ISSN: 0975-3583, 0976-2833 VOL14, ISSUE11, 2023

Original Research Article

Efficacy of Hematological and Biochemical Parameters in Predicting the Severity of Pregnancy Induced Hypertension and Preeclampsia

[1]Dr. Shashank Tyagi, [2]Narendra Rahaengdale, [3]Dr. K B Verma, [4]Dr. Yashvardhan Raghuvanshi, [5]Dr. Rajesh Kumar Ahirwar

Professor & Head, Department of Biochemistry, SRVS Government Medical College, Shivpuri, MP, India[1]

Lab chemist, Department of Biochemistry, SRVS Government Medical College, Shivpuri, MP, India[3]

Professor, Department of Physiology, SRVS Government Medical College, Shivpuri, MP, India[2]

Tutor, Department of Physiology, SRVS Government Medical College, Shivpuri, MP, India[4]

[5]Professor & Head, Department of Community Medicine, SRVS Government Medical College, Shivpuri, MP, India[5]

Corresponding Author: [4]Dr. Yashvardhan Raghuvanshi

[4]yashvardhanraghuvanshi23@gmail.com

Abstract

Objectives: Pregnancy-induced hypertension (PIH) is a serious pregnancy complication that contributes significantly to both maternal and neonatal morbidity and mortality. The study aimed to evaluate various hematological and biochemical parameters predictive the severity of PIH and preeclampsia.

Methods: This was a cross sectional observational study included the study group (120 preeclampsia patients) and the control group consisted of 120 healthy pregnant women. Venous blood samples were collected to study hematological profile, including coagulation and biochemical analysis.

Results: out of total subjects, 40 were categorized as mild preeclampsia, 80 as severe preeclampsia, and 120 as healthy pregnant women. The mean hemoglobin level and mean platelet count was decreased significantly in Preeclampsia patients as the disease progressed ($p<0.05$). The mean Prothrombin time and activated partial thromboplastin time were increased significantly in PIH with disease progression ($p<0.05$). Liver enzymes, creatinine, and uric acid levels increased significantly in preeclampsia as the disease progressed ($p<0.05$)**.**

Conclusion:. Most of the hematological and biochemical parameters altered as PIH progressed in severity; these indices combined with other parameters can be used in the prediction of preeclampsia.

Keywords: Pregnancy induced hypertension, preeclampsia, biochemical parameters, hematological parameters

1. Introduction

Pregnancy-induced hypertension (PIH) is one of the most common pregnancy complications, affecting approximately 5-7% of all pregnancies. It is also a significant cause of maternal and fetal morbidity and mortality [1-2]. Gestational hypertension is defined as systolic blood pressure (SBP) ≥ 140mmHg and/or diastolic blood pressure (DBP) ≥ 90mmHg at two

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE11, 2023

measurements 4hours apart at 20weeks of gestation in a previously normotensive woman [3]. Incidence of Hypertensive disorders in pregnancy occur in 2-10% worldwide and incidence of PIH in India ranges from 5% to 15% [4]. Preeclampsia is defined as the presence of systolic blood pressure of 140 mm Hg or more or diastolic blood pressure of 90 mm Hg or more on two occasions at least 4 hours apart after 20 weeks of gestation in a woman with previously normal blood pressure and proteinuria 300 mg or more per 24-hour urine collection (or this amount extrapolated from a timed collection) or protein/creatinine ratio of 0.3 mg/dL or more or dipstick reading of 2+ (used only if other quantitative methods not available) [5]. Preeclampsia is a serious multisystem disorder unique in human pregnancy, is a major cause of potentially preventable maternal and fetal morbidity and mortality [6]. The most common immediate maternal complications of PIH are eclampsia, oligohydramnios, accidental hemorrhages, disseminated intravascular coagulation, and hemolysis, elevated liver enzymes and low platelets (HELLP) syndrome. Remote complications include residual hypertension, recurrent preeclampsia, and chronic renal failure [7]. Several methods focus on early trimester screening, such as those of angiogenic factors or biomarkers, the current guideline for immediately diagnosing preeclampsia severity depends mainly on blood pressure levels and proteinuria [8]. Preeclampsia develops a variety of hematologic aberrations, which affect the outcome of the patients, the coagulation-fibrinolytic system is thought to be one of the most seriously affected systems in preeclampsia by maternal inflammatory reactions and immune dysfunction [9]. Leukocyte counts are more elevated in pregnant women with PE than in normal pregnancy, mainly due to an increased number of neutrophils as opposed to a decreased number of leukocytes [10]. Several studies reported a significant decrease in platelet count and increase in mean platelet volume (MPV) and platelet distribution width (PDW) in pregnant women who developed PE compared with pregnant women who did not [11-12]. Complete blood count, urine examination, and liver function tests performed to identify platelet abnormalities, red cell abnormality, and to detect patients who progress to HELLP syndrome. Various strategies have been proposed to reduce the perinatal effects of preeclampsia. This can be achieved by early diagnosis of preeclampsia simply via assessment of blood coagulation profile [13].

