Effects of Acute Nutritional Deprivation on Lymphocyte Subsets and Membrane Function in Cats

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(ABSTRACT)

Identification of patients with suboptimal nutritional status allows for early treatment intervention. Currently, no definitive test of nutritional status exists. Therefore, this study was conducted to identify possible functional indicators of acute nutritional deprivation. The effects of total nutritional deprivation and subsequent refeeding on lymphocyte functions and subpopulations were examined in 23 healthy cats. Peripheral blood samples were analyzed at various times during fasting and refeeding periods. During the fasting period, decreases were observed in leukocyte number (day 4; p < 0.04), lymphocyte number (p < 0.02), CD4+ cells (day 4; p < 0.06), CD4:CD8 ratio (0 hours; p < 0.004), and mitogen stimulated CD4:CD8 ratio (72 hours; p < 0.15) during the fasting period as compared to baseline. Increases were seen in CD4+ cells (day 7; p < 0.09), CD8+ cells (day 7; p < 0.04) and intracellular calcium (day 4; p < 0.02) as compared to baseline. During the refeeding period increases (p < 0.05) were observed in leukocyte number, CD4+ cells, CD8+ cells, lymphocyte proliferation (p < 0.07) and lymphocyte number (p < 0.004) as compared to day 7. These findings suggest that 7 days starvation had immunosuppressive effects on cats which were alleviated during 7 days refeeding. The use of CD4:CD8 ratio in conjunction with intracellular calcium flux may be useful as indices of nutritional status.
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<tbody>
<tr>
<td>CD</td>
<td>Cluster Differentiation</td>
</tr>
<tr>
<td>TSF</td>
<td>Tricep Skinfold Thickness</td>
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<tr>
<td>MAC</td>
<td>Mid-arm Circumference</td>
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<tr>
<td>BMI</td>
<td>Body Mass Index</td>
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<tr>
<td>BIE</td>
<td>Bio-electrical Impedance</td>
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<tr>
<td>TLC</td>
<td>Total Lymphocyte Count</td>
</tr>
<tr>
<td>DH</td>
<td>Delayed Hypersensitivity</td>
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<tr>
<td>Th</td>
<td>T helper</td>
</tr>
<tr>
<td>CTL</td>
<td>Cytotoxic lymphocytes</td>
</tr>
<tr>
<td>Con-A</td>
<td>Concanavalin A</td>
</tr>
<tr>
<td>VMRCVM</td>
<td>Virginia-Maryland Regional College of Veterinary Medicine</td>
</tr>
<tr>
<td>CBCD</td>
<td>Complete Blood Count with Differential</td>
</tr>
<tr>
<td>PBMC</td>
<td>Peripheral Blood Mononuclear Cells</td>
</tr>
<tr>
<td>PMNC</td>
<td>Polymorphonuclear Cells</td>
</tr>
<tr>
<td>HBSS</td>
<td>Hank’s Balanced Salt Solution</td>
</tr>
<tr>
<td>FBS</td>
<td>Fetal Bovine Serum</td>
</tr>
<tr>
<td>FITC</td>
<td>Fluorescein Isothiocyanate</td>
</tr>
<tr>
<td>SAS</td>
<td>Statistical Analysis for Social Sciences</td>
</tr>
<tr>
<td>DMSO</td>
<td>Dimethylsulphoxide</td>
</tr>
<tr>
<td>([Ca^{2+}]_i)</td>
<td>Intracellular Calcium Concentration</td>
</tr>
<tr>
<td>PEM</td>
<td>Protein Energy Malnutrition</td>
</tr>
<tr>
<td>WBC</td>
<td>White Blood Cell</td>
</tr>
<tr>
<td>PKC</td>
<td>Protein Kinase C</td>
</tr>
<tr>
<td>DAG</td>
<td>Diacylglycerol</td>
</tr>
<tr>
<td>TCR</td>
<td>T Cell Receptor</td>
</tr>
<tr>
<td>CRF</td>
<td>Corticotrophin Releasing Factor</td>
</tr>
<tr>
<td>ACTH</td>
<td>Adrenocorticotropic Hormone</td>
</tr>
<tr>
<td>DHEA</td>
<td>Dehydroepiandrosterone</td>
</tr>
<tr>
<td>IP$_3$</td>
<td>Inositol Triphosphate</td>
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CHAPTER I

INTRODUCTION

Patients often are malnourished as well as critically ill when admitted to a hospital. Whether the critically ill patient requires surgery or treatment of disease, or is post traumatic or septic, assessing nutritional status is important for identifying nutritional risk (Manning and Shenkin 1995). Incidence of sepsis (Chandra 1983), prolonged ventilation, and increased mortality have been associated with malnutrition in the critically ill (Reinhardt et al. 1980). The primary goal of nutritional status assessment is to identify nutritional insufficiencies so that the nutritional status of a patient can be improved to enhance the body’s capability to fight infection and/or illness. Nutritional assessment can be defined as a systematic method of gathering data on individual patients, classifying the degree of malnutrition and instituting appropriate treatment and intervention techniques (Gilbride et al. 1984).

Current methods for nutritional status assessment include anthropometric, biochemical, dietary and clinical evaluation. As of yet, no definitive test of nutritional status exists due to the complexity of the human diet and the multiple effects that nutrients have on various tissues, organs and physiological functions (Manning and Shenkin 1995). A nonnutritional aspect of the response to illness affects many of these assessment tests. It has been proposed that tests of immunological function would be indicative of nutritional status and would be sensitive to overall nutritional status as opposed to deficiencies of individual nutrients (Puri et al. 1985).

The purpose of the proposed research was to identify indicators of an acute nutrient deprivation in cats. Specifically, the quantification of CD4 and CD8 markers in T lymphocytes (pre and post-stimulation), lymphocyte proliferation, and intracellular calcium flux of mononuclear cell membranes as a measure of membrane function, were examined in cats before, during and after a 7-day period of acute food deprivation. The adult neutered cat was chosen as an animal model in this study for several reasons. As a species they; 1) have less variation in their metabolic rate due to a more uniform adult body size,
2) are less tolerant of energy and protein deficiencies due to their general inability to regulate enzymes and utilize alternative metabolic pathways and substrates, and 3) are a better representation of a human being’s anatomy than other available animals (Walker 1982). This type of animal model allows for more control with regard to dietary intervention as well as environmental and physical variables that may affect the immune system. Although results from this study cannot be directly applied to humans, the data will provide information about relationships among dietary restriction and measures of immune status. These findings could provide pilot data that will serve as a basis for human studies.
Specific Aims

The objectives of this research were:

1. To determine the response of CD4 and CD8 differentiation and monocyte and lymphocyte membrane function to acute nutrient deprivation in healthy cats.

2. To investigate the relationships among days of acute nutrient deprivation, CD4 and CD8 differentiation and lymphocyte and monocyte membrane function.

3. To determine the relationships among CD4 and CD8 differentiation, lymphocyte and monocyte membrane function, body weight, CBCD and serum albumin following acute nutrient deprivation in healthy cats.

4. To determine the response of CD4 and CD8 differentiation and monocyte and lymphocyte membrane function to refeeding after acute nutrient deprivation in healthy cats.

5. To investigate the relationships among days of refeeding, CD4 and CD8 differentiation and lymphocyte and monocyte membrane function.

6. To determine relationships among CD4 and CD8 differentiation, lymphocyte and monocyte membrane function and body weight, serum albumin and CBCD following refeeding.