

The Significance of Blood Parameters in Women with Preeclampsia

Abeer .A. Alkredes, Zaherra.S

Abstract: Background: Pre-eclampsia is one of the major causes of maternal and perinatal morbidity and mortality worldwide. **Aims:** This study aimed to determine if any significant differences in participants' blood parameter indices (Hb, MCH, MCHC, and MCV) existed between those with pre-eclampsia and those without pre-eclampsia. In addition, we tried to find out which of the clinical features of pre-eclampsia significantly moderates the blood indices. **Settings and Design:** This prospective, case control study was conducted in the Maternity and Child Hospital, Buraidah, AlQassim. **Methods:** The study was conducted over a period of five months from 1/12/2016 to 1/5/2017. Pregnant women (N/94) were selected as population of the study, among them (45) were patients with preeclampsia and (49) normotensive pregnancies as controls.

Results: Participants that did experience pre-eclampsia had significantly lower platelet counts ($M = 206.240$, $SD = 51.377$) compared to those that did not experience pre-eclampsia ($M = 277.451$, $SD = 87.431$). In contrast, participants that did experience pre-eclampsia had significantly higher WBC scores ($M = 11.261$, $SD = 2.054$) compared to those that did not experience pre-eclampsia ($M = 9.573$, $SD = 2.497$). The logistic regression analyses indicated that the relationships between criterion variable (headaches) and three predictor variables (platelet count, hematocrit, RBC) were significantly moderated by pre-eclampsia statuses (yes, no). **Conclusions:** Women with pre-eclampsia have raised WBC count and low platelets. Presence of preeclampsia significantly moderates the values of four predictor variables (platelet count, hematocrit, RBC, and MCV) in pre-eclamptic women having headache. None of the other clinical features moderated the hemogram. **Conclusion:** Women with pre-eclampsia have raised WBC count and low platelets.

Keywords -- Preeclampsia, Pregnancy, Hypertension, proteinuria, Platelet indices.

INTRODUCTION

Preeclampsia (PE) is considered a pregnancy specific disorder in women [1]. It is one of the major causes of maternal and perinatal mortality and morbidity.

Understanding the significance of blood parameters, demographic factors and differences between a normal woman and preeclampsia would assist health care professionals in saving life for the mother and the unborn [1]. Preeclampsia complications occur in 2-8% of all pregnancies across the world that results in 63,000 maternal deaths annually [2]. The maternal death rate is higher in developing countries as compared to developed countries. However, the condition is life threatening occurrences even in the developed world [2]. The complications that are linked with the condition include eclampsia, abruption, cerebral haemorrhage, pulmonary oedema, hepatic failure, haemolysis elevated liver enzymes, low platelet count (HELLP syndrome) and also acute renal failure [3]. It is also a major cause of prenatal deaths among the unborn [3]. It is found, that women who had an experience of preeclampsia complications, are likely to experience cardiac failure, cerebrovascular accidents, peripheral arterial diseases and higher cardiovascular mortality. Previous pregnancy with the condition is found to be the major risk factor, though it is believed that preeclampsia has multivariate risk factors [4]. An institutional study showed that the prevalence of preeclampsia in Saudi community was lower than other Asian and African countries, but condition still poses a major burden on health care facilities in Saudi Arabia [5]. PE is characterized by increased blood pressure more than (160/110 mmHg), with proteinuria (0.3 g/d), and other symptoms that may start as early as the 20th week of gestation [6]. The exact cause of PE is not

fully understood yet, and is related to many causes like reduced placental perfusion, changes in the coagulation factor, platelet activation, and endothelial dysfunction [7, 9]. Literature review revealed that researchers have tried to link platelet indices with the complexity of disease as well as prognosis of preeclampsia [8, 10]. Despite diagnosis and management, a number of women fail to respond to treatment and have poor fetomaternal outcome. Therefore, not only it is important to consider the diagnosis and detection for early management and treatment but, also to find out predictors of poor maternal response. Only few studies have been able to analyses the impact and strength of platelets and blood indices on the progress of condition. A recent study from the Qassim region has used platelet indices as the predictors for preeclampsia [11]. There is no study to our knowledge from Qassim region which have used parameters other than platelets to predict the fetomaternal prognosis. Our study will be the first from the region to recognize the weaknesses and strength of simple and cheap blood indices (MCH, MCHC, and MCV) in women with preeclampsia and those without.