Aims & objectives: The aim of this study was to examine whether hematological and serum biochemical parameters may be of use in predicting the severity and perinatal outcome in preeclampsia.

2. Material & Methods

This cross sectional study was done in the Department of Pathology with the support of the Department of OBG in a tertiary care hospital, India. In this study, we examined and classified the all pregnant women admitted to the delivery room or outpatient clinic of OBG department.

Inclusion criteria:

- Women were >20 weeks of gestation
- Blood pressure (BP) of >140/90 mmHg and ≥1+ proteinuria
- Participants who provides written informed consent for the study

Exclusion criteria:

- Previously known cases of hypertension
- Bleeding disorders and preeclampsia superimposed on a known case of essential hypertension
- Participants who not willing for the study
- All patients with coexisting medical, surgical or gestational conditions were excluded

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE11, 2023

The criteria for diagnosis of preeclampsia were new onset arterial hypertension, or diastolic pressures of ≥ 90 mmHg and systolic pressures of ≥ 140 mmHg, measured on two separate occasions within 24h, more than 6 hours apart, and proteinuria of ≥ 300 mg of protein in 24-hour urine samples which were developed after the 20th week of pregnancy in previously normotensive women. In the analysis of clinical parameters, the highest recorded values of arterial blood pressure were used. The study group was divided into two subgroups: severe and mild preeclampsia, based on the presence of criterion for severe preeclampsia.
Preliminary data of patients with PIH were collected at admission, coded, and recorded into a master chart.

Venous blood samples were collected in EDTA tubes for hematological profile, in sodium citrate tube for coagulation studies, and in plain tubes for biochemical analysis. The hematological parameters were assessed using an auto analyzer. Erythrocyte sedimentation rate (ESR) was determined using disposable Westergren's tubes. Automated blood coagulation analyzer and the biochemical analysis using automated analyzer.
Statistical analysis: IBM SPSS version 22.0 statistics program was used to analyze the data. Before statistical analysis, all variables were checked for normality. P-values less than 0.05 ($P < 0.05$) were accepted as significant.

3. Results

A total of 120 diagnosed cases of preeclampsia and same number of control were enrolled and analysed, out of that, 40 were categorized as mild preeclampsia and 80 as severe preeclampsia. The mean age and BMI was significantly higher among preeclampsia group as compared to control. In preeclampsia, the mean gestational age, parity and neonate birth weight was significantly lower than the control group ($p<0.05$) [table: 1].

Table 1: Comparison of socio-demographics characteristics between preeclampsia and control group

Parameters	**Mild Preeclampsia (n=40)**	**Severe Preeclampsia (n=80)**	**Control (n=120)**	**P value**
Age (years)	30.43 ± 3.24	31.91 ± 6.55	28.63 ± 3.54	0.001
Parity	1.63 ± 0.67	1.35 ± 0.85	1.83 ± 0.46	0.001
BMI	30.4 ± 5.5	31.8 ± 6.3	27.7 ± 5.2	0.001
Gestational age	37.43 ±2.43	36.22 ± 2.33	38.58 ± 2.17	0.001
Birth weight (kg)	2.8 ± 0.3	2.6±0.4	3.3 ± 0.2	0.001

We found significantly higher SBP, DBP and mean arterial pressure in the mild and severe preeclampsia group than control groups ($p<0.05$). **S**ignificant Proteinuria was seen in severe preeclampsia followed by mild preeclampsia, but no proteinuria in control group.

Table 2: Comparison of clinical characteristics between preeclampsia and control group

Clinical parameters	**Mild Preeclampsia**	**Severe Preeclampsia**	**Control (n=120)**	**P value**
Systolic blood pressure	148.53 ±7.64	170.76 ±13.39	108.12 ±9.62	0.001

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE11, 2023

Diastolic blood pressure	98.58 ± 4.65	112.76 ± 8.15	70.44 ± 6.46	0.001
Proteinuria (grams/24h)	0.58 ± 0.26	2.68 ± 1.36	0.0±0.0	0.001
MAP at hospitalization	110.0 ± 5.4	124.0 ± 8.8	85.0 ± 2.6	0.001

Among hematological parameters, the mean levels of hemoglobin (Hb), platelets, Red blood cells count, Hematocrit, Prothrombin time (PT), international normalized ratio (INR) and partial thromboplastin time (aPTT) differed significantly between preeclampsia patients and control group ($p<0.05$).

