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Title : EFFECTS OF PARENTERAL NUTRITION ON VENTILATORY DRIVE

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Introduction. Stimuli which increase metabolic rate (exercise, hyperthyroidism) have been demonstrated to increase the hypoxic ventilatory response. Studies in patients with a decreased metabolic rate (thyroid hormone deficiency, semistarvation) have demonstrated a diminished hypoxic ventilatory response.

This study examines the ventilatory response to CO_2 in hospitalized patients suffering from chronic semistarvation (greater than 15% weight loss) secondary to prolonged administration of 5% dextrose as nutritional support. The influence of total parenteral nutrition with 2 levels of nitrogen intake on ventilatory drive is examined in these patients.

Methods. The canopy-computer-spirometry system used in the present study has been described in detail previously (1); it is composed of a head canopy connected to a spirometer (Med-Science model 470) and a Prime 300 computer. The canopy is a rigid transparent head chamber with a neck seal, ventilated by a continuous airstream. The spirometer connected to the canopy provides a breath-by-breath record of lung volume changes and gas exchange.

Studies were performed on 6 nutritionally depleted patients. No patient had evidence of active infection or was within 2 weeks of operation or injury. Resting energy expenditure (REE) was measured in each patient, while receiving 5% dextrose (2). Energy intake was set at 1.5 times the resting energy expenditure. Non protein calories were administered as 50% glucose + 50% fat. Nitrogen (N) intake was set at either a) 7.5 mg N/kcal REE (low nitrogen intake) or b) 15 mgs N/kcal REE (high nitrogen intake). Each patient received both regimens for a one week period. The initial diet was randomly assigned.

The ventilatory response to CO_2 was assessed prior to TPN and after 1 week on the assigned diet. Ventilatory responses were assessed by administering 2% and 4% CO_2 into the canopy system and measuring the resultant arterial P_{CO_2}, minute ventilation and breathing patterns.

The details of the experiments, including risks, were explained to each patient, and written consent was obtained. The protocol of this study had been approved by the Columbia University Institutional Review Board.

Results. Figure 1 shows the ventilatory response to CO_2 under 3 conditions. With administration of low nitrogen TPN there is a restoration of the depressed ventilatory response seen with semistarvation. With high nitrogen TPN a further increase in ventilatory sensitivity results.

Discussion. Depression of the hypoxic and hypercapnic ventilatory response following 10 days of semistarvation has previously been demonstrated (3). The increase in metabolic rate, secondary to feeding a protein rich meal to normal subjects will augment the hypoxic ventilatory response (4). The data reported in the present study demonstrates that TPN will augment the ventilatory response to CO_2 which is depressed in patients receiving 5% dextrose for prolonged periods. At the same level of caloric intake the higher proportion of N leads to a further increase in sensitivity to CO_2. Although this study demonstrates that the effects occurs in one week, our pilot studies have shown that it occurs almost entirely within 24 hours. This has clinical implications in the care of patients with CO_2 retention.

References.

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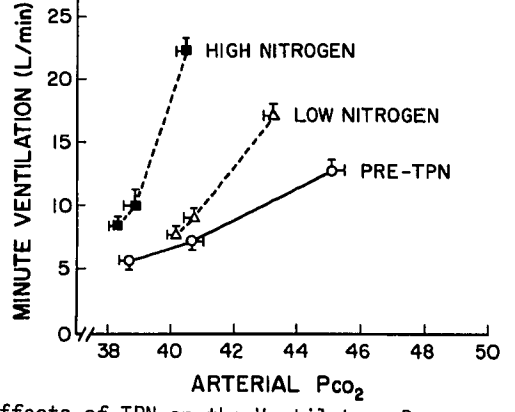

Effects of TPN on the Ventilatory Response to CO_2 (mean ± SEM)

Figure 1