

Comparative Study of Serum Creatinine Level in Normotensive and Hypertensive Individuals

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Abstract

Background: Hypertension is a major contributor to the global disease burden. Persistent hypertension is a leading cause of chronic renal failure. One of the simple and most commonly performed renal function tests to determine the functioning state of the kidney is the determination of serum creatinine level.

Aims and Objectives: To evaluate and compare serum creatinine levels in hypertensive and normotensive individuals.

Materials and Methods: The study was conducted in tertiary care hospital. The study was done in 50 hypertensive patients and 50 normotensive subjects between the age group of 40 and 60 years. Blood pressure was measured using sphygmomanometer and serum creatinine was estimated by the alkaline picrate method.

Results: The serum creatinine was higher in hypertensive cases than normotensive controls, i.e., 2.15 ± 0.47 mg/dl versus 0.86 ± 0.14 mg/dl, $P < 0.0001$. Serum creatinine level is higher in Stage-1 ($P < 0.01$) and Stage-2 hypertensive subjects ($P < 0.01$) than normal.

Conclusion: From this study, it can be concluded that serum creatinine is an important indicator for the determination of functional state of the kidneys, so routine monitoring of serum creatinine level is required in hypertensive patients to prevent end-stage renal disease.

Key words: Blood pressure, End-stage renal disease, Hypertension, Serum creatinine

INTRODUCTION

Hypertension is a major contributor to the global disease burden. It poses an important public health challenge to both economically developing and developed countries, including India.^[1] Persistent hypertension is a leading cause of chronic renal failure (CRF).^[2]

One of the simple and most commonly performed renal function tests to determine the functioning state of the kidney is the determination of serum creatinine level.

Creatinine is a breakdown product of creatine phosphate. Creatine is synthesized in the liver, transported to the

muscles for storage as creatine phosphate, and then catabolized in the muscle to form creatinine. Creatinine is removed from the body entirely by the kidneys. If kidney function is abnormal, creatinine level will increase in the blood.^[3-5]

Aims and Objectives

To evaluate and compare serum creatinine levels in hypertensive and normotensive individuals.

MATERIALS AND METHODS

This study was carried out in a tertiary care hospital. The study was done in 50 hypertensive patients and 50 normotensive subjects between the age group of 40 and 60 years, which included both males and females.

Inclusion Criteria

The criteria of considering patient hypertensive was blood pressure (BP) $>140/90$ mm of Hg based on the average of two readings with a duration of <5 years on

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medication. The controls were healthy volunteers with BP <120/80 mm of Hg.^[6]

Exclusion Criteria

The subjects with any associated diseases such as diabetes, peripheral vascular diseases, pregnancy, alcohol, tobacco, smoking, terminally ill hypertensive patients, leprosy, or other conditions, which are known to cause peripheral neuropathy were excluded from the study.

Estimation of Serum Creatinine Level^[7-9]

- Fresh sample of serum with no evidence of hemolysis was specimen of choice.
- Serum creatinine level was estimated by the alkaline picrate method.

Measurement of BP^[10-11]

- BP was measured by an indirect method using a sphygmomanometer.
- Current clinical criteria for defining hypertension are generally based on the average of two or more BP readings during each or more outpatient visits.

RESULTS

Statistical Analysis

All the data would be selected randomly and tabulated, and then analyzed with appropriate statistical tools “MedCalc”. Data will be presented as mean with standard deviation or proportions as appropriate. Mean, median, standard deviation, and variance would be calculated and the following statistical significance tests would be applied.

1. Student’s paired *t*-test will be used as the statistical tool to test for significance of observed mean differences.

Finally, the calculated value should be compared with the tabulated value at particular degree of freedom and finds the level of significance.

A “*P*-value” should be considered to be non-significant if >0.05 and significant if <0.05.

For Test of Significance, Here we use

“Test of significance difference between two means { | *t* | -Test}”

| *t* | *cal*=12.68 {at 95% confidence limit,with degree of freedom =58, | *t* | *tab* = 1.96}

| *t* | *cal* > | *t* | *tab* {12.68 >1.96} at 5% level of significance.

Hence, the hypertensive group is statistically significant than the Normotensive group, according to their Systolic BP, in hypertensive group mean was much more than Normotensive group, with *P* – value {*P* < 0.0001}.

For Test of Significance, Here we use

“Test of significance difference between two means { | *t* | -Test}”

| *t* | *cal*=14.714 {at 95% confidence limit,with degree of freedom =58, | *t* | *tab* = 1.96}

| *t* | *cal* > | *t* | *tab* { 14.714 >1.96} at 5% level of significance

Hence, Hypertensive group is Statistically significant than Normotensive group, according to their Diastolic BP, in Hypertensive group mean was much more than Normotensive group, with *P* – value {*P* < 0.0001}.

