Galore International Journal of Applied Sciences and Humanities
Vol. 8; Issue: 4; October-December 2024
Website: www.gijash.com
Research Paper *P-ISSN: 2456-8430*

Adequacy of Hemodialysis Assessed in CKD-ESRD Patients using Urea Reduction Rate and Single-Pool Kt/V.

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DOI: https://doi.org/10.52403/gijash.20240403

ABSTRACT

Introduction: Chronic kidney disease and end stage renal disease (ESRD) are major cause of morbidity and mortality. Renal replacement treatment in the form of hemodialysis, peritoneal dialysis or renal transplantation are the treatment of choice to ESRD. Hemodialysis has been the most preferred modality of treatment for sustaining the life of patients with end-stage kidney disease. Achieving adequacy in hemodialysis is a major challenge in treating these patients. Inadequate dialysis will result in high mortality. This study aimed to find out the mean value of the urea reduction ratio and Kt/V in fifty session of hemodialysis in 4 patients undergoing hemodialysis at a tertiary care centre.

Methods: This was a prospective open labelled, controlled study design conducted over 3 month. Patients aged >18 years, undergoing maintenance hemodialysis were included in the study. Urea reduction rate and single-pool Kt/V were estimated.

Statistical analysis: All data pertinent to the patients are obtained and the analysis of efficacy in terms of dialysis dose, urea reduction ratio (URR) and Kt/V were analysed using the Student's paired T test, with a $p <= 0.05$ will be considered statistically significant.

Results: Among fifty session of hemodialysis done for four hours through AV fistula the mean urea reduction ratio and standard deviation in the study was 62.49% and 9.7 respectively. Single pool Kt/V mean and standard deviation was 1.22 and 0.2 respectively

Conclusions: URR was little lower and Kt/V was optimal as per standard guidelines. Hence estimating URR and Kt/V gives the evidence of adequacy of hemodialysis in addition to clinical assessment and thus helps in reducing morbidity and mortality in these patients.

Keywords: *chronic kidney disease (CKD), End stage renal disease (ESRD), hemodialysis, urea reduction ratio (URR) and Kt/V.*

INTRODUCTION

Chronic kidney disease (CKD) is an emerging disease [1]. Over the past half century, there has been a remarkable achievement in hemodialysis (HD) as a modality for renal replacement therapy.[2] India with over a 1.2 billion population, is projected to be a major future reservoir of non-communicable disease, especially diabetes and hypertension[3]. Out of the 25-40% diabetics are likely to develop chronic kidney disease (CKD) in India, 10% will contribute to the burgeoning ESRD burden [3]. An ESRD prevalence figure of 100-250 per million population (pmp) per year is cited, based on worldwide

estimates and local tertiary care centers research .[4] [5] [6]

Most hemodialysis centres are providing twice-a-week hemodialysis and reusing dialysers which may affect the quality of hemodialysis.[7,8] In our institute based on patient condition two to three session per week hemodialysis given. We are using single use blood tubing and dialyser. All patients in our study three session of hemodialysis per week given. It is imperative to know the quality of HD provided at individual centres since morbidity and mortality is very high in ESRD patients if quality of dialysis given is not optimal. Hence, we designed this study to estimate URR and single pool Kt/V in patients undergoing HD in order to assess adequacy of hemodialysis.

MATERIALS & METHODS

This was a prospective open label study conducted over three months. Patients aged >18 years, undergoing maintenance hemodialysis and giving informed and written consent were included in the study. Fifty session of hemodialysis done for four hours in four patients were included.

Urea reduction rate and single-pool Kt/V were estimated using the formulas mentioned below:

Urea Reduction Ratio (URR)

URR = (pre-dialysis Urea-post-dialysis Urea) (pre-dialysis Urea) × 100%

Single-Pool Index (spKt/V)

Parameters spKt/V and URR are connected mathematically as follows:

SpKt/V = - *In* (1 - URR),[4]

Where *In* stands for natural logarithm.

Single pool KT/V 1.2 or URR more than 65% have been shown to be effective in improving dialysis patients' prognosis.[9]

Inclusion Criteria

1. Patient willing and competent to sign the approved informed consent.
2. Patients must be at least 21 years of age or older.
3. Patients must weigh between 40 and 100kg, inclusive.
4. Patients must have End Stage Renal Disease and currently undergoing consistent intermittent HD at least 2 times a week for at least 3 months prior to being enrolled.
5. Vascular access must be through a functioning arteriovenous fistula (AVF)/ Internal Jugular Catheter (IJC)/ Femoral catheter with no thrombolytic therapy or clotting of the AVF within the past 4 weeks.
6. Expected survival of no less than 6 months.
7. Consent to allow review of their medical records by the investigators, and monitors.
8. Hemoglobin level ≥ 8.0 g/dL prior to hemodialysis treatment.

Exclusion Criteria

1. Anticipating or scheduled for a living related donor kidney transplant in less than 2 months.
2. History (within the 12 weeks prior to the study) of cardiovascular events including.

a. Unstable angina
b. Myocardial Infarction
c. Stroke

3. Clinical Significant Arrhythmia.
4. Life threatening arrhythmia within the past 30 days.
5. Severe intra-dialytic hypotension within the last 30 days.
6. Shock within the last 30 days.
7. Hemodynamic instability as demonstrated by repeated episodes of hypotension or hypertension requiring intervention by dialysis personnel or representing a present hazard to the patient.
8. Seizure disorder requiring active treatment for a seizure episode during the last 6 months.
9. Major Surgery (excluding vascular access surgery) within the past 30 days.
10. Currently receiving intravenous antibiotic therapy for systemic infection.

