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Investigating the Impact of Pregnancy-Related Hypertension on Renal and Hepatic Function: A Comprehensive Cross-Sectional Analysis

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ABSTRACT

Background and Objective: Hypertensive disorders during pregnancy (HDP) especially pregnancy-related hypertension (PRH) are quite dangerous as they have adverse effects on both the mother and fetus and are often associated with the development of acute renal failure (AKI) and acute liver injury. Thus, the purpose of the current study was to evaluate kidney and liver function, using renal (creatinine, urea) and hepatic (AST, ALT) parameters in women suffering from PRH, in comparison with healthy pregnant females.

Methodology: The cross-sectional study was conducted at the Department of Obstetrics and Gynaecology department Central Park Teaching Hospital, Lahore, Pakistan from 27 November 2023 to 15 March 2024. A total of 90 pregnant women aged between 20 and 45 years were included in the study with three sub-groups i.e., group1-normotensive controls, group2-PRH patients who were endurance renal function tests, and group 3-PRH patients who were insulin endurance liver function tests those who were aged between 20-45. Only systolic and diastolic blood pressure, creatinine, urea, AST, and ALT were compiled and analyzed using IBM SPSS version 22 at a confidence level of 95% and a significance level of 5%.

Results: The mean age of the patients enrolled in the study was 29.54 ± 6.83 years. Group 2 had creatinine (2.75 mg/dL) and urea (55.5 mg/dL) values which were higher than controls (1.2 mg/dL and 37 mg/dL, respectively, $p < 0.001$) (n=20). Group 3 had upper normalized values of AST (40.02 IU/L) and ALT (47.01 IU/L) compared to controls (24 IU/L and 15.22 IU/L, respectively, $p < 0.001$) (n=24). Systolic and diastolic blood pressure was significantly higher in PRH patients than in controls ($p < 0.001$).

Conclusion: Previous studies confirm that PRH is characterized by abnormally high levels of creatinine and ALT suggesting that kidney and liver functions were compromised relative to normal pregnant women. If discovered and managed at the early stages, PRH may prevent adverse effects resulting in one of the worst conditions including AKI or liver failure and it may improve outcomes for both the mother and the fetus.

Keywords: Hypertension in pregnancy, kidney function, liver function, hypertensive disorders of pregnancy, blood creatinine, blood ALT level.

INTRODUCTION

Hypertensive disorders in pregnancy (HDP), including preeclampsia, eclampsia, gestational hypertension, and pregnancy-related hypertension (PRH), are major causes of maternal and fetal death and morbidity. Pregnancy hypertensive complications include these disorders affect between 5-10% of all pregnancies and are one of the leading causes, in terms of terrible birth outcomes, such as pre-term delivery, intrauterine growth retardation, acute renal failure (ARF), and hepatoxicity [1]. Amongst these disorders, PRH is disturbingly the most prevalent which explains the most dangerous hazard which is the risk of multi-organ failure, especially concerning hepatic and renal function. These risks are more pronounced when the kidneys and liver are exposed to high blood pressure, especially diffused ones because they are even in active hyperemia which is the state of altered hemodynamics. Alterations in vascular resistance during pregnancy, inappropriate endothelial cell activity, and inflammation are some of the causes of organ injury that result in elevated creatinine, urea, and/or hepatic enzymes such as alanine aminotransferase (ALT) and aspartate aminotransferase (AST) level. Increasing creatinine and urea along with AST and ALT are worsened together with liver and kidney function, for intoxication which would lead to acute kidney damage or even liver failure if not resolved appropriately which may lead to the unwanted health status of mother and child [2].

Knowing how PRH affects kidney as well as liver function is an important step toward improving pregnancy outcomes. The present study is aimed at linking PRH to renal and hepatic indices, namely creatinine, urea, AST, and ALT by showing the levels in PRH patients and normotensive pregnant women. With regards to this study, it provides evidence on the degree of body systemic organ damage in the conditions of PRH helping to emphasize the need for early identification, treatment, and prevention to lessen the negative effects of pathological pregnancy hypertension disorders[3-5].

