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MULTIMODAL SERUM BIOMARKERS FOR PREECLAMPSIA PREDICTION AND RISK ASSESSMENT: THE ROLE OF PROTEIN, ALBUMIN, CREATININE, AND URIC ACID

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ABSTRACT

Background: Preeclampsia is a pregnancy-related illness characterized by high blood pressure and damage to organs such as the liver and kidneys. When preeclampsia is present, serum proteins, albumin, creatinine, and uric acid are often measured. All cells and tissues require proteins as building blocks. Proteins are crucial to the growth, development, and health of the fetus as well as the expectant mother during pregnancy. **Objective:** The goal of the current study was to evaluate whether liver and kidney function tests might be utilized as markers to predict pregnancy-induced hypertension (PIH) and to highlight the possible roles that protein, albumin, creatinine, and uric acid may play in women with pre-eclampsia (PE). **Material and Methods:** The present study was under taken in 100 healthy pregnant women and 100 pre-eclampsia pregnant women of age group between 19-40 years during second trimester of pregnancy. Pregnant women who were pre-eclamptic had greater blood pressure than the control group ($P < 0.001$). In 200 pregnant women, serum protein and albumin were determined using a standardized test using kit procedures. When compared to the controls, pre-eclamptic pregnant women had a clinically significant proteinemia status. RFTs, such as the Infinite Diagnostic Kit method for measuring uric acid and the CRTN in vitro Diagnostic Kit method for measuring creatinine. **Results:** Compared to controls, pre-eclamptic pregnant women had considerably higher levels of creatinine and uric acid (10.862% and 44.19%), although blood protein and albumin levels were significantly lower (9.30% and 17.47%).

KEYWORDS: Pre-eclampsia, hypoproteinemia, creatinine, and uric acid.

INTRODUCTION

High blood pressure and organ malfunction are the hallmarks of preeclampsia, which often develops during the 20th week of pregnancy and poses hazards to the mother and fetus (Roberts, J.M., et al., 2013). Pregnancy-induced hypertension (PIH), another name for pre-eclampsia, is a hypertensive disease during pregnancy. According to Curtin et al. (1999), patients with hemolysis, increased liver enzymes, and low platelet count are defined as having HELLP syndrome.

The brain, lung, kidney, and liver may all be affected by pre-eclampsia, which is why it is important to acknowledge that it is a multiple system condition despite the definitions' emphasis on these easily measured clinical criteria. In early pregnancy, protein and albumin perform critical roles in promoting fetal development, maintaining mother health, and ensuring correct blood volume expansion. These proteins support a number of physiological functions, including immunological response, tissue growth, and the maintenance of oncotic pressure, which stops blood vessel fluid leakage.

Macromolecules known as proteins are vital for fetal development because they aid in the creation of new tissues, cells, and organs. Enough protein consumed in the early stages of pregnancy guarantees that the mother can supply the growing fetus with the nutrients it needs. The creation of hormones and enzymes that control metabolic processes during pregnancy also depends on protein. King (2000) underlined that maternal protein consumption during early pregnancy is crucial for the normal growth and development of the embryo, particularly during the first trimester when major organ systems are emerging. Maternal protein intake during the early stages of pregnancy has a major impact on placental and fetal growth, as revealed by Symonds et al. (2010). According to the study, protein restriction

changed the expression of growth factors that are essential for the development of fetuses.

II. MATERIALS AND METHODS

The present study was performed in 200 pregnant women during second and third trimester of pregnancy, who were visiting and admitted in Department of Obstetrics and Gynecology, Swaroop Rani Nehru Hospital, Prayagraj, (U.P.). Pregnant women were divided into two comparison groups: 100 preeclamptic pregnant women (also known as the study group) and 100 normal pregnant women (also known as the control group). The ladies were aged 19 to 40. Between 8 a.m. and 10 a.m., the subject provided blood samples (5 ml), which were centrifuged at 3000 rpm for 15 minutes at 40C. The serum was then separated for the estimation of LFT parameters, such as total protein and albumin, using kits and autoanalyzers, as well as renal function tests, or RFTs, such as uric acid analysis using an Infinite Diagnostic kit method and creatinine analysis using CRTN in vitro.

Statistical analysis

We compute the statistical data using mean ± S.D. The student t-test and probability distribution were used to determine the significance of the difference between the two groups**.**

III. RESULTS

Serum protein and albumin levels were lower in preeclamptic pregnant women than in the controls, suggesting a significant hypoproteinemia condition. Comparing pre-eclamptic pregnant women to normal pregnant women, serum albumin was virtually significant (P<0.05) and serum protein was statistically highly significant (P<0.001).

