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Effect of Elevated Creatinine Level in Blood Serum of Chronic Renal Failure Patients

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ABSTRACT: Kidney is main seat of excretion. It has to handle all the excretory products of metabolic and toxins of the body. When kidney itself gets injured, due to various systemic and renal diseases, its excretory capacity is reduced by an amount proportional to the number of nephrons which have ceased to function. Chronic renal failure is characterized by a wide variety of biochemical disturbances. Creatinine is formed largely in the muscles by the irreversible and non enzymetic removal of water from creatine phosphate. Creatinine is a waste product and it is removed from the plasma by glomerular filteration and then excreted in the urine without being reabsorbed by the tubules. If plasma levels of creatinine increase above the normal concentration of creatinine in the blood, the kidney can also excrete creatinine through the tubules. In case of chronic renal failure the level of serum creatinine is largely increased. The present paper includes the study of serum creatinine levels of 200 patients (according to age group and sex) with chronic renal failure (CRF) before and after the process of treatment. It has been compared with 50 normal healthy individuals comprising the control group.

Key Words: Chronic Renal Failure, GFR, Dialysis, Serum Creatinine

INTRODUCTION

Creatinine is a waste product derived from creatine. It is the internal hydride of creatine. Renal failure is associated with major systemic, biochemical, hematological dearrangement. Biochemically, serum creatinine is the most widely used screening test for the evaluation of kidney function. Studies differ regarding the status of serum creatinine in chronic renal failure. Oleson *et. al.,* 1951 and Basette *et. al.,* 1932 noticed that creatinine and minerals are removed from the plasma by glomerular filtration is excreted in the urine without being reabsorbed. If plasma levels of creatinine increase above the normal concentration of creatinine in blood, the kidneys can also excrete creatinine through the tubules. So serum creatinine levels in renal disease generally do not increase until renal function is substantially impaired. Decreased creatinine excretion is regularly observed in chronic renal failure even at serum creatinine concentration as low as 0.35- 0.50 µmol/L. (Goldman *et. al.,* 1954, Effersoe *et. al.,* 1957, Doolan *et. al.,* 1962 and Enger *et. al.,* 1964). McCombs *et. al.,* 1965 observed that serum creatinine is being used as an important index of renal function.

Values greater than 1 mg/100ml are indicative of at least 50% decrease in renal function. Bennett *et. al.,* 1992 concluded that the range of plasma creatine level in uraemic patients (13-84 µmol/L) was similar to that of the controls (21-78 µmol/L). The variation of red cells creatine levels in uremic patients was significantly different from controls ($p < 0.02$) and the plasma of red cells creatine gradient was low in some patients. Bergamo *et. al.,* 1993 observed in normal individuals, the level of serum creatinine is 0.93 ± 0.12 mg/dl and ranged from 0.6-1.1 mg/dl but in CRF cases the level of serum creatinine is significantly high. The level was 4.7 ± 0.7 mg/dl ranged between 2.7-7.5 mg/dl**.** Coresh *et. al.,* 1998 noticed creatinine clearance as a measure of GFR in screenees for the African-American study of kidney disease. The purpose of present study is to find out biochemical procedures which may be helpful in making the diagnose of chronic renal failure and monitoring the prognosis of disease and find out any biochemical abnormalities in the patients of chronic renal failure. Yadav *et. al.* 2014 studied level of serum urea in the patients of chronic renal failure.

MATERIALS AND METHODS

The present study was carried out on 200 adult patients of chronic renal failure attended in the S.V.B.P. hospital attached to L.L.R.M. Medical College, Meerut and also 50 normal healthy individuals with age, sex matched who had no history of renal failure to serve as controls. All the known cases of chronic renal failure were included in this study on the basis of clinical and biochemical criteria. A known case of renal failure for more than three months duration (Harrison, 1992) and persons having serum creatinine more than 1.5 mg% were chosen for study. After confirmation of diagnosis on the above parameters, blood samples were drawn from these patients for the estimation of serum creatinine. All the chemicals and reagents used were of analytical grade.

Creatinine forms a yellow-orange compound in alkaline solution with picric acid. At the low picric acid concentration a precipitation of protein does not take place. The concentration of the dyestuff formed over a certain reaction time is a measure of the creatinine concentration.

