FIRST-TRIMESTER NEUTROPHIL-TO-LYMPHOCYTE AND PLATELET-TO-LYMPHOCYTE RATIOS AS INDICATORS FOR EARLY DIAGNOSIS OF PREECLAMPSIA

By

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ABSTRACT

Background: Preeclampsia is a popular obstetric complication. Neutrophil to lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR) have gained notable attention as systemic inflammatory response indicators in diverse clinical settings.

Objective: To evaluate the diagnostic worth NLR and PLR during the first trimester of gestation to forecast the subsequent occurrence of preeclampsia.

Patients and methods: The present study was a prospective cohort study that enrolled 300 pregnant ladies. Initial CBC was done for all eligible cases at 7-14 weeks of gestation then cases were followed up till delivery.

Results: The results showed progressively statistically increase in the mean NLR in PE cases compared to control cases and a statistically significant difference between the control and PE cases s regard PLR. Cut off value 1.7538 NLR can differentiate normotensive pregnant women from preeclampsia women with sensitivity of 86.5 %, specificity of 91.6% %, PPV of 64 %, and NPV of 97.5 %. However, PLR can differentiate normotensive pregnant women from preeclampsia women at a cut off value 80.70 with sensitivity of 81.1 %, specificity of 95.1 %, PPV of 28.6 %, and NPV of 64.6 %.

Conclusion: Neutrophil to lymphocyte ratio and platelet to lymphocyte ratios is cheap, simple, rapid, and readily accessible marker that may be beneficial to predict preeclampsia in early pregnancy. Hence, these easy applicable parameters can be applied as low-cost predictive factors for the development of PE.

Keywords: Preeclampsia, Neutrophil-to-lymphocyte ratio (NLR), platelet-to-lymphocyte Ratio (PLR).

INTRODUCTION

The search for novel predictive markers residues as an unaccomplished goal since the pathogenesis of preeclampsia has not been entirely explicated *(Melchiorre et al., 2014)*.

The clinical consumption of biomarkers for risk prediction, pre-clinical diagnosis, and to define cases more predisposed to develop complications is broadly reviewed to a better understanding of the preeclampsia pathophysiology *(de Siqueira et al., 2017)*.

Normal pregnancies are associated with a degree of systemic inflammation.

Furthermore, PE is correlated with a maladaptive immune response of T-helper (TH) 1 cells and TH 2 cells and hyper-inflammatory state *(Kim et al., 2018)*.

In the last preceding years, elevated neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR) have gained noteworthy attention as systemic inflammatory response markers in a multitude of clinical conditions *(Qin et al., 2016)*.

Based on the pathogenesis of PE, this study was designed to evaluate the diagnostic efficiency of NLR and PLR, as well as neutrophil, lymphocyte and platelet counts through the first trimester of gestation to expect the consequent occurrence of preeclampsia.

PATIENTS AND METHODS

The present study enrolled 300 pregnant females who attended the departments of Obstetrics and Gynecology at Helwan General and Al-Azhar University during the period of research from December 2017 to December 2019.

Inclusion criteria:

Pregnant women from 7-14 weeks, primigravida or multigravida with or without history of preeclampsia.

Exclusion criteria:

Systemic diseases, history of hematopoietic system disorders, malignancies, acute or chronic inflammatory diseases, or on any medication which could have affected the CBC results.

The selected patients were subjected to thorough history taking complete general and abdominal examination, examination by abdominal ultrasound.

Blood samples were drawn in the first trimester; a 5 ml of the blood was collected on EDTA tube for routine CBC by Sysmex the automated hematology analyzer SF-300, Japan. The NLR and the PLR ratios were calculated as the ratio of neutrophil count to lymphocyte count and the ratio of platelet count to lymphocyte count respectively.

Cases were followed up on routine antenatal care visits and were included into four groups: 215 preeclampsia free pregnant women (control) after the 20th week of gestation, 37 pregnant women who developed preeclampsia diagnosed according to the American College of Obstetrics and Gynecology *(ACOG) (2013)*, 22 pregnant Egyptian women who failed to complete their pregnancy (had abortion), and 26 study participants who were excluded from the present study due to loss of follow-up.