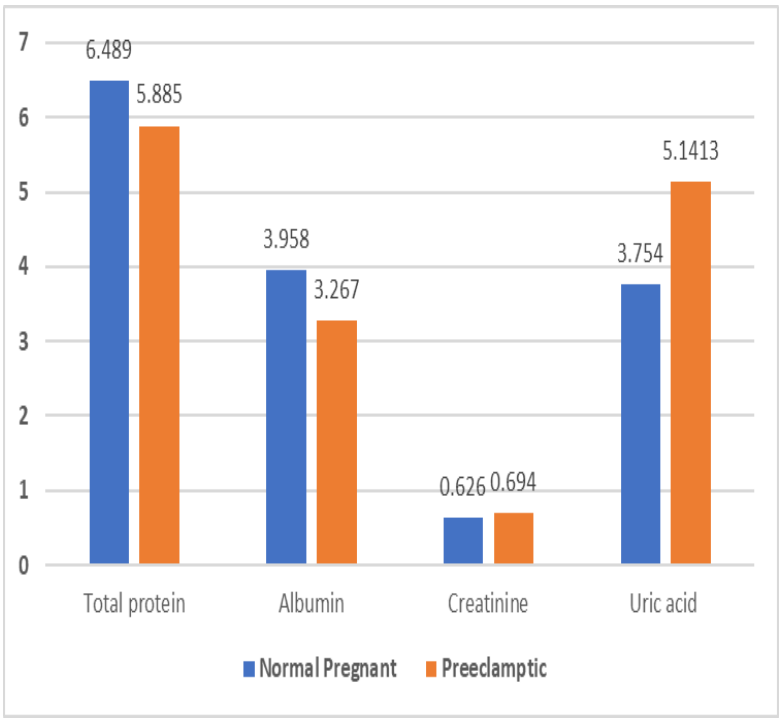
Levels of creatinine and serum uric acid were observed to be increased in preeclamptic pregnant women as compared with the normal pregnant women. Serum uric acid was almost significant (P<0.05), whereas serum creatinine was not significant (P<0.50).

Observation table

Levels of serum protein, serum albumin, serum creatinine and serum uric acid in normal pregnant and pre-eclamptic women.

Values were expressed as Mean ± S.D.

Parameters	Normal pregnant n=100	Pre-eclamptic n=100	P- value
Total protein(mg/dl)	6.489± 0.7313	5.885± 0.3066	<0.001
Albumin (mg/dl)	3.958± 0.6135	3.267± 0.0713	<0.05
Creatinine (mg/dl)	0.626± 0.187	0.694± 0.2089	<0.50
Uric acid (mg/dl)	3.754± 0.657	5.413± 0.562	< 0.05



Graph of serum protein, serum albumin, and serum creatinine and serum uric acid in normotensive and pre-eclamptic pregnant women.

IV. DISCUSSION

The pathophysiology of preeclampsia is significantly influenced by serum protein, specifically albumin. The most prevalent plasma protein, albumin is necessary for fatty acid, medication, hormone, and fatty acid transportation in addition to serving as an antioxidant. It also helps to maintain oncotic pressure. Excessive protein in the urine, or proteinuria, is a characteristic of preeclampsia and indicates renal impairment and endothelial dysfunction. According to Kondrackiene et al. (2010), preeclamptic pregnant women had considerably lower serum albumin levels than normotensive pregnant women. This study demonstrated the connection between elevated preeclampsia severity and decreased serum albumin levels. The presence of severe proteinuria, which includes albumin loss, is one of the diagnostic criteria for preeclampsia. Due to the decreased plasma oncotic pressure, there is an increase in vascular permeability and edema. These results give strengthen our similar findings.

The pathophysiology of preeclampsia was investigated by Baumwell and Karumanchi's (2012) research, which focused on the involvement of serum proteins like albumin. The authors noted that hypoalbuminemia may function as a biomarker to identify women who are more vulnerable to unfavorable outcomes and proposed that decreased serum albumin may be a factor in increased vascular permeability. This outcome and our findings are comparable. Severe variations of the illness, such as HELLP syndrome (Hemolysis, Elevated Liver Enzymes, and Low Platelets), are linked to low albumin levels.

Additionally, albumin neutralizes free radicals through its antioxidant properties. Serum albumin levels are decreased in preeclampsia due to its consumption during oxidative stress. The disease then progresses as a result of the weakened antioxidant defense aggravating endothelial damage. Oxidative stress is a hallmark of preeclampsia, and albumin's antioxidant potential becomes vital (Al-Gubory et al., 2012).

