Detection of Nephropathy in Prehypertensive Subjects

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Abstract

Background: To study the trend in levels of serum creatinine in prehypertensive people for detection of renal dysfunction.

Methods: In this descriptive study a total of 90 apparently healthy subjects with age being 30-55 years and without any other illness were selected. Blood pressure of participants was monitored and categorised into two groups; normotensive group 1 (n=43) and prehypertensive group 2 (n=43). Any volunteer with raised blood sugar was excluded from the study. Average height and weight of all volunteers were calculated. Blood samples were drawn and serum creatinine was analysed of all participants with Jaffe’s procedure. Serum creatinine > 1.4 mg/dl was set as an outcome variable whereas high normal blood pressure levels were taken as the predictor variables in order to find a cross sectional association amongst them. Effects of demographic factors such as age, weight and height were already adjusted so they did not affect the outcome variables.

Results: Mean systolic and diastolic blood pressures in normotensive group were 111.6±3.4 mmHg and 72.93±3.04 mmHg respectively whereas mean systolic blood pressure in prehypertensive group was 122.74±3.05 mmHg and diastolic 82.37±2.66 mmHg respectively (p<0.0001). Frequencies and percentages for serum creatinine above cutoff levels in prehypertensives were 1 and 2.3% respectively whereas below cutoff levels were 42% and 97.7% respectively. Frequencies and percentages below cutoff levels of serum creatinine were 43 and 100% respectively for the normotensive group. Mean values of serum creatinine levels were 0.9521±0.199 mg/dl in prehypertensives which were statistically not higher than the serum creatinine levels of normotensive group 0.9126±0.157 mg/dl (p>0.05).

Conclusion: Negligible difference in serum creatinine concentrates were found amongst prehypertensives and control group.

Key Words: Prehypertension, creatinine, nephropathy.

Introduction

Prehypertension is an insidious disease and may go unnoticed for many years till the state of full blown hypertension is achieved. There are no specific signs and symptoms associated with prehypertensive state. Studies have demonstrated prehypertensive state to be as fatal as hypertensive state. Prehypertension is linked with heart diseases, stroke and nephropathy as reported in several clinical studies. National heart, lung and blood institute has reported that population having prehypertension for an extended period of time are at increased risk for developing malignant hypertension in future. Sedentary lifestyle, higher body mass index (BMI) and increased dietary sodium can contribute to rise in blood pressure by the middle age of adolescence if their values stay above cutoff point for prehypertension (120/80 mmHg). National high blood pressure education program working group presented the fourth report which documented that persistently higher than normal blood pressure in prehypertension state would enhance the risk of progression of renal disease from its mild state to the fully developed chronic renal disease. Prehypertensive and hypertensive people have usually low arterial compliance which is due to the action of aldosterone on smooth walls of vessels and potentiating the total peripheral resistance. Prehypertensive population have higher circulating blood levels of various stress hormones namely cortisol and aldosterone which are attributed to the stressful life at a younger age which may develop into full blown hypertension.

Assessment of renal function and its impairment is still the most frequently by the measurement of serum creatinine owing to its established reciprocal relationship with its clearance from nephrons. Several creatinine based tests have now been the basis of non invasive and cost effective tests to grade level of kidney damage. Serum creatinine and creatinine based tests have been frequently utilized around the world as an index of kidney functions.

Creatinine with molecular mass of 113kilo Daltons is a byproduct of creatine/phosphocreatine and is basically an amino acid derivative. Total creatine concentration in muscle, where it is found in
abundance (125 mmol/kg dry mass) and nearly about 2% of creatine formed in the body is converted into waste product creatinine at a fairly constant rate provided all others contributing factors remain constant. Creatinine formed is filtered freely through glomerular membrane and 5% to 10% is usually secreted through proximal tubules. Free filtration of creatinine occurs through glomeruli thereby making serum creatinine level dependent on the rate of glomerular filtration rate (GFR). Renal disease would not allow creatinine to filter through renal glomeruli thereby increasing serum creatinine levels. It is evident from the fact that strict control in blood pressure would improve serum creatinine and ultimately lessen chances of nephron loss and reduction of morbidity and mortality. High serum creatinine levels have been found in adult US population due to the inadequate control of their elevated blood pressure levels.

Patients and Methods
In this descriptive study a total of 90 apparently healthy subjects with age being 30-55 years and without any other illness were selected from Army Medical College, Rawalpindi from January 2013 to Feb 2014. The study was conducted in accordance with the current Good Clinical Practices and the Declaration of Helsinki. Blood pressure of participants was monitored and categorised into two groups; normotensive group 1 (n=43) and prehypertensive group 2 (n=43). Any volunteer with raised blood sugar was excluded from the study. Average height and weight of all volunteers were calculated. Blood samples were drawn and serum was separated at the current Good Clinical Practices and the Declaration of Helsinki. Blood pressure was taken as the predictor variables in order to find a cross sectional association amongst them. Effects of demographic factors such as age, weight and height were already adjusted so they did not affect the outcome variables. Difference between variables amongst two groups were calculated by applying independant student t-test.

