Original Article

The Significance of (Platelet/White Blood Cell) Counts Ratio in Screening for High Risk for Preeclampsia and Its Related Complications

Wisam Akram, Duha Muaeed[1]

Department of Gynecoloy and Obstetrics, Al Yarmook Teaching Hospital, Al Mustansiriyah Medical College, [1]Arab Board Candidate, Al Yarmook Teaching Hospital, Baghdad, Iraq

Abstract

Background: We have taken a standpoint that the scope of the platelet count or its variance is significantly higher in pregnancy; 50,000-6,00, 000 compared to the white blood cells(WBC) 9,000-11,000. Hence, their ratio may be a useful marker in predicting preeclampsia. **Aim of the Study:** The aim of this study was to verify that placental weight (PW ratio) or platelet/WBC count might be a useful screening ratio for preeclampsia and its related complications. **Patients and Methods:** We have taken a total of 104 primigravida patients, each one is corresponding to the gestational ages (GA) 20–34 weeks, and seven patients per each week for initial PW ratio assessment. In addition, all women were told to come again at 34 weeks of gestation for reassessment of PW ratio (platelet/WBC) count, and a meticulous ultrasound examination for intrauterine growth restriction (IUGR) as well as biophysical profile. **Results:** At the end of the study, we subdivided the 104 initial sample into three subgroups; normal women ($n = 76$); women with preeclampsia but no IUGR ($n = 16$); and women with preeclampsia and IUGR ($n = 12$). There was a statistically significant difference between the three groups with regard to systolic, diastolic, and PW ratio. In addition, the PW ratio was significantly different among the three subgroups using the analysis of variance test. Nonlinear polynomial of the third degree between PW ratio and GA has shown a significant correlation between PW ratio and GA. The correlation between them was statistically significant, yet the distribution of PW was normal in distribution $P = 0.16$. In addition, since all screening test should be subject to Weibull distribution, we challenged the PW ratio against this distribution and was found to be positive $P = 0.3$ by using the Kolmogorov–Smirnov test. At last, logistic regression was constructed to evaluate the correlation between PW ratio and the number of infants with IUGR, and a highly positive correlation was found $P = 0.0001$. Moreover, PW was significant with all the items of the biophysical profile which includes body posture, gross body movement, respiratory fetal movement, oligohydramnios, and NST. At last, we have constructed easily used chart and reference tables for PW ratio between 20 and 34 weeks; hence, they can be used in clinical practice to verify this ratio among women with preeclampsia. **Conclusion:** A simple easily to calculate ratio has been constructed which has been shown in this paper to be significantly correlated to preeclampsia and IUGR, and from this ratio, easy reference table and figure have been constructed. Yet, by no mean, we call that this ratio or table is used as a substitute for clinical methods to screen or to diagnose preeclampsia until its significance is evaluated by further trials. However, it may be of value as an adjuvant test to other standard tests used for preeclampsia screening or monitoring.

Keywords: Platelet/white blood cells ratio, preeclampsia, screening test

Introduction

Preeclampsia is now well documented to be a disease of the placenta. In normal pregnancy, there is an increase in the blood volume which includes both cellular and plasma volume.[1] The increase in plasma volume is about 40% while in red blood cells (RBC) is about 20%.[2] The increase in plasma volume has been ascribed to placental aldosterone which is chemically different from maternal in structure, yet it has the same physiological action through increasing the water reabsorption from the maternal kidneys.[3] On the other hand, the increase in

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Address for correspondence: Dr. Wisam Akram, Al Yarmook Teaching Hospital, Al Mustansiriyah Medical College, Baghdad, Iraq.
E-mail: wisamakram@hotmail.com

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maternal RBC is still mediated by placental erythropoietin which is chemically different from maternal in chemical structure yet has the same physiological action in inducing erythropoiesis.[4] The reason for increase in blood volume with reduction of viscosity through hemodilution, is to accommodate to new placental circulation which accounts to 1.5–2 L.[4] In women with preeclampsia, the placenta produces 8-fold the amount of prostaglandin $F2_a$ which is strong platelets aggregator and strong vasoconstrictor.[5] In addition, the placental Rennin is secreted in significantly higher amount than normal placenta. Accordingly, the normal increase in platelet counts noticed among healthy pregnant women which may be 400,000–600,000 cell/ml^3 is significantly reduced by the low-grade disseminated intravascular coagulation syndrome or DIC.[5] The platelet reduction in preeclampsia may be well below the lower limit 150,000 cells/ml^3 depending on the severity of preeclampsia. The white blood cells or WBC count usually remain within much narrow range 9000–11,000 cell/ml^3 and consist mainly by neutrophils. The count of WBC is the same among normotensive and preeclampsia women. The cause is unknown and thought to be a defensive mechanism against immune modulation – suppression which occurs in pregnancy so that 50% paternal antigens are tolerated throughout the pregnancy.[6] Based on those facts, it is possible to conclude on a theoretical basis that platelet/WBC or placental weight (PW) ratio for the sake of simplicity, may be useful in screening for preeclampsia and its related complications. PW ratio is expressed as