Table 3: Comparison of hematological parameter between preeclampsia and control group

Hematological parameters	**Preeclampsia (n=120)**	**Control (n=120)**	**P value**
Hemoglobin (g/dl)	11.4 ± 1.6	10.5 ± 1.2	<0.001
Platelets (10^9cells/L)	208 ± 53	246 ± 76	<0.001
ESR (mm/hr)	66.51 ± 20.2	70.92 ± 23.4	0.119
Total leukocyte count (10^9/L)	9.43 ± 2.04	9.15 ± 2.18	0.305
Red blood cells count (10^{12}/L)	4.66 ± 0.58	4.11 ± 2.23	0.009
HCT - Hematocrit (%)	36.80 ± 4.32	33.61 ± 3.52	<0.001
MPV (fl)	10.68 ± 2.45	11.18 ± 1.87	0.076
Prothrombin time (seconds)	12.46 ± 1.87	11.24 ± 1.24	<0.001
Activated partial thromboplastin time (APTT|)	27.66 ± 3.81	32.44 ± 4.24	<0.001
International normalized ratio (INR)	1.03 ± 0.10	1.1 ± 0.2	0.007

The preeclampsia group reported statistically significant higher values of aspartate aminotranferase (AST), alanine aminotranferase (ALT), lactate dehydrogenase (LDH), total cholesterol, triglyceride, urea, creatinine and uric acid compared to the control group,and lower values of albumin ($p < 0.05$).

Table 4: Comparison of biochemical parameter between preeclampsia and control group

Biochemical parameters	**Preeclampsia (n=120)**	**Control (n=120)**	**P value**
Serum proteins (mg/dL)	5.82 ± 0.26	6.6 ± 0.16	<0.001
Serum albumin (mg/dL)	2.7 ± 0.14	3.6 ± 0.20	<0.001
AST - aspartate aminotrans (U/L)	68 ± 10.4	19.8 ± 5.6	<0.001
ALT - alanine aminotrans (U/L)	44 ± 7.2	14 ± 4.5	<0.001
LDH - lactate dehydrogenase (U/L)	456.41 ± 98.47	312.97 ± 82.64	<0.001
Total bilirubin (µmol/L)	6.34 ± 1.74	3.27 ± 0.72	<0.001

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE11, 2023

Direct bilirubin (µmol/L)	0.92 ± 0.40	1.14 ± 0.52	0.003
Total cholesterol (mmol/L)	8.06 ± 1.35	6.32 ±1.02	<0.001
Triglycerides (mmol/L)	4.17 ±1.14	3.33 ± 1.07	<0.001
Urea (mg/dL)	26.6 ± 10.5	16.8 ± 3.4	<0.001
Creatinine (mg/dL)	0.78 ± 0.31	0.44 ± 0.13	<0.001
Uric acid (mg/dL)	6.78 ± 1.75	4.74 ± 1.25	<0.001
CRP - C-reactive protein (mg/L)	6.86 ± 2.74	5.18 ± 1.79	<0.001

4. Discussion

Preeclampsia is one of the leading causes of maternal and fetal morbidity and mortality. After active research for many years, the etiology of PIH remains unclear. Evidence suggests that there were several underlying causes for endothelial dysfunction such as hypertension, proteinuria, and edema, as well as preeclampsia [14].

Our study showed that patients with severe preeclampsia were on average slightly older than those with mild preeclampsia and healthy group, concordance to Nadkarni J,et al [15], advanced age is a risk factor for severe preeclampsia.

BMI of severe preeclampsia subjects was significantly higher than the mild preeclampsia and healthy group, similar finding also reported by Han L, et al [16] and D. Ozkan et al [17].

The present study showed that the mean gestational age, parity and neonate birth weight was significantly lower in preeclampsia than the control group, accordance with the M Hackelöer et al [18] and Sandstroem et al[19].

Proteinuria is one of the essential criteria for defining preeclampsia, current study significantly proteinuria was found among severe preeclampsia group as compared to mild preeclampsia, results correlate with the Jelena et al [20] and Morris RK et al [21].

