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Unraveling the Complex Relationship with Acute Kidney Injury and Acute Liver Failure in Pregnancy-Induced Hypertension

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ABSTRACT

Background and objective: Pregnancy-induced hypertension (PIH) poses serious risks to the mothers and unborn children, and in most cases leads to life-threatening conditions such as acute kidney injury (AKI) and acute liver failure (ALF). The objective of the study was to explore the biomarkers of these conditions, shared by creatinine, urea levels, AST, and ALT levels in PIH patients.

METHODOLOGY

This cross-sectional study was carried out at the Department of Obstetrics and Gynaecology, Shalamar Hospital Lahore Pakistan from 27 November 2023 to 15 March 2024. The study comprised 90 patients, who were allocated into groups and treated as follows: Group 1 with normal blood pressure was the control group, Group 2 were those with PIH and underwent renal function tests and Group 3 had PIH and underwent liver function tests. Information on blood pressure, creatinine, urea, AST, and ALT was abstracted and analyzed. A statistical package version 22 of IBM SPSS was applied for this analysis with a 95% confidence level and a 5% level of significance.

RESULTS

The mean age of participants was 29.54 ± 6.83 years. The average creatinine level was 2.75 mg/dL in Group I (80 % increase as against that of controls) while that of the urea was 55.5 mg/dL (10% increase). The Serum level of AST in Group 2 was 40.02 IU/L (44 % increase) while that of ALT was 47.01 IU/L (71 % increase) compared with controls (p values < 0.001 in all comparisons). The systolic blood pressure and diastolic blood pressure of PIH patients were found to be higher than control subjects (p< 0.001).

CONCLUSION

The study demonstrates that creatinine and ALT levels are raised in PIH patients when compared with urea and AST. Always preventing and treating PIH at its very early stages using appropriate dietary habits and medications represents one of the most effective ways to decrease these values and avoid such endpoints as stillbirths, kidney failure, or liver failure.

KEYWORDS: Pregnancy Hypertensive disorders, AKI, Acute hepatic failure.

INTRODUCTION

Hypertensive disorders during pregnancy (HDP) are one of the most important problems faced by obstetricians since they are detrimental to both maternal and fetal health [1]. As reported, in most countries, HDP accounts for 18% of diseases in the US, and 10% of diseases in China, and in many regions, it is the second disease-causing maternal death. These disorders are also responsible for fetal deaths where the rates are 9.1% in Latin American regions and 18% in Africa[2]. AKI can emanate from HDP, and it is estimated that Chinese populations report between 0.02% and 1.84% of AKI which accounts for a 27% stillbirth rate[3]. On the other hand, some patients, despite optimal management of AKI, continue to deteriorate upwards of 4.5% to some point of renal impairment. Aside from AKI evolving as a singular entity or part of a syndrome AKI is associated with various causative processes which include apoptosis, necrosis, oxidative stress, and inflammation. New

studies have demonstrated an association between AKI and lower levels of Klotho (KL), a protein. Still, the interaction between KL and AKI in the case of KD remains poorly understood and documented[4-6].

The differential diagnosis of acute kidney injury (AKI) in procedures during pregnancy is further hampered by physiological conditions that modify the baseline level of creatinine and compromise the criteria employed for diagnosis. Causes of AKI vary with the trimester and include hyperemesis gravidarum, septic abortion, pre-eclampsia, HELLP syndrome, and urinary tract infections[7]. In addition, the enlarging uterus frequently gives rise to post-obstructive acute kidney injury (AKI) with the advancement of pregnancy. To obtain the appropriate control of health-related diseases of pregnancy (HDP), it is important to take reliable arterial blood pressure and implement comprehensive diagnostic methods aimed at extending the benefits and reducing the risks for mother and child[8-9].

Liver diseases in pregnancy are also quite troublesome and are divided into pregnancy-related liver disorders, pregnancy-associated liver diseases, and pre-existing liver diseases with pregnancy complicating matters. The absence of established specific recommendations in certain areas has made it necessary to form consensus recommendations on the management of these conditions[10-11]. Indian National Association for the Study of the Liver (INASL) and the Federation of Obstetric and Gynaecological Societies of India (FOGSI) prescription recommendations concerning the diagnosis and treatment of liver disease in pregnancy. Acute hepatic failure (AHL), a form that is not very common but poses serious complications, can result from viral hepatitis or hepatitis secondary to toxin exposure among other factors reender of a graft, and it acetate horrible[12].

