

# A Study of Renal Dysfunction in Chronic Alcoholic Men in a Tertiary Care Hospital

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## ABSTRACT

**Background:** Alcoholism is a serious social threat in our country leading to morbidity and mortality in various aspects. It causes damage to almost all the systems of the body including central nervous system, cardiovascular system, liver and kidneys out of which liver being the most commonly affected. However renal dysfunction is usually noticed during the terminal stages by then the other systems have already damaged.

**Aims and Objectives:** This study is to measure the parameters of renal functions like serum urea, creatinine, creatinine clearance, sodium, potassium, calcium and phosphorus in chronic alcoholic men without dependence features and to show the need to assay simple renal function tests periodically as damage to the kidneys are usually missed.

**Materials and Methodology:** The study was conducted in 60 middle aged men of age 30-50 yrs in Dr. B. R. A. M. C. H from outpatient and inpatient departments. Among them 30 were controls and 30 were chronic alcoholics. Informed consent obtained from all subjects. A detailed history was obtained by questionnaire and serum collected from fasting sample was measured for the following analytes urea, creatinine, creatinine clearance, sodium, potassium, calcium and phosphorus.

**Results and Conclusion:** The serum urea and creatinine values are significantly raised in cases of chronic alcoholic with  $p$  value of  $<0.01$ . The creatinine clearance is significantly lowered in cases of chronic alcoholic intake with  $p$  value of  $0.006$ . The levels of serum sodium, potassium, calcium and phosphorus are significantly lowered when compared to the controls with a  $p$  value of  $<0.01$ . This strongly suggests chronic alcohol consumption is associated with renal dysfunction.

**Key Words:** Alcoholics, Urea, Creatinine, Creatinine clearance, Sodium, Potassium, Calcium and Phosphorus.

Access this article online	
Quick Response Code:	Website: www.innovativepublication.com
	DOI: 10.5958/2394-6377.2015.00012.X

## INTRODUCTION

Alcohol is a chemical substance producing variable effects on all organs and induces euphoria, tolerance and addiction. The word alcohol has been derived from an Arabic word 'Alkuli' meaning essence. Alcoholism or Alcohol dependence is a repetitive pattern of drinking alcohol that has adverse effects on social, family, occupational or health status. An alcoholic individual often experiences problems with physical and psychiatric illness, family relationships, finances, employment, social and legal accountability(1). An alcoholic is a person who progressively consumes an amount of ethanol capable of producing pathological changes and exhibits a cumulative pattern of social behaviours associated with drinking including physical injuries, problem with family and job and accidents while drinking(1). Alcoholism is a major threat to public health in both developed and developing countries. Alcoholism or alcohol dependence is a maladaptive pattern of chronic alcohol use leading to tolerance,

dependence and severe behaviour impairment. Dependence may be physical or psychological. Physical dependence is characterized by presence of withdrawal symptoms and tolerance. Alcohol affects the liver most commonly and disease ranges from fatty liver, alcoholic hepatitis and alcoholic cirrhosis. The alcoholic liver diseases are very common in low socioeconomic status due to heavy drinking habits and multiple nutritional deficiencies(2). Alcoholism is usually associated with a variety of biochemical alterations in electrolytes like hyponatremia, hypokalemia, hypocalcemia, hypophosphatemia, hypomagnesemia(3) and in acid base balance like metabolic acidosis and respiratory alkalosis(4). After ethanol administration, ethanol and its metabolites go through kidneys and are excreted into urine, and its content in the urine is higher than that of the blood and the liver. The kidney is often involved in the development, maintenance and counter regulation of complex electrolyte disturbances like phosphate and potassium hypoglycemia etc.(5). Some studies suggest that chronic ethanol ingestion per se is not nephrotoxic(6). Causes of low phosphate may be due to the following in severe alcoholics like phosphorus deficiency in the diet, increased blood pH due to prolonged rapid breathing, insulin administration, administration of nutrients beyond normal requirements (in hospital settings), excessive excretion in urine(7). The severity and clinical importance of these disorders depends on quantity of alcohol ingested, duration of

drinking and associated factors such as malnutrition, chronic liver disease and intermittent illness.

