TITLE: DETERMINATION OF HYPER AND HYPOMETABOLISM IN THE POSTOPERATIVE ICU PATIENT

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To determine whether a patient is hyper or hypometabolic, measured resting energy expenditure (MREE) is compared to estimated energy expenditure (EREE). The latter is calculated using equations derived from measurements performed in large groups of subjects. Height, weight, body surface area, and age are the variables used in these equations. Yet, in the postop period weight is often increased by the fluid used for periop resuscitation. Also, preop weights are often not obtained. We, therefore, examined the effect of preoperative, postoperative, and ideal (using both the 1975 and 1989 National Academy of Science RDA Tables) weights on some of the equations used to estimate REE and also examined the differences in MREE/EREE. The equations included two older ones (early 1900's): Harris-Benedict (H-B)[1] and Bothby (as derived by Staats[2]) and two recently derived ones: Quebbman[3] and Owen[4]. All were derived from REE measured in normal subjects except Quebbman's which is from ICU patients.

Fourteen mechanically ventilated Surgery-Anesthesiology ICU patients (aged 56-79 years) had their REE calculated from oxygen consumption and carbon dioxide production measurements made on the first postop day with a Datex Deltatrac (SensorMedics, Anaheim CA). This MREE was compared with EREE calculated with the four equations using preop, postop, and ideal weights. MREE/EREE was calculated using each EREE. This study had IRB approval.

MREE on the first postop day was 1517 ± 362 Kcal/24hr.

	Weight(kg)	BSA(m2)	H-B (kcal/day)	Quebbman (kcal/day)	Staats (kcal/day)	Owen (kcal/day)
Preop	72.6±11.6	1.81±0.20	1439±234	1507±204	1483±214	1497±218
Postop	77.4±10.0	1.86±0.17	1489±198	1537±185	1522±185	1534±194
Ideal'75	59.9±10.5	1.67±0.21	1293±213	1416±200	1369±224	1402±197
Ideal'89	69.7±10	1.78±0.2	1411±221	1492±205	1460±220	1492±205

MREE/EREE	H-B	Quebbman	Staats	Owen
Preop	1.06±0.26	1.01±0.24	1.03±0.24	1.02±0.25
Postop	1.03±0.26	0.99±0.24	1.00±0.24	1.00±0.25
Ideal'75	0.87±0.15	1.0±0.18	0.96±0.16	1.03±0.21
Ideal'89	0.96±0.16	1.06±0.20	1.02±0.18	1.10±0.22

Calculation of hyper or hypometabolism is altered by whether the preop or postop weight is used. The average increase in body weight of 5kg (6.6%) resulted in an increase in EREE that ranged from 50kcal/d (3.5%) with the H-B equation to 30kcal/d (2.0%) with the Quebbman one. The MREE/EREE ratio decreased 0.02-0.03 with the postop weight. Since the increase in metabolic rate following elective surgery is only 10-25%, an increase in weight of over 5kg as fluid may significantly affect the evaluation of hyper or hypometabolism i.e., the use of postop weight may cause underestimation of the degree of hypermetabolism since fluid is not metabolically active. The 1975 and 1989 ideal weights did not appear useful for estimating preop weight in these patients. In conclusion, it is important to carefully consider the effect of weight when evaluating hyper or hypometabolism. Ideally, metabolically active, lean body mass should be used instead of weight.

1. *Standard Basal Metabolism Constants for Physiologists and Clinicians*. Philadelphia: JB Lippincott, 1919; 223.
2. Mayo Clin Proc 63:409-1410, 1988.
3. Ann Surg 195:282-5, 1982.
4. Mayo Clin Proc 63:503, 1988.

TITLE: USE OF TOPICAL NITROGLYCERIN IN THE TREATMENT OF PURPURA FULMINANS

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Purpura fulminans with subsequent tissue infarction and necrosis is a source of significant morbidity associated with several infectious disease entities. The pathophysiology of cutaneous lesions is presumed to involve endotoxemia, vasculitis and disseminated intravascular coagulation with vasospasm resulting in a low-flow state and thrombosis of the microcirculation. Recently, we[1] and others have begun to employ regional anesthetic techniques of sympathetic blockade to promote patency of deep vascular structures and thereby prevent whole-limb ischemia and gangrene. While this approach has shown to be effective in selected cases, it fails to adequately address the issue of cutaneous involvement and the extensive skin necrosis which can be both disfiguring and debilitating. As one approach to this issue, we have begun to employ topical nitroglycerin in the care of these patients.

Two patients, aged sixteen months and four months, presented with fever, tachypnea, shock, and enlarging purpura: the latter ultimately involving approximately 10% of the total B.S.A. After circulatory stabilization with pressors, inotropes and volume replacement, perfusion to the extremities and purpuric regions remained poor or absent. In the first patient, continuous thoracic epidural blockade restored perfusion to the upper extremities and in the second, general perfusion was restored by a nitroprusside infusion. Large purpuric areas remained black and unperfused, however.

In an attempt to avert gangrene, 2% Nitroglycerin ointment was applied to black areas, producing return of capillary refill, increased tactile temperature, and a color change from black to violet-red within 30 minutes. Skin blood flow (SBF) in these regions, as measured by laser doppler techniques in the second patient (table), increased markedly in areas with a potential for collateral flow (such as forearms, thighs, buttocks and penis) but not in areas of terminal circulation (such as fingertips). SBF was maintained for the duration of therapy (days) and no significant cardiovascular side effects were noted. Despite large cumulative doses (approximately 40 mg/kg/d), methemoglobin levels remained within normal limits.

We have found that topically applied nitroglycerin can be successfully employed as an adjunct to other modalities aimed at minimizing the tissue necrosis and morbidity associated with severe purpura fulminans. The side effects of therapy are minimal and the results encouraging. Unlike regional anesthetic techniques, its use is not contraindicated by coagulopathy and is unaffected by concurrent infusion of vasopressors.

SBF (ml/100g tissue/min) vs. hours of treatment

	penis	forearm	thigh	toes
baseline	0	0	0	0
6 hours	0.3	0.07	0.15	0
12 hours	0.3	0.23	0.15	0

1. Anesthesiology 71: 463, 1989