

Sodium and Potassium Ions Levels in Cirrhosis and Chronic Liver Disease of Iraqi Patients

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Abstract- Serum sodium and potassium ions are independent predictors of severity in chronic and cirrhotic liver disease (LD) patients. To investigate the ratio of these electrolytes in patients infected by LD and how far they associated with type of LD, prospective data were polled on 41 patients had chronic and cirrhosis LD from Baghdad in Iraq for a period of two months. The results were compared with those obtained from healthy subjects. All samples were collected from The City of Medicine hospital of digestive tract diseases. The prevalence of hyponatremia had a significance appearance in cirrhotic patients when compared with the healthy group (130.4 vs. 147.1mmol/l, $p<0.05$), and a significance hyperkalemia in chronic liver patients when compared with healthy subjects (5.7 vs. 3.9 mmol/l, $p<0.05$). A strong correlation between the type of liver disease and the level of sodium and potassium ions indicates that cirrhosis liver lead to hyponatremia ($r=0.78$, $p<0.03$), and chronic liver leads to hyperkalemia ($r=0.83$, $p<0.02$).

In conclusion low serum sodium levels are associated with cirrhotic LD type and lead to increase potassium level, while hyperkalemia is positively related to chronic LD type.

Abbreviations- Chronic LD: chronic liver disease, Cirrhosis LD: cirrhosis liver disease, GPT: glutamate pyruvate transaminase.

Keywords- hyponatremia, cirrhosis liver disease, hyperkalemia, Na-K pump.

I. INTRODUCTION

Cirrhosis LD might be considered as a final common histological pathway of chronic LD) and it could be described by converting liver tissues into fibrosis, scar tissues and regenerative nodules (lumps that occur when damaged tissue regenerates) which would lead to liver dysfunction [1]. Chronic and cirrhosis LD are causing about 35,000 deaths/ year in the United States, moreover, cirrhosis is recorded to be the ninth leading cause of death annually in the United States [2]. The term cirrhosis (scirrhus in Greece) was firstly introduced by

Laennec in 1826 to describe the orange color surface of liver seen at autopsy [1, 3].

In advanced liver cirrhosis; disturbance in body water homeostasis is commonly seen and this is can be detected by a reduction in solute-free water clearance which caused by a higher rate of renal retention of water when compared to sodium concentration [4], if the amount of excreted water in urine was not adjusted to the amount of ingested water then dilution hyponatremia will appear, however, large advance had been made to acknowledge the pathogenesis effect of reduced solute-free water clearance in cirrhosis patients is related to the severity of cirrhosis [5].

Previous studies in large proportion of cirrhotic patients have shown that the renal ability to excrete free water (measured either by testing solute-free water clearance or serum sodium concentration) has a strong correlation with survival, however, hyponatremia patients are having a poor survival than those without hyponatremia [6,7]. Moreover, recent several studies have shown that survival is related with serum sodium concentration in cirrhotic patients awaiting liver transplantation [8-11].

Although potassium ion level has a physiological effects on many actions like muscle contractibility and cardiac function, hydrogen ion exchange in the tubule and acid-base balance; but the potassium status of cirrhotic patients is affected adversely by many factors including diet, diuretic treatment or gastrointestinal losses [12].

The most usual causes of increased potassium concentration in cirrhotic patients are related with the amount of potassium intake, release of potassium from cells into extracellular fluid and reduce secretion of urinary potassium [13].

The electrochemical gradient of low intracellular sodium and high intracellular potassium is maintained by Na-K pump; however this gradient is essential to provide energy for the transportation of metabolites and nutrients through cell membrane, for cell volume regulation and also for the nerve and muscle action potential. It was found that there is interdependent between the concentrations of sodium and potassium ions on both sides of the membrane, suggesting that both ions are carried by the same carrier transports [14].

The aim of the present study was to investigate sodium ion status in both chronic and cirrhosis LD, the clear association between the ion concentration and these diseases, occurrence of other complications with potassium ion level by means of a prospective epidemiological study in Iraqi men patients, and make a review about effect of ions disturbance on Na⁺ - K⁺ pump activity.

II. MATERIALS AND METHODS

A. Study location, kind of population and including criteria

The study involved the prospective collection of data on patients from Medical City hospital- Digestive center for a period of 60days (Jan- march 2010).