Abnormalities of renal function are common in patients with advanced liver disease which has been extensively studied. One study on alcoholics shows acute kidney injury in patients with alcoholic hepatitis could occur due to decompensation of underlying cirrhosis or due to mechanisms peculiar to hepatitis(8). Alcoholic hepatitis and cirrhosis are associated with systemic arterial vasodilation because of increased endogenous vasodilators, especially nitric oxide and 3', 5' cyclic guanosine monophosphate. Systemic arterial vasodilation causes a decrease in systemic vascular resistance leading to high cardiac output and hyperdynamic circulation. Increase in cardiac output may be insufficient to keep up with a drop in SVR leading to hypotension. Further insult in the form of sepsis or decreased cardiac output may overcome renal blood flow autoregulation, rendering patients prone to pre-renal acute kidney injury and acute tubular necrosis(9). Alcohol can disrupt the hormonal control mechanisms that govern kidney function. By promoting liver disease, chronic drinking causes further detrimental effects on the kidneys including impaired sodium and fluid handling and even acute kidney failure. Hepatorenal syndrome a serious complication of alcoholism is fatal and characterized by azotemia, hyponatremia, progressive oliguria and hypotension(10). Renal dysfunction can present as acute kidney injury (AKI), defined as an abrupt or rapid decline in renal function, or as chronic kidney disease secondary or concomitant to liver dysfunction(8). The effects of alcohol abuse on renal function in the absence of chronic liver disease are not well defined. This study is to measure the parameters of renal functions like serum urea, creatinine, creatinine clearance, sodium, potassium, calcium and phosphorus in chronic alcoholic men without dependence features and to show the need to assay simple renal function tests periodically as damage to the kidneys are usually missed.

## MATERIALS AND METHODS

The study was conducted in 60 middle aged men of age 30-50 yrs in Dr. B. R. A. M. C. H from outpatient and inpatient departments. Among them 30 subjects were chronic alcoholics with regular alcohol intake for at least 10 yrs without dependence symptoms and with normal liver function tests. Control subjects are men of age 30 – 50 yrs with no history of drinking. All these subjects were subjected to medical examination as per a fixed proforma. Alcohol drinking history was assessed by interview and questionnaire. Data from questionnaire are used to establish the number of standard drinks consumed, duration, type, pattern of alcohol intake.

Interviewer-administered questionnaires also contained questions regarding alcohol consumption status. The participants were asked: 'In terms of drinking alcohol, which category would you generally put yourself in?'

given the response options (i) I have never drunk alcohol; (ii) I used to drink but gave it up; (iii) I'm a heavy drinker; (iv) I'm a moderate drinker or (v) I'm a light drinker. The participants were also asked: 'Have you ever considered yourself a heavy drinker?' From these data, current drinking was defined by self-categorization as a light/moderate/heavy drinker; non-drinkers were defined as those respondents who reported having never drunk alcohol or having given up alcohol. Further information regarding frequency and volume of alcohol consumption was collected using a self-administered validated questionnaire. The participants were asked about the frequency and pattern of alcohol intake as light drinkers  $\leq 1$  drink/week, moderate drinker's 2 – 3 drinks/week and heavy drinker's  $\geq 4$  drinks/week.

The participants were asked about the type they usually consumed in terms of standard drinks. A standard drink is equivalent to 1 oz (30ml) of whiskey, 1.5 oz (45ml) of liquor, 4 oz (120 ml) of wine, 12 oz (360 ml) of beer. Different forms of alcohol are available like beer a form of fermented malt and contains 4-8% of alcohol, wine a form of fermented fruit juices and contains 10-20% of alcohol and sugar (0.1-4%), cider and perry are a form of wine of low alcohol content (3-8%) and high sugar content, spirits a form of distilled fermented products, whiskey a form of distilled beer, brandy a form of distilled wine free of sugar and alcohol 30-50%, liquor a form of alcohol sweetened with cane sugar and flavored herbs or essences with sugar 30% and alcohol 35-55%. An alcoholic beverage is equivalent to 10g of alcohol which produces an approximate blood alcohol concentration (BAC) of 25mg/dl(1).

The amount of ethanol capable of producing disease depends on a variety of factors like genetic predisposition, nutritional status and concomitant illness. For most persons the amount of alcohol necessary to produce disease is 80gm/day for at least 10-15 yrs. According to WHO a guideline, at risk drinking is daily alcohol intake over 40g (three drinks) for male(11).

Informed consent obtained from all subjects. Exclusion criteria includes patients with clinical evidence of diabetes mellitus, hypertension, liver diseases, pancreatic diseases, malnutrition, vomiting, diarrhea, patients on insulin, antacids, steroids, diuretics, cephalosporins, metronidazole and females. A detailed history if on any medications, performing an ultrasound and measuring serum liver function tests, glucose helped in excluding subjects. Anthropometric measurements like height, weight, blood pressure and body mass index were recorded in both the groups.

5 ml venous blood was collected after an overnight fast and centrifuged. Serum was collected and analyzed for urea by Diacetyl monooxime method(12), creatinine by Jaffe's method(12), calcium by cresolphthalein complexone method(13), phosphorus by Gomorri's method(13), sodium and potassium by flame photometer(14), creatinine clearance by Cockcroft-Gault

formula(15). Statistical analysis is done by Student t test (two tailed, independent) to find the significance of study parameters on continuous scale between two groups (Inter group analysis) on metric parameters.