Approval of ethical committee was obtained from quality education assurance unit, Al-Azhar university faculty of medicine, Egypt. An informed consent was taken from every woman before participation in this study. The nature and aim of this work were fully discussed to all women who agreed to participate in the study. Patients were explained the procedure.

Statistical analysis:

All statistical calculations were done using computer programs SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 23 for Microsoft Windows Data were statistically described in terms of

mean ± standard deviation (SD), or median and range. Categorical data were summarized as percentages. Comparison of numerical variables between the study groups was done using Mann-whitney U test, and one way ANOVA test followed by post-hoe test. For comparing categorical data, Chi square (χ2) test was performed. Receiver operator characteristic (ROC) analysis was used to determine the optimum cut off value for the studied diagnostic markers. Correlations between different parameters

were done using spearman's and Pearson's correlation coefficient and the area under the curve (AUC). The probability (P) values of ≤0.05 were considered statistically significant.

Sample size justification: MedCalc® version 12.3.0.0 program was used for calculations of sample size; statistical calculator based on 95% confidence interval and power of the study 80% with α error 5%.

RESULTS

The mean age in the present study was 30.14 ± 5.22 years in control group, 29.35 ± 6.95 years in preeclampsia group, and 26.73 ± 4.72 in miscarriage group (P= 0.019).

There were no statistically significant differences between the mean age of cases in preeclampsia group and control subjects (P >0.05). Also, there was no statistically significant difference between all studied groups according to gravidity, parity, and body mass index.

In preeclampsia cases, the mean gestational age at delivery was 34.66±3.53 weeks while it was 37.33±2.04 weeks in control cases.

These results revealed that there was significant decrease in the mean gestational age at delivery in preeclampsia group control group (P <0.001).

As regard number of fetuses, it was found that multiple gestation was found in 10 (4.6%), and 8 (21.6%) of control and preeclampsia groups respectively, with a statistically significant difference between groups (P-value=0.002).

Considering neonatal birth weight after delivery, 7 (18.9%) of newborns to preeclampsia mothers had weight less

than 1000g: 4(10.8%) of them had weight ranged from 1000-1499 g. In another 23(62.2%) cases, weight at birth was 1500-2499 g. It was only in 3 (8.1%) cases weight at the time of birth was recorded to be >2500g. Mean of weight at birth was 1686.75±683.01g ranged from 750 - 4000 g in preeclampsia group compared to 3310.5 ± 340.85 grams in the controls (P <0.001).

Complications were observed in mothers who suffered from preeclampsia as follow: only 1 case (2.7%) had HELLP, and 3(8.1%) had eclampsia, whereas there were 8 cases (3.7%) in control group had PPROM.

There was a significant difference between the studied groups with regards to blood pressure both systolic and diastolic which increased with the occurrence of preeclampsia (P<0.001). The study showed that the average systolic blood pressure among cases was found to be 160.54 ± 20.13 mmHg compared with 113.58 ± 9.79 mmHg among controls. Average diastolic blood pressure was found to be 103.95 ± 11.55 mmHg among preeclampsia cases

compared with 71.07 ± 6.21 mmHg among controls.

All control cases have no proteinuria whereas, in preeclampsia group, fourteen (37.8%) of the cases showed proteinuria level ranged from (+ - ++), whereas 23 (62.2%) of them showed a level ranged from (+++ - ++++). There was a significant difference between the studied groups with regards to appearance of protein in urea which increased in patients with preeclampsia (P<0.001).

The results showed that the mean ± SD of hematological parameters was 12.86 ± 1.23 Vs 12.18 ± 1.08 g/dL for the hemoglobin, 4.1 ± 0.312 Vs 3.99 ± 0.062 (106/µL) for the red blood cell count (RBCs). Also, the mean platelets count was 268.273 ± 45.850 Vs 222.127 ± 73.398 (103/µL), and the mean white blood cells count (WBCs) was 7.969 ± 3.009 Vs 11.467 ± 2.352 in control, and preeclampsia groups respectively.