Because of its adverse obstetric outcomes association, diastolic hypertension and proteinuria, which were previously excluded from the criteria, have also been added to the definition of preeclampsia because the disease is now defined as evolution from a neurological to a vascular disease. It is also crucial to recognize that the condition is multisystemic to facilitate its management and the management of fetal outcomes[13].

Methodology

The setting for this study was the Department of Obstetrics and Gynecology, Shalamar Hospital Lahore Pakistan Hospital and it ran for a period between 27th November 2023 to March 15, 2024. The study was ethically approved by the institute. 90 pregnant women aged 20-45 years with a blood pressure of more than 140/90 mmHg were enrolled. Subjects were registered in three groups: Group 1 (control group), Group 2 (PIH with Renal function tests), and Group 3 (PIH with Liver function tests).

The lower age limit was set at 20 years and the upper limit is 45 years, for patients with a history of diabetes, history of hypertension, history of cardiovascular diseases, and history of multiple pregnancies. Group 1 control participants were normotensive with unremarkable renal function tests (RFTs) and Liver function tests (LFTs). In groups two and three, after three (3) consecutive blood pressure readings, blood samples were collected for the estimation of blood urea, creatinine, and enzymes AST, and ALT.

SPSS version 22 from IBM was used to collect and analyze data, which included descriptive and inferential analysis. Ratio and its standard deviation (SD) are given in qualitative variables such

as age. To compare parameters between Groups 2 and 3 Chi-square tests were applied with a p-value less than or equal to 0.05 as the confidence interval.

Results

Table: Mean blood pressure of cases and control

Subjects	**Number**	**Mean±SD**	**P- value**
Systolic BP (mmHg)			
Cases	30	165±2.02	<0.001
Controls	30	115±9.02	<0.001
Systolic BP (mmHg)			
Cases	30	105.41±12.13	<0.001
controls	30	75.23±6.18	<0.001

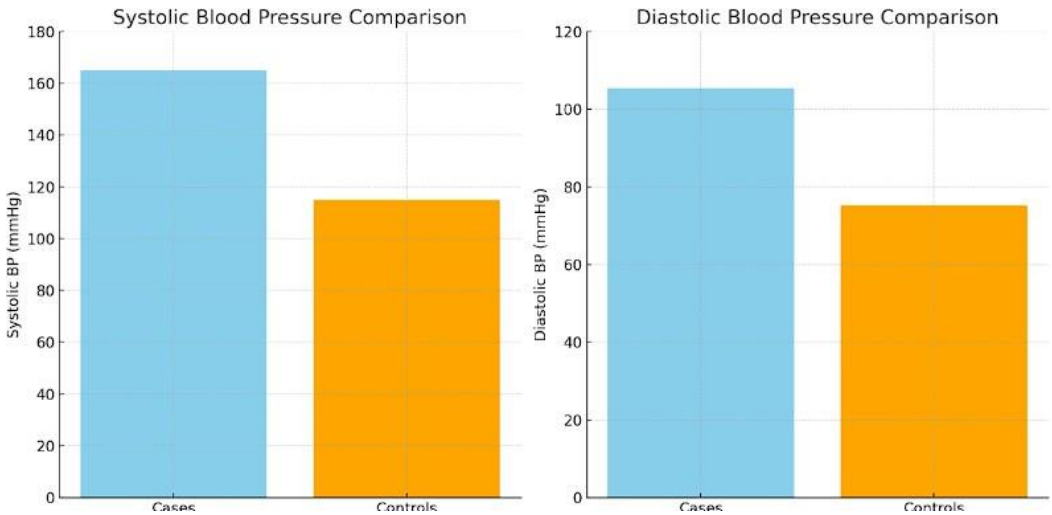

Figure 1: Systolic and diastolic blood pressure of cases and controls

Table 2: Mean Renal and Liver profile of cases and controls

Parameters (Normal Range)	**Subjects**	**Mean±SD**	**P- value**
Creatinine (mg/dl) 0.50-1.03			
Cases	30	2.75±1.0	<0.001
Controls	30	1.2±0.35	<0.001
Urea(mg/dl) 10-50			
Cases	30	55.5±1.2	<0.001
Controls	30	37±0.91	<0.002
AST (IU/L) 9-37			
Cases	30	40.02±0.71	<0.001
Control	30	24±2.54	<0.001
ALT (IU/L) 9-37			
Cases	30	47±0.1	<0.012
Control	30	15.22±3.30	<0.001

