Title : RESPIRATORY PATTERNS IN PROFOUND NUTRITIONAL DEPLETION

Authors : S.H. Rosenbaum, M.D., J. Askanazi, M.D., A.I. Hyman, M.D., P.A. Silverberg, B.A., J. Milic-Emili, M.D., J.M. Kinney, M.D.

Affiliation: Departments of Anesthesiology and Surgery, Columbia University College of Physicians and Surgeons, New York, N.Y. 10032

Introduction. Profound nutritional depletion has been regarded by some as having an affect on the respiratory status of those affected. Starvation in critically ill patients makes respiratory failure quite difficult to manage (1). And the severe starvation, as in wartime, of otherwise healthy victims, often demonstrates the truth of the adage that "death from starvation is death from pneumonia" (2). To determine the effect that profound nutritional depletion has on respiratory patterns we studied 8 adults who suffered from severe disease-related chronic starvation, but who had not been severely traumatized, septic or otherwise acutely ill in the recent past. We believe this is the first reported study of breathing patterns in such patients.

Methods. We studied 8 adult patients who had been admitted to our metabolic unit prior to commencement of total parenteral nutrition. Seven of them were unable to eat because of post-operative or post-traumatic G.I. tract damage and one suffered from anorexia nervosa. After suitable consent (and our Institutional Review Board's approval), each subject was studied with our canopy-spirometer-computer system (3) which consisted of a rigid transparent chamber enclosing the subject's head ventilated by a high flow of room air connected to a spirometer and gas analyzer which provided data for a computerized breath-by-breath analysis of breathing patterns, O_2 uptake and CO_2 production. There was no need for the subjects to be encumbered by a face mask, mouthpiece or nose clip. We measured tidal volume (V_T), minute ventilation ($\dot{V}_E$), respiratory rate (f), oxygen consumption ($\dot{V}_{O2}$), CO_2 production ($\dot{V}_{CO2}$) and sigh frequency in runs lasting at least 20 minutes and including at least 400 breaths.

Results. The 8 subjects had a mean body surface area (BSA) of 1.52 m^2 which was 14% down from their mean pre-morbid BSA of 1.76 m^2 (calculated from what they reported as their previous "normal" weight. This reflected a mean 28% weight loss with their prolonged illnesses. Normal values obtained from previous studies (4, 5) of 30 healthy young adults in our non-invasive canopy system are used in the table below. As can be seen in the table, the chronically depleted subjects seem to be hypometabolic with a reduction in O_2 uptake and CO_2 production, and a proportional decrease in tidal volume, respiratory rate remaining unchanged within the limits of error. There was a marked reduction in the frequency of sighs (defined as a breath larger than 3 times the subject's mean tidal volume).

Discussion. These chronically starved subjects demonstrated a most striking loss of the periodic deep breaths that provide reinflation of atelectatic areas (6). This, especially when combined with their smaller tidal breaths, may well make them more susceptible to respiratory inadequacy and pulmonary infection. Decreased efficiency of gas exchange is also suggested by their need to maintain an almost normal minute ventilation despite significant decreases in O_2 uptake and CO_2 production.

REFERENCES

1. Hedley-White J, Burgess GE, Feeley TW, Miller MJG: Applied Physiology of Respiratory Care. Boston, Little Brown & Co., 1976, p 83
2. Dmochowski JR, Moore FD: Choroba glodowa. N Engl J Med 293:356-57, 1975
3. Spencer JL, Zikria BA, Kinney JM, et al: A system for continuous measurement of gas exchange and respiratory function. J Appl Physiol 33:523-528, 1972
4. Askanazi J, Milic-Emili J, Broell JR, et al: Influence of exercise and CO_2 on breathing patterns of normal man. J Appl Physiol, in press
5. Askanazi J, Silverberg PA, Hyman AI, et al: Effect of mask and mouthpiece plus noseclip on spontaneous breathing pattern. Crit Care Med 6:143-146, 1978
6. Bendixen HH, Smith FM, Mead J: Pattern of ventilation in young adults. J Appl Physiol 19:195-198, 1964

	Normals (N=30)	Observed (N=8)
V_T (ml/m^2)	214 ± 51	154 ± 36*
$\dot{V}_E$ (l/min/m^2)	3.1 ± .6	2.89 ± 1.2
f (breath/min)	17.1 ± 3	18.8 ± 7
$\dot{V}_{O2}$ (ml/min/m^2)	140 ± 24	96 ± 18*
$\dot{V}_{CO2}$ (ml/min/m^2)	111 ± 15	88 ± 22*
% sighs	1.3%	0.1%*

* Significant at p<.005