This study aimed to determine if any significant differences in participants' blood parameter indices (HGB, MCH, MCHC, and MCV) existed between those with preeclampsia and those without preeclampsia. In addition, we tried to find out which of the clinical features of preeclampsia significantly moderates the blood indices. Preeclampsia (PE) is considered a pregnancy specific disorder in women [1]. It is one of the major causes of maternal and perinatal mortality and morbidity. Understanding the significance of blood parameters, demographic factors and differences between a normal woman and

preeclampsia would assist health care professionals in saving life for the mother and the unborn [1]. Preeclampsia complications occur in 2-8% of all pregnancies across the world that results in 63,000 maternal deaths annually [2]. The maternal death rate is higher in developing countries as compared to developed countries. However, the condition is life threatening occurrences even in the developed world [2]. The complications that are linked with the condition include eclampsia, abruptio, cerebral haemorrhage, pulmonary oedema, hepatic failure, haemolysis elevated liver enzymes, low platelet count (HELLP syndrome) and also acute renal failure [3]. It is also a major cause of prenatal deaths among the unborn [3]. It is found, that women who had an experience of preeclampsia complications, are likely to experience cardiac failure, cerebrovascular accidents, peripheral arterial diseases and higher cardiovascular mortality. Previous pregnancy with the condition is found to be the major risk factor, though it is believed that preeclampsia has multivariate risk factors [4]. An institutional study showed that the prevalence of preeclampsia in Saudi community was lower than other Asian and African countries, but condition still poses a major burden on health care facilities in Saudi Arabia [5]. PE is characterized by increased blood pressure more than (160/110 mmHg), with proteinuria (0.3 g/d), and other symptoms that may start as early as the 20th week of gestation [6]. The exact cause of PE is not fully understood yet, and is related to many causes like reduced placental perfusion, changes in the coagulation factor, platelet activation, and endothelial dysfunction [7, 9]. Literature review revealed that researchers have tried to link platelet indices with the complexity of disease as well as prognosis of preeclampsia [8, 10]. Despite diagnosis and management, a number of women fail to respond to treatment and have poor fetomaternal outcome. Therefore, not only it is important to consider the diagnosis and detection for early management and treatment but, also to find out predictors of poor maternal response. Only few studies have been able to analyses the impact and strength of platelets and blood indices on the progress of condition. A recent study from the Qassim region has used platelet indices as the predictors for preeclampsia [11]. There is no study to our knowledge from Qassim region which have used parameters other than platelets to predict the fetomaternal prognosis. Our study will be the first from the region to recognize the weaknesses and strength of simple and cheap blood indices (MCH, MCHC, and MCV) in women with preeclampsia and those without.

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Material and Methods:

Retrospective case control study was targeted pregnant women with preeclampsia. It was conducted at the department of obstetrics and gynecology, Maternity and Child Hospital, Buraidah during the period from 1/12/2016 to 1/5/2017 for six month duration. Blood parameters were reviewed from the patients' files from 45 preeclampsia and 49 normotensive women. Inclusion criteria: Participants were divided into two groups; PE group and normotensive group as control. The criteria for preeclampsia group were women clinically detected with confirmed the diagnosis of preeclampsia between 20-38 weeks of gestation. The patients diagnosed with severe preeclampsia, was based on blood pressure of 160/110 mmHg, with proteinuria (presence of 300 mg or more of protein in 24 h urine sample or $\geq 2+$ on dipstick) in a pregnant in the second half of pregnancy (woman at 20 weeks gestation) or a blood pressure of 140/90 mmHg in the presence of severe prodromal symptoms such as headache, blurred vision, epigastric pain, elevated liver enzymes, massive proteinuria, or swelling feet. Criteria for controlled group: women of normal pregnancies; all healthy had a normal obstetric history, with normal blood pressure, systolic/diastolic blood pressure $\leq 120/80$ mmHg without a history of hypertension or proteinuria. They had regular follow up to antenatal care, have no complication during their pregnancies and no complication to the foetus. These women were taken from outpatient department. Women with hypertension, thyroid disease, Diabetic mellitus, renal disease or liver disease were excluded from the study for each group controlled and PE group. Data were collected from both groups by using predesigned a questionnaire that included personal data and weight and height recorded as well as symptom and outcome for maternal and blood parameter from the file recorded. The research protocol was approved by Regional ethical committee in Qassim. Informed written consent was taken from all participants. General physical and clinical examination was performed at Hospital to obtain information about height, weight, systolic and diastolic blood pressure and oedema. A 24 hour urine protein was performed as part of routine diagnosis for PE in the hospital's laboratory. Considering the 8% prevalence of preeclampsia the sample size of 45 had a 95% Confidence level and a confidence Interval of 5 [2, 12].

Ethics This study was approved by Regional Research Ethical Committee, Ministry of Health, Qassim, KSA who deemed written consent was not required due to the retrospective nature of the study.