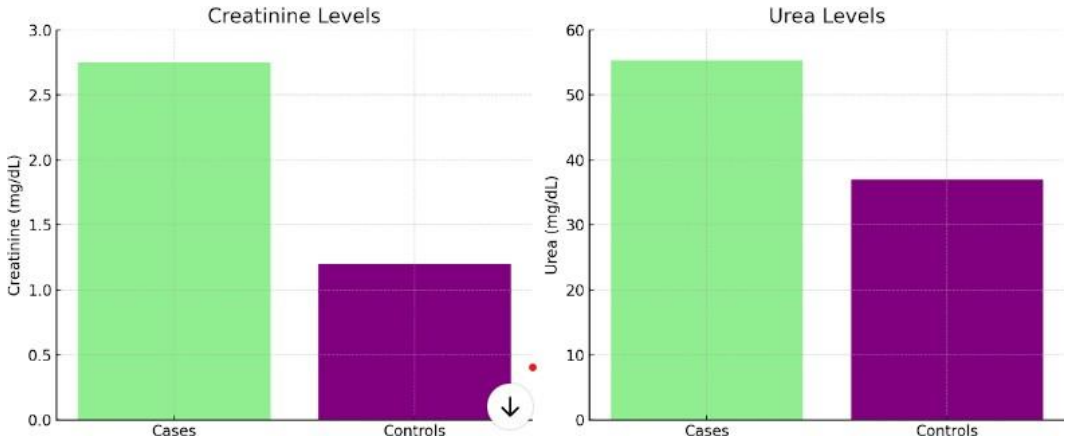

Figure 2: Creatinine and urea levels of cases and controls

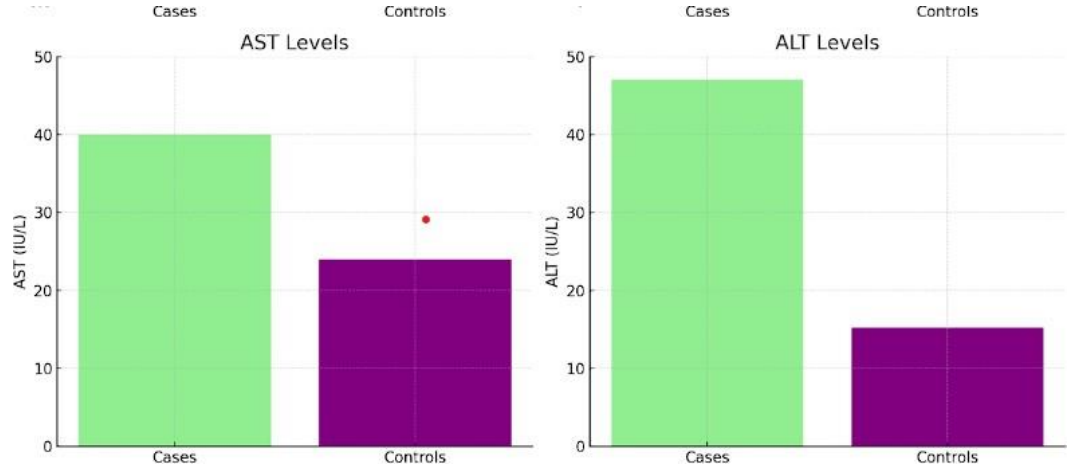

Figure 3: AST and ALT levels of cases and controls

In this study, 90 patients were recruited, with a regression case-control study comprising three groups of 30 participants in each group. The mean age of the patients was 29.54 ± 6.83 years. In group 2 (PIH with renal function testing), creatinine levels were elevated, being more than 2.75 mg/dL in 80% of cases of which it was significantly more than the control group of 1.2 mg/dL ($p < 0.001$)as shown in table 2 and figure 2. Urea levels were also elevated in group 2 as the average was 55.3 mg/dL (10%) against 37 mg/dL in the control group ($p < 0.002$).

In group 3 (PIH with liver function testing) out of the 158 patients evaluated, 44% had an AST average value above 40.02 U/L which is significantly higher than the average of 24 ± 2.54 U/L

that the control group had ($p<0.001$) as shown in table 2 and figure 3. Lastly, ALT levels were also high in group 3 as the mean among 71 patients was 47.01 U/L ($p = 0.012$) as compared to control of 15.22 ± 3.30 U/L ($p < 0.001$).