In addition, we observed lower levels of serum albumin and serum protein in the current investigation. Comparing pre-eclamptic pregnant women to normal pregnant women, serum albumin was virtually significant ($P<0.05$) and serum protein was statistically highly significant ($P<0.001$). These outcomes confirm those of Ghuman et al. (2016), who found that hypoalbuminemia causes preeclamptic women's fluid and tissue edema to be spread differently, which in turn worsens maternal difficulties. Generalized edema results from fluid leaking from blood arteries into the interstitial spaces, which is helped by the drop in serum albumin.

Important indicators that shed light on kidney function and metabolic alterations in preeclampsia include serum creatinine and serum uric acid. Elevated levels of both are typically detected in preeclamptic women, showing renal impairment and altered purine metabolism, both of which are significant elements of the disease's pathophysiology. Women with severe preeclampsia have significantly higher serum creatinine levels, according to Agarwal et al. (2011). This increase indicates the severity of renal impairment and is associated with a lower glomerular filtration rate (GFR). The kidneys filter serum creatinine, which is a waste product of muscle metabolism.

Elevated blood creatinine levels in preeclampsia are suggestive of altered renal function brought on by glomerular injury and endothelial dysfunction. Our findings and these observations are comparable. Preeclampsia severity and maternal problems can be predicted by serum creatinine levels, according to another study. Stepan et al. (2013) found that women with higher creatinine levels had a higher risk of complications such HELLP syndrome or eclampsia.

Elevated serum uric acid is linked to a higher risk of preeclampsia and its consequences, per a meta-analysis conducted by Bellos et al. (2016). The results of the study showed that serum uric acid might be used as a prognostic indicator for the disease before any symptoms appear. Purine metabolism results in elevated levels of serum uric acid, which are frequently observed in preeclampsia because of decreased renal clearance and increased oxidative stress. Given the strength of our observations, it is recommended as a marker for the severity of preeclampsia.

Similar findings were made in this study, which revealed that preeclamptic pregnant women had higher serum uric acid levels than normal pregnant women. There was almost significant ($P<0.05$) serum uric acid. These findings support the hypothesis put forward by Bainbridge and Roberts (2012), who suggested that uric acid is more than merely a kidney function marker. It directly contributes to oxidative stress and endothelial dysfunction, which exacerbates the course of preeclampsia. Poorer outcomes for mothers and fetuses were associated with elevated uric acid levels.

Elevated serum uric acid levels in the second trimester have been linked to a higher risk of preeclampsia onset, as confirmed by a longitudinal study conducted by Kuo et al. (2015) and our own research. In a similar vein, this study revealed that elevated uric acid levels are caused by heightened oxidative stress as well as compromised renal function. Because glomerular endotheliosis prevents the kidneys from excreting uric acid from the body efficiently, elevated serum uric acid levels in preeclampsia also indicate limited renal clearance.

In a 2017 study by Lopes van Balen et al., observed that the combination of increased serum creatinine and uric acid levels improved the capacity to predict unfavorable maternal outcomes in preeclampsia. These findings are consistent with our own, which showed that a more useful method for identifying and evaluating the degree

of preeclampsia is to combine measures of serum creatinine and uric acid. Significant renal involvement is indicated by elevated levels of both biomarkers, which is typical of severe preeclampsia.

CONCLUSION

Preeclampsia is a pregnancy complication characterized by high blood pressure (hypertension) and often significant damage to organ systems, most commonly the liver and kidneys. It usually occurs after the 20th week of pregnancy in women who previously had normal blood pressure. Preeclampsia can lead to serious, even fatal, complications for both the mother and the baby if left untreated. From our findings it can be concluded that serum albumin is not only a marker for preeclampsia but also plays a pivotal role in its pathophysiology. Hypoalbuminemia, a common feature of preeclampsia, leads to increased vascular permeability, edema, oxidative stress, and worsened clinical outcomes. Serum creatinine and uric acid have been increasingly recognized as key biomarkers in the diagnosis and management of preeclampsia. Elevated serum creatinine reflects impaired renal function, while elevated uric acid levels are linked to both renal dysfunction and oxidative stress. Together, they offer valuable insights into disease severity and prognosis, making them useful in both clinical practice and research. Future research is needed to understand the role of protein, albumin, creatinine and uric acid in the treatment and avoidance of pre-eclampsia will require more investigation.

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