Statistics The data was analysed using Microsoft office and Statistical software 'Statistical Package for Social Science (SPSS) program for windows version 24.0 Simple T-test was used to compare the platelets count and indices in the both study groups case and control.

Hypothesis-1 our hypothesis was evaluated using independent-samples *t*-tests to determine if any significant differences in participants' blood parameter scores existed between those with preeclampsia and controlled group. The dependent variables were seven blood parameters including HGB, MCV, MCHC, platelet count, haematocrit, RBC, and WBC. The independent variable was preeclampsia status (with preeclampsia, without preeclampsia). The null and alternative hypotheses

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- *Corresponding First author: Abeer. A. Alkredes (Intern Doctor MD, Qassim University, PH:016-3824226. Email: drabeerali92@gmail.com) Saadia Zaheera (MBBS, FCPS, MPH, Associate Professor Obstetrics & Gynaecology, Qassim University Email: 311201625@gmail.com)*

the blood indices.

were:

H1₀ - There are no significant differences in blood parameters between those with preeclampsia and those without.

H1₁ - There are significant differences in blood parameters between those with preeclampsia and those without.

Hypothesis-2 the null and alternative hypotheses were:

H2₀ - Blood parameters have no effect on the symptoms and signs

H2₁ - Any of the blood parameters have an association with symptoms and signs

The symptoms and signs that were evaluated include headache, nausea, vomiting, epigastric pain and swelling feet.

Results:

A total 94 cases were recruited in the reviewed period. While there was no significant difference in the basic characteristics (age, parity, and BMI) between the two study groups (50 women in each arm) but the blood parameter was significantly differ between the two study groups. Using SPSS 24.0, results from the independent-samples *t*-tests indicated that, there were significant differences in participants' platelet counts and WBC scores between those with preeclampsia and those without ($p < 0.001$ and $p 0.001$, respectively) That is, participants that did experience preeclampsia had significantly lower platelet counts ($M = 206.240$, $SD = 51.377$) compared to those that did not experience preeclampsia ($M = 277.451$, $SD = 87.431$). In contrast, participants that did experience preeclampsia had significantly higher WBC scores ($M = 11.261$, $SD = 2.054$) compared to those that did not experience preeclampsia ($M = 9.573$, $SD = 2.497$).

Displayed in Table 1 are summary statistics of the seven independent-samples *t*-tests conducted for hypothesis 1

TABLE1: Descriptive Statistics of Participants' Blood Parameter Scores by Preeclampsia and control group.

*Note. $N = 94$ Values are given as the median (range) unless otherwise indicated

| Predict or Variables | Min | Max | Mean | Std. Deviation | Skewness | Kurtosis |
|------------------------------------|---------|---------|---------|----------------|----------|----------|
| Without preeclampsia (n=49) | | | | | | |
| HGB | 7.000 | 14.000 | 10.826 | 1.892 | 0.118 | -1.055 |
| MCV* | 65.000 | 98.800 | 81.582 | 8.763 | 0.059 | -0.754 |
| MCHC† | 25.000 | 36.700 | 31.284 | 1.835 | -0.161 | 3.011 |
| Platelet Count | 112.000 | 459.000 | 277.451 | 87.431 | 0.515 | -0.322 |
| Haematocrit | 21.800 | 44.800 | 33.796 | 4.768 | -0.426 | 0.556 |
| RBC‡ | 2.350 | 5.300 | 4.168 | 0.581 | -1.019 | 2.148 |
| WBC§ | 4.110 | 16.400 | 9.573 | 2.497 | 0.354 | 0.378 |

vAbbreviations *: mean corpuscular volume; †: mean corpuscular

| Predictor Variables | Min | Max | Mean | Std. Deviation | Skewness | Kurtosis |
|---------------------------------|---------|---------|---------|----------------|----------|----------|
| With preeclampsia (n=45) | | | | | | |
| HGB | 7.300 | 14.000 | 11.293 | 1.803 | -0.379 | -0.688 |
| MCV* | 30.000 | 93.000 | 78.538 | 10.859 | -1.987 | 8.075 |
| MCHC† | 27.300 | 33.500 | 31.371 | 1.508 | -0.625 | -0.254 |
| Platelet Count | 139.000 | 390.000 | 206.240 | 51.377 | 1.709 | 3.160 |
| Haematocrit | 27.000 | 41.000 | 34.971 | 3.569 | -0.426 | -0.336 |
| RBC‡ | 3.100 | 5.500 | 4.163 | 0.609 | -0.508 | -0.435 |
| WBC§ | 7.200 | 15.000 | 11.261 | 2.054 | -0.210 | -0.767 |

haemoglobin concentration, †: red blood cell; §, white blood cell

Table2. There were no other significant differences in the remaining five blood parameters (HGB, MCV, MCH, Haematocrit, and RBC) between preeclampsia groups ($p > .05$).