PW ratio = Platelet counts/white blood cells

The idea is that PW ratio should decrease as a result from the DIC which reduce their count. Hence, the aim of this study was to verify whether such ratio is useful in predicting high-risk women for preeclampsia.

Patients and Methods

Setting

The study has lasted between early 2017 and March 2018 which was conducted in AL Yarmook Teaching Hospital – Department of Obstetrics and Gynecology and in the antenatal clinic. During this period, a total of 104 primigravida patients, who were completely risk free from all the condition, which makes pregnancy high risk. As will be explained below, each woman was assessed for two times; the first time at initial meeting, when the patient was found to be eligible for the study by taking the platelets/WBC count at the time of first meeting. Then, the patient according to her last menstrual period was given an appointment at 34 weeks of gestation in which the second reading for PW ratio was taken, and meticulous ultrasound examination for intrauterine growth restriction (IUGR) as well as for five parameters of biophysical profile was assessed also. For all the women, participated in the study, their verbal consent to enter the study was taken.

Definitions

Hypertension

Hypertension is said to be present when systolic blood pressure is 140 mm/mg and diastolic blood pressure is 90 mm/mg 4–6 apart or when single reading of diastolic blood pressure is 110 mm/mg or more.

Proteinurea

Proteinurea is said to be present when total urinary excretion of protein is 300 mg or more per litre.

Intrauterine growth restriction

IUGR is said to be present when the fetal weight is <10th centile for the corresponding gestational. It is screened for by measuring the biparietal diameter every 2–4 weeks and diagnosed by measuring the head/abdomen circumference ratio more than one.

Preeclampsia

Preeclampsia is a syndrome which affects women and is characterized by hypertension, proteinuria, and generalized edema.

Protocol

As a matter of fact, all the women who were collected in this study, were in between 20 and 34 weeks of gestation, or 15 weeks for reason will be explained later. She should be risk-free from any condition that makes pregnancy high risk apart from preeclampsia. In addition, all women should have conceived within 3 months of marriage to avoid any possibility of taking ovulation-inducing drugs intake such as clomiphene citrate. Moreover, this may have some unpredictable or unknown effect on the count of either white blood cells or platelet count. Finally, the participant is between 20 and 30 years of age as the incidence of preeclampsia is higher below those limits. The women initially were taken as one group irrespective of their blood pressure or proteinurea. As the two-way ANOVA or analysis of variance was the primary statistical procedure taken in this study, all 104 women were further subdivided into three subgroups from the initial sample taken to enter the study. The uptake of data was predesigned according to an initial table; hence, the ANOVA will be balanced. ANOVA differs from all other statistical investigations in the form that data distribution, according to the primary groups and secondary subgroups upon which the data will be taken, should be equal for all the groups – subgroups. In this study, the gestational ages (GA) in weeks from 20 to 34 weeks were the primary group for the classification of patients. While for each group in every week, the following subgroups were taken GA (20–34 weeks) +0, 1, 2, 3, 4, 5, and 6 days corresponding to the days in each week was the secondary subgroup as shown in Table 1. In this table, once a space is filled, it is immediately crossed, and no further patient occupying this space has been taken. The aim is to obtain balanced evenly distributed data which is a primary prerequisite for ANOVA test especially the two-way type.

Initially, the week 20 weeks was skipped, yet we collected five patients except 20+2 days; hence, the total number of women

Table 1: The manner in which patients in this study were taken – one patient for each square!

Single week	Days within the same week						
Week	+0	+1	+2	+3	+4	+5	+6
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							

taken in this study was 104 women. Once a patient with certain GA with regard to a certain week and day was sampled, the empty square was crossed and continued to search until the entire whole table was filled by finding women eligible to enter the study which occupies one square in the table and should never be taken twice for other reading. Those women have the following characteristics.

