Platelet Indices in Pregnant and Non Pregnant Females: A Comparative Study at a Tertiary Care Diagnostic Laboratory

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ABSTRACT

Objective: To compare the platelet indices in pregnant and non-pregnant females at a tertiary care diagnostic laboratory.
Study Design: Comparative cross-sectional study.
Place and Duration of Study: Armed Forces Institute of Pathology, Rawalpindi Pakistan, from Jul to Dec 2020.
Methodology: 166 healthy pregnant females were included in group-1, and 166 non-pregnant healthy females were recruited in group-2. 5 ml of fresh venous blood from the antecubital vein was collected under aseptic conditions in EDTA anticoagulant tubes. This sample was analyzed to determine complete blood counts (TLC, RBC, HB, and Platelet Count) and platelet parameters, namely Platelet distribution width (PDW), Mean platelet volume (MPV) and Plateletcrit (PCT), using an automated haematology analyzer Sysmex XN-3000.
Results: A total of 332 patients with a mean age of 26.5 ± 5.12 years were included in the study. Platelet count, PCT and PDW values were higher among group-2 than the pregnant females (p=0.001). MPV was higher among the group-1 females than the group-2 females (p=0.001). The distribution of platelet parameters across the trimesters showed that platelet count and PDW among the trimesters showed a statistically significant difference (p=0.001).
Conclusion: Pregnancy brings along many physiological changes in the female body. Various haematological and biochemical changes accompany these changes. MPV, PDW and PCT values were decreased in the pregnancy group. However, MPV was found to be increased as compared to group-2.

Keywords: Gestational thrombocytopenia, Mean platelet volume (MPV), Plateletcrit (PCT), Pregnancy, Trimester**.**

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INTRODUCTION

Platelets play a vital role in the body's haemostatic mechanism. On average, around 1500 to 2000 platelets are produced by a single bone marrow megakaryocyte that enters the circulation.[1] The average life span of the platelets is 7 to 10 days. A normal healthy individual's platelet count is 150 to 450 x 10^9/L of blood.[2]

It is a widely known fact that pregnancy brings along many physiological and biochemical changes in the body of a female. In addition, it brings about many alterations in the various body systems, including the haematological system.[3] Many researchers have elaborated on the changes in packed red cell volume, total blood volume and white blood cell count during pregnancy.[4] However, the scarcity of literature on the changes in platelet count and indices in pregnant females and their clinical consequences prompted us to perform this study in our population.

Automated haematology analyzers are now widely used to assess platelet counts and platelet indices.[5] Platelet indices include the Mean platelet volume (MPV), plateletcrit (PCT), platelet distribution width (PDW) and platelet-large cell ratio (P-LCR). MPV is the reflection of the average size of the platelets.[6] MPV is increased in various conditions such as myeloproliferative disorders, eclampsia, etc.[7] PCT is the volume of platelets in a given blood volume. Therefore, in conditions where blood volume is in- creased, PCT will be found to have a decreased value.[8]

Platelet count and platelet indices are now being utilized for screening healthy and non-healthy pregnancies. Its association with eclampsia and pree-clampsia has been established by Tesfay *et al*.[9] This study aimed to compare the Platelet Indices in Pregnant and non pregnant females at a Tertiary Care Diagnostic Laboratory. Additionally, the comparison of platelet indices in three trimesters were carried out.

METHODOLOGY

It was a comparative cross-sectional study carried out at the Department of Haematology, Armed Forces Institute of Pathology, Rawalpindi Pakistan. This institute receives patients coming in from all over the

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country and is one of the country's biggest tertiary care diagnostic centres. The total duration for which the study was carried out was six months, from July 2020 to December 2020.