Of hematological parameters among our patients, the most significant is the statistically lower hemoglobin and platelet count in the study group compared to the control group. According to the findings of most other authors like Navamar et al [22], Alisi PN et al 23] and Monteiro G et al [24], Platelet count variations in PIH may be due to increased consumption, decreased life span and increased aggregation by increased levels of thromboxane A2 in placental circulation.

In the present study, TLC and MPV were not found to be significantly different in preeclampsia and the control group, agreement with the Taşın et al [25].

In this study, PT, aPTT, and INR were significantly differed between preeclampsia patients and control group, with significantly increased PT levels, Similar to our findings, Shetty et al [26], Hsiao-Wen Lu et al [27] and Chaware SA et al [28] also reported same results.

In our study, the mean serum protein and albumin significantly decreased, whereas SGOT and SGPT levels were significant increase in preeclampsia group as compared to control, which are similar to the Boddapati et al [29] and Bhowmik et al [30].

The levels of urea, creatinine, and uric acid were increased in patients with preeclampsia when compared to normal individuals, indicating impaired renal function in PIH. These findings are in agreement with findings of some previous studies [31-32].

5. Conclusion

The laboratory parameters changes such as anemia, thrombocytopenia, and deranged coagulation profile as well as altered liver and renal profile are seen in Preeclampsia. The

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE11, 2023

degree of thrombocytopenia, anemia, and deranged parameters increases as the disease progresses.
The results show that repeated blood test could help in careful monitoring, early detection, and appropriate management of PIH in order to reduce risk of morbidity and mortality.

6. References

1. Fatemeh T, Marziyeh G, Nayereh G, Anahita G, Samira T. Maternal and perinatal outcome in nulliparious women complicated with pregnancy hypertension. JPMA. The Journal of the Pakistan Medical Association. 2010 Sep 1; 60(9):707.
2. Gillon TE, Pels A, von Dadelszen P, MacDonell K, Magee LA. Hypertensive disorders of pregnancy: a systematic review of International Clinical Practice Guidelines. PLoS One. 2014; 9:e113715. doi: 10.1371/journal. pone.0113715.
3. Metz, T.D., et al., 2020. Obstetric care consensus# 10: management of stillbirth: (replaces practice bulletin number 102, March 2009). American Journal of Obstetrics and Gynecology, 222 (3), 2–20.
4. Sultana F, Parthiban R, Shariff S. Thrombocytopenia in pregnancy induced hypertension. J Med Sci Health. 2015;1(2):19-24.
5. Chen KH, Seow KM, Chen LR. Progression of gestational hypertension to pre-eclampsia: A cohort study of 20,103 pregnancies. Pregnancy Hypertens. 2017; 10:230-37.
6. Shennan AH, Redman C, Cooper C, Milne F (2012) Are most maternal deaths from pre-eclampsia avoidable? Lancet 379(9827):1686–1687.
7. Dutta.D.C. Hypertensive Disorders In Pregnancy. In: Hiralal, K (ed.) Textbook of Obstetrics Including. Kolkata, India: Jaypee Brothers Medical Publishers (P) Ltd; 2013.p. 219-240.
8. Practice Bulletin ACOG. No. 202: gestational hypertension and preeclampsia. Obstet Gynecol. 2019;133:485.
9. Pinheiro MB, Gomes KB, Dusse LM (2013) Fibrinolytic system in preeclampsia. Clin Chim Acta 416: 67–71.
10. Canzoneri, B.J., et al., 2009. Increased neutrophil numbers account for leukocytosis in women with preeclampsia. American Journal of Perinatology, 26 (10), 729–732.
11. Yang, S.W., et al., 2014. Significance of the platelet distribution width as a severity marker for the development of preeclampsia. European Journal of Obstetrics & Gynecology and Reproductive Biology, 175, 107–111.
12. Roberts, J.M. and Bell, M.J., 2013. If we know so much about preeclampsia, why haven't we cured the disease? Journal of Reproductive Immunology, 99 (1–2), 1–9.
13. Karim R, Sacher RA. Thrombocytopenia in pregnancy. Current Hematology Reports. 2004 Mar 1;3(2):128-33.
14. Monteiro G, Subbalakshmi NK, Pai SR. Relevance of measurement of hematological parameters in subjects with pregnancy induced hypertension. Nitte University Journal of Health Science. 2014 ;4(1):15
15. Nadkarni J, Patne SK, Kispotta R. Hypoxia as a predisposing factor for the development of early onset neonatal thrombocytopenia. J Clin Neonatol 2012; 1:131-4
16. Han L, Liu X, Li H, Zou J, Yang Z, et al. (2014) Blood Coagulation Parameters and Platelet Indices: Changes in Normal and Preeclamptic Pregnancies and Predictive Values for Preeclampsia. PLoS ONE 9(12): e114488. doi:10.1371/journal.pone.0114488
17. Dogukan Ozkan, Mujde Can Ibanoglu, Kevser Adar, Merve Ozkan, Omer Lutfi Tapisiz, Yaprak Engin-Ustun & Can Tekin Iskender (2023) Efficacy of blood parameters in

