

A Hospital-based Study of Renal Function Tests in Chronic Alcoholics

¹Velu Malarkodi, ²Mala Malathi

ABSTRACT

Aim: The purpose of the study is to assess the glomerular filtration rate (GFR) using Modification of Diet in Renal Disease (MDRD) formulae, and to estimate renal parameters including electrolytes in chronic alcoholics and compare all the parameters with normal controls.

Materials and methods: A total of 50 male alcoholics were taken for the study on admission to the deaddiction center in Father Muller Medical College and Hospital. All the serum parameters were analyzed in auto analyzer Cobas c 311, and qualitative analysis of urine was done using dipsticks. Statistical evaluation was done using Student's t-test and Karl Pearson's correlation coefficient.

Results: The mean estimated GFR (eGFR) in alcoholics of our study was slightly increased with an increase in 32% of alcoholics. A significant negative correlation of eGFR with age ($p = 0.027$) and urea ($p = 0.039$) was seen. There was a significant decrease in the levels of urea ($p = -0.022$) and potassium ($p = -0.008$). There was a mean increase in uric acid and decrease in phosphate levels. Qualitative analysis of urine showed proteinuria and hematuria in alcoholics with $eGFR < 110$.

Conclusion: The study showed a spectrum of variation in the renal parameters assayed, with a significant decrease in urea and potassium levels. Validation of the findings by large-scale cohort studies is needed.

Clinical significance: There is a significant decrease in the renal function with variations in electrolytes and a decrease in phosphate levels. Some cases also had proteinuria and hematuria, indicating progress toward chronic renal disease.

Keywords: Chronic alcoholism, Chronic renal disease, Estimated glomerular filtration rate, Modification of diet in renal disease.

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¹Assistant Professor, ²Professor and Head

¹Department of Biochemistry, Government Sivagangai Medical College, Sivagangai, Tamil Nadu, India

²Department of Biochemistry, Father Muller Medical College Mangaluru, Karnataka, India

Corresponding Author: Velu Malarkodi, Assistant Professor Department of Biochemistry, Government Sivagangai Medical College, Sivagangai, Tamil Nadu, India, Phone: +917358558458 e-mail: drmalarkodi@gmail.com

INTRODUCTION

Alcohol ingestion is associated with a myriad of deleterious effects on the kidney, ranging from tubular dysfunction and various forms of acute renal failure.¹ The World Health Organization statistics say that 4.5% of the global burden of disease and injury was attributable to alcohol. Worldwide, about 11.5% of drinkers have weekly heavy episodic drinking occasions.² About 5.11 million consumers in Karnataka state annually consume 100.87 million liters of absolute alcohol equivalent. Per capita consumption of alcohol in Karnataka is about 2.98 L of absolute alcohol per year.³ Studies⁴⁻⁶ have linked higher serum creatinine and an increased risk of end-stage renal disease (ESRD) to higher alcohol intake. Based on the very few population-based studies conducted in India, the estimated prevalence of overt chronic kidney disease (CKD) ESRD is 0.79 to 1.39%.⁷ The relationship between alcohol consumption and CKD has been the subject of relatively little research. The GFR is a better indicator of renal disease than serum creatinine. A study found that men who consumed at least seven drinks weekly had an odds ratio of 0.71 to develop new onset of renal dysfunction.⁸ The present study intends to highlight the effect of chronic alcoholism on the renal function well before a rise in serum creatinine is seen.

In this study, we aim to assess eGFR using MDRD formulae along with the estimation of urea uric acid and electrolytes in serum of alcoholics and compare them with those of nonalcoholics. We perform qualitative urine analysis of alcoholics to detect abnormalities.

MATERIALS AND METHODS

A total of 50 male alcoholics aged 21 to 60 years were taken for the study, in comparison with 50 male nonalcoholic healthy controls, on admission to the deaddiction center in Father Muller Medical College and Hospital after institutional ethical committee clearance. Alcohol dependence was assessed by Alcohol Use Disorders Identification test (AUDIT) questionnaire. The AUDIT score above 8 indicated hazardous drinking and more than 15 in males indicates alcohol dependence. Harmful levels of absolute alcohol for males are > 50 units (400 gm)/week.⁹ Alcohol-dependent males with AUDIT score more than 15 were considered for this study after taking informed written