For Test of Significance, Here we use

“Test of significance difference between two means { | *t* | -Test}”

| *t* | *cal*=14.408 {at 95% confidence limit,with degree of freedom =58, | *t* | *tab* = 1.96}

| *t* | *cal* > | *t* | *tab* { 14.408 >1.96} at 5% level of significance.

Hence, the hypertensive group is Statistically significant than the Normotensive group, according to their serum creatinine, in hypertensive group mean was much less than Normotensive group, with *P* – value {*P* < 0.0001}.

For Test of Significance, Here we use

“Test of significance difference between two means { | *t* | -Test}”

At 95% confidence limit,with degree of freedom 58, | *t* | *tab* = 1.96

In all the above cases | *t* | *cal* > | *t* | *tab* {at 5% level of significance}.

Hence, the hypertensive group is statistically significant than the Normotensive group, according to their Systolic BP, Diastolic BP, serum creatinine in hypertensive group means are much less than Normotensive group, with *P* – value {*P* < 0.05}.

DISCUSSION

Several studies worldwide have been done on serum creatinine in relation to the risk of chronic kidney disease such as CRF and end-stage renal disease (ESRD), but a few studies are in relation to hypertension have been found yet. The observations of our study are discussed as below:

In our study serum creatinine was higher in hypertensive cases than normotensive controls, i.e., 2.15 ± 0.47 mg/dl versus 0.86 ± 0.14 mg/dl, $P < 0.0001$ [Tables 1-4 and Graphs 1-4]. The creatinine difference was found statistically significant. Similar findings were obtained in multiple risk factor intervention trial, which showed that no relationship was seen between BP at baseline and serum creatinine levels, but in hypertensive patients showed greatest increase in serum creatinine over 6 years follow up.^[12]

Similarly, findings of study by Nagah *et al.* in Sudan have shown that mean values of serum creatinine was higher in hypertensive cases than normotensive controls, i.e., $141.3 \pm 39.0 \mu\text{ mol/L}$ versus $52.4 \pm 18.0 \mu\text{ mol/L}$ and the difference was statistically significant. They found elevated serum creatinine and protein, in addition to the presence of protein in urine might be direct effect of hypertension and its related complication on renal function.^[13] A 9 years follow-up study on 897 subjects in hypertension conducted

by Rosanky *et al.*, has shown that essential hypertensive subjects had a considerably high rate of turndown in renal function compared with normotensive subjects.^[14]

The results of National Health and Nutrition Examination Survey third have shown that serum creatinine level is an indicator of chronic renal disease and was found common and strongly related to inadequate treatment of hypertension.^[15]

A study done in Japan by Ishida *et al.*, to know the effect of high BP on renal function by estimating serum creatinine as a marker of kidney functioning and shown that high serum creatinine levels are accelerated in hypertensive subjects and in those with proteinuria and especially in those in whom both are present.^[16]

In contrast, study by Kadri *et al.*, showed that serum creatinine was higher in hypertensive subjects than normotensive subjects but the differences were not statistically significant.^[17] A study done by Wannamethee *et al.*, have shown that elevated serum creatinine was found in 13.8% of hypertensive cases and in 8.6% of normotensive subjects (test of difference, $P < 0.001$). The serum creatinine levels in male hypertensive cases was higher than male normotensive control, i.e., 0.95 ± 0.05 mg/dl versus 0.89 ± 0.05 mg/dl ($P = 0.396$). The difference was not found statistically insignificant.^[18] Another study done by Sarkar *et al.* has shown that serum creatinine was higher in hypertensive cases than normotensive control group i.e., 0.86 ± 3.20 mg/dl versus

Table 1: Comparison of systolic blood pressure

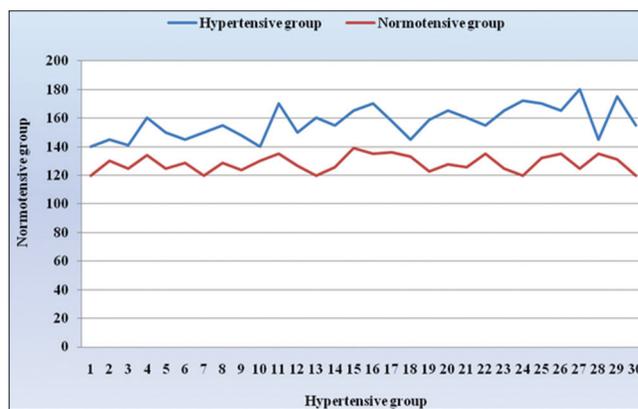
Parameter	Hypertensive (n=30)	Normotensive (n=30)
Mean	157.10	128.40
Standard deviation	11.03	5.65