1. All women where primigravida
2. They are 20–30 years of age
3. Conceived with 3 months of marriage
4. She should be pregnancy risk free from any obstetrical or developed only preeclampsia alone to increase the variance of PW ratio and include the abnormal values associated with preeclampsia. Women, with any obstetrical problem apart from preeclampsia, were excluded from the study
5. She accepts to enter the study by taking her PW ratio at the GA wanted to be filled as carrying in our pocket to isolate the weeks and days that are not filled! Hence, her mobile phone was taken either to report a new complication that may have newly developed and to contact her to come at 34 weeks for second PW ratio as well as doing ultrasound examination for exclusion or diagnosis of intrauterine growth restriction in addition to doing biophysical profile which includes gross body movement, fetal respiratory movement, amount of liquor, and reactivity of the fetal heart to gross body movement. On the other hand, the PW ratio is defined as below.

PW ratio = platelets count/WBC count being sampled at the same time

At 34 weeks of gestation, the PW ratio was also measured. In addition, their systolic, diastolic blood pressure was also recorded. Moreover, finally, meticulous ultrasound examination for exclusion or confirmation of IUGR as well as to measure the five parameters of biophysical profile fetal tone, gross body movement, respiratory movement, and amount of liquor as well as acceleration of fetal heart rate with fetal movement or NST. At the end of the study, a total of 104 patients, each one corresponding to a single GA in weeks and days has been collected; then, 76 patient remained normotensive, 16 patients developed preeclampsia only, and 12 patients have developed preeclampsia and IUGR. There were four patients excluded from the study as three developed bleeding before 28 weeks of gestation while one developed diabetes of the gestational type as shown by her predone glucose tolerance test. Kindly be advised that we have over detailed the concept of patient intake as two-way ANOVA test which is an extremely complicated test and homogenization of the data in two-way ANOVA is extremely important. Hence, the results of the test become reliable; the first way is the GA from 20 to 34 weeks; while the second way is the day inside this week and have 7 days +0, +1, +2, +3, +4, +5, and +6 and only 1 patient was assigned to this to every vacation except 20 weeks plus 2 days; hence, the total number is 104 patients ensuring that we have covered the power analysis shortly explained below.

Statistical analysis

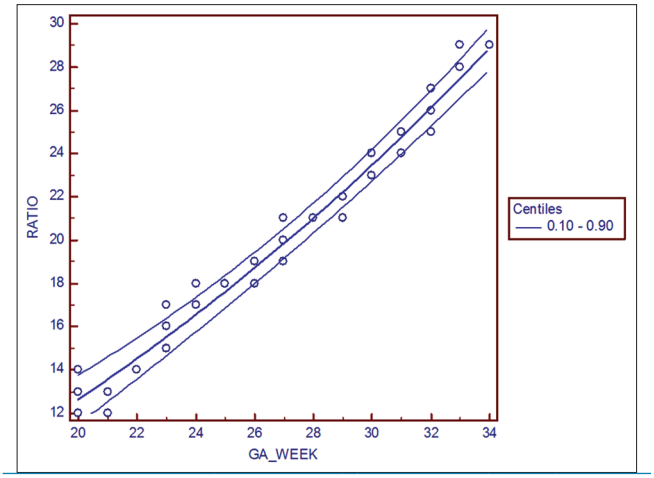
As far the minimum sample size required in this study since we have one group which will be further subdivided into unknown number of subgroups at the end of the study (in this study three subgroups) for alpha equal 95% and beta 80%, the estimated sample size was 32 patients. However, since we have initially predicted some three subgroups will be obtained, the total number is 96 women. However, the number collected was 104, and that is why we have included week 20 initially though it lies outside the study limits. Initially, patients, age, blood pressure, and PW ratio were all compared for the three study groups with ANOVA test. On the other hand, the number of infants with IUGR was compared with the Chi-square test. Nonlinear regression of the polynomial style of the third degree was constructed to show whether there is a significant correlation between PW ratio and GA while Shapiro–Wilk test was used to assess the normality of distribution. In addition, as all screening tests are subject to Weibull distribution, we challenged the PW data against Weibull distribution and found to have this style of curve style. This means simply that PW can be safely used as a screening test for preeclampsia. Logistic regression was done comparing women with PW ratio with <25 centile versus above for both fetuses with IUGR and the five variables of biophysical profile to show whether PW ratio is correlated to those complications at 34 weeks of gestation. Finally, an easy reference table with easy reference area figure has been constructed to determine the fetuses at high risk of preeclampsia with or without IUGR at the end of the study through dividing the different ranges of PW ratios across GAs to three regions <25 centile, 25–75 centile, and above than 75 centile. Those tables can be used in further studies to evaluate PW ratio in predicting high-risk women for preeclampsia.

Results

In Table 2, the basic demographic criteria for all the patients were collected at 34 weeks of gestation, and we found the

maternal age is not different statistically among the three study groups, while systolic, diastolic, and PW ratio were statistically significant using the ANOVA test in between the three study groups. At last, the number of infants with IUGR was significantly higher among women with preeclampsia with or without IUGR, than normotensive women. The subdivision was done according to the blood pressure, proteinuria, and the number of infants with IUGR.

In Figure 1, the correlation between PW and gestational age is shown in the form of nonlinear polynomial equation of the third degree. More important is that the data of PW for patients in this study show normal distribution repetition of show using the Shapiro–Wilk test, $P = 0.16$.



Model summary

PA ratio=−1.0911 + 0.08093 age + 0.0000007607 age^3

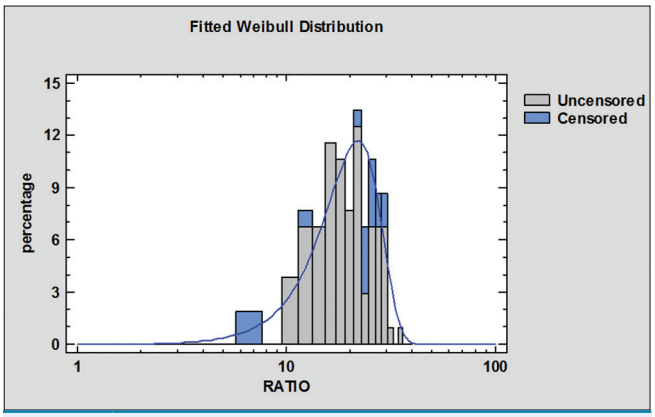
Fitted equation for mean

Terms	Coefficient	SE	*t*	*P*
Constant	−1.0911			
Age	0.08093	0.01553	5.211	<0.0001
Age^3	0.0000007607	0.0000001378	5.521	<0.0001
Shapiro-Wilk test for normal distribution	*W*=0.9811, accept normality (*P*=0.1677)			

SE: Standard error, PW: Platelet/WBC, WBC: White blood cell

Figure 1: The correlation between GA and PW ratio is shown in non linear third degree polynomial equation. The legend below shows a highly significant corrleation between them with normal distribution by Shapiro Willik test $P = 0.16$

It might be strange and unfamiliar that all screening test have in addition to normal distribution they should have Weibull distribution as preeclampsia screening represent a screening test for 'Failed' pregnancy from biological point of view. We have test the PW data for patients in this study by Kolmogorov-Smirnov test which test the number of points above and below and those who lie on the curve. The *P* value equal 0.37 which mean that PW ratio can be used as screening test safely for screening preeclampsia and its related complications. It worth saying that Kolmogrov-Smirnov test principle is to compare every point in any variable with any known distribution. Those like natural, alpha, beta Poisson distribution. This test has nothing to do with any distribution it can be applied to any one. It works by comparing the points of variable with regard to the values above the curve, below the curve and on the curve for any distribution. In [Figure 2] the *P* value of points above Weibull distribution is 0.08. While the point below the Weibull distribution their *P* value is 0.07. Finally the *P* value for the points of PW ratio lying on the curve 0.08 those stands for DPLUS, DMINUS and DN, respectively.



Weibull analysis for platelet/white blood cell ratio

Goodness-of-fit tests for ratio

	Weibull
DPLUS	0.0897439
DMINUS	0.074119
DN	0.0897439
P	0.375761

Kolmogorov-Smirnov test

Figure 2: The distribution of PW ratio as being subject to Weibull distribution which is essential in every screening test