Consecutive patients with cirrhosis and chronic attending the hepatology outpatient clinics or under the care of hepatologists (don't have renal function diseases and stopped alcohol intake) as inpatients were included in the study according to a couple of criteria: [1] diagnosis of cirrhosis LD either by histology or a combination of clinical, biochemical, and ultrasonographic findings; and [2] presence of chronic detected by ultrasonography.

Data on each patient was recorded at the beginning of the collection time if the patient was hosting in the hospital or if he was on admission as an inpatient. The data collection was planned to include 41 patients. Nineteen of them were infected by chronic LD and 22 subjects were cirrhotic LD patient. Another 19 subjects were enrolled as healthy group. These samples age were among 40 – 50 years old.

B. Presence of liver disease

Needle biopsy of the liver was used to establish the occurrence of cirrhosis LD in each case in addition to the demonstration of the characteristic abnormalities of serum proteins, increased bilirubin levels, decreased bromsulphalein excretion, elevated GPT level, and etc. The tolerance studies were conducted once convalescence from hepatic decomposition had been well established.

C. Sera Samples

Five ml of blood were thrown, centrifuged at 100 cycle/sec. for 5 min, and then sera were analyzed immediately by Blood Gases Analysis instrument.

D. Statistical analysis:

Results are expressed as the mean + SD. The significance of differences was assessed Students t-test for groups of non-paired observations. Association of serum sodium with several variables including patient characteristics, management of complications of cirrhosis was tested using Pearson's Correlation Coefficients. Differences were considered significant if P<0.05. All the statistical analysis were performed by SPSS version [10] software.

III. RESULTS

Results indicate an important decrease of sodium level (hyponatremia) in cirrhosis than chronic LD when compared to that of normal subjects (130.4±6.4 vs 145.5±12.23 mmol/l, p<0.05), while the level of potassium was significantly higher (hyperkalemia) in chronic than cirrhosis when compared with normal subjects (5.7±0.93 vs 4.2±0.66 mmol/l, p<0.05), Table 1, Fig. 1 and 2 According to Table (2), it appears noticeably that hyponatremia and hyperkalemia occurrence is highly dependent on LD type. The data shows that reduction of sodium level increases when there is cirrhotic LD (r=0.78, p<0.03), and enhancement of hyperkalemia occurrence is related to chronic LD (r=0.83, p<0.02). In order to consider the effect of hyponatremia on changes of potassium level, the present analysis shows a kindly signal indicate a strong correlation between both ions levels, nevertheless, this relation elevated in cirrhotic LD patients (r=0.77, 0.81 respectively, p<0.05).

TABLE I. LEVELS OF Na⁺ AND K⁺ IN DIFFERENT TYPES OF LIVER DISEASES

Type of disease	Age(yr)	No. of cases	Na ⁺ level mmol/L	K ⁺ level mmol/L
Chronic LD	47± 11.5	N=19	145.5± 12.23 N.S	5.7 ± 0.93*
Cirrhosis LD	48±11.1	N=22	130.4 ± 6.4*	4.2 ± 0.66 N.S
Normal	45±11.6	N= 19	147.1 ± 5.1	3.9 ± 0.51

* = p < 0.05, N.S= non-significant

TABLE II. CORRELATION FACTORS OF Na⁺ AND K⁺ LEVELS IN THE LIVER DISEASE

Ions concentration mmol/l	Chronic LD (r value)	Cirrhosis LD (r value)
Na ⁺	0.65 *	0.78**
K ⁺	0.83***	0.55*
Na ⁺ vs K ⁺	0.77*	0.81*

