Comparison between Two Different Methods of Measuring Dialysis Adequacy and its Relation to Health Related Quality of Life in Prevalent Hemodialysis Patients

Thesis

Submitted for Partial Fulfillment of the Requirement
of Master Degree in Nephrology

By

Mohamed Rashad Mohamed El Sheimy
M.B., B. Ch, Cairo university (2007)

Under Supervision of

Prof. Dr. Iman Ibraheim Sarhan
Professor of Nephrology and Internal Medicine
Faculty of Medicine – Ain Shams University

Prof. Dr. Ahmed Shaban Serageldeen
Assistant Professor of Nephrology and Internal Medicine
Faculty of Medicine - Ain Shams University

Faculty of Medicine
Ain Shams University
2016

List of Contents

Subject	*Page No.*

List of Abbreviations

Abbr.	Full-term
ACT	Activated Clotting Time
AVF	Arterio Venous Fistula
BP	Blood Pressure
BUN	Blood Urea Nitrogen
CKD	Chronic Kidney Disease
CVC	Central Venous Catheter
ESRD	End Stage Renal Disease
EQ-5D	Euro Quality Of Life 5 Dimensions Model
g/dL	Gram per deciliter
Hb	Hemoglobin
HD	Hemodialysis
HDF	Hemodiafiltration
HEMO	Hemodialysis Study
HF	Hemofiltration
HRQOL	Health Related Quality Of Life
HR	Hazard Ratio
KDIGO	Kidney Disease: Improving Global Outcomes
KDOQI	Kidney Disease Outcomes Quality Initiative
K	Dialyzer Urea Clearance
K^+	Potassium ion
K0	Mass transfer coefficient
K0A	Mass transfer area coefficient
KUf	Ultrafiltration coeffecient
Mg+	Magnesium
NKF	National Kidney Foundation
NCDS	National Cooperative Dialysis Study
nPCR	Normalized Protein Catabolic Rate

PROMIS	Patients Reported Outcome Measurement Information System
QOL	Quality Of Life
RRT	Renal Replacement Therapy
SF-36	Short Form 36
UKM	Urea Kinetic Modeling
URR	Urea Reduction Ratio
URP	Urea Reduction Percent
USRDS	The United States Renal Data System

List of Tables

List of Figures

Abstract

Background

The factors that influence **HRQOL** in patients with *ESRD* have received little attention. *Single pool* ***KT/V*** equation used to assess hemodialysis adequacy, ***nPCR*** equation used to assess patient nutrition. In this study we Compared between the two previous equations for measuring hemodialysis adequacy and their relation to health related quality of life in prevalent hemodialysis patients.

Methods

This descriptive analytic study included the available data in hemodialysis patients in Port-Said General Hospital Hemodialysis Unit. Data was collected between June and July 2015. 100 patients answered **KDQOL** questionnaire and we compared the 3 main scales ***PCS***,***MCS*** and ***KDCS*** scores and the total questionnaire score to ***KT/V*** and ***nPCR*** equations results to assess which of them is better to measure hemodialysis adequacy.

Results

The mean result for ***KDQOL*** questionnaire for all patients was 41.2±16, the mean result for ***KT/V*** equation was 1.02±0.28, the mean result for ***nPCR*** equation was1.01±0.25, correlation between ***KDQOL*** questionnaire score and Adequacy of hemodialysis by both formulas *(KT/V and nPCR)* was assessed and Both showed positive strong correlations which were statistically significant *(both **p**=0.0001)* , however *KT/V* formula showed a stronger correlation than *nPCR* calculation, The result revealed a **strong**, **direct**, **positive** and **significant correlation**(**p**=0.0001)**between** ***KT/V*** equation results **and** the results of the **3** main scales of **KDQOL** questionnaire *(**PCS**, **MCS** and **KDCS**)*, There was a **strong**, **positive** and **significant correlation between** ***nPCR*** equation results **and** the results of only 2 of the 3 scales of *KDQOL* questionnaire: Physical Component Scale and Kidney Disease Component Scale *(**PCS** and **KDCS**)*, There was a **weak**, **positive** and **significant correlation**(**p**=0.003) **between** ***nPCR*** equation results and Mental Component Scale results *(**MCS**)*.

Conclusion

To assess hemodialysis adequacy we can use two equations, ***KT/V*** and *n**PCR***, but ***KT/V*** is more accurate to assess all parameters of **KDQOL** questionnaire: physical, mental and kidney disease component scales.

Key Words Health related quality of life, hemodialysis adequacy, **KT/V, nPCR**, kidney disease quality of life questionnaire, end stage renal disease.

Introduction

Because survival among patients with end-stage renal disease (ESRD) is improving, health-related quality of life is becoming more important as an outcome measure in the evaluation of the various renal replacement therapies (RRTs) and other therapeutic interventions for these patients. Moreover, it has been argued that quality of life of patients on RRT can predict their future morbidity and mortality ***(Mapes et al., 2004).***

The concept of health-related quality of life (HRQOL) in patients with chronic kidney disease (CKD), including end-stage renal disease (ESRD), has evolved since the inception of renal replacement therapy, evolving from ensuring easy survival to achieving a sense of well-being ***(Kalantar-Zadeh and Unruh, 2005).***

Very little data are available concerning the quality of life (QOL) of patients with end-stage renal disease (ESRD) maintained on dialysis in the developing world. In contrast, assessments of the QOL of ESRD patients in the developed world have been recently attracting much attention and have been used as key outcome measures in several studies examining new approaches to ESRD care, QOL assessments have generally relied on the use of standardized questionnaires that assess patient perceptions of their health and life ***(Finkelstien et al., 2009).***