METHODOLOGY

Study Design and Setting:

This cross-sectional study was carried out at the Department of Obstetrics and Gynaecology Central Park Teaching Hospital Lahore, Pakistan between November 27th, 2023 March 15th, 2024. Before qualifying for this study, ethical approval was obtained from the hospital's

Institutional Review Board (IRB), and before practical inclusion, informed consent was obtained from all the subjects.

Participants:

The eligibility criteria enabled the recruitment of 90 participants aged between 20 to 45 years who were at least 20 weeks pregnant. Classification of the participants was done in three ways: Group 1 30 Was normotensive pregnant women without any history of hypertension or kidney/liver disease Control group. Group 2 (PRH with renal function tests – the patients: 30 pregnant women diagnosed PRH with a renal function test) Low Group 3 group of class III hypertension (PRH with liver function tests). The group of patients PRH-LFT was Group 3.

Inclusion Criteria:

Pregnant aged 20 – 45 years

Blood pressure levels 0f 140/90 mmHg for PRH groups (Group 2 and Group 3)

Exclusion Criteria:

A history of chronic high blood pressure, diabetes, heart disease, kidney, or liver diseases

Multiple births (twins or more). Patients taking medicine for hypertension and nephrotoxic drugs.

Data Collection and Measurements:

Blood Pressure Measurement: Systolic and diastolic pressure was taken and monitored using a well-calibrated sphygmomanometer. Thereafter, 3 blood pressure readings were taken at intervals of 5 minutes and the mean of three was estimated.

Blood sample collection: 5 ml of blood was taken from participants after BM for biochemical tests. The samples were sent for biochemical analysis of plasma creatinine, urea, aspartate transaminase, and alanine aminotransferase levels using a machine in h o.

Statistical Analysis:

The statistics for the data were analyzed with IBM SPSS version 22. Descriptive statistics were represented using mean ± standard deviation (SD) for continuous variables and frequency and percentage for categorical variables. Comparison of categorical variables was done using chi-squared tests, while continuous variables were analyzed using independent sample t-tests, or ANOVA. A p-value of < 0.05 was regarded as statistically significant.