Table2: Summary of the Independent-samples *t*-tests Conducted for the determination of difference of hem-gram values between both groups (preeclampsia and control group)

| Dependent Variable | Mean Scores | | |
|--------------------|----------------------------|----------------------------------|-----------------------|
| | With Preeclampsia (j) Case | Without Preeclampsia (i) Control | Mean Difference (j-i) |
| HGB | 11.293 | 11.439 | 0.468 |
| MCV [†] | 78.538 | 81.582 | -3.044 |
| MCHC [‡] | 31.371 | 31.284 | 0.087 |
| Platelet Count | 205,7 | 277.451 | -71.211 |
| Haematocrit | 34.971 | 33.796 | 1.175 |
| RBC [§] | 4.163 | 4.168 | -0.005 |
| WBC [¶] | 11.261 | 9.573 | 1.688 |

| Dependent Variable | t-test Results | | |
|--------------------|----------------|----|----------|
| | t | df | Sig. (p) |
| HGB | -1.224 | 92 | 0.224 |
| MCV [†] | 1.501 | 92 | 0.137 |
| MCHC [‡] | -0.251 | 92 | 0.802 |
| Platelet Count | 4.860 | 79 | <0.0001 |
| Haematocrit | -1.343 | 92 | 0.182 |
| RBC [§] | 0.040 | 92 | 0.968 |
| WBC [¶] | -3.561 | 92 | <0.0001 |

Note; Group = cases with preeclampsia (1), cases without preeclampsia (0). N = 94 *Blood parameter was significantly different across preeclampsia groups *(p < .05) Abbreviations; †, mean corpuscular volume; ‡, mean corpuscular haemoglobin concentration; §, red blood cell. ¶, white blood cell.

Hypothesis 2 was evaluated using logistic regression analyses to determine if the relationships between blood parameters of women with preeclampsia and outcome symptom.

The result were significantly different between those with preeclampsia (case) and those without (control). The criterion variables were participants' symptoms (headaches, nausea and vomiting, epigastria pain, and swelling feet. The predictor variables were seven blood parameters including HGB, MCV, MCHC, platelet count, haematocrit, RBC, and WBC. The moderating variable was preeclampsia status (0 = no, 1 = yes).

Using SPSS 24.0, results from the logistic regression analyses indicated that the relationships between criterion variable (headaches) and four predictor variables (platelet count, haematocrit, RBC, and MCV) were significantly moderated by preeclampsia statuses (yes, no). The relationships between the remaining criterion and predictor variables were not significantly different between those women with preeclampsia.

Table -3Summary of Results and Variables used in the Logistic Regressions for Analyses

| Criterion Variable | Sig. (P) | | | | Moderator |
|----------------------|-----------|-----------------|---------------|--------|-----------|
| | Head-ache | Epigastria Pain | Swelling Feet | Oedema | |
| — Predictor Variable | | | | | |
| HGB | 0.189 | 0.128 | 0.319 | 0.983 | Group |
| MCV | <0.001 | 0.870 | 0.679 | 0.146 | Group |
| MCHC | 0.894 | 0.658 | 0.737 | 0.431 | Group |
| Platelet Count | <0.001 | 0.252 | 0.661 | 0.792 | Group |
| Haematocrit | <0.001 | 0.665 | 0.591 | 0.899 | Group |
| RBC | <0.001 | 0.476 | 0.873 | 0.351 | Group |
| WBC | 0.179 | 0.321 | 0.863 | 0.904 | Group |

Note. Group = cases with preeclampsia (1), cases without preeclampsia (0). N = 94* the relationship between criterion and predictor variables are significantly moderated by groups

Discussion:

Preeclampsia remains one of the major causes of perinatal and maternal mortality and morbidity in most developing countries [2]. The current study demonstrated higher significant of blood parameter among two groups of pregnant women: control and preeclampsia. Revealing the platelet counts (PC) of the PE group was lower in compare with control group. Vikse et al reports that low platelet count (PC) can help in the early detection of preeclampsia [3]. Fernando et al also found decreased platelet count in patients with PE compared to normal pregnancy [4]. The current study showed a high WBC count among women with preeclampsia as compared to control participate pregnant women. Therefore, high WBC count can supplement the low platelet count in early diagnosing preeclampsia. Likewise, Schroeder reported lower PC in women with preeclampsia associated with higher WBC can be diagnostic criteria for preeclampsia. There was no significant difference to find out in the remaining values MCV, MCH, MCHC, RBC, HGB the platelet count, between the control case and women with preeclampsia [13].