Table 1: Analysis of parameters in alcoholics and controls

| Parameter | Alcoholics (n = 50) | Controls (n = 50) | Comparison | Significance |
|-------------|---------------------|-------------------|------------|--------------|
| Age | 40.2 ± 9.82 | 42.7 ± 11.23 | p = 0.239 | NS |
| eGFR | 111.03 ± 23.99 | 108.42 ± 22.01 | p = 0.572 | NS |
| Urea | 20.14 ± 9.78 | 24.16 ± 7.24 | p = 0.022 | sig |
| Creatinine | 0.85 ± 0.17 | 0.85 ± 0.14 | p = 0.948 | NS |
| Uric acid | 5.63 ± 1.22 | 5.18 ± 1.29 | p = 0.076 | NS |
| Sodium | 138.94 ± 4.5 | 137 ± 4.5 | p = 0.068 | NS |
| Potassium | 3.8 ± 0.49 | 4 ± 0.5 | p = 0.008 | HS |
| Chloride | 100.6 ± 5.2 | 99.6 ± 4.9 | p = 1.034 | NS |
| Bicarbonate | 23.02 ± 3.21 | 23.4 ± 2.3 | p = 0.504 | NS |
| Phosphate | 3.72 ± 1.02 | 4.01 ± .61 | P = 0.088 | NS |

NS: Not significant; sig: Significant correlation with p<0.05; HS: Highly significant correlation with p<0.01

consent. Alcoholics with other associated premorbid conditions like diabetes mellitus, advanced liver disease, and those on prolonged medication known to affect the renal function were excluded. Serum parameters were analyzed in autoanalyzer Cobas c 311. The eGFR was calculated using the MDRD formula based on serum creatinine levels. According to CKD National Kidney Foundation The Kidney Disease Outcome Quality Improvement (NKF K/DOQI), the MDRD formula¹⁰ is recommended for eGFR calculation.

MDRD = $186 \times (\text{SCr})^{1.154} \times [\text{age (years)}]^{0.203} \times (0.742 \text{ if female}) \times (1.210 \text{ if African-American})$, where SCr is serum creatinine in mg/dL

The qualitative analysis of the urine was done using DX urine test 10 reagent strips from Piramal health care Limited. Statistical analysis by Statistical Package for the Social Sciences software was done using student t-test and Karl Pearson's correlation coefficient.

RESULTS

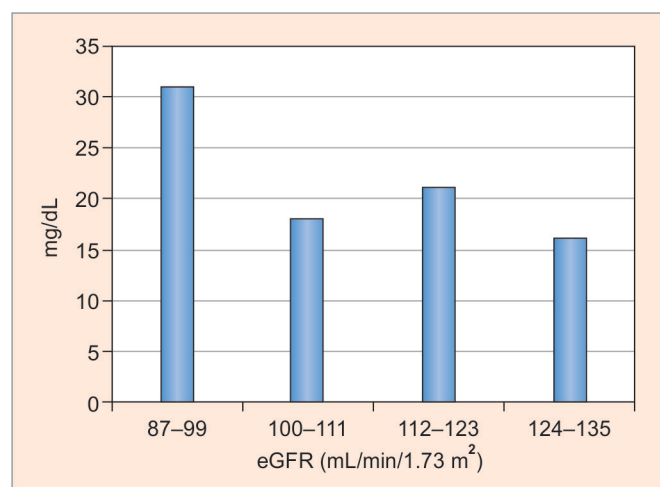
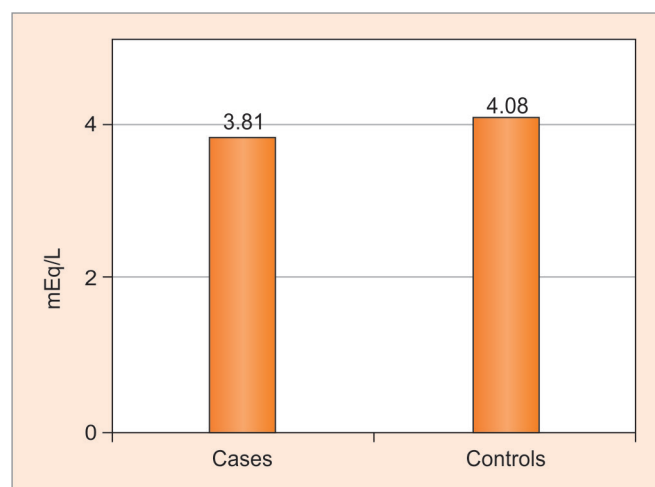
Mean eGFR in alcoholics was increased in alcoholics compared with normal. Student's t-test was done to compare the parameters of alcoholics with controls (Table 1). A

