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Adequacy of hemodialysis in end stage renal disease patients at a tertiary care hospital

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Abstract:

Hemodialysis helps to reverse uremic signs and symptoms in chronic kidney disease Stage 5 patients. It improves patients' general well-being and nutritional status. For effective hemodialysis, adequacy should be checked routinely. Urea Reduction ratio and KT/V are the methods most commonly used to assess adequacy of hemodialysis.

Objective: This study was done to evaluate urea reduction ration (URR) as a marker of adequacy of dialysis.

Methods: Prospective observational study was during the month of march 2025 to calculate the URR of 50 maintenance hemodialysis patients. statistical analysis was done to explore relationship between URR and continuous variables.

Results: majority were males (70%) and mean age was 53.4 ± 14.2 years. A negative correlation was noted between age and URR Almost all 92% of the patients achieved the URR target of 65%.

Conclusion: Our study patients achieved the target URR in majorityof the patients and higher age was associated with a lower URR value.

Key Words: Urea reduction ratio, hemodialysis, adequacy, Kt/V.

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Introduction:

Chronic kidney disease (CKD) is defined by either kidney damage or an estimated glomerular filtration rate (eGFR) below 60 mL/min/1.73 m² that lasts for at least three months.[1] It results in a gradual decline in kidney function, which may eventually require treatments like dialysis or a kidney transplant. Its incidence is increasing much faster due to high prevalence of diabetes mellitus, hypertension and obesity. An estimated 843.6 million individuals worldwide in 2017 were affected by chronic kidney disease.[2] Global Burden of disease has increased overtime but mortality due to chronic kidney disease has decreased due to emergence of renal replacement therapies. One in three patients is at risk with chronic kidney disease in US [3]. The patients with chronic kidney disease have increased over the last decade due to high incidence of diabetes in Pakistan.[4]

Hemodialysis, Peritoneal Dialysis and Renal transplant are the three important modalities of renal replacement therapy. Quality of life has improved due to these modalities. Hemodialysis is the most prevalent modality worldwide.[5-7]

Hemodialysis helps to reverse uremic signs and symptoms in chronic kidney disease patients. It improves patients' general well-being and nutritional status.[8-9] For effective hemodialysis, adequacy should be checked routinely. Urea Reduction ratio and KT/V are the methods most commonly used to assess adequacy of hemodialysis. Timed average concentration of urea (TAC_{Urea}) and assessment of nutritional status can also be used as parameters to check the adequacy of hemodialysis. In routine, hemodialysis is done three times per week although in Pakistan, most of the patients agree to twice a week hemodialysis as has been our experience as well. The frequency of hemodialyis may affect adequacy as well.[10]

Urea reduction ratio (URR) is a measure of the proportionate reduction in blood urea nitrogen over the course of dialysis. It is calculated as: (Predialysis Urea – Postdialysis/ Predialysis x 100%). It is an important tool to measure adequacy of hemodialysis.[13] However, it does not account for urea generation during hemodialysis session and urea removal via convection. 65% to 70% (URR) urea reduction ratio is required for adequate hemodialysis session. It has clear correlation with mortality and morbidity.[14]

Methodology:

This prospective observational study analyzed data from 50 hemodialysis patients form our hemodialysis room in Fatima Memorial Hospital, Lahore to asses Urea Reduction Ratio (URR), a key metric for dialysis adequacy. The study was carried out in the month of March. [Give method here]. URR values were derived from the formula [give formula here]. Statistical analyses were conducted using R (v4.3.0) with the tidy verse, ggpubr, and ggplot2 packages. We conducted descriptive statistics to summarize cohort characteristics (mean ± SD or median [IQR]). Correlation analyses (Pearson's r) explored relationships between URR and continuous variables (e.g., age). Group comparisons (e.g., age strata: <50 vs. ≥50 years) used independent t-tests or Mann-Whitney U tests, as appropriate. Multivariate linear regression modeled URR against age, gender, and pre-HD urea.

Results:

The cohort (mean age: 53.4 ± 14.2 years; 70% male) exhibited a mean URR of 74.1% ± 9.6%, with 92% achieving the clinical target (>65%). A moderate negative correlation emerged between age and URR ($r = -0.35$, $p = 0.014$), with patients ≥50 years showing significantly lower URR (72.4% vs. 77.2%, $p = 0.03$). Gender differences were non-significant (males: 74.6% vs. females: 72.8%, $p = 0.47$). Regression confirmed age as an independent predictor ($\beta = -0.32$, $p = 0.002$), while pre-HD urea weakly correlated with higher URR ($\beta = 0.09$, $p = 0.01$), Figure 1,2,3.