OpenEpi sample size calculator version 3.0 was used to calculate the sample size. A sample size of 332 was calculated considering the mean platelet count in the pregnant females as 241.7 ± 0.745 x10^9/L and 269 ± 1.01 x10^9/L in Group-2, from a study conducted by Raychaudhuri *et al,* in northern India.[10] Value for Alpha was taken at 0.05, confidence interval of 95%, and 90% Power of test was used. Non-probability consecutive sampling technique was used. This sample was divided into two groups of equal participants. One hundred sixty-six study participants were in group-1 and group- 2 each.

Inclusion Criteria: Healthy pregnant females were included in the group-1 and non-pregnant healthy females were recruited in the group-2.

Exclusion Criteria: Subjects with a known history of diabetes mellitus, hypertension, coagulation disorder, anaemia, and any other cardiovascular, respiratory or renal comorbid conditions were excluded. Patients with multiple gestations and taking any medications such as (oral contraceptives) were also excluded.

Pregnant females were further categorized into three groups based on the trimester of pregnancy (first, second and third trimester). Ethical approval was taken from the Institutional Review Board. Patients or guardians whose samples were collected and analyzed had an informed consent signed prior to starting the study. 5 ml of fresh blood from the antecubital vein was collected under aseptic conditions in EDTA anti-coagulant containing tubes. This sample was analyzed to determine platelet counts and platelet parameters (PDW, MPV, and PCT) using the automa-ted haema-tology analyzer Sysmex XN-3000.

Statistical Package for Social Sciences (SPSS) version 25.0 was used for the data analysis. Mean, SD, median and IQR were calculated for age, platelet count, MPV, PCT and PDW. Percentage and Frequency were calculated for variables (categorical) such as gender and patients falling in each trimester. Data Normality was assessed using the Shapiro Wilk test, which showed a non-parametric distribution of data. Association between groups was calculated by applying independent samples Mann Whitney U test among group-1 and 2 and one-way ANOVA where applicable. Correlation between platelet count, MPV, PCT and PDW was calculated using Spearman correla-tion. The *p*-value of ≤0.05 was considered significant.

RESULTS

A total of 332 patients with a mean age of 26.5 ± 5.12 years were included in the study. The age range was 18 - 43 years. A total of 55 (33.1%) patients were in their first trimester, 76 (45.8%) were in their second trimester, and 35 (21.1%) were in the third trimester.

Platelet count, PCT and PDW values were higher among group-2 than the pregnant females (p=0.001). MPV was higher among the pregnant females than in group-2 (p=0.001) (Table-I).

Table-I: Comparison of platelet count and indices in pregnant and non-pregnant females (n=332).

Parameter	Pregnant Females (n=166)	Non Pregnant Females (n=166)	*p*-value
	Median (IQR)	Median (IQR)	
Platelet Count (x10^9/L)	153.00 (57.00)	262.00 (27.00)	0.001
Mean Platelet Volume (fL)	9.49 (0.31)	8.53 (0.40)	0.001
Plateletcrit (%)	0.17 (0.06)	0.29 (0.07)	0.001
Platelet Distribution Width (fL)	12.44 (0.26)	13.16 (0.42)	0.001

The distribution of platelet parameters across the trimesters showed that only the platelet count among the four indices showed a statistically significant difference (p=0.001) (Table-II).

Table-II: Distribution of platelet parameters across the trimesters.

Parameter	1st Trimester (n=55)	2nd Trimester (n=76)	3rd Trimester (n=35)	*p*-value
Platelet Count (x10^9/L)	193.5 ± 14.14	145.9 ± 14.42	115.7 ± 7.61	0.001
Mean Platelet Volume (fL)	9.45 ± 0.24	9.46 ± 0.26	9.48 ± 0.21	0.84
Plateletcrit (%)	0.175 ± 0.03	0.173 ± 0.03	0.168 ± 0.03	0.65
Platelet Distribution Width (fL)	12.46 ± 0.17	12.41 ± 0.19	12.51 ± 0.16	0.20

Correlation between platelet and MPV revealed a statistically significant negative correlation (rho=-0.75 p=0.01), whereas PCT (rho= 0.73) and PDW (rho= 0.73) showed a significant positive correlation (p=0.01) (Figure-1 & 2).