These results revealed that there was significantly decrease in the mean value of platelets counts and hemoglobin levels in preeclampsia cases when compared to healthy control (P<0.001 & P = 0.002; respectively). There was a significant increase in WBCs in preeclampsia patients when compared to control group (P < 0.001). No significant difference we found in the mean value of RBCs between studied groups (P > 0.05).

Mean neutrophils was higher in women with pre-eclampsia compared with women in the control group (7043.59± 1494.7 vs 4265.1± 1627.33/ µL; P<0.001). Values were also significantly higher in patents with pre-eclampsia compared with healthy pregnant controls for lymphocysts (3404.49± 823.84 vs 2944.47 ± 1113.45/ µL; P=0.004).

Regarding neutrophil to lmphocye ratio (NLR), the results showed a progressively increase in the mean NLR in PE cases compared to control cases (2.11 ± .0.36) and (1.46 ± 0.19) respectively. There was a statistically significant difference between patients with PE and healthy pregnant women (P<0.001) **(Figure 1)**.

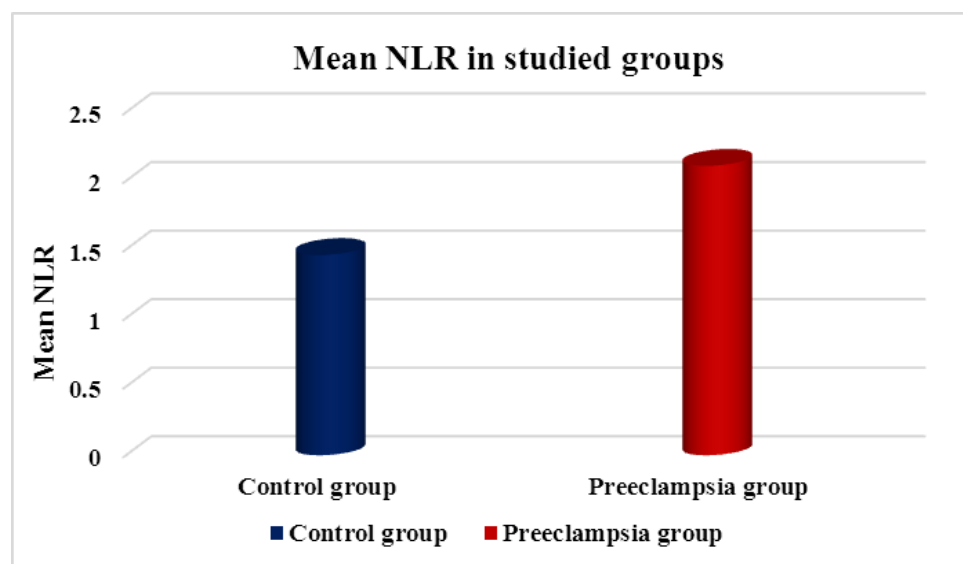**Figure (1):** **Mean of NLR among patients and control groups.**

Also, platelets to lymphocyte ratio (PLR) showed a statistically significant difference between the control and PE cases (P<0.001), as the mean PLR in control cases was (103.3 ± 39.3) compared to (70.38 ± 37.2) in Preeclampsia cases **(Figure 2)**. **Table 1** summarizes the demographic data and biochemical parameters of the patients and controls.
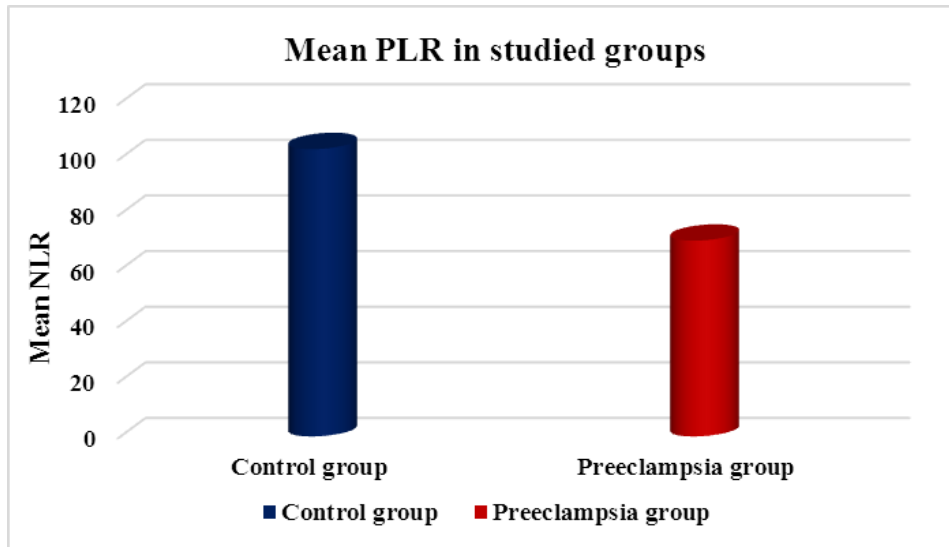

Figure (2):   Mean of PLR among patients and control groups.

Table (1): Demographic data and biochemical parameters of the patients and controls

Variables \ Groups	Healthy Controls (n=215)	Preeclampsia Group (n=37)	P-value Mann Whitney test
Age(Yrs.)	30.14 ± 5.22	29.35 ± 6.95	0.514
Gestational age at delivery (weeks)	37.33±2.04	34.66±3.53	<0.001**
BMI at enrollment	27.03 ± 3.08	27.79 ± 6.75	0.503
Systolic Blood Pressure (mmHg)	113.58 ± 9.79	160.54 ± 20.13	<0.001**
Diastolic Blood Pressure (mmHg)	71.07 ± 6.21	103.95 ± 11.55	<0.001**
Gravidity	2.81 ± 1.58	2.76 ± 1.66	0.840
Parity	0.312 ± 0.46	0.324 ± 0.63	0.885
Number of fetuses. Singleton Multiple	205(95.3%) 10(4.7%)	29(78.4%) 8(21.6%)	0.002**
Appearance of proteinuria None 1-2 3-4	215(100%) 0(0%) 0(0%)	0(0%) 14(37.8%) 23(62.2%)	0.001**
Birth weight [g]	3310.5 ± 340.85	1686.75 ± 683.01	<0.001**
Complications None PPROM HELLP Eclampsia	207(96.3%) 8(3.7%) 0(0%) 0(0%)	33(89.2%) 0(0%) 1(2.7%) 3(8.1%)	<0.001**
Hemoglobin (g/dL)	12.86 ±1.23	12.18 ± 1.08	0.002**
RBCs count (×10^6/ μL)	4.1 ± 0.312	3.99 ± 0.62	0.318
Leukocytes count (x10^3/ μL)	7.969 ± 3.009	11.467 ± 2.352	<0.001**
Neutrophils (/μl)	4265.1± 1627.33	7043.59± 1494.7	<0.001**
Lymphocytes (/μl)	2944.47 ± 1113.45	3404.49± 823.84	0.004**
PLT (×10^3/ μL)	268.273 ± 45.850	222.127 ± 73.398	<0.001**
NRL	1.46 ± 0.19	2.11 ± .0.36	<0.001**
PLR	103.3 ± 39.3	70.38 ± 37.2	<0.001**

Values are expressed as mean ± standard deviation or n (%) unless otherwise specified;
BMI — body mass index; NLR — neutrophil to lymphocyte ratio; PLR — platelet to lymphocyte ratio

The mean NLR had significant positive correlation with systolic and diastolic blood pressure, and WBCs (p<0.05). Also, it had significant negative correlation with gestational age, birth weight, and PLTs (p<0.05). In addition, PLR was significantly positive correlated with gestational age, birth weight, proteinuria, hemoglobin, and PLTs, whereas it was negatively correlated with BMI, systolic and diastolic blood pressure, albumin and WBCs (p<0.05) **(Table 2)**.