*=p<0.05, **= p<0.03, ***=p<0.02

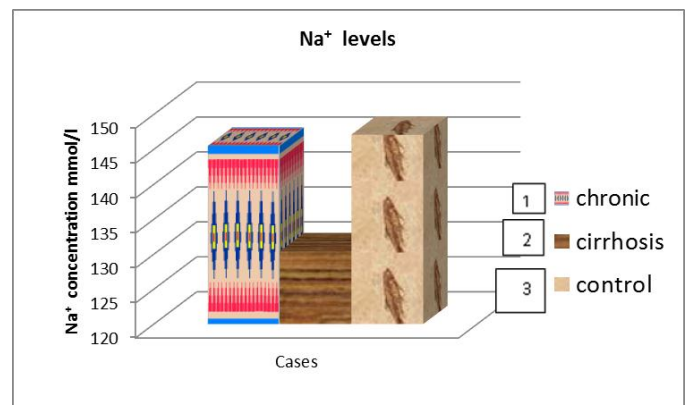


Figure 1. Levels of Na⁺ in different types of liver disease and control

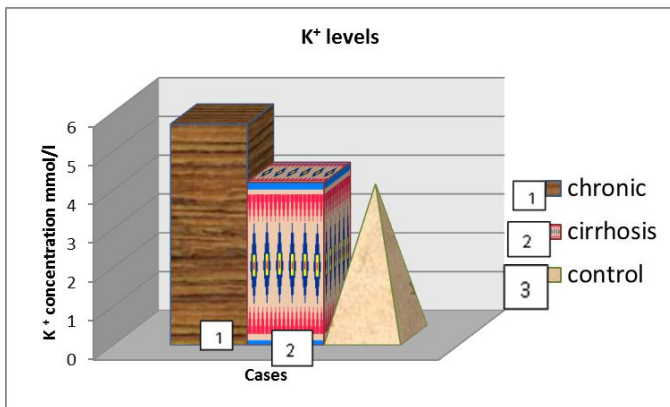


Figure 2. Levels of K⁺ in different types of liver disease and control

IV. DISCUSSION

This study represents the most important investigation reported thus far assessing serum sodium concentration and its association with occurrence of further complications in cirrhotic or chronic liver patients.

Our results indicate that patients with cirrhosis have abnormal values of serum sodium concentration, in fact, they had hyponatremia. Recent study shows that hyponatremia in cirrhosis was highly associated with the severity of liver cirrhosis rather than age, sex, or other causes of cirrhosis [15]. Nevertheless, it should be mentioned here that the mean cause of hyponatremia in cirrhosis was related to the kidney's inability to discharge the water normally and that means excessive retention of free-water as a result of over hydration, beside, we should think of the additional factors that responsible on hyponatremia like reduction of sodium delivery to the distal tubule as a result of decrease glomerular filtration rate in addition to the re absorption of sodium in the proximal tubule in an increscent degree [16,17].

The morbidity and death rate related with hyponatraemia is highly attributable to the disturbance of central nervous system, whereby brain water content increases according to hyponatremia duration and mechanisms of compensatory processes [18]. Hyponatraemia encephalopathy in cirrhotic patients might develop by altered steroid and peptide hormones, and this symptom overlaps with hepatic encephalopathy and uremia [18, 19].

On the other hand, potassium level in chronic liver disease has a complex handling, expected a risk of either low levels which are related to vomiting, diarrhea, or high levels which are associated with renal impairment, potassium-sparing diuretics, or metabolic acidosis, however, the significant elevation of potassium concentration in our chronic patients is acceptable with that obtained by other investigators [20] who explained the hyperkalemia by the failure of the kidneys to normally excrete potassium ions into the urine and the release of potassium ion from cells and tissues into the blood stream which accounts for about three quarters of all cases. While in cirrhotic patients, serum potassium concentrations usually were

none significantly higher than normal. This result was acceptable with other study [21], but it disagrees with others [22] who indicates that there is a depletion in potassium in cirrhotic patients associated with a diabetic glucose tolerance test and reduced output of both insulin and growth hormone.

Potassium level was studied here because of the intimate relationship of sodium and potassium to the regulation of intra- and extracellular fluids, therefore potassium is influenced by reduction of sodium concentration. Our results pointed out a positive strong influence of hyponatremia on hyperkalemia in both cirrhosis and chronic liver patients and this is one of low sodium level complication, however, Knight and Welt [23, 24] demonstrated that high level of K could inhibit the Na - K pump, especially when sodium level is being low, in a manner analogous to the inhibitory effect of sodium.

Possible effects of K⁺, on the Na⁺-K⁺ pump have not been studied previously in intact human cells, On the other side, Szõnvi, L. et.al [25] indicates that Na⁺-K⁺ pump activity of children with chronic liver disease had been depressed due to the depressed function of Na⁺-K⁺ ATPase.

In conclusion, results of this study indicate that low serum sodium levels are a common feature in patients with cirrhosis; moreover, this feature long regarded as a poor prognostic sign, might be a function of unrecognized underlying hyperkalemia. The existence of serum potassium concentration is significantly related with a type of liver disease when compared with patients with serum potassium concentration in track within normal. Nevertheless, even a mild decrease in serum sodium concentration should not be neglected because further complications of cirrhosis may be frequented compared with normal serum sodium concentration patients. Those complications are significantly related to the enhancement of potassium concentration in chronic patients which may lead to depress the Na⁺-K⁺ pump activity. Further investigation is required to elucidate this phenomenon.

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