Results
BMI was 24.7±2.32 kg/m² in normotensive and 25.07±2.21 Kg/m² in prehypertensive group (p>0.05).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Normotensive Group-1 (n=43)</th>
<th>Prehypertensive Group-2 (n=43)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Years)</td>
<td>39.3±6.17</td>
<td>37.6±3.95</td>
<td>0.143</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>24.7±2.32</td>
<td>25.07±2.21</td>
<td>0.477</td>
</tr>
<tr>
<td>Systolic blood pressure</td>
<td>111.6±3.4</td>
<td>122.7±3.05</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Diastolic blood pressure</td>
<td>72.9±3.04</td>
<td>82.3±2.66</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Serum creatinine (mg/dl)</td>
<td>0.9126±0.157</td>
<td>0.9521±0.199</td>
<td>0.311</td>
</tr>
</tbody>
</table>

Table 2: Frequencies and percentages of serum creatinine above and below cutoff levels in prehypertensive and normotensive subjects.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Levels of serum creatinine</th>
<th>Risk status</th>
<th>Normotensives</th>
<th>Prehypertensives</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>No</td>
<td>Percentage</td>
</tr>
<tr>
<td>Serum creatinine (mg/dl)</td>
<td>&gt;1.4 high</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>&lt;1.4 Desirable</td>
<td>43</td>
<td>100</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>&lt;0.79 Low</td>
<td>12</td>
<td>27.9</td>
<td>14</td>
</tr>
</tbody>
</table>

Cutoff values set according to the Council for Continuing Pharmaceutical Education (CCPE) percentages of serum creatinine levels above cutoff values were zero percent in normotensive group whereas frequency was 1 and percentage was 2.3% in prehypertensive group. Frequency of serum creatinine
levels below cutoff levels was 43 and percentage was 100% in normotensive subjects whereas frequency and percentage of serum creatinine levels were 42 and 97.7% in prehypertensive group respectively. Frequency and percentage of serum creatinine levels below normal range of 0.79mg/dl-1.4 mg/dl were 12 and 27.9% respectively in normal subjects whereas 14 and 32.6% respectively in prehypertensive group as presented in (Table 2).

Discussion

Prehypertension increases the risk of renal arteriosclerosis which can gradually decline renal function which may lead to rise in serum creatinine. Levels of serum creatinine kept on rising with increasing systolic and diastolic blood pressure which started from prehypertensive range to the full blown hypertension. Few scientists documented results similar to our study in which no renal dysfunction was found when assessed with serum creatinine based tests but a strong association with insulin resistance was found. Prevalence of chronic kidney disease was 17% higher in prehypertensive subjects as evident from increase in serum creatinine and rise in urinary albumin:creatinine ratio with increasing blood pressure. Our study demonstrated only a small frequency and percentage of high serum creatinine in perhypertensive participants. Similar to our results, prehypertension has not been established as an independent risk factor for renal disease due to the normal serum creatinine in all 771 participants of African descent (p<0.05).

There exists an association between varying blood pressure levels and serum creatinine. In the Atherosclerosis Risk in Communities study (ARIC), researchers ruled out the association between rising trends in blood pressure and serum creatinine levels in middle aged people residing in Washington county in which the odds of rise in serum creatinine increased to 1.5-2 fold with 20 mmHg increase in blood pressure values. These results indicate that even higher than normal blood pressure can induce early renal dysfunction even before the onset of full blown hypertension. Baseline levels of serum creatinine can significantly predict 8 year mortality risk. In The Hypertension Detection and Follow-up Program, the baseline serum creatinine >1.7 mg/dl in hypertensive subjects, mortality rate shot three times (28%) than group with normal serum creatinine concentrations. Incidence of a 5 year decline in renal function was 226/1000 with serum creatinine values ranging from 1.5-1.7 mg/dl in a referred care group having high blood pressure values (p<0.01). Third National Health and Nutrition Examination survey (NHANES III) did a cross sectional study in adult population with persistently high blood pressure levels in USA in which elevations in serum creatinine concentrations more than 1.4-1.6 mg/dl was ruled out which was the main outcome measure. Researchers found out that there were a strong association of high systolic and diastolic blood pressure levels and antihypertensive drugs like angiotensin enzyme inhibitors with elevations in serum creatinine concentrations and progression of renal disease. 5.5 million of US individuals had elevated levels of serum creatinine and more than 70% of people having hypercreatinenaemia had slight to moderately elevated blood pressure levels thereby indicating the renal disease.

Owing to the normal serum creatinine concentrations (p>0.05) in the present study in prehypertensive subjects with no other comorbidity, it is still a matter of question whether persistant state of higher than normal blood pressure levels would expose kidneys to some kind of progressive damage. However, prehypertension is known to cause mild renal impairment which can eventually set up a vicious cycle for the progression to hypertension and chronic renal disease. It is clearly evident from various epidemiological data that moderately elevated blood pressure can lead to subclinical renal damage which was detected with elevated levels of serum creatinine in general population.

Conclusion

Prehypertension does not seem to indicate any gross renal impairment when tested with serum creatinine.

References