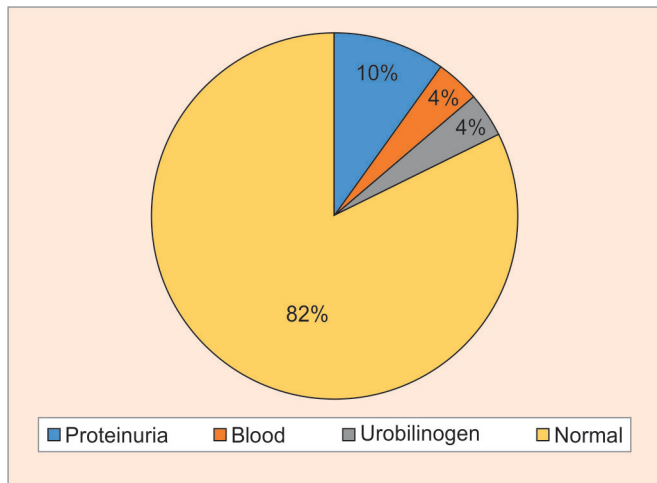
Table 2: Correlation of eGFR with the other parameters

| Parameters | Alcoholics | | Controls | |
|-------------|---------------------|---------|---------------------|---------|
| | Correlation | p-value | Correlation | p-value |
| Age | -0.312 ^a | 0.027 | -0.262 | 0.067 |
| Urea | -0.293 ^a | 0.039 | -0.255 | 0.074 |
| Creatinine | -0.916 ^b | 0 | -0.929 ^b | 0 |
| Uric acid | -0.085 | 0.557 | -0.337 ^a | 0.017 |
| Sodium | 0.187 | 0.193 | 0.130 | 0.368 |
| Potassium | -0.079 | 0.587 | -0.379 ^b | 0.007 |
| Chloride | 0.111 | 0.441 | 0.110 | 0.445 |
| Bicarbonate | 0.026 | 0.857 | -0.149 | 0.302 |
| Phosphate | 0.008 | 0.954 | -0.140 | 0.332 |

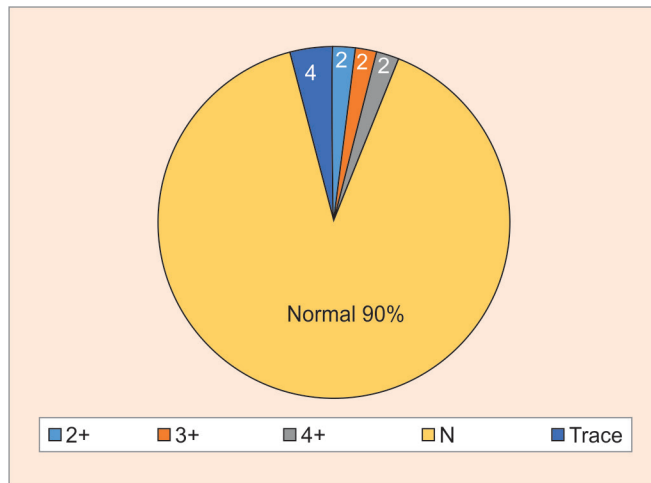
^aCorrelation is significant at the 0.05 level (2-tailed); ^bCorrelation is significant at the 0.01 level (2-tailed)

significant decrease in the urea and potassium levels was seen. There was a mean increase in uric acid, sodium and chloride. A mean decrease in the phosphate levels was also noted (Table 2). Karl Pearson's correlation of eGFR with other parameters showed a significant correlation with age, urea, uric acid, and potassium (Table 2). The eGFR was divided into quartiles based on mean and standard deviation and the changes in urea are noted (Graph 1), and a significant decrease in potassium in alcoholics is seen (Graph 2).