Our results conflict the symptom of preeclampsia, (headaches, swelling feet, and epigastria pain) moderate the values of blood indices. The logistic regression analyses indicated that the relationships between criterion variable (headaches) and three predictor variables (platelet count, haematocrit, MCV and RBC) were significantly moderated by preeclampsia statuses. The relationships between the remaining criterion (epigastria pain, swelling feet and oedema) and predictor variables were not significantly. This signifies the importance of headache as a clinical feature which must be considered seriously, as it is associated with altered blood indices. It can be a signal towards the progression of underlying pathophysiology of preeclampsia.

One limitation of this study is the lack to find out association with other clinical symptom as significant moderators of blood indices, as well clinical predictor toward the diagnosis.

The current study suggests future researches in this area to find out whether or not there is any association between preeclampsia symptomology and any other blood parameters.

However, based on current data, better access to appropriate obstetric care, particularly during labour and delivery and better screening and treatment of identified cases should reduce preeclampsia rates in developing countries.

Thus, our study will open a new debate to find new associations between clinical presentations and blood parameters of preeclampsia and help to understand the pathophysiology of disease. This help in early intervention to prevent the progression of the condition.

Conclusion:

Findings from the current study showed women with preeclampsia have raised WBC count and low platelets. Presence of preeclampsia significantly moderates the values of predictor variables (platelet count, haematocrit and RBC) in preeclampsia women having headache. None of the other clinical features moderated the hemogram.

The mainstay of control remains health care based strategies should channel efforts at strengthening and improving access to health care providers.

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References

- [1] Manjareeka, M, & Nanda. S. Elevated levels of serum uric acid, creatinine or urea in preeclamptic women. India. *ijmsph*.2013.2.43-47.
- [2] Saritas, T., & Moeller, M. J. Glomerular disease: Pre-eclampsia, podocyturia and the role of parietal epithelial cells. New York. Seiten. Artikel Nr.2014.615-616
- [3] Vikse, B. E., Hallan, S., Bostad, L, et al. Previous preeclampsia and risk for progression of biopsy-verified kidney disease to end-stage renal disease. Norway. *Nature Reviews Nephrology journal*.2010. 25: 3289-3296
- [4] Mark C.AlanisMDar J.RobinsonMDaThomas C.HulseyScD,MSPIhbMylaEbelingRABDonna D.JohnsonMDa, et al. Early-onset severe preeclampsia: induction of labour versus elective caesarean delivery and neonatal outcomes. *Am J Obstet Gynecol* 2008; 199-262
- [5] A. A. Sobande, M. Eskandar, A. Bahar & A. Abusham. Severe preeclampsia and eclampsia in Abha, the south west region of Saudi Arabia. *Journal of obstetrics and gynaecology* 2007:150-154.
- [6] Paulino Vigil-De G, Osvaldo Reyes T, Andrés Calle M, Gerardo T, Vicente Y, Edgar H, et al. Expectant management of severe preeclampsia remote from term. A randomized, multicenter clinical trial. The MEXPRE Latin Study. *Am J Obstet Gynecol* 2013. 209- 425.e1-8.
- [7] Osungbade KO and Ige OK. Public Health Perspectives of Preeclampsia in Developing Countries: Implication for Health System Strengthening. *J of Pregnancy*. 2011. 481095.
- [8] Fernando A, Daftary SN, Bhide AG. Hypertensive disorders in pregnancy. *Practical guide to high risk pregnancy and delivery*. 3rd ed. New Delhi: Elsevier, 2008, p. 411.
- [9] Francisco V, Alejandra P, María T, Paula C, Gabriela R, Sebastián I. Pathogenesis of Preeclampsia: The Genetic Component. *J. Pregnancy*. 2012. 632-732
- [10] Leticia F, Patricia N Alpoim, Flávia K, Maria C, Luci Maria S. Preeclampsia: Are platelet count and indices useful for its prognostic. *J. Haematology*. 2013 360-364
- [11] AlSheeha Muneera, Rafi S, Mohammad A, Javed I, Platelet count and platelet indices in women with preeclampsia. *J. Vascular Health and Risk Management* 2016: 12 477-480
- [12] The survey system 2012. Retrieved from <https://www.surveysystem.com/sscalc.htm>
- [13] Conde A, Romero R, Kusanovic JP, Hassan SS. Supplementation with vitamins C and E during pregnancy for the prevention of preeclampsia and other adverse maternal and perinatal outcomes: a systematic review and metaanalysis. *Am. J. Obstet Gynecol* 2011: 204-503.