## RESULTS

**Table 1: Age distribution**

Age in years	Controls		Cases	
	No	%	No	%
30-34	9	30.0	8	26.7
35-39	9	30.0	4	13.3
40-44	5	16.7	7	23.3
45-50	7	23.3	11	36.7
Total	30	100.0	30	100.0
Mean $\pm$ SD	38.87 $\pm$ 6.63		40.57 $\pm$ 7.10	

**Table 2: Comparison of study variables between two groups**

Variables	Controls	Cases	P value
Age in years	38.87 $\pm$ 6.63	40.57 $\pm$ 7.10	0.342
Weight in kg	66.33 $\pm$ 5.33	68.63 $\pm$ 5.12	0.093+
Serum Urea mg/dl	27.90 $\pm$ 6.19	35.23 $\pm$ 12.41	0.005**
Serum creatinine mg/dl	0.89 $\pm$ 0.11	1.16 $\pm$ 0.44	0.002**
Creatinine Clearance ml/min	105.08 $\pm$ 7.74	91.48 $\pm$ 25.06	0.006**
Serum Sodium mEq/l	138.10 $\pm$ 2.23	136.13 $\pm$ 2.54	0.002**
Serum Potassium mEq/l	3.76 $\pm$ 0.30	3.62 $\pm$ 0.25	0.05*
Serum calcium mg/dl	9.57 $\pm$ 0.40	9.14 $\pm$ 0.39	<0.001**
Serum phosphorus mg/dl	3.78 $\pm$ 0.33	3.20 $\pm$ 0.58	<0.001**

\* Moderately significant (P value: 0.01 < P  $\leq$  0.05)

\*\* Strongly significant (P value: P $\leq$ 0.01)

## DISCUSSION

**Table 1:** Shows the age wise distribution of the cases and controls.

Out of 30 cases 26.7% are in age group 30 – 34 yrs, 13.3% are in age group 35 – 39 yrs, 23.3% are in age group 40 – 44 yrs and 36.7% in age group 45 – 50 yrs. The mean age of the test subjects is 40.57 with standard deviation 7.10. Out of 30 controls 30% are in age group 30 – 34 yrs, 30% are in age group 35 – 39 yrs, 16.7% are in age group 40 – 44 yrs and 23.3% in age group 45 – 50 yrs. The mean age of the controls is 38.87 and standard deviation 6.63.

**Table 2:** Shows the comparison of study parameters between the two groups.

The mean of systolic blood pressure and diastolic blood pressure is high in cases when compared to controls, this is because 6 subjects among cases had blood pressure (BP) >140/90 and all the controls had BP normal limits. This shows a close relationship between alcohol

abuse and hypertension similar to a study on alcoholics where 5-30% of alcoholics were hypertensives(16). According to a study three drinks a day may trigger a 10mmHg BP increase per 10g/day alcohol intake.

The serum urea and creatinine values are significantly raised in chronic alcoholics with p value of <0.01 as compared to control. The creatinine clearance is significantly lowered in cases with a p value of 0.006 similar to a study done on apparently healthy men and alcoholics(17). Chronic ethanol administration results in decrease in renal tubular reabsorption and decrease in renal function. The vulnerability of the kidneys to oxidative damage has been partly attributed to its high content of long chain PUFA. In a study of alcoholics mixed electrolyte disturbances were noted like hyponatremia, pseudo hyponatremia, hypokalemia, hypomagnesemia, hypophosphatemia and hypocalcemia (18). Hypomagnesemia is also common in alcoholics due to increased urinary excretion and decreased dietary intake(19). Hypophosphatemia causes reduced cardiac output, respiratory failure and increased risk of sepsis. Hypocalcemia leads to osteoporosis and increases risk of fractures. The kidneys play a vital role in regulating the electrolyte balance which in turn maintains body's homeostasis. Alcohol causes glomerular and tubulo interstitial damage evident in heavy drinkers. However alcohol consumption is associated with endstage renal disease(20). Alcohol has a diuretic effect thereby increasing urine volume and hence produces alterations in electrolyte disturbances like hypocalcemia, hypophosphatemia<sup>21</sup>. The levels of serum sodium, potassium, calcium and phosphorus are significantly lowered when compared to the controls with a p value of <0.01. In a study to assess the glomerular and tubular functions a similar findings of electrolyte disturbance was noted(21). So there is an apparent association between alcohol consumption and renal functions. Chronic alcoholics have low blood levels of key electrolytes due to impaired renal function. There are not many studies to emphasize the renal functions and electrolyte imbalance.

## CONCLUSION

Alcohol consumption is a major threat to public health, however liver is the primary target of alcohol. Alcohol abuse predisposes the subjects to increased risk of renal dysfunction even before the liver damage and chronic alcohol intake impairs the renal function and results in wide range of electrolyte disorders like hyponatremia, hypokalemia, hypocalcemia, hypomagnesemia, hypophosphatemia. This study is carried out to assess the renal dysfunction in chronic alcoholics by estimating serum urea, creatinine, creatinine clearance and also the electrolyte disturbances.

**Acknowledgements:** Nil

**Conflicts of interest:** Nil

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