OBSERVATIONS

Out of 50 control cases, 34 (68.0%) cases were males and 16 (32.0%) were females. 54.0% were found in the age group 51-70 years, 36.0% were 31-50 years age group and 10.0% were 10-30 years age group (Table 1 and 2). The majority of chronic renal failure cases were among more than 6 months- 1 year duration (114 cases, 57.0%) and then more than I year children (44 cases, 22.0%, Table 3).

Table 1: Distribution of C.R.F. Cases According to Age and Sex.

Age Groups (Years)	Number of cases		Total
	Males	Females	
10-30	5	2	7(3.5%)
31-50	50	25	75(37.5%)
51-70	63	40	103(51.5%)
71-above	10	5	15(7.5%)
Total	**128(64.0%)**	**72(36.0%)**	**200(100.0%)**

Table 2: Distribution of Control Cases According to Age and Sex.

Age Groups (Years)	Number of cases		Total
	Males	Females	
10-30	4	1	5(10.0%)
31-50	12	6	18(36.0%)
51-70	18	9	27(54.0%)
Total	**34**	**16**	**50(100.0%)**

Table 3 : Distribution of C.R.F. Cases According to Duration of Illness.

Duration of illness	No. of cases	Percentage %
3 months-6 months	42	21.0%
6 months-1 year	114	57.0%
More than 1 year	44	22.0%
Total	**200**	**100.0%**

Table 4: Serum Creatinine Level in Normal Healthy Controls.

Age in years	*Male*			*Female*			*Total*		
	No.	Range (mg/dl)	Mean ± S.D.	No.	Range (mg/dl)	Mean ± S.D.	No.	Range (mg/dl)	Mean ± S.D.
10-30	4	0.7-1.0	0.88±0.12	1	0.6-0.7	0.63±0.06	5	0.6-1.0	0.83±0.15
31-50	12	0.8-1.1	0.97±0.08	6	0.7-0.9	0.81±0.07	18	0.7-1.1	0.91±0.11
51-70	18	0.9-1.1	1.01±0.05	9	0.7-0.9	0.84±0.05	27	0.7-1.1	0.95±0.09
Total	**34**	**0.7-1.1**	**0.98±0.09**	**16**	**0.6-0.9**	**0.81±0.08**	**50**	**0.6-1.1**	**0.93±0.12**

The range of serum creatinine in healthy subjects was 0.6-1.1 mg/dl (mean 0.93±0.12mg/dl). In males it ranged from 0.7-1.1 mg/dl (mean 0.98±0.09 mg/dl) and in females 0.6-0.9 mg/dl (mean 0.81±o0.08mg/dl).

The highest creatinine level was observed in the age group of 51-70 years, ranged as 0.7-1.1 mg/dl (mean 0.95±0.09 mg/dl) followed by the age group of 31-50 years, ranged as 0.7-1.1 mg/dl (mean 0.91±0.11 mg/dl) and the age group of 10-30 years, ranged as 0.6-1.0 mg/dl (mean 0.83±0.15 mg/dl) respectively. No significant difference was seen among the serum creatinine levels of different age groups and sexes (Table 4).

Table 5: Serum Creatinine Levels Before and After Treatment in Total Cases of Chronic Renal Failure.

Interval	No. of Cases	Serum Creatinine	
		Range (mg/dl)	Mean ± S.D.
Control	50	0.6-1.1	0.93±0.12
Before treatment	200	2.2-6.0	4.68±1.03***
15 days after treatment	186	1.8-5.3	4.19±0.85***
30 days after treatment	169	1.7-4.8	3.74±0.79***
60 days after treatment	145	1.6-4.0	3.30±0.63***
90 days after treatment	122	1.5-3.8	3.03±0.60***

P- Significance, control vs treatment, *p < 0.05, **p < 0.01, ***p < 0.001.

The creatinine levels were significantly raised before and after 90 days of treatment in chronic renal failure cases as compared to controls. The range of creatinine levels were 2.2-6.0 mg/dl (mean 4.68±1.03 mg/dl), 1.8-5.3 mg/dl (mean 4.19±0.85 mg/dl), 1.7-4.8 mg/dl (mean 3.74±0.79 mg/dl), 1.6-4.0 mg/dl (mean 3.30±0.63 mg/dl) and 1.5-3.8 mg/dl (mean 3.30±0.60 mg/dl), before and after fifteen, thirty, sixty and ninety days of treatment respectively (Table 5).

