complete neuromuscular blockade for seven days of ventilator support were studied. On each patient one leg was placed in a "Straumann" lower limb continuous passive motion (CPM) unit for three 3 hour periods per day to produce about 25% functional stretch of the anterior tibialis muscle at 10 cycles per minute. Percutaneous muscle biopsies were taken from both limbs at the start and after seven days.

Results: Prevention of fibre atrophy could be seen in the more severely ill patients (admission APACHE scores 19, 21, 22) with a slight gain in fibre area, mean +15% (-10% to +27%) in the CPM limb compared with the control leg which decreased by a mean -36% (-32% to -42%) over seven days ($p=0.027$, n=3). Changes in fibre size were not significant in the less severely ill patients (APACHE= 11 & 13). The preservation of fibre area was seen in both fibre types but was more pronounced in type 1 muscle fibres (CPM +8%, control -36%, $p=0.02$, n=3). There was no change in the proportion of type 1 fibres (mean 75%). Qualitative changes were varied, but apparent between the two limbs. In one patient type 2 fibre atrophy in the CPM limb matched the increase in type 1 fibre area. In one of the patients in renal failure passive motion prevented the development of marked atrophy and necrosis seen in the control limb. The loss of protein (g% wet wt) was significantly less in the CPM limb -2.7g% v control -5.4g%, ($n=5, p=0.004$). There was a significantly greater increase in the wet wt per mg DNA in the control limb (33% v 10%,$p=0.03$, n=5). However, as an index of wasting, the protein/DNA ratio decreased similarly in both limbs (CPM -8.4% v control -12.1%, n=5, N.S.). There was no change in the RNA/protein ratio which suggests that the protein synthetic capacity was unaltered.

Conclusion: Passive stretching can preserve the architecture of muscle fibres. Whether it can prevent muscle protein loss remains uncertain. In the critically-ill the presence of oedema, necrotic, de/regenerating fibres and leukocytes confuse the interpretation of the biochemical markers of wasting. Protein synthesis could be masked by a stimulation of satellite cells increasing DNA in the CPM limb, or conversely these changes may be due to a reduction in tissue oedema.

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Organization and management I

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THE USE OF TECHNOLOGY IN DEFINING CASE-MIX IN INTENSIVE CARE UNITS; RESULTS FROM A MULTI-CENTRE STUDY

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From February through July 1990 data were pooled from 36 Dutch ICUs to evaluate their performance and cost-effectiveness. From each patient admitted in this period physiologic parameters were registered together with a daily TISS. This resulted in a database containing 11.665 patients and more than 37.000 patient-days.

This study reports on the ongoing research at our division on how patient characteristics, other than severity of illness, age, etc. can contribute to the development of a simplified case-mix scoring system on admission on the ICU.

An analysis was done on 8703 patients to identify a relationship between technology used on the day of admission and outcome (mortality), workload during the admission period (TISS) and length of stay (LOS).

Groups were formed based upon the used technology. Group II: mechanical ventilation; group III: pulmonary artery catheter; group IV: the use of more than one vaso-active drug. Patients who used none of these technologies were classified as group I. The results are listed in the table (MORT=mortality on the ICU, SURG=the percentage of surgical patients).

Characteristics of technology-based groups (n=8703)

	I	II	III	IV	II+III	II+IV	II+III+IV
(n)	5951	1210	179	232	232	286	485
APACHE	9.8±6.0	12.8±7.2	12.4±6.7	15.3±7.2	13.5±6.1	17.5±8.6	14.5 ± 6.5
TISS	15.6±6.7	28.8±7.1	29.3±7.2	22.3±7.0	40.5±6.4	34.6±7.0	45.2 ± 6.5
LOS	2.2±4.1	5.7±9.5	3.1±4.4	2.7±3.5	6.6±10.5	5.6±10.3	4.4±8.3
AGE	60.9±17.8	58.1±17.4	63.5±14.3	68.6±14.4	63.8±13.2	63.9±17.0	63.7±11.6
MORT.	3.7%	13.1%	10.1%	18.5%	12.9%	32.2%	15.9%
SURG.	51%	67%	56%	32%	80%	53%	85%

Mean age was, unlike the other variables, not significantly different between groups.

Group I (n=5951), representing 65% of the admitted patients had the lowest mortality rate (3.7%), mean APACHEII-score (9.8 ± 6.0) and mean TISS-score (15.6 ± 6.7). The highest mortality was found in group II+IV (32.2%). The lower mortality (15.9%) observed in the group of patients utilizing all three technologies (II+III+IV) can be explained by the high percentage coronary artery bypass surgical patients (58%) compared to group II+III (8%).

The same analysis was done concerning these technologies used during the whole admission. The results from this second analysis were not different from those presented above. In other words, the technology used on the day of admission was representative for the whole length of stay.

It can be concluded that there is a strong relationship between the used technology on the day of admission on the ICU and APACHEII, TISS, LOS and mortality.

The use of technology on admission may contribute to identifying case-mix categories, providing better insight into the cost-effectiveness analysis of ICUs.

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MONITORING THE CORRESPONDENCE BETWEEN RESOURCE UTILIZATION AND SEVERITY WHEN SEVERITY IS MAXIMUM

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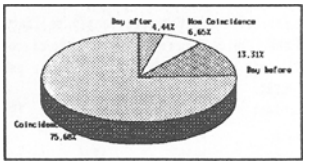
The purpose of this study was to investigate the correspondence between resource consumption, as indicated by TISS (Keene R. and Cullen D.J., C.C.M., January 1983; 11, 1:1-3), and severity, as indicated by SAPS (Le Gall J.R. et al., The Lancet, 1983; II:741) when severity was maximum. Consecutive and prospective determinations of SAPS and TISS were made on a daily basis during a period of 20 months for a total of 541 patients.

At weekends the ICU is attended only by physicians - on - call, hence an analysis was also done to see if there were variations in the correspondence depending on the variable weekend / week day. A Chi square statistical test was used to measure the difference ($p<0.05$). DBase III plus and SPSS 3.0. software were using. The study was performed in the medical & surgical ICU of a general hospital.



RESULTS

Coincidence.....75.60%
Non coincidence..... 6.65%
Max TISS the day before max.SAPS.....13.31%
Max TISS the day after max. SAPS.. .... 4.44%
% of coincidence in regard to weekends (115 cases):
During week days ..... 70.4 %
During weekends ..... 77.2% ($X^2=2.28; p=0.1312$)

DISCUSSION: If greater resource utilization is significantly related to greater severity, TISS could be used to monitor the correspondence of resource consumption when severity is maximum. It can thus be used to monitor intrinsic quality. Rather than indicating a "failure" of TISS to respond adequately to severity variations, the 25 % deviation found in this study is the result of inappropriate utilization of resources; though, at lest, this phenomenon was not found to increase significantly at weekends.

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