Table (2): Correlation between NLR and PLR and other studied parameters

Parameters \ Groups	NLR r	NLR P-value	PLR r	PLR P-value
NLR	1.000	-	-0.123	0.053
PLR	-0.123	0.053	1.000	-
Age (years)	-0.041	0.514	0.058	0.343
Gestational age (weeks)	-0.196	0.002**	0.390	<0.001**
Birth weight (g)	-0.526	<0.001**	0.322	<0.001**
Gravidity	0.084	0.185	0.009	0.884
Parity	0.045	0.480	0.038	0.531
BMI (Kg/m^2)	0.091	0.150	-0.147	0.016*
Systolic Blood pressure (mmHg)	0.597	<0.001**	-0.276	<0.001**
Diastolic Blood Pressure (mmHg)	0.656	<0.001**	-0.297	<0.001**
Proteinuria	0.092	0.590	0.297	<0.025*
Hemoglobin (g/dL)	-0.047	0.460	0.190	0.003*
WBCs (×10^3/ μL)	0.292	<0.001**	-0.796	<0.001**
Platelet count (×10^3/ μL)	-0.275	<0.001**	0.453	<0.001**
RBCs (×10^6/ μL)	0.008	0.905	-0.071	0.247

In this study, the optimal cut-off levels of NLR and PLR parameters for prediction of development of preeclampsia were identified using ROC analysis. ROC curve analysis showed that NLR can differentiate normotensive pregnant women from preeclamptic pregnant women at a cut off value 1.7538 with sensitivity of 86.5 % and specificity of 91.6% %, PPV of 64 %, NPV of 97.5 % and AUROC was 0.961(P<0.001).

However, PLR can differentiate normotensive pregnant women from preeclamptic pregnant women at a cut off value 80.70 with sensitivity of 81.1 % and specificity of 95.1 %, PPV of 28.6 %, NPV of 64.6 %. The area under the curve (AUC= was 0.768; CI :(0.691-0.846)), the previous results indicating the two parameters are important for predicting preeclampsia (**Figures 3-4**).
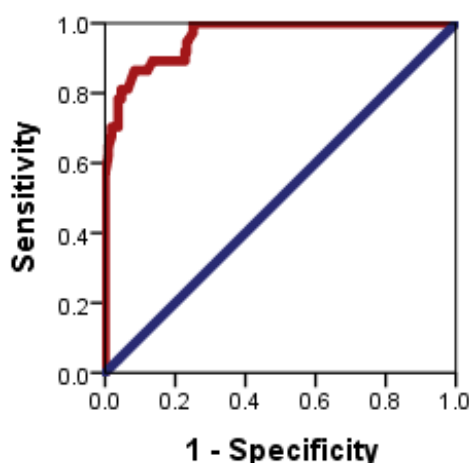

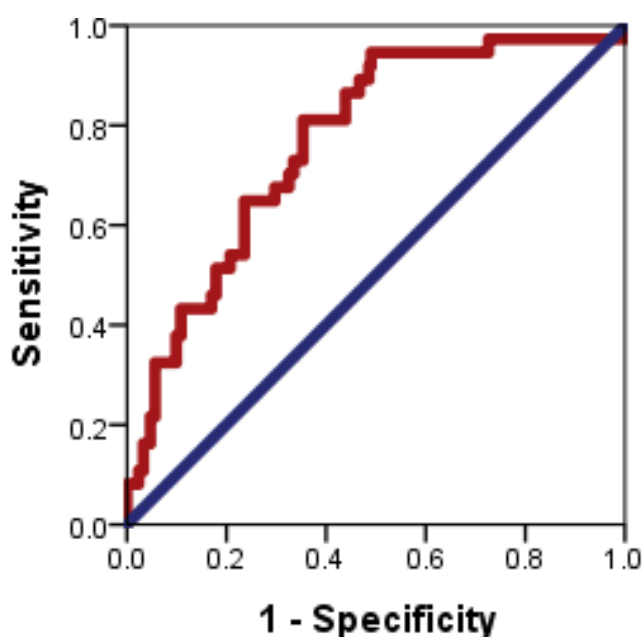**Figure (3): ROC curve of NLR for discriminating preeclampsia patients from healthy volunteers**