The factors that influence HRQOL in patients with ESRD have received little attention. Previous research has focused on the effects of erythropoietin ***(Canadian Erythropoietin Study Group, 1990)***, exercise ***(Tawney et al., 2000),*** and on the impact of the various modalities of renal replacement therapy ***(Laupacis et al., 1996).***

Another factor that may influence HRQOL in ESRD patients is dialysis adequacy as evidenced by a recent uncontrolled study that showed an improvement in six of eight domains of Short Form-36 (SF-36) in 14 patients whose KT/V levels increased on average by 0.2 ***(Powers et al., 2000).***

Kidney Diseases Outcomes Quality Initiatives (KDOQI) guidelines for dialysis adequacy recommend that delivered single-pool KT/V be at least 1.2 in patients receiving thrice-weekly hemodialysis ***(National Kidney Foundation, 2006).***

KT/V index is considered as the prevailing index of hemodialysis adequacy. Urea Reduction Ratio (URR) is also considered as a simple and important index. The basic element of both indexes is blood urea, which is the most useful parameter for the quantification and estimation of haemodialysis adequacy. There is always a danger, however, to over-estimate the outcome of hemodialysis. The reasons for this overestimation, as they are reported in bibliography are the following: the blood reception for determination of urea is usually made in the beginning and immediately after the end of the therapy; this may overestimate the haemodialysis output, because there is no calculation of the urea rebound. In addition, the cardiopulmonary recirculation effect must also be considered; this causes a difference of blood urea concentration between filter entrance and the peripheral veins in the order of 8-11% ***(Kalochairetis et al., 2003).***

In hemodialysis, urea clearance is calculated by using KT/V formula (K: dialyzer clearance; T: time; V: urea distribution volume) with the normal level of 0.5.According to reliable references, the level less than 0.8 indicates insufficiency. Ratio of after/before urea percent is also another indicator with normal levels of 0.42, and0.5 or more shows dialysis insufficiency, Urea Reduction Percent (URP) has linear relationship with Kt/V indicator and is a very important index. But in researches, another indicator called Urea Reduction Ratio (URR) is also considered that its acceptable level is 65% and more ***(Jindal et al., 2006).***

Different known factors affect dialysis quality such as diet, the filter type, the apparatus turn, dialysis time, training of patients, history of other diseases (especially Diabetes) ***(Solati et al., 2003).***

Routine application of urea kinetic modelling (UKM) has proven indispensable for guiding end-stage renal failure patient therapy. UKM has two major components: KT/V, the dose of dialysis administered per treatment session, and protein catabolic rate, ameasure of dietary protein intake for patients in protein steady state. Kt/V is most commonly evaluated using algebraic equation requiring predialysis and postdialysis measurements of patient urea concentration. There is, however, a paucity of similar equations allowing simple evaluation of the normalized protein catabolic rate (nPCR) for hemodialysis patients from C pre and C post. A recent simple nPCR equations has been published and valid for the midweek dialysis session for patients dialyzed three times weekly and having negligible residual renal function ***(Garred et al., 1995)***.

Aim of the Work

The aim of this study is to compare between two different formulas used for calculation of the adequacy of hemodialysis, the first one is ***KT/V*** formula, and the other one is ***nPCR*** formula (normalized Protein Catabolic Rate) and their relation to health related quality of life among chronic renal failure patients on regular hemodialysis.

Chapter 1:
Hemodialysis Prescription

Morbidity and mortality rates in patients on renal replacement therapy are unacceptably high. Many factors contribute to these such as age, comorbidities especially cardiovascular and infectious diseases ***(Racki et al., 2005).***

Uremia is a quite complex syndrome characterized by accumulation of various sized uremic toxins ***(Vanholder et al., 2003)***, So it would be impossible for intermittent renal replacement therapy (RRT) to replace the homeostatic role of the kidneys. Hence**,** the importance of providing at least adequate dialysis ***(Eknoyan, 2005)***.

Hemodialysis (HD) therapy has been one of the true success stories in the annals of medical science. Before the availability of this treatment, the diagnosis of kidney failure was a death sentence ***(Butman and Nissenson, 2005)***.

Unfortunately, despite major advances in the technology of HD and in the management of its complications, the morbidity and mortality of patients on dialysis remain high, at a time that the incidence and prevalence of kidney failure persistently are increasing ***(Eknoyan, 2005)***.

Optimal care of the patient receiving long-term HD requires broad knowledge of the HD technique and appropriate prescription according to patient- and device-dependent variables ***(Ikizler and Schulman, 2005)***.

Elements of HD prescription *(Taal et al., 2012)*:

1-Dialyzers

The dialyzers are classified according to the material they were made of. All dialyzers in clinical use are of the hollow-fiber type with membranes of cellulose, modified cellulose or synthetic polymers **(*Ronco and Clark, 2005*).**

A bio-compatible dialysis membrane is one in which minimal reaction occurs between the humoral and cellular components of blood as they come into contact with the surface of the dialyzer ***(Hakim, 1993)***.

Cellulosic membranes have the propensity to activate the complement system. This activation of complement is partially responsible for the activation of neutrophils and other leukocytes, making these membranes bio-incompatible ***(Chenoweth, 1984)***, whereas substituted cellulosic or synthetic membranes have more bio-compatible characteristics ***(Ambalavanan et al., 1999).***

Dialyzers are also classified according to their hydrokinetics properties into high-flux and low-flux dialyzers ***(Ronco and Clark, 2005)***. High-flux membranes have ultrafiltration coefficient (K_{uf}) values > 12 mL/h/mm Hg, and as high as 80 mL/h/mm Hg. Low-flux membranes have K_{uf} values < 12 mL/h/mm Hg. The K_{uf} as in figure (1), is calculated