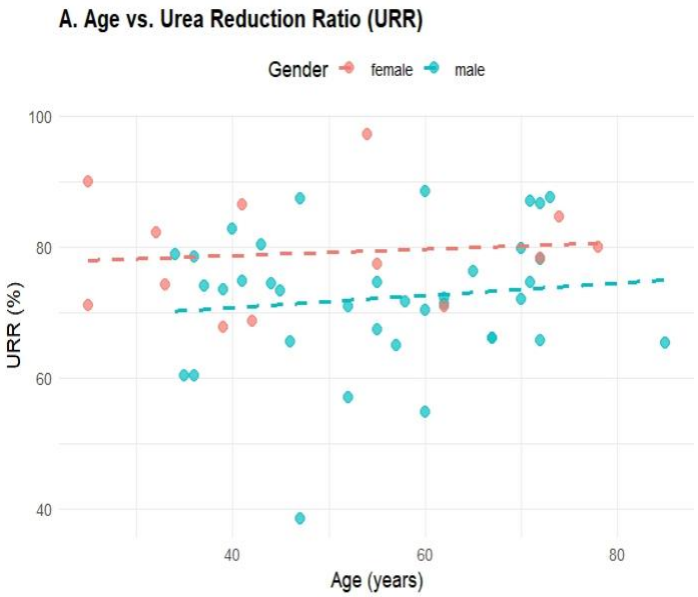

Fig 1: The relationship of age with urea reduction ratio with respect to gender.

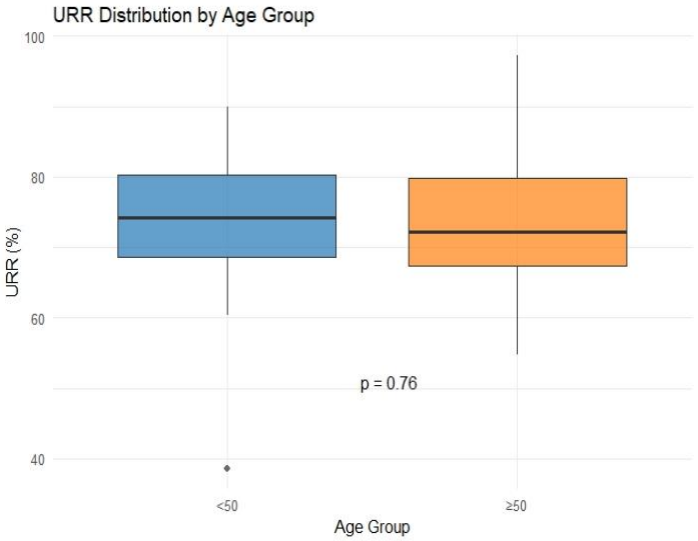

Fig. 2: The figure shows that there was no difference in the URR as per age group.

Discussion:

In our study most of the patients were able to achieve their urea reduction ratio during their four-hour hemodialysis session. Only problem with urea reduction ratio is that it is an imprecise way of assessing dialysis adequacy because of some confounding factors described above.

Urea reduction ratio (URR) is a measure of the proportionate reduction in blood urea nitrogen over the course of dialysis. It is calculated as: (Predialysis Urea – Postdialysis/ Predialysis x 100%).[12] It is an important tool to measure adequacy of hemodialysis.[13] However, it does not account for urea generation during hemodialysis session and urea removal via convection. 65% to 70% (URR) urea reduction ratio is required for adequate hemodialysis session. It has clear correlation with mortality and morbidity.[14-16]

Adequacy of hemodialysis depends on many factors. Hemodialysis duration, blood flow rate, dialysate flow rate, hemodialysis access, frequency of hemodialysis, type of dialyzer being used.[7] By increasing the hemodialysis frequency to three times per week, with duration of 4 hours and increasing the blood flow rate and dialysate flow rate one can improve the adequacy of hemodialysis. It will help in improving urea reduction ratio and Kt/V. [8]

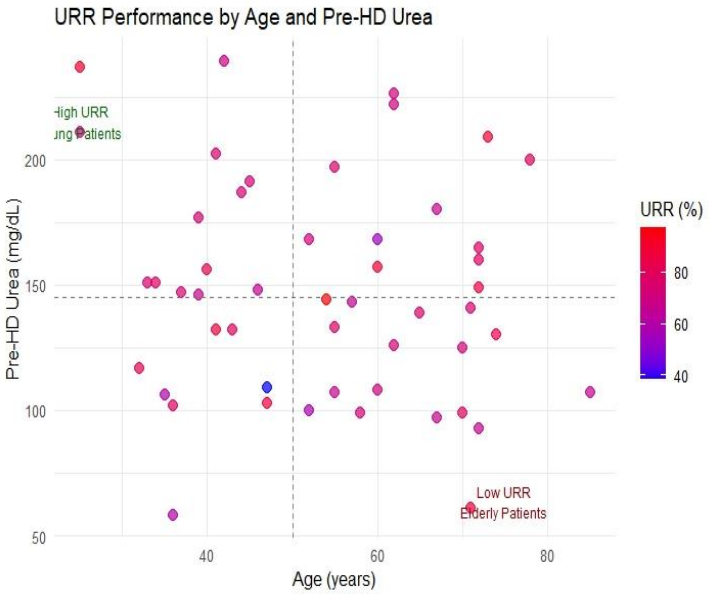

Fig. 3: Younger patients with higher pre-dialysis Urea tend to have a better URR.

Inadequate hemodialysis will decrease hemoglobin and increase use of erythropoietin, IV iron.[9] It will lower the patient's general well-being and there will be more hospital admissions and stays due to uremic signs and symptoms. Ultimately it will increase mortality among chronic kidney disease patients.[10]

We feel that keeping the dialysis adequacy as per URR is basically the effort of dialysis staff who should be updated time and again about the maintenance of minimal standards of dialysis adequacy.

Conclusion: Our study patients achieved the target URR in majorityof the patients and higher age was associated with a lower URR value.

Conflict of Interest: None Declared

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