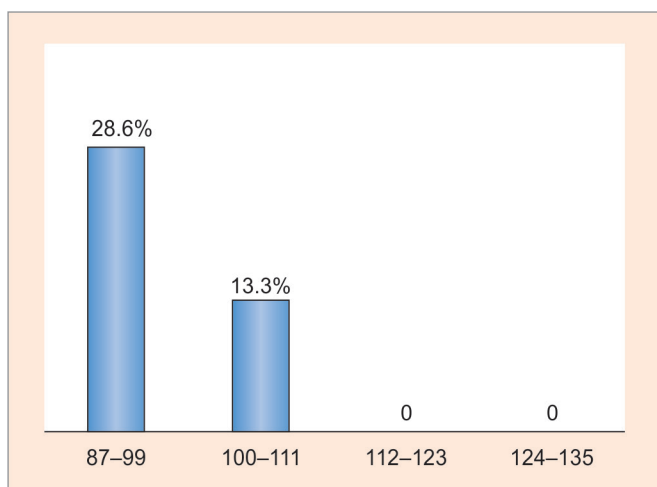
**Graph 1:** Urea levels in eGFR quartiles of alcoholics**Graph 2:** Serum potassium levels in cases and controls



Graph 3: Incidence of abnormal constituents of urine in alcoholic subjects



Graph 4: Incidence of proteinuria in the alcoholic subject



Graph 5: Incidence of proteinuria in percentage with respect to eGFR quartiles

The analysis of urine revealed that 49% of the subjects had diuresis; 51% of alcoholics had acidification of the urine. Some of the subjects had abnormal findings in the urine like proteinuria (10%), hematuria (4%), and urobilinogen (4%) in the study population (Graphs 3 and 4). The eGFR range was divided into quartiles and the result of urine examination was analyzed. The incidence of proteinuria was high in the first quartile of eGFR (28.6%) and was nil in the third and fourth quartiles (Graph 5).

DISCUSSION

Alcohol consumption may affect the regulation of vasoactive substances, consequently affecting renal hemodynamics and GFR.¹¹ Estimating GFR using the formulae based on serum creatinine was equally accurate when compared with the clearance studies according to the NKF K/DOQI guidelines.^{10,12} The simplified MDRD equation is widely used in daily clinical practice and its accuracy has been studied in normorenal and CKD

patients.¹⁰ Subjects with chronic alcohol consumption have significantly higher estimated GFR and creatinine clearance values than nondrinkers.¹¹ Males consuming seven or more units of alcohol per week were associated with a significant increase in eGFR over 7 years of follow-up versus abstinence, although the same was not observed for females.¹³ Our study showed a mean increase in eGFR. Similar to our study, decreased urea was reported in two studies.^{14,15} An animal study¹⁶ on rat kidneys has shown that the urea and creatinine levels have been elevated over the weeks of ethanol exposure. A case-control study⁶ concluded that individuals who consumed 2 or fewer drinks per day had higher serum creatinine concentrations than matched controls. This study found an increase in uric acid levels. The clearance of uric acid is hampered and there is also increased synthesis in alcoholics.¹⁷⁻²⁰ The values obtained for sodium and potassium in a study done by Oduola et al²¹ were significantly lower in heavy drinkers. The abnormalities in the electrolytes are also supported by the study done by Mahboob et al, and a study by Sergio De Marchi et al²² showed that 13% had hypokalemia. This finding of hypokalemia is also supported by many studies.^{17,23} Our study has shown a mean decrease in the phosphate levels. A study by De Marchi et al²² also showed that 30% had hypophosphatemia. About 18% of the present study population had hyperphosphatemia. A study by Martin et al²³ showed that there were 13.6% of alcoholics with hyperphosphatemia and hypophosphatemia each. These findings are also supported by the study done by Liamis et al.¹⁷ There was diuresis in most of the alcoholics (49%) in our study which coincides with the finding in many studies.^{24,25} Proteinuria, hematuria, and leukocyturia in chronic alcoholics were mostly pronounced in abstinence, particularly in those with a long-term alcoholism.²⁶

CONCLUSION

In conclusion, the study showed that the mean eGFR was higher, indicating predominant diuresis. The study showed a spectrum of variation in the renal parameters assayed, with a significant decrease in urea and potassium. The qualitative analysis of urine showed proteinuria and hematuria, which indicates renal impairment. Validation of the findings by large-scale cohort studies is needed. The renal dysfunction in alcoholics is to be ascertained using newer markers like Cystatin C in Indian population.

CLINICAL SIGNIFICANCE

Alcohol has widespread effect on various tissues; in this study, there is a significant decrease in the renal function with variations in electrolytes and a decrease in the phosphate levels. Some cases also had proteinuria and hematuria, indicating the progress toward chronic renal disease. Hence, chronic alcoholism has a deleterious effect on the renal function as well as other organs due to the electrolyte imbalance and reduced GFR. It also could be assumed from this study that the renal tubules are also affected other than glomerular function.

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