Table 2: The basic demographic criteria for women participated in this study

Criteria	Women who remained normotensive at 34 weeks (*n*=76)	Women with preeclampsia at 34 weeks but no IUGR (*n*=16)	Women with preeclampsia and IUGR at 34 weeks (*n*=12)	*P* (test name)
Maternal age	25±3.28	24±2.87	24.9±3.17	0.25 (ANOVA)
PW ratio at 34 weeks	28.1667±0.3892	22.37±1.2042	12.1667±0.3892	<0.001 (ANOVA)
SBP at 34 weeks	121.23±30.2540	194.25±±11.29	221.08±9.5770	<0.001 (ANOVA)
DBP at 34 weeks	84.01±15.	112.68±2.54	116.5767±2.5487	<0.001 (ANOVA)
IUGR at 34 weeks (%)	3 (3.9)	12 (75)	10 (90)	0.01 (χ^2)

IUGR: Intrauterine growth restriction, PW: Platelet/WBC, WBC: White blood cell, ANOVA: Analysis of variance, SBP: Systolic blood pressure, DBP: Diastolic blood pressure

Accordingly, the *P* value of PW ratio above, below and on the typical Weibull distribution, is not statistically significant for this type as *P* value for all of them is 0.37. The non significant *P* value means that PW ratio points are not different from statistical point from those of typical for Weibull distribution. In turn, this means that PW ratio can be used to predict or used as a screening test as Weibull test is used for screening. Really it sounds amazing that PW ratio points are subject both to natural distribution as well as to Weibull type. This gave us a confidence that PW ratio is highly suitable to be used as screening test as in this paper!.

As shown in Table 3, the odds ratio was calculated for number of infants with IUGR and variables of biophysical profile as guided by the number of hypertensive women with and without IUGR versus normotensive women. As the table shows the number of infants who are liable to IUGR with PW <25 centile, is 37 times higher than those women with PW ratio above than 25 centile. On the other hand, the odds ratio for fetal tone, gross body movement, respiratory fetal movement, oligohydramnios, and NST was 4.5, 7, 5, 5.6, and 6 times higher than control women with PW ratio above than 25 centiles, respectively. This indicates that PW ratio has a definite correlation with preeclampsia and its related complications in the form of IUGR. Since the PW ratio is based on one of the most important variables of preeclampsia, namely the platelet count and that the platelets counts vary greatly among normal women versus preeclampsia women, the table demonstrates this correlation in a clear-cut way.

Finally, we have constructed Figure 3 which shows the area of PW ratio <25 centile with red color, 25–75 centile with yellow color, and >75 centile with green color, while the cutoff values, as given in Table 4, offers our colleagues a chance for testing those values in predicting preeclampsia and its related complications. Hence, with this table and graph, we end the results and hope that we offered a simple, comprehensive, reproducible way to assess those values against women in real-life practice to verify whether this PW ratio work or otherwise not.

Discussion

As a matter of fact, the discussion of this kind of papers is very simple and very complicated at the same time. It is very simple as the whole subject is about a ratio which is taken from simple parameters of the blood while very complicated as no such article can be found in the literature and needs logic to explain every word written in this thesis. First, we have derived

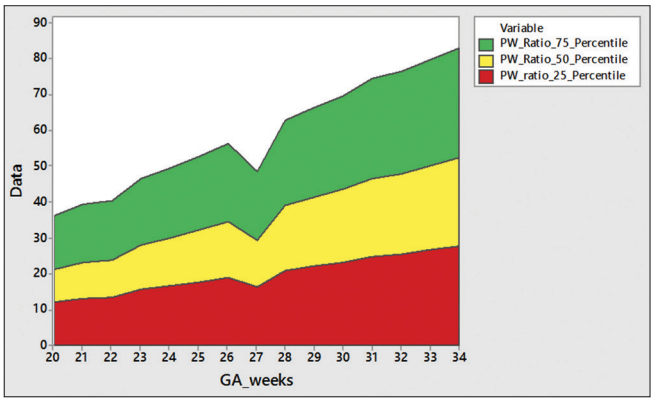


Figure 3: Showing area curve for the values of PW <25 centile, 25-75 centiles and above 75 centile from 20 to 34 weeks of gestational age (red, yellow and green)

Table 3: The ODD ratio for infants with IUGR and the 5 variables of biophysical profiles are shown as assessed by logistic regression for women with PW <25 centile and above 25 centile