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE11, 2023

predicting the severity of gestational hypertension and preeclampsia, Journal of Obstetrics and Gynaecology, 43:1, 2144175, DOI: 10.1080/01443615.2022.2144175
18. Sandström A, Snowden JM, Höijer J, Bottai M, Wikström AK (2019) Clinical risk assessment in early pregnancy for preeclampsia in nulliparous women: a population based cohort study. PLoS One 14(11):e0225716
19. Max Hackelöer, Leon Schmidt, Stefan Verlohren, New advances in prediction and surveillance of preeclampsia: role of machine learning approaches and remote monitoring, Archives of Gynecology and Obstetrics (2023) 308:1663–1677.
20. Jelena Milošević-Stevanović, Dragana Radović-Janošević, Jasmina Popović, Milan Stefanović, Ranko Kutlešić, Aleksandra Petrić, Marko Stanojević, value of haematological and serum biochemical parameters in the prediction of perinatal outcome in preeclampsia, Acta Medica Medianae 2020;59(3):27-35
21. Morris RK, Riley RD, Doug M, Deeks JJ, Kilby MD. Diagnostic accuracy of spot urinary protein and albumin to creatinine ratios for detection of significant proteinuria or adverse pregnancy outcome in patients with suspected pre-eclampsia: systematic review and meta-analysis. BMJ 2012; 345:e4342
22. B Namavar Jahromi, SH Rafiee. Coagulation Factors in Severe Preeclampsia. Iranian Red Crescent Medical Journal. 2009; 11(3):321-324.
23. Alisi PN, Buseri FI, Alisi CS. Some Blood Cell Changes and Alteration in Renal and Hepatic Function in Pre-eclampsia: A Study in Owerri Nigeria. IBRR 2014; 4; 132-139.
24. Monteiro G, Subbalakshmi NK, Pai SR. Relevance of measurement of hematological parameters in subjects with pregnancy induced hypertension. Nitte University Journal of Health Science. 2014 ;4(1):15
25. Cuma taşin,* , Nezaket kadioglu , Revan Sabri ciftci , Ayhan coskun, Hakan aytan, The role of platelet mass index in the prediction of preeclampsia full, J Exp Clin Med 2022; 39(1): 221-225 doi: 10.52142/omujecm.39.1.43
26. Shetty J, Rao S, Kulkarni MH. Hematological Changes in Pregnancyinduced Hypertension. International journal of scientific study. 2016;4(5):215-20.
27. Hsiao-Wen Lu, Han-Shui Hsu, Detecting Preeclampsia Severity Using Maternal-Obstetrical Characteristics and Complete Blood Cell Counts, International Journal of General Medicine 2022:15 8715–8726
28. Chaware SA, Dhake R, Ingole AS, Bahattare VN, Bhopale KS. Study of Coagulation Profile in Preeclampsia and Eclampsia. International Medical Journal. 2015;2(3):164-70
29. Amulya Boddapati, Renuka Inuganti Venkata,Parveen Riyaz, Vydehi B.V, Vamshi Deepak.Hematological and Biochemical Abnormalities in Pregnancy-Induced Hypertension.Journal of Clinical and Basic Research. 2022; 6 (2) :12-20
30. Bhowmik DK, Akhtari R, Kumar SU, Saha M, Adhikary DK. Alteration of liver function in preeclampsia and eclampsia. Chattagram Maa-O-Shishu Hospital Medical College Journal. 2013 Oct 28; 12(3):9-10.
31. Powers RW, Bodnar LM, Ness RB, Cooper KM, Gallaher MJ, Frank MP, et al. Uric acid concentration in early pregnancy among preeclamptic women with gestational hyperuricemia at delivery. Am J Obstet Gynecol 2006;194:160
32. Ganai I, Shazia JS, Parveen N, Arif K, Farooq AG. To Study Biochemical and Hematological Parameters in Pre-Eclampsia; JMSCR; 2014; 2(1); 315-320.