The mean of the systolic blood pressure being the cases was 165 ± 2.02 mmHg which was higher than that of the control group 115 ± 9.02 mmHg ($p < 0.001$). The mean of diastolic blood pressure was also raised in the cases averaging 105.41 ± 12.13 mmHg $p < 0.001$ whereas the control subjects recorded 75.23 ± 6.18 mmHg as shown in Table 1 and Figure 1. This study shows an increase in creatinine and ALT levels among PIH patients as opposed to urea and AST levels respectively which demonstrates the effect of PIH on renal and liver functions.

Discussion: Management Hypertensive disorders include chronic hypertension, gestational hypertension, pre-eclampsia-eclampsia also referred to as pregnancy-induced hypertension; superimposed pre-eclampsia on chronic hypertension all pose considerable risks to both maternal and fetal health[14]. There is a direct correlation between model elevated blood pressure and the timely diagnosis and alteration of factors, to prevent more serious diseases such as liver and acute kidney injury wherein the last condition i.e. pregnancy-induced hypertension (PIH) the most common complication occurs[15]. Prompt action is required in this case, especially if the patient has blood pressure over 160/110 mmHg, or in addition, the patient has some other signs like AKI, elevated liver enzymes, pulmonary edema, or neurological status changes. These complications may pose a danger to the well-being of both the mother and the fetus and warrant urgent action[16].

The effects of PIH in terms of renal and liver function (as shown by creatinine and ALT levels, respectively) as compared to urea and AST levels were the main focus of our analysis. The findings showed creatinine levels at a mean of 2975 mg/dL and ALT at a mean of 47.01 U/L amongst PIH patients significantly higher than in controls[17]. Chronic kidney disease and liver cirrhosis are advanced to further regarding these elevations. Subsequently, they are important predictors for adverse outcomes in these PIH patients such that an elevation above normal/adequate creatinine reflects declining kidney function whilst an elevated ALT portrays liver involvement[18].

As observed in previous works of literature, in the pathophysiological mechanisms of PIH intimate absorption of the placenta is altered well as the perfusion of the placenta because of dystopic vascular adaptogenesis. The result of this is elevated blood pressure together with renal lesions

and hepatic lesions[19]. The increase of systolic (165 ± 2.02 mmHg) and diastolic blood pressure (105.41 ± 12.13 mmHg) in our sample highlights the hypertrophy of the vascular system that accompanies PIH. Prompt control of treatment in these cases and such cases involves pharmacological treatment and dietary treatment to be able to lower the risk of maternal morbidity and mortality[20].

Preeclampsia, one of the common hypertensive disorders of pregnancy, is understood to influence both the immediate and future health of women and their unborn babies, especially concerning future cardiovascular or renal diseases. The high levels of creatinine and ALT in our study correlate with the widespread data that indicates that patients with PIH are predisposed to renal failure and liver injury if adequate measures are not taken 21. Early recognition of such abnormal biochemical alterations can help formulate better clinical strategies leading to better results.

Identifying the factors responsible for these elevations will assist in the formulation of a rational treatment plan. Potassium (K+) channels which are known to be responsible for vascular dynamics and induce vasorelaxation, are involved in the pathophysiology of PIH[22]. Alteration of these channels can result in placental and maternal vascular impairment, worsening the condition of PIH. These mechanisms deserve attention as they may have may provide new targets for the treatment of PIH.

The current study aims to stress the need for a qualitative assessment of renal and liver function in patients with PIH. Relatively higher levels of creatinine and ALT as compared to urea and AST point towards the need to act early to contain the damage to the kidneys and the liver, this would eliminate the risk of poor outcomes including stillbirth, kidney and liver failure. This reaffirms the potential for both prevention and full-fledged therapy in the management of preeclampsia[23].

Conclusion

This study establishes that patients with PIH have higher levels of creatinine and ALT than urea and AST explaining how much more such patients have problems with kidney and liver functions. Assessing and treating these biochemical alterations in PIH patients early can help avert complications like stillbirths, liver, and renal failure. Treating preventable risk factors like nutrition, especially in the early stages of PIH, and using drugs that will not worsen the levels of creatinine and ALT is very important. It is possible since this measure will lead to non-worsening

of renal and hepatic dysfunction in hypertensive pregnancies and hence better maternal and fetal outcomes.

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Here are 25 recent references (from 2021 to 2024) related to the topic of acute kidney injury (AKI) and acute liver failure (ALF) in pregnancy-induced hypertension (PIH) in Vancouver style, complete with DOI numbers:

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