RESULT AND DISCUSSION

The present study is conducted on a total of 250 individuals, out of which 50 are normal healthy individuals comprising the control group and rest 200 is of chronic renal failure. Results of biochemical parameter like serum creatinine from this study are discussed below-

Out of 50 healthy controls, 34 (68%) controls were males individuals and rest 16 (32%) were females. The range of serum creatinine in healthy subjects was 0.6-1.1 mg/dl (mean 0.93±0.12 mg/dl). In males, it ranged from 0.7-1.1 mg/dl (mean 0.98±0.09 mg/dl) and in females, 0.6-0.9 mg/dl (mean 0.81±0.08 mg/dl). Highest serum creatinine level was observed in the age group of 51-70 years (0.95±0.09 mg/dl) followed by the age group of 31-50 years (0.91±0.11 mg/dl) and the age group of 10-30 years (0.83±0.15 mg/dl, Table 2). No significant difference was found in normal healthy controls of individuals of different age group and sexes. Our findings are close to those reported as normal by Shannon *et. al.,* 1935, Bonsnes *et. al.,* 1945, Smith et. al., 1951, Owen *et. al.,* 1965.

Out of 200 individuals, 128 (64%) controls were males individuals and rest 72 (36%) were females. All the 200 individuals were between the age group of 10 to 70 years.

The maximum number of cases, 103 (51.5%), were observed in the age group of 51-70 years followed by 75 (37.5%) cases in the age group of31-50 years, 15(7.5%) cases in the age group of above 70 years and 7 (3.5%) cases in the age group of 10-30 years (Table 1). It has been observed that the incidence of chronic renal failure reaches its maximum strength during middle age and later part of life.

In case of chronic renal failure, serum creatinine was found increased in 97% cases. Before treatment, the level of serum creatinine was 4.68±1.03 mg/dl which was significantly high ($p < 0.001$) as compared to that of controls 0.93±0.12 mg/dl. Mitch *et. al.*, 1980, Avram *et. al.*, 1983 and Levey *et. al.*, 1988 also found a significant increase in the levels of serum creatinine. After 15 days of treatment, the level of serum creatinine decreased to 4.19±0.85 mg/dl. But still it was significantly high ($p < 0.001$) as compared to controls. After 30 days of treatment, the level of serum creatinine declined to 3.74±0.79 mg/dl. This was significantly high ($p < 0.001$) as compared to controls. After 60 days of treatment, the level of serum creatinine declined to 3.30±0.63 mg/dl. This was significantly high ($p < 0.001$) as compared to controls. After 90 days of treatment, the level of serum creatinine was decreased to 3.03±0.60 mg/dl but still it was significantly high ($p < 0.001$) as compared to controls (Table 4). The level of serum creatinine remained significantly high throughout the follow -up. In the present study, only 122 cases out of 200 cases turned up for follow-up to the last. This figure was low, because most of the cases defaulted in treatment.

Highly elevated creatinine levels were found in chronic renal failure patients. In normal healthy subjects, creatinine level ranged between 0.6-1.1 mg/dl and mean 0.93±0.12 mg/dl.

In study group, creatinine levels were highly increased and ranged between 2.2-6.0 mg/dl and mean 4.68±1.03 mg/dl. After 15, 30, 60 and 90 days of treatment, the level of serum creatinine ranged from 1.8-5.3 mg/dl, 1.7-4.8 mg/dl, 1.6-4.0 mg/dl and 1.5-3.8 mg/dl and mean 4.19±0.85 mg/dl, 3.74±0.79 mg/dl, 3.30±0.63 mg/dl and 3.03±0.60 mg/dl respectively. The difference between chronic renal failure patients and controls was found highly significant ($p < 0.001$) and it remains increased throughout the follow-up. The serum creatinine levels are directly related to severity of the disease. Maximum probabilities of chronic renal failure were found in the age group 51-70 years (51.5%). Minimum probabilities of chronic renal failure were found in the age group 10-30 years (3.5%). From the present study it has been concluded that the creatinine levels were significantly raised before and after 90 days of treatment in chronic renal failure cases as compared to controls. Our whole finding are in accordance to the observations and experiments conducted by Levey *et.al.,* 2007, Reznichenko *et. al.* 2013, Levey *et. al.* 1996, Branten *et. al.* 2005, Hsu *et. al.* 2011 and Joffe *et. al.*, 2010.

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