Figure (4): **ROC curve of PLR for discriminating preeclampsia patients from healthy volunteers.**

DISCUSSION

Platelets, neutrophils, and lymphocytes are major blood parameters allied to immune surveillance, and the platelet/lymphocyte ratio (PLR) and the netrophils/lymphocyte ratio (NLR) play an important role in cytokine-dependent immune response. It was proposed that PLR was a more sensitive marker of systemic inflammation in various conditions. Although association of PLR with inflammation and numerous diseases was reported, there are limited data evaluating the association of PLR and PE *(Kholief et al., 2019)*.

As regard results of initial hematological parameters recorded at the beginning of the study, these results revealed that there was a significantly decrease in the mean value of platelets counts in preeclampsia cases when compared to healthy control. These findings were in agreement with other studies that found significant decrease in platelet count *(Alkholy et al., 2013* and *Vilchez et al., 2017)*.

Fluid retention occurs during pregnancy because of sodium and water retention owing to estrogen and progesterone hormone effects, leading to hemodilution or pseudo-thrombocytopenia. The underlying trigger of thrombocytopenia in hypertensive pregnant woman is mysterious. It was proposed that, to an increased vascular tone during pregnancy, inducing platelet destruction and coagulation defects also ensue. Moreover, increased platelet-related IgG serum level may occur in some hypertensive pregnant women. Yet, the increase in immunoglobulin is non-specific and does not inevitably indicate an immunologic-mediated thrombocytopenia *(Habas et al., 2013)*. Moreover, contact of platelets with the damaged endothelium stimulates the coagulation cascade, which can increase

both consumption and bone marrow production of platelets *(AlSheeha et al., 2016)*.

In addition, there was a statistically significant decrease in the mean value of hemoglobin (Hb) levels in preeclampsia cases when compared to their healthy counterparts. There was no significant difference in the mean value of RBCs between studied groups. These results were in line with the findings reported by *Khoigani et al. (2012)* who conducted a study in the first and second half of the pregnancy separately. They concluded that Low Hb values during the first pregnancy half was related to preeclampsia occurrence.

Prior literature have also reported low maternal Hb levels in preeclampsia and this was thought to be a reflection of low socio-economic and poor nutritional state in developing nations *(Cordina et al., 2015)*.

Monteiro et al. (2014) showed that the Hb concentration did not vary significantly between normotensive and females with preeclampsia. In discordance to the present work, Hassan and his *Co-workers (2016)* showed that there was an increase in maternal Hb levels but without any statistical significance. Also, *Nasiri et al. (2015)* and *Ali (2016)* showed that the women with preeclampsia had a higher mean of hemoglobin.

At this point, there is a controversial question in which trimesters the hemoglobin can better forecast preeclampsia. *Nasiri et al. (2015)* stated that the second trimester was more informative than other trimesters. Results of the current study revealed a significant increase in WBCs in preeclampsia

patients when compared to control group. Moreover, mean neutrophils were higher in women with pre-eclampsia compared with women in the control group. Values were also signifcantly higher in patents with pre-eclampsia compared with healthy pregnant controls for lymphocysts.

Canzoneri et al. (2010) have showed that increased total leukocyte count was related to both preeclampsia and disease severity. Neutrophilia was the only WBC subgroup associated with severe preeclampsia. Moreover, first trimester leukocytosis is allied to unpleasant pregnancy outcomes, particularly with preterm delivery *(Tzur et al., 2013)*. *Gezer et al. (2016)* detected that the mean neutrophil count in the first trimester was significantly higher in patients who developed preeclampsia. *Alkredes and Zaherra (2018)* and *Phaloprakarn et al. (2018)* showed a high WBC count among women with preeclampsia as compared to their control counterparts. Leukocytosis is a physiologic change detected in healthy pregnancies resultant from neutrophilia, and WBCs are well-known to be the mediator of inflammation *(Örgül et al., 2019)*. *Örgül et al. (2019)* found that lymphocytes did not differ in preeclamptic women compared with controls.