Groups	OR	95% CI	Significance
Variable number of infant with IUGR			
Preeclampsia with and without IUGR (*n*=28) with PW ratio <25 centile	37.12	14.19-97.10	*P*<0.0001
Normotensive (*n*=76) with PW ratio >25 centile		Reference	
Variable flaccid fetal posture in US scan			
Preeclampsia with and without IUGR (*n*=28) with PW ratio <25 centile	4.5	1.64-12.12	*P*=0.0033
Normotensive (*n*=76) with PW ratio >25 centile		Reference	
Variable no gross body movement			
Preeclampsia with and without IUGR (*n*=28) with PW ratio <25 centile	7.04	2.46-20.36	*P*=0.00033
Normotensive (*n*=76) with PW ratio >25 centile		Reference	
Variable absence of respiratory movement			
Preeclampsia with and without IUGR (*n*=28) with PW ratio <25 centile	5.31	1.91-14.74	0.0013
Normotensive (*n*=76) with PW ratio >25 centile		Reference	
Variable oligohydramnios			
Preeclampsia with and without IUGR (*n*=28) with PW ratio <25 centile	5.65	2.0-15.66	0.0009
Normotensive (*n*=76) with PW ratio >25 centile		Reference	
Variable absence of fetal heart			
Preeclampsia with and without IUGR (*n*=28) with PW ratio <25 centile	6.18	2.2-17.29	*P*=0.0005
Normotensive (*n*=76) with PW ratio >25 centile		Reference	

IUGR: Intrauterine growth restriction, PW: Platelet/WBC, WBC: White blood cell, OR: Odds ratio, CI: Confidence interval, US: Ultrasound

Table 4: The cut off values of PW ratio are given from 20-34 weeks for clinical use including less 25 centile, above 75 and in between centiles

GA weeks	<25 centile	25-75 centile	>75 centile
20	9.00	12.00	15.00
21	10.12	13.12	16.12
22	11.24	14.24	17.24
22	11.40	14.40	17.40
23	12.36	15.36	18.36
24	13.48	16.48	19.48
24	13.64	16.64	19.64
25	14.60	17.60	20.60
25	14.76	17.76	20.76
26	15.72	18.72	21.72
26	16.68	19.68	22.68
27	16.84	19.84	22.84
28	17.96	20.96	23.96
28	18.12	21.12	24.12
29	19.08	22.08	25.08
30	20.20	23.20	26.20
31	21.32	24.32	27.32
32	22.44	25.44	28.44
33	23.56	26.56	29.56
34	24.68	27.68	30.68

GA: Gestational age

PW ratio from simple ratio of platelet/WBC count. Let us take the variables A, B, and C in the following format

$C = A/B$

The number A is called the divisor while the number B is called the divided by. It goes without saying that in the state where B is fixed and when A increases the result C also increases as a simple fact of Math science. On the other hand, when A is fixed and when B increases the result C decreases and vice versa is true. In this paper, the divisor is platelet count while the divided by is the white blood cell count. It is well established that in normal pregnancy platelet counts increase progressively until labor to provide a protective mechanism against postpartum hemorrhage. The increase in the platelet count is brought about by the increase of all steroid hormones whether those secreted from the placenta or from the mother such as estriol, progesterone, and cortisol from the maternal adrenal gland.[6,7] As far as the divisor in PW ratio, the reduction in the platelet count seen in women with preeclampsia is well known to be mediated by the low-grade DIC seen as early as 16 weeks of gestation. In pregnancies, liable to develop preeclampsia later on the release of prostaglandin F_{2a}, is secreted in eight times higher from the placenta of normal women than a peer of normal women. Prostaglandin $F2_a$ is a strong vasoconstrictor as well as platelet aggregator. Accordingly, this induces intravascular coagulation early in the second trimester.[8] On the other hand, the placenta of women with preeclampsia has increased secretion for placental rennin to combat the high placental resistance seen in women liable to develop preeclampsia.[9] Moreover, this, in turn, contributes to the development of hypertension seen in preeclampsia. On the other hand, taking the (divided by) or white blood cells, the main increase occurs only to neutrophils.[10] It was indeed surprising to us that the reason of slight increase in the white blood cells is largely unknown. The most acceptable explanation is that in normal pregnancy there is huge immune suppression/modulation so that women can tolerate the fetus which carries 50% foreign paternal antigen. Accordingly, the increase in white blood cells, especially neutrophils, represents a protective mechanism to the mother which is mediated by immune suppression seen in pregnancy.[10-12] In this paper, as we have subdivided the patients into three subgroups according to the centile of PW ratio at 34 weeks of gestation, the systolic, diastolic blood pressure values were different in between the three groups; <25, 25–75, and >75 centiles. In addition, the number of fetuses with IUGR was significantly higher in women with low PW ratio than <25 centiles. The nonlinear regression of the polynomial type has shown a significant correlation between PW and GA while the distribution of PW ratio was normal. In addition, we have challenged PW values against Weibull distribution which is essential in every screening test and found that PW distribution is subject to Weibull type of distribution.[13] Accordingly, the PW ratio can be used as a screening test as any other ratio or test. Odds ratio among women with PW ratio <25 centile which is calculated at 34 weeks of gestation was significantly related to number of infants with growth restriction. Moreover, the odds ratio with items of biophysical profile, including fetal tone, gross body movement, respiratory movement, amount of liquor, and NST, was all significantly related to PW centile <25 centile.