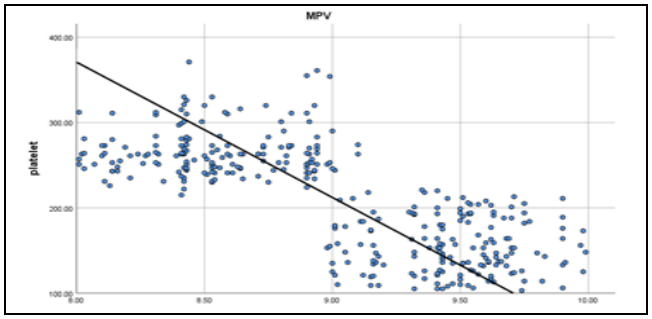

Figure-1: Correlation between MPV and platelet count (r=-0.75).

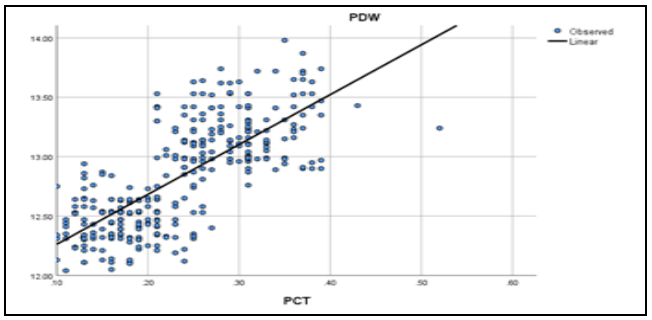

Figure-2: Correlation between PDW and PCT (r=0.73).

DISCUSSION

Pregnancy is usually accompanied by a decreased platelet count, referred to as gestational thrombocytopenia. It is usually seen in around 10% of uncomplicated pregnancies.[11] It is more commonly prevalent in the third trimester. Results of our study also supported these findings. The leading cause identified is the aggregation of platelets due to increased stress on the endothelial system. This stress leads to the increased production of intracellular calcium and thromboxane A2 and a decreased level of cyclic AMP. In addition, the increased blood volume associated with pregnancy also decreases platelet counts due to dilutional thrombocytopenia.

In our study, the platelet count (x10^9/L) in the pregnant women (155.35 ± 32.13) was significantly decreased as compared to the group-2 females (266.39 ± 28.77) (p=0.01). Similar results were published by Reese *et al*. They concluded that mean platelet counts in pregnant women were significantly lower (251,000 per cubic millimetre) than in non-pregnant women (273,000 per cubic millimetre).[12] In addition, lower platelet counts in pregnant women (234 ± 60.2 x10^9/L) than in non-pregnant females (243 ± 58.4 x10^9/L) were also reported by Bakrim *et al*.[13]

Our study showed a decreasing trend in the mean platelet counts as the pregnancy progressed from the first to the third trimester. This trend was statistically significant. Reese *et al,* reported similar results in which the mean platelet count was observed in 4568 uncomplicated pregnancies. It was shown that platelet count in the first trimester was 251000/µL, in the second trimester 230000/µL and 225000/µL in the third trimester.[14] Similar results were shown by Mutua *et al,* displaying a decreasing platelet count as the gestational age-progressed from the first to the third trimester.[15]

MPV and platelet count showed an inverse relationship in our study. This is because when platelet aggregation increases, the bone marrow compensates for this increasing demand by synthesizing relatively larger and younger platelets into the circulation. Contradictory results were shown by Bakram *et al*. They reported that MPV in the pregnant patients was 10.89 ± 1.22 fL and in the non-pregnant females was 11.20 ± 1.19 fL, which was statistically significantly raised.[13] Tygart *et al*, also demonstrated an inverse relationship between the MPV and platelet count. These parameters (platelet count and MPV) differed significantly in the pregnant and non-pregnant control group.[16]

The study results conducted by Alemu *et al*, also supported our findings. The mean Platