Relationship between severity of hypertension and renal impairment in preeclampsia

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Article Info

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Abstract

The aim of this study was to determine the relationship between the severity of hypertension and renal impairment in preeclampsia. This study was conducted on 92 diagnosed cases of mild (n=42) and severe (n=50) preeclampsia patients from August 2010 to July 2011. All the patients were almost identical in terms of age and socioeconomic status. The results of the study showed that the mean serum creatinine and uric acid levels were significantly high in severe preeclampsia patient compared to mild preeclampsia and both systolic and diastolic blood pressures had the positive and significant effects on the serum creatinine and uric acid levels. In conclusion, impairment of renal function has the positive and significant relationship with the severity of blood pressure in the preeclamptic patient.

Introduction

Preeclampsia is the most common hypertensive disorder during pregnancy and has the greatest effect on the maternal and infant outcome.[1] It is a multisystem disorder of unknown etiology characterized by the development of hypertension to the extent of 140/90 mmHg or more with proteinuria after the 20th week of pregnancy in a previously normotensive and non-proteinuric patient.[2] It is a serious complication of the second half of pregnancy. Despite the advancement in the field of medicine, preeclampsia/eclampsia still remains the third leading cause of maternal mortality.[3] Though preeclampsia/eclampsia is a largely preventable condition and the incidence is decreasing in the developed countries. It occurs in about 6% of the general population.[4] Unfortunately such cases still possess a great problem in the developing countries like Bangladesh.

Preeclampsia is known as "the disease of multiple theories". Among them genetic, immunological, circulatory factors, uterine vascular changes and endothelial dysfunction are important.[5] Women with preeclampsia are at increased risk for such complications like abruptio placentae, acute renal failure, cerebral hemorrhage, disseminated intravascular coagulation, pulmonary edema, circulatory collapse and eclampsia.[6] Renal involvement has been seen and recognized by many observers that some changes to severe damage can occur and the characteristic renal lesions ranges from simple ischemia to patchy or complete tubular or cortical necrosis.[7] Renal perfusion and glomerular filtration are reduced.[8] This hampers the excretion of the metabolic waste products mainly urea and creatinine, the secretion of uric acid and causes the loss of non-selective plasma protein. All these lead to elevation of serum creatinine, blood urea, uric acid, proteinuria and changes in the urinary sediment.[8] The degree of hyperuricemia in preeclampsia reflects the severity of the disorder.[9] Serum uric acid is not only a marker of severity of disease but also contributes to the pathology of the disorder.[10] Various studies have reported on elevated levels of serum uric acid and creatinine in the hypertensive disorder of pregnancy and also its effects on maternal and fetal outcomes.[11-13] But a few studies on the relationship between severity of hypertension and renal function impairment in preeclampsia patient were reported.[14]

The aim of this study was to determine the extent of renal impairment by detecting the level of serum creatinine, uric acid and urinary albumin level and also to find out the relationship between the severity of hypertension and impairment of renal function in preeclampsia patient.

Materials and Methods

This study carried out at Dhaka Medical College Hospital. There were 92 diagnosed

cases of preeclamptic patients included in this study. Out of 92 cases, 42 were mild preeclampsia and were classified as Group A and 50 were severe preeclampsia and were classified as Group B.

The mild preeclamptic patient was selected as a systolic BP≥ 140 mmHg but <160 mmHg and diastolic BP≥90 mmHg but <110 mm Hg and proteinuria (≥1+ or more by dip stick test). Severe preeclamptic were selected as a systolic BP ≥ 160 mmHg and diastolic BP ≥110 mmHg along with proteinuria(3+ or more by dip stick test).

Patients with pre-existing hypertension, cardiovascular disease, renal disease, liver disease, thyroid disease, diabetes mellitus and patient with acute or chronic illness were excluded from the study.

All patients enrolled in this study were explained about the nature and purpose of the study. An informed written consent was taken from each of them. All data were collected in a preformed questionnaire. The clinical examination was done by a standard method.

Blood pressure was measured by the same sphygmomanometer in sitting position. Two measurements were taken out in 4 hours apart. From each patient, 5 mL of blood was collected under all aseptic precaution from the antecubital vein with a disposable plastic syringe and was transferred to a test tube. The blood sample was analyzed for serum creatinine and serum uric acid. The midstream urine (10 mL) was collected in a test tube from the study subject.