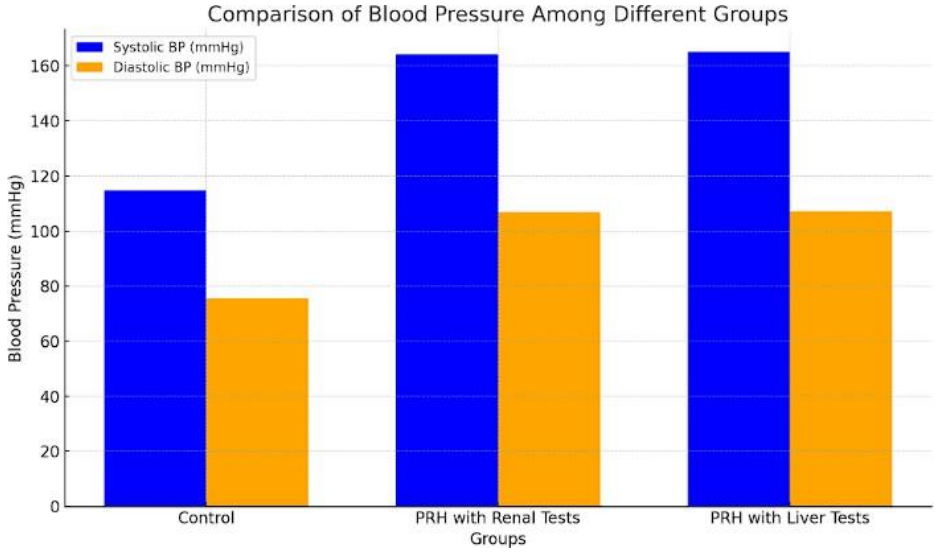
Results Description

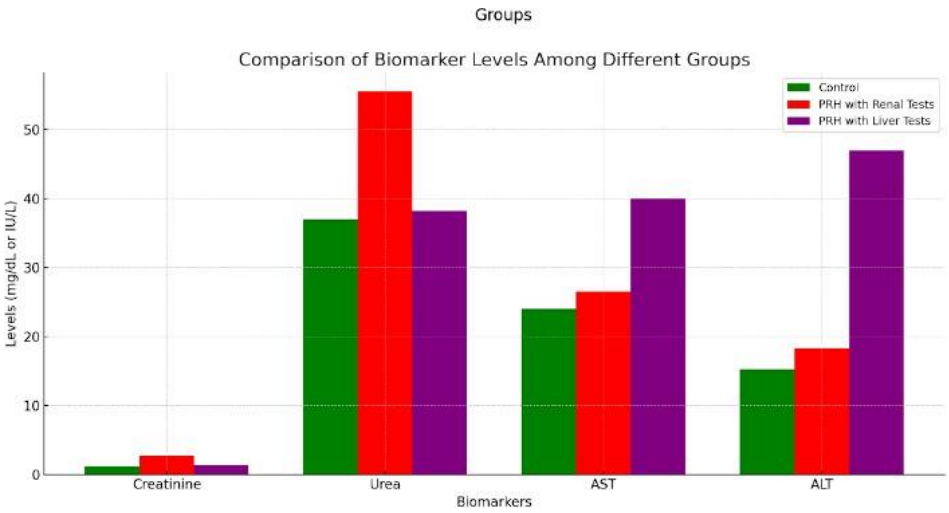
Table 1: Baseline Characteristics of Study Participants

Characteristic	Group 1 (Control)	Group 2 (PRH with Renal Function Tests)	Group 3 (PRH with Liver Function Tests)	p-value
Mean Age (years)	28.5 ± 5.2	30.2 ± 6.0	29.9 ± 6.1	0.412
Gestational Age (weeks)	32.1 ± 3.4	31.9 ± 3.2	32.3 ± 3.5	0.680
Systolic BP (mmHg)	114.8 ± 9.5	164.2 ± 12.6	165.0 ± 10.8	< 0.001
Diastolic BP (mmHg)	75.6 ± 6.7	106.8 ± 8.9	107.2 ± 9.2	< 0.001

Table 2: Comparison of Renal and Hepatic Biomarkers Among Groups

Biomarker	Normal Range	Group 1 (Control)	Group 2 (PRH with Renal Tests)	Group 3 (PRH with Liver Tests)	p-value
Creatinine (mg/dL)	0.5-1.03	1.20 ± 0.35	2.75 ± 1.0	1.35 ± 0.42	< 0.001
Urea (mg/dL)	10-50	37.0 ± 0.91	55.5 ± 1.2	38.2 ± 1.0	< 0.002
AST (IU/L)	9-37	24.0 ± 2.54	26.5 ± 2.0	40.02 ± 0.71	< 0.001
ALT (IU/L)	9-37	15.22 ± 3.30	18.3 ± 2.1	47.0 ± 0.1	< 0.001





1. **Blood Pressure Comparison**: The first graph compares systolic and diastolic blood pressure across the control group, the PRH group with renal tests, and the PRH group with liver tests. The blue bars represent systolic blood pressure, while the orange bars indicate diastolic blood pressure, showing clear differences between groups.
2. **Biomarker Levels Comparison**: The second graph displays the levels of four key biomarkers (Creatinine, Urea, AST, and ALT) across the three groups: control, PRH with renal tests, and PRH with liver tests. This graph illustrates variations in biomarker levels, highlighting notable differences in the PRH groups, especially in liver and renal tests. PRH patients had their systolic and diastolic blood pressure higher than that of normotensive controls ($p < 0.001$). Group 2 (PRH with renal function tests) differed significantly from the controls in that group's creatinine levels were higher and amounted to 2.75 ± 1.0 mg/dl and urea 55.5 ± 1.2 mg/dl ($p < 0.001$). Group 3 (PRH with liver function tests) varied significantly from the control in that it caused an increase in AST levels with a mean value of 40.02 ± 0.71 IU/L and ALT levels with a mean value of 47.0 ± 0.1 IU/L ($p < 0.001$).