Regarding neutrophil to lymphocyte ratio (NLR), the results showed progressively increase in the mean NLR in PE cases compared to control cases.

Yıldız et al. (2016) and *Phaloprakarn et al. (2018)* found that NLR values were greater in patients who established preeclampsia. Neutrophils are reported to have a role in in the inflammatory processes. They are the first blood cells

reacting to inflammation *(Gezer et al., 2016)*.

Nevertheless, *Kurt et al. (2015)* reported higher neutrophil counts in preeclamptic patients, inferring the presence of an increased inflammatory state, but they reported that NLR was not significantly dissimilar between preeclampsia and control groups. Moreover, *Yücel and Ustun (2017)*, *Kholief et al. (2019)* and *Örgül et al. (2019)* found decreased NLR from PE to controls but without statistical significance and they justified these results by the small number of participants.

Though NLR is easy to measure, its utility as a marker of systemic inflammation may be influenced by numerous conditions such as maternal systemic infections, maternal malignancies, and chronic inflammatory diseases *(Yıldız et al., 2019)*. Thus, those conditions were excluded from our work.

Considering platelets to lymphocyte ratio (PLR), results of the present work showed a statistically significant difference between the control and PE cases.

Generally, the results concerning to PLR changes in preeclampsia are conflicting, with both increased *(Gezer et al., 2016)* and decreased levels *(Yücel and Ustun, 2017* and *Mannaerts et al., 2019)* reported in the literature.

Platelets consumption after endothelial injury brings about thrombocytopenia in preeclampsia. As a result, researchers have claimed that PLR levels may decrease in preeclampsia which Corresponds to our findings *(Örgül et al.,*

2019). *Toptas and Colleagues (2016)* also found that PLR levels were comparable between PE and normal pregnancies and severe PE patients had lower PLR levels compared with women with mild PE.

Studies that reported higher PLR in PE than controls recommended that PLR was a more sensitive marker of systemic inflammation *(Kholief et al., 2019)*.

In this study, ROC curve analysis showed that NLR can differentiate normotensive pregnant women from preeclamptic pregnant women at a cut off value 1.7538 with sensitivity of 86.5 % and specificity of 91.6% %, PPV of 64 %, NPV of 97.5 % and AUROC was 0.961.

This was lower than the cut of value reported by *Gezer et al. (2016)* that was 3.08, with the sensitivity and specificity of 74.6% and70.1% respectively. The receiver operating curve by *Sachan et al. (2017)* showed significant diagnostic accuracy of NLR between controls and PE cases.

However, PLR can differentiate normotensive pregnant women from preeclamptic pregnant women at a cut off value 80.70 with sensitivity of 81.1 % and specificity of 95.1 %, PPV of 28.6 %, NPV of 64.6 %. The cut of value reported by *Gezer et al. (2016)* was 126.8 or higher, with the sensitivity and specificity of 71.8% and72.4% respectively to predict preeclampsia. *Kholief and his co-workers (2017)* reported a cut off value less than or equal to 77.5 for PLR with 35.71% sensitivity, 85.71% specificity, 83.3% PPV, and 40% NPV. *Yucel and Ustun (2017)* reported that the AUC for NLR, PLR were not statistically significant (p=0.636, and 0.104, respectively).

CONCLUSION

Multiple restraints of alpha fetoprotein (AFP) highlighted the necessity and urgency of identifying extra biomarkers with the potential of being utilized per se or complementing AFP for hepatocellular carcinoma (HCC) diagnosis and prognosis. Chromogranin A (CgA) may act as such useful diagnostic as well as prognostic biomarker for HCC as it was significantly higher in patients with HCC than in cirrhotic patients and it had higher sensitivity, specificity than AFP for HCC diagnosis. So, CgA is a good biomarker for HCC detection.

