UTILIZATION OF EXOGENOUS AND ENDOGENOUS LIPIDS FOR ENERGY PRODUCTION DURING PARENTERAL NUTRITION

by

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DISSERTATION ABSTRACT

The role of endogenous lipid stores and exogenously provided fat emulsion in energy metabolism was examined in patients with acute illness (secondary to injury and infection) or nutritional depletion. Measurements of plasma clearance and oxidation of intravenous fat emulsion and free fatty acids (FFA), nitrogen and energy balance, hormonal and ventilatory effects were made. The patients were studied while receiving a 5 % dextrose solution (D_5W) and during the administration of total parenteral nutrition (TPN). Non-protein energy during TPN was given as either a) glucose alone (Glucose System) or b) equal proportions of glucose and intravenous fat emulsion (Lipid System).

Patients with acute illness receiving D_5W displayed increased plasma clearance and oxidation rates of intravenous fat emulsion compared to normal postabsorptive subjects. In comparison to TPN using the Lipid System, the Glucose System was associated with higher plasma clearance and lower oxidation rates in both acutely ill and depleted patients.

Acutely ill patients receiving D_5W showed an increased mobilization of FFA from endogenous fat depots but plasma FFA oxidation and fat oxidation measured by indirect calorimetry were in the normal range. TPN did not significantly decrease FFA mobilization but FFA oxidation decreased linearly with increasing glucose intake. This indicates that the infused glucose acts to increase FFA reesterification. Despite administration of glucose energy in excess of energy expenditure, the non-protein respiratory quotient remained below 1.0 indicating an abnormal persistence of fat oxidation.

A hormonal milieu favouring lipolysis was observed during D_5W infusion including increased urinary norepinephrine excretion and elevated plasma glucagon levels. TPN was associated with a rise in the already elevated level of norepinephrine excretion in acutely ill patients. Plasma insulin levels increased following administration of TPN but were relatively low for the degree of hyperglycemia. Plasma glucagon levels were not significantly reduced by TPN.

The present study indicates that acutely ill patients have a metabolic status directed to the mobilization and oxidation of endogenous fat stores and are readily capable of utilizing intravenous fat emulsion as an energy source. A relative unresponsiveness to glucose is also present with respect to net fat oxidation, FFA mobilization and oxidation. The excessive administration of glucose may be associated with detrimental side effects including increased catecholamine excretion, elevated oxygen consumption and carbon dioxide production. When fat emulsions are substituted for a major part of the glucose energy these changes are reduced without compromising nitrogen balance.

The thesis is a summary of the following papers:

I. Plasma clearance of fat emulsion in trauma and sepsis: Use of a three-stage lipid clearance test.
(A.P. Robin, J. Nordenström, J. Askanazi, D.H. Elwyn, Y.A. Carpentier, J.M. Kinney). Journal of Parenteral and Enteral nutrition 4:505-510, 1980.

II. Metabolic utilization of intravenous fat emulsion during total parenteral nutrition.
(J. Nordenström, Y.A. Carpentier, J. Askanazi, A.P. Robin, D.H. Elwyn, T.W. Hensle, J.M. Kinney).
Annals of Surgery 196:221-231, 1982.

III. Free fatty acid mobilization and oxidation during total parenteral nutrition in trauma and sepsis.
(J. Nordenström, Y.A. Carpentier, J. Askanazi, A.P. Robin, D.H. Elwyn, J.M. Kinney). Manuscript.

IV. Nitrogen balance during total parenteral nutrition: glucose versus fat.
(J. Nordenström, J. Askanazi, D.H. Elwyn, P. Martin, Y.A. Carpentier, A.P. Robin, J.M. Kinney).
Annals of Surgery 197:27-33, 1983.

V. Increasing glucose intake during total parenteral nutrition increases norepinephrine excretion in trauma and sepsis.
(J. Nordenström, M. Jeevanandam, D.H. Elwyn, Y.A. Carpentier, J. Askanazi, A.P. Robin, J.M. Kinney).
Clinical Physiology 1:525-534, 1981.

VI. Nutrition for the patient with respiratory failure. Glucose vs fat.
(J. Askanazi, J. Nordenström, S.H. Rosenbaum, D.H. Elwyn, A.I. Hyman, Y.A. Carpentier, J.M. Kinney).
Anesthesiology 54:373-377, 1981.

In the text these papers will be referred to by the Roman numerals I-VI.