

This document only includes an excerpt of the corresponding thesis or dissertation. To request a digital scan of the full text, please contact the Ruth Lilly Medical Library's Interlibrary Loan Department (rlmlill@iu.edu).

**Impact of Nutritional Regimen on Urea Appearance Rate
and Net Nitrogen Balance in Patients with
Acute Renal Failure Receiving Continuous
Venovenous Hemofiltration**

by

Karla J. Alaka

A Thesis

Submitted to the faculty of Indiana University School of Medicine,

Indianapolis, Indiana

in partial fulfillment of the requirements for the degree

of

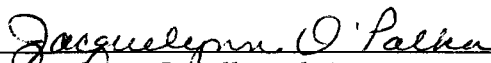
Master of Science in Medical Science

April 1994

Supported by a grant from the National Kidney Foundation

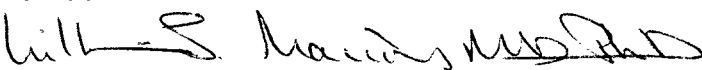
Accepted by the advisory committee in partial fulfillment of the requirements of the degree of Master of Science in Medical Science:

Research Chairman:




Jacquelynn O'Palka, Ph.D., R.D.
Clinical Professor of Nutrition and Dietetics
Indiana University School of Medicine

Member:




William L. Macias, M.D., Ph.D.
Assistant Professor of Medicine
Indiana University School of Medicine

Member:




Michael E. Miller, Ph.D.
Associate Professor of Public Health Sciences
Bowman Gray School of Medicine

Member:



Karyl A. Rickard, Ph.D., R.D.
Professor of Nutrition and Dietetics
Indiana University School of Medicine

Member:



Sara A. Blackburn, D.Sc., R.D.
Clinical Associate Professor of Nutrition and Dietetics
Indiana University School of Medicine

ABSTRACT

Patients with acute renal failure are in substantial negative nitrogen balance as a result of their extremely high urea appearance rates (UAR). A series of patients with acute renal failure managed with continuous venovenous hemofiltration were evaluated to determine which nutritional and non-nutritional variables might be predictive of the UAR. All data (including nutritional regimen, laboratory values, APACHE II score, administered blood products, hemofiltration parameters, and medications) were collected daily. Forty consecutive patients (age 52 ± 20 yrs; mean \pm sd) were monitored for a total of 357 treatment days (average duration 8.9 ± 8.6 days). The mean UAR was 13.2 ± 4.7 g nitrogen/day. The nutritional regimen provided 1440 ± 903 kcal/day (21.4 ± 12.7 kcal/kg/day) and 49.1 ± 30.2 g protein/day (0.7 ± 0.4 g protein/kg/day). The net nitrogen deficit was 7.1 ± 5.9 g nitrogen/day. Using univariate regression analysis, the previous day's UAR, protein provision, energy provision, blood product nitrogen provision, presence or absence of infection, and APACHE II score were selected for use in multivariable analyses of UAR ($p < 0.30$). The nonprotein calorie to nitrogen ratio and the use of steroids or vasopressors were not significant predictors. In a multivariable analysis (controlling for the previous day's UAR) the following variables were significantly predictive of the UAR ($p \leq 0.05$): g protein/kg/day, kilocalories/kg/day, the interaction between kilocalorie and protein provision, presence or absence of infection, and the APACHE II score. Predicted values, using this regression equation, indicate that at lower protein administration rates (≤ 1.0 g/kg/day), increasing energy provision (from 10 to 40 kcal/kg/day) may reduce UAR but patients remain in negative nitrogen balance. At higher protein administration rates (1.5 to 2.0 g/kg/day), which

are necessary to reach positive nitrogen balance, UAR may increase and excessive energy provision (from 30 to 60 kcal/kg/day) may further elevate the UAR. Consequently, the optimal nutritional regimen in acute renal failure may require a higher protein (≈ 2 g/kg/day) and lower energy (30 to 35 kcal/kg/day) content than previously recommended (1.0-1.5 g protein/kg/day and 35-55 kcal/kg/day) for acute renal failure patients. The results of this study suggest that UAR is a complex phenomenon, yet predictors of UAR can be identified and possibly modified to reduce the UAR and improve nitrogen balance.

TABLE OF CONTENTS

	Page
LIST OF TABLES.....	viii
LIST OF FIGURES.....	ix
LIST OF APPENDICES.....	x
LIST OF TERMS AND ABBREVIATIONS.....	xii
ABSTRACT.....	1
CHAPTER 1: INTRODUCTION.....	3
Purpose.....	5
CHAPTER 2: REVIEW OF RELATED LITERATURE.....	6
Acute Renal Failure.....	6
Definition and Incidence.....	6
Metabolic Changes in Acute Renal Failure.....	7
Mortality and Acute Renal Failure.....	12
Nutritional Support in Acute Renal Failure.....	20
Nutritional Assessment in Acute Renal Failure.....	20
History of Protein and Renal Failure.....	25
Current Recommendations for Protein Provision.....	31
Energy Requirements in Acute Renal Failure.....	35
Nutritional Needs in Multiply Compromised Patients.....	40
Impact of Renal Replacement Therapy on Nutritional Support....	42
Indications for Renal Replacement Therapy.....	42
Choices in Renal Replacement Therapy.....	43
Choice of Renal Replacement Therapy:	
Impact on Nutrition.....	50

	Page
CHAPTER 3: METHODS AND PROCEDURES.....	53
Subjects.....	53
Hemofiltration Procedure.....	53
Data Collection.....	54
Data Analysis.....	57
Notation and Formulas.....	57
Descriptive Analyses.....	59
Modeling of Outcomes.....	60
CHAPTER 4: RESULTS.....	63
Patient Population.....	63
Outcomes.....	63
CVVH Parameters.....	64
Metabolic Control.....	66
Pre-CVVH Nutritional Parameters.....	68
Nutrition Administration During CVVH.....	69
Nutrition Provision and Requirements.....	73
Non-Nutritional Nitrogen.....	76
Urea Appearance Rate.....	76
Net Nitrogen Balance.....	77
Protein Catabolic Rate.....	81
Predictors of Urea Appearance Rate: Statistical Analyses.....	83
Univariate Analysis.....	83
Multivariable Analysis: The Final Predictive Model.....	84
Multivariable Analysis of Two Subgroups of Data.....	91
Predictors of Protein Catabolic Rate: Statistical Analyses.....	96
CHAPTER 5: DISCUSSION.....	99
Patient Population.....	99
CVVH Parameters.....	100
Pre-CVVH Nutritional Parameters.....	101
Effects of Fasting on Ureagenesis.....	102
Impact of Nutrition on Survival.....	105
Nutrition Provision and CVVH.....	108
Factors Influencing Underfeeding During CVVH.....	109
Traditional Nutritional Assessment Parameters.....	111
Urea Appearance Rate.....	113
Protein Catabolic Rate.....	113
Net Nitrogen Balance.....	114

	Page
Predictors of Urea Appearance Rate: Statistical Analyses.....	116
Univariate Analysis.....	116
Multivariable Regression Analysis.....	119
Multivariable Analysis: Explanation of the Model.....	121
Support for the Relationship between Energy and Protein: A Separate Analysis.....	130
Appropriate Use of the Predictive Model for UAR.....	131
Predictors of Protein Catabolic Rate: Statistical Analysis.....	133
 CHAPTER 6: CONCLUSIONS.....	 135
 LIST OF REFERENCES.....	 138
 APPENDICES.....	 154
 CURRICULUM VITAE.....	 188