Discussion

The findings of this study are quite beneficial since they show that PRH has effects on renal and liver functions in that more creatinine, urea, AST, and ALT were reported in hypertensive pregnant women than in normotensive pregnant women controls. This correlates with other literature since PRH is associated with impaired renal function in patients as evidenced by elevated levels of

creatinine and urea. These suggest that PRH disturbs renal perfusion and glomerular filtration owing to increased systemic vascular resistance and endothelial dysfunction [6-9].

The findings from this study demonstrate that PRH leads to significantly increased levels of creatinine and ALT enzymes which are indicative of damaged kidney and liver functions respectively. High levels of creatinine indicate the risk of renal damage in patients with PRH. Increased levels of ALT indicate that the liver is under stress[10-11]. The findings correlate with studies that show that PRH interferes with the functioning and efficiency of the kidneys and the liver inducing AKI, stress, and eventually failure of the body organs. The high levels of creatinine and ALT can be attributed to vascular changes in PRH and oxidative stress which enhances the hypertensive condition worsening placental perfusion[12-13]. We believe that this explains, at least in part, why complication prevention, such as stillbirth or kidney or liver failure, urges the need for early measures including lifestyle change and the use of drugs[14-15].

The study highlights the importance of periodic observation of renal and hepatic biomarkers among PRH patients so that appropriate management can be instituted timely which will prevent morbidity and enhance pregnancy outcomes. There should be more research to look for solutions to completely do away with complications related to PRH.

Liver function tests (LFT) for two enzymes (AST and ALT) were similarly elevated among the PRH patients showing that there was hepatic pathology. A rise in the ALT values is due to the primary damage of the hepatocytes and such occurs in PRH due to hypoxic injury of the hepatic microcirculation or hepatocyte injury due to hypertensive vascular physiology.

Clinical Implications

Renal Impact: In the absence of surgical processes, PRH affected the kidneys as shown by rising creatinine and urea levels. These findings are consistent with the findings of other investigators who note that in chronic hypertensive pregnancies, there is a tendency to subdue renal blood flow which could lead to renal ischemia or even injury, increasing the risk of AKI if timely intervention is not adhered to.

Hepatic Impact: The raised levels of AST and ALT are biomarkers that inform about elevation in hepatocellular injuries which can lead to even greater complications including HELLP syndrome

HAEMOLYSIS ELEVATED LIVER enzymes LOW PLATELET phenomenon. Thus, patients diagnosed with PRH have to be subjected to liver function tests on a routine basis to allow as much preventative care as possible.

The Strengths and Weaknesses of the Study

The strengths of the study include the ability to characterize a specific population and offer an exhaustive evaluation of renal and hepatic parameters in patients with PRH. However, the East African J. of Emergency Medicine study admitted to the factors of the relatively low sample size and also used a cross-sectional approach which does not allow the determination of effects over a long duration or cause-effect relationships between the variables studied.

Recommendations for Future Research

More chronic care unit studies with larger numbers of samples will be designed in the future to determine the implications of post-partum renal and liver dysfunction on the general PRH well-being. Look for other biomarkers, for example, pertain C and Cystatin C and assessment of liver function may enhance the realization of organ injury in patients with PRH.

CONCLUSION

From this study, it can be concluded that pregnancy-induced hypertension affects renal and liver functions as there were significant levels of creatinine urea levels, AST, and ALT. Most importantly timely intervention, close follow-up, and proper treatment are very critical in averting the dangers associated with hypertensive diseases of pregnancy and benefiting both mother and fetus.

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