Conclusion

Thus, we can conclude that PW ratio may be used as an adjuvant to other test of fetal well-being in the antepartum era as it is simple and very cheap to measure. Moreover, for this reason, we have built reference table and figure which ease the use of PW ratio between 20 and 34 weeks of gestation to sort out high-risk women for preeclampsia and its related complications. However, under no circumstances, we may use this ratio now as a substitute for the current fetal surveillance tests. The initial results here should be verified by further researchers and not until then that PW ratio may be used for fetal surveillance.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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تقيم معامل الصفائح الدموية على نسبة كريات الدم البيضاء كمعامل مستقل يمكن من خلاله التنباء بمتلازمة ماقبل الارتعاج و المضاعفات المصاحبة لها

خلفية البحث؛ ان حقيقة تباين الصفائح الدموية اكبر بكثير من من تباين الكريات البيضاء في دم الحوامل يمكن ان يستغل لعمل نسبة يمكن من خلالها التنباء بمتلازمة ماقبل الارتعاج و المضاعفات المصاحبة لها

الهدف من الدراسة؛ لمعرفة فيما اذا كانت نسبة (تعداد الصائح / تعداد الكريات البيضاء) يمكن من خلال هذه النسبة معرفة النساء المعرضات لمتلازمة ماقبل الارتعاج, تخلف نموا الجنين و غيرها من المضاعفات المصاحبة

الطرق البحثية؛ يتم انتقاء نساء ذوا حمل طبيعي عادة ماقبل 28 اسبوع او نساء مصابات بمتلازمة ماقبل الارتعاج عادة بعد 28 اسبوع من الحمل و لكن الخاليات من اي مضاعفات اخرى للحمل اولا لتقيم نسبة الصائح الدموية/ تعداد الكريات البيضاء مابين -20 34 اسبوع من الحمل اولا. و بعدها و عندما تصل المراة الى العمر الجنيني 34 اسبوع يعاد تقيم هذه النسبة بالاضافة الى قياس ضغط الدم و فحص دقيق بالامواج فوق الصوتية لمعرفة الاجنة المصابات بتخلف النموا و كذالك لحساب قيمة الفيزياء البايولوجية في الاسبوع 34 من الحمل

النتيجة؛ وجد ان هنالك علاقة مابين نسبة الصفائح الدموية على الكريات البيضاء و العمر الجنيني من خلال انشاء معادلة غير خطية من نوع متعددات الحدود من الدرجة الثالثة. كما وجد ان انتشار نقاط نسبة الصفائح على الكريات البيضاء يخضع لكل من الانتشار الطبيعي في المعادلة و انتشار وايبول الخاص بالمعاملات التي تستعمل للتنباء. كما وجدت ان نسبة الاحتمالية مميزة احصائيا مابين النسبة و عدد الاجنة المصابون بتخلف النموا و عناصر الفيزياء البايولوجية و تشمل كل من وضع الجنين داخل الرحم- حركة الجنين- حركة تنفس الجنين- كمية السائل الامنيوني و تغير معدل النبض في الحنين مع حركته. تم انشاء جدول و صورة يمكن من خلالهما استعمال نسبة الفائح على الكريات البيضاء للتنباء بالنساء المعرضات لمتلازمة ماقبل الارتعاج لتسهيل استعمالها و تقييمها من قبل الزملاء المختصين مستقبلا

الخلاصة: ان انشاء هذه الجدول او الصورة لايعد باي طريقة بديلا عن الطرق المستعملة حاليا لتقيم حالة الجنين قبل الولادة او معرفة النساء المعرضات لمتلازمة ماقبل الارتعاج. و لايمكن عمل ذالك الا من خلال دراسات مستقبلية يتم فيها اثبات او استثناء النتائج التي تم الحصول عليها في هذا البحث