The serum creatinine was measured by a kinetic method.[15] Creatinine reagent was used for the quantitative determination of creatinine in the human serum. Creatinine reacts with the picric acid in an alkaline condition to form a color complex which absorbs at 510 nm. The rate of formation of color is proportional to the creatinine concentration in the sample. The serum uric acid was measured by the enzymatic method.[16] The uric acid in the sample is oxidized to allantoin and hydrogen peroxide in the presence of uricase. The liberated hydrogen per-oxide is detected by chromogenic oxygen acceptor in the presence of peroxidase. The red quinine formed is proportional to the amount of uric acid present in the sample. The urinary albumin was measured by dipstick method which used a reagent strip.[17] Fresh, well mixed and uncentrifuzed urine specimen was collected for the test. The color is compared with the color chart provided, which indicates the approximate protein concentration.

Statistical analysis

The data collected were compiled with the help of a personal computer and appropriate statistical analysis was carried out using SPSS program. Students t test and chi-square test were done to compare the results between the groups. The difference was considered significant when the p value was <0.05.

Results

Among all preeclamptic women, the mean (±SD) age of the mild preeclampsia was 29.1 ± 4.4 years which was significantly higher (p<0.01) than the severe preeclampsia 25.8 ± 4.91 years. In severe preeclampsia, significantly higher (p<0.01) number of women belonged to the age group of <30 years (78%) (Table I). The distribution of gravidity among the study subjects showed that in mild preeclampsia, all women were multigravida, while in severe preeclampsia 20 were primigravida and 30 multigravida. Statistically, the distribution was highly significant (p<0.001). The present study showed the comparison and distribution of gestational age between the two study groups. None showed statistically significant variation. The mean gestational age in mild and severe preeclampsia was 31.7 ± 3.8 and 33.1 ± 3.1 respectively.

Table II shows that the mean serum creatinine was significantly high (p<0.001) in severe preeclamptic women (1.0 ± 0.3) mg/dL than mild preeclamptic women (0.9 ± 0.2) mg/dL. The mean serum uric acid was significantly high (p<0.001) in severe preeclamptic (6.9 ± 1.0) mg/dL compared to mild preeclamptic (5.0 ± 0.8) mg/dL. The urinary albumin also shows highly significant (p<0.001) variation between the groups. In mild preeclamptic, the maximum number of women had mild urinary albumin (57.2%) level, while in severe preeclamptic, the maximum number of women had moderate and severe urinary albumin (82%) level.

Table I

Age, gravidity and gestational age distribution of study subjects

	Mild preeclampsis (n=42)	Severe preeclampsia (n=50)	p value
Age (years)*			
Mean ± SD	29.1 ± 4.4	25.8 ± 4.9	0.001
<30 (n)	19	39	0.001
30-40 (n)	23	11	
Gravidity**			
Mean ± SD	3.6 ± 1.9	2.4 ± 1.6	0.001
Primi (n)	0	20	0.0001
Multi (n)	40	30	
Gestational age (weeks)**			
Mean ± SD	31.7 ± 3.8	33.1 ± 3.1	0.068
≤34 (n)	34	36	0.316
>34 (n)	8	14	

*Chi-square test; **Unpaired Student's t-test

Table II

Status of serum creatinine, serum uric acid and urinary albumin

	Mild preeclampsia (n = 42)	Severe preeclampsia (n = 50)	p value
Serum creatinine (mg/dL)	0.9 ± 0.2	1.0 ± 0.3	0.0001
Serum uric acid (mg/dL)	5.0 ± 0.8	6.9 ± 1.0	0.0001
Mild urinary albumin	24	9	
Severe urinary albumin	18	41	0.0001

Serum creatinine and uric acid level was analyzed by unpaired Student's t-test; urinary albumin was analyzed by Chi-square test

severe preeclampsia showed changes in renal function when compared with 13 normotensive controls. The present study also shows that both systolic and diastolic blood pressure have positive and significant effect on serum creatinine level.