11. Clinical evidence of metastatic malignancy, receiving radiation or chemotherapy, within the past 365 days.
12. Active bleeding.
13. Hematological disease (e.g. malignancies, hemolytic anemia, thrombocytopenia), and other conditions that may interfere with data.
14. Current enrollment in another investigational device or drug trial.
15. Subject is pregnant (e.g., positive HCG test) or is breast-feeding.
16. Subject has any disorder (excluding illiteracy or visual impairment) that compromises the ability of the subject to give written informed consent and/or to comply with the study procedures.
17. Allergy to heparin or ethylene oxide.
18. Hypertension deemed uncontrolled, at the discretion of the investigator, within the past 30 days.
19. Has an implantable electronic device (e.g. pacemaker).
20. Has no positive viral serology.

STATISTICAL ANALYSIS

Performa included the demographic, clinical and laboratory parameters All data pertinent to the patients are obtained and the analysis of efficacy in terms of dialysis dose, urea reduction ratio (URR) and Kt/V were analyzed using the Student's paired T test, with a p <= 0.05 will be considered statistically significant, with the inclusion of tolerance limits for pertinent variables.
Dialysis dose, urea reduction ratio (URR) and Kt/V were analyzed to evaluate dialysis adequacy. Inclusion / Exclusion criteria for data sets are described.

RESULT

A total of Fifty session of hemodialysis done for four hours in four patient were enrolled in the study. Two patients had both Diabetes and Hypertension and other two were hypertensive patients.

Table .1 Mean URR and spKT/V in all fifty session and in each patient was estimated.

	Urea Reduction Ratio Mean ± SD (%)	**sp KT/V Mean ± SD (%)**
In fifty hemodialysis session	62.49% ± 9.7	1.22± **0.2**
Patient 1	54.98±**8.29**	1.06±0.98
Patient 2	70.67± 6.45	1.41±0.15
Patient 3	62.76±10.59	1.23±0.27
Patient 4	58.09± 3.2	1.14±0.08

Table .2

Laboratory parameters	**Mean ± SD**
Hemoglobin (gm/dl)	8.5±1.04
Serum Calcium (mg/dl)	7.13±1.84
Serum Phosphorous (mg/dl	3.12±1.63
Serum albumin (gm/dl)	3.86±0.16
Pre-HD Serum Urea (mg/dl)	73.13±18.55
Post HD Serum Urea (mg/dl)	26.86±8.6
serum Creatinine	8.19±1.43

DISCUSSION

This study highlighted the importance of estimation of URR and calculating spKT/V in patients undergoing hemodialysis to asses adequacy. In our study of 50 hemodialysis sessions, which was similar to a study done in Chitwan, Nepal.[9] The average age of all the 4 patients was 50 ±15 years, with an average weight of 50 ±15 Kg.

The commonest cause of end-stage kidney disease (ESKD) in our study was hypertension followed by type 2 diabetes mellitus and chronic glomerulonephritis whereas in another study it was found that diabetic nephropathy followed by hypertension were common causes of ESRD. On the contrary, another study found chronic glomerulonephritis to be the most common cause followed by diabetic nephropathy.[9] Mean Hemoglobin level in our study population was found to be 8.5±1.04 gm/dl which was similar to the

study done at a center in Kathmandu.[9] The mean calcium level in the study was7.13 ± 1.84 found to be lower. Anaemia is common feature in CKD_ESRD. Hypocalcaemia is a part of abnormal mineral metabolism in CKD and evident from stage 4 CKD. Pre-dialysis urea was 73.13±18.55 mg/dl and mean post-dialysis urea was 26.86±8.6 mg/dl.

URR in our study was 62.49% ± 9.7 and Mean single pool Kt/V was 1.22± 0.2. As per KDIGO guidelines URR greater than 65% and single pool Kt/V - 1.2 were considered optimal for hemodialysis adequacy. So URR in our study was near optimal and single pool Kt/V was adequate. This gives us evidence objectively that dialysis given to these patients are adequate in our center and there by decreases morbidity and mortality. First and fourth patients had suboptimal URR and single pool Kt/V compared to second and third patient whose URR and single pool Kt/V were optimal. First and fourth patients were noncompliant with fluid intake and hence volume of urea distribution into extra vascular spaces was high in oedematous status thus removal during dialysis is low and no other factors like

average time of dialysis treatment was adequate and hence it did not contribute. Low-flux membranes used for HD in these patients would also lead to this. Vascular access used for hemodialysis were arteriovenous fistula which included Radiocephalic arteriovenous fistula and brachiocephalic arteriovenous fistula.

CONCLUSION

Estimating URR and single pool Kt/V gives the evidence of adequacy of hemodialysis in addition to clinical assessment and thus helps in reducing morbidity and mortality in these patients.

Declaration by Authors

Ethical Approval: Approved

Acknowledgement: Shyam Vasudev Rao, Managing Director Renalyx and BEL, Bangalore for guiding us.

Conflict of Interest: The authors declare no conflict of interest.

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How to cite this article: Himamani. S, Niranjan. M. R, Srinivas. K, Harshavardhan Guptha M. N. Adequacy of hemodialysis assessed in CKD-ESRD patients using urea reduction rate and single-pool Kt/V. *Galore International Journal of Applied Sciences & Humanities*. 2024; 8(4): 14-17. *DOI: 10.52403/gijash.20240403*

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