Conflict of interest: The authors declare that they have no conflicts of interest.

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النسب الأولى من العدلات إلى الخلايا اللمفاوية ونسبة الصفائح الدموية إلى الخلايا الليمفاوية كمؤشرات للتشخيص المبكر لمقدمات الارتعاج

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خلفية البحث: يعد ارتفاع ضغط الدم اثناء الحمل حالة مرضية خاصة تحدث خلال النصف الثانى من الحمل وتم تشخيصها عن طريق ارتفاع ضغط الدم بالأضافة الى وجود زلال في البول من بعد الأسبوع العشرين من الحمل. ويعد ارتفاع ضغط الدم اثناء الحمل من اشهر المضاعفات التي تحدث اثناء الحمل والتي قد تؤدى الى اضرار للأم قد تصل الى الوفاة. وبالرغم من كون ارتفاع ضغط الدم اثناء الحمل مرض شائع الحدوث حيث نسبة حدوثه تتراوح بين 5% الى 10% ألا انه يحتوى على كثير من الأسئلة التي لم يتم الإجابة عنها بعد.

الهدف من البحث: هو معرفة القيمة التشخيصية لنسب خلايا النيتروفيل الى الخلايا الليمفاوية والصفائح الدموية الى الخلايا الليمفاوية في الثلث الأول من الحمل كمؤشرات للتشخيص المبكر لأرتفاع ضغط الدم مع الحمل.

المريضات وطرق البحث: تم اجراء الدراسة على 300 حالة من السيدات الحوامل المترددات على مستشفى حلوان العام ومستشفيات جامعة الازهر في الفترة من ديسمبر 2017 وحتى ديسمبر 2019.

وقد تم عمل صورة دم كاملة من 7-14 أسبوع لحساب النيتروفيل الى الخلايا الليمفاوية ونسبة الصفائح الدموية الى الخلايا الليمفاوية.

وقد تم متابعة الحالات حتى الولادة لمتابعة نسبة التعرض لمرض ارتفاع ضغط الدم مع الحمل مع الاخذ في الاعتبار طريقة الولادة والعمر الرحمى عند ظهور المرض وعند الولادة.

نتـائج البحـث: كانـت هنـاك زيـادة كبيـرة احصـائيا تتعلـق بنسـبة خلايـا النيتروفيـل إلـى الخلايـا الليمفاويـة فـي مجموعـة الدراسـة مقارنـة بالمجموعـة الضـابطة. كمـا كـان هنـاك نقصـا ذا دلالـة أحصـائية فـي نسـب الصـفائح الدمويـة الـى الخلايـا الليمفاويـة فـي مجموعـة الدراسـة مقارنـة بالمجموعـة الضـابطة. بلغـت القيمـة الفاصـلة لنسـب خلايـا النيتروفيـل إلـى الخلايـا الليمفاويـة 1.7538 مـع معامـل حساسـية 86.5% وخصوصـية 91.6% وقيمـة تنبـوء إيجابيـة 64% وقيمـة تنبـوء سـلبية 97.5% بلغـت القيمـة الفاصـلة لنسـب الصـفائح الدمويـة الـى الخلايـا الليمفاويـة 80.70مـع معامـل حساسـية 81.1% خصوصـية 95.1% قيمـة تنبـوء إيجابيـة 28.6% قيمـة تنبوء سلبية 64.6%.

الإسـتنتاج: يمكـن إسـتخدام نسـب خلايـا النيتروفيـل الـى الخلايـا الليمفاويـة والصـفائح الدمويـة الـى الخلايـا الليمفاويـة فـي الثلـث الأول مـن الحمـل كمؤشـرات للتشـخيص المبكر لأرتفاع ضغط الدم مع الحمل.

الكلمـات الدالـة : الخلايـا للمفاوبـة – الصـفائح الدمويـة – التشـخيص المبكـر لمقـدمات الارتجاع .