The status of serum uric acid in this study shows that mean serum uric acid was significantly high ($p<0.001$) in severe preeclampsia compared to mild preeclampsia. Both systolic and diastolic blood pressure have positive and significant ($r=+0.531$, $p<0.001$) and ($r=+0.692$, $p<0.001$) effect on serum uric acid. Punthumapol and Kittichotpanich (2008)[19] conducted a case-control study to evaluate the serum uric acid level in mild and severe preeclamp-

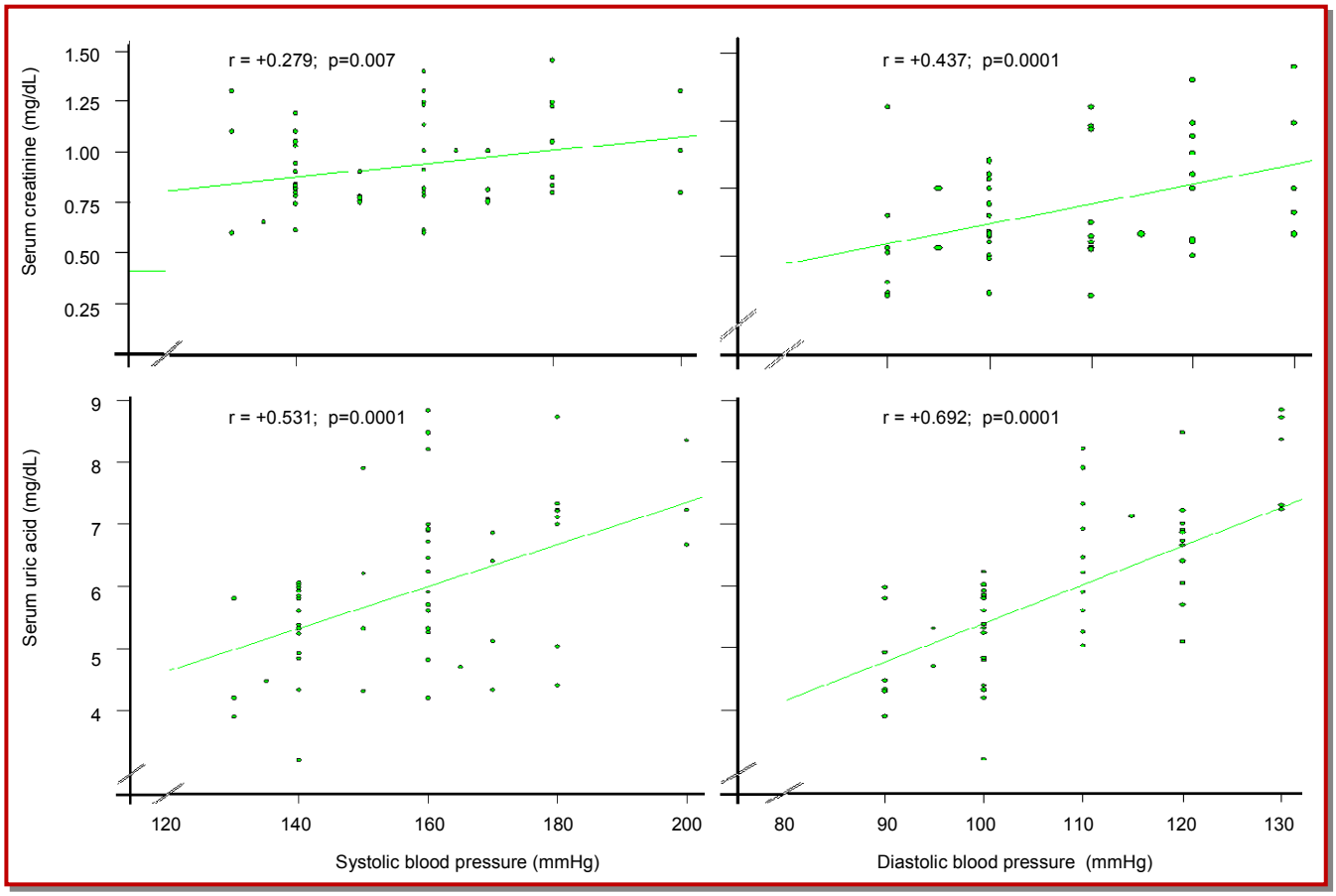

Figure 1: Effect of serum creatinine and uric acid levels on systolic and diastolic blood pressure

Figure 1 shows that both systolic and diastolic blood pressure have positive and significant relationship between serum creatinine and uric acid level.

Discussion

In the present study, mean serum creatinine was significantly higher in severely preeclamptic women than the mild preeclamptic women which is similar to another study done.[18] Ten patients with

tic and normal pregnant women. The result showed that in severe preeclamptic women the serum uric acid was significantly higher than in normal pregnant women and mild preeclamptic women respectively but there was no difference between normal and mild preeclamptic women. Hyperuricemia correlated to severe preeclamptic. Suchanda et al. (2011) studied to assess the serum uric acid concentration in preeclamptic and normal pregnancy. The study comprised of 30 normal and 30 preeclampsia cases in their third trimester of pregnancy. There was an increase in both serum and urine uric acid

levels in cases though the urinary pH in both the groups was similar.[20] Kharb studied uric acid level in pregnancy with preeclampsia and diabetes.[21] The study was done on 40 preeclamptic patients (18 diabetic women) (DM-PRW) and 22 without diabetes (PRW) and 20 normotensive pregnant women (8 with gestational diabetes and rest 12 were healthy preeclamptic women) and the control group consisting of 20 healthy non-pregnant women. Study result showed that serum uric acid value was significantly increased in PRW & DM-PRW as compared to controls and were higher in PRW than DM-PRW($p>0.05$).[21]

A comparative study between preeclampsia, pregnancy-induced hypertension and normal pregnant women showed that serum uric acid and creatinine levels were significantly elevated in preeclampsia (6.3 ± 1.2 and 0.9 ± 0.26 mg/dL) when compared to pregnancy-induced hypertension (4.3 ± 1.0 and 0.7 ± 0.2 mg/dL) and normal pregnancy (4.3 ± 0.8 and 0.6 ± 0.1 mg/dL).[22]

The present study demonstrated that urinary albumin shows highly significant ($p<0.001$) variation bet-ween the groups. In mild preeclampsia, maximum number of women had mild urinary albumin (57.2%), while in severe preeclampsia, maximum number of women had moderate and severe urinary albumin (82%). Both systolic and diastolic blood pressure also have a positive and significant relation with the urinary albumin level. Quablan et al. showed that preeclamptic women obviously showed a statistically significant increase in terms of levels of urinary albumin compared with the healthy controls.[23]

The exact nature of the primary event causing preeclampsia is not known. However, evidence accumulated in the past 20 years indicates that in a large number of these women abnormal placentation is one of the initial events. The anatomic and physiologic disruption of normal placentation is thought to lead to the synthesis of products that affect angiogenesis and to abnormal lipid peroxidation. This causes an alteration of prostacyclin and thromboxane A_2 levels. So, intense vasospasm occurs that causes the rise in blood pressure. With the advance in gestation, these products will affect the endothelial system with the production of signs and symptoms of multiple organ compromise.[24] Widespread disturbance of the maternal vascular endothelium is responsible for hypertension, altered vascular reactivity, activation of the coagulation cascade and the multisystem damage which accompany preeclampsia.[24] Serum uric acid and creatinine levels are the part of work for the pregnant women with hypertension. The elevated levels of these parameters were due to decreased urinary clearance secondary to reduced GFR and increased reabsorption.[25] Due to reduced renal perfusion and glomerular filtration rate which interfere with the excretion of creatinine, uric acid and causes loss of non-selected plasma protein mainly albumin. All these changes cause the rise of serum creatinine, serum uric acid and urinary albumin level. In mild preeclampsia, there is less endothelial change as less vasospasm. So, serum creatinine and uric acid levels cause less rise compared to severe preeclampsia. The results of the current study when considered with those of others, suggested that there is an alteration of renal function in preeclampsia and there is a relationship between severity of hypertension with impaired renal function in preeclampsia.

Conclusion

Serum creatinine, uric acid and urinary albumin have the positive and significant relationship with the blood pressure and the relationship in severe preeclamptic was more significant than the mild preeclamptic patient. All the parameters correlated positively and significantly with increased blood pressure.

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