Table 2: Comparison of diastolic blood pressure

Parameter	Hypertensive (n=30)	Normotensive (n=30)
Mean	96.87	82.27
Standard deviation	4.67	2.78

Table 3: Comparison of serum creatinine

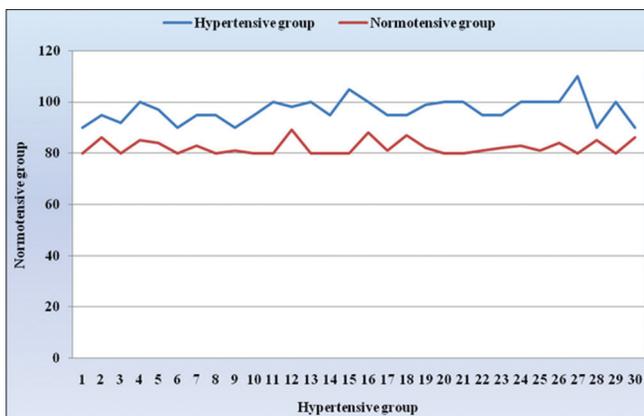
Parameter	Hypertensive (n=30)	Normotensive (n=30)
Mean	2.15	0.86
Standard deviation	0.47	0.14



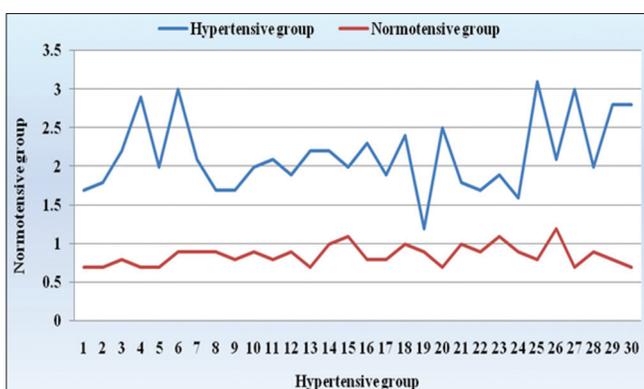
Graph 1: Comparison of systolic blood pressure between the two groups

Table 4: Comparison of different parameters

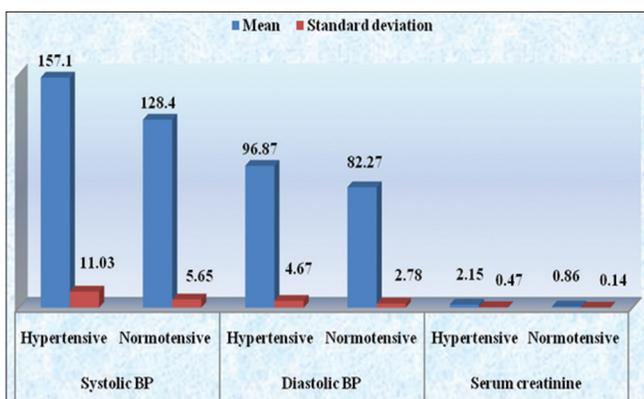
Parameter	Hypertensive (n=30) Mean±s.d.	Normotensive (n=30) Mean±s.d.	t cal	d.f	P-value	Conclusion
Systolic BP	157.1±11.03	128.4±5.65	12.68	58	$P < 0.0001$	Significant
Diastolic BP	96.87±4.67	82.27±2.78	14.714	58	$P < 0.0001$	Significant
Serum creatinine	2.15±0.47	0.86±0.14	14.408	58	$P < 0.0001$	Significant



Graph 2: Comparison of diastolic blood pressure between two groups



Graph 3: Comparison of serum creatinine between two groups



Graph 4: Comparison of different parameters

0.79 ± 4.01 mg/dl, $P = 0.990$, but the difference was not statistically significant.^[19]

The present study shows that serum creatinine level was higher in hypertensive cases than in normal healthy controls. Hence, it is concluded that hypertensive patients are more prone to develop elevated serum creatinine levels and chronic kidney diseases. Hence to prevent the chronic kidney disease and other consequences in hypertension,

it is needed to plan the estimation of serum creatinine in daily clinical practice.

CONCLUSION

- The following conclusion can be drawn from this study serum creatinine is higher in hypertensive subjects than non-hypertensive subjects.
- As serum creatinine is an important indicator for the determination of the functional state of the kidneys, so routine monitoring of serum creatinine level is required in hypertensive patients to prevent ESRD.

DATA AVAILABILITY

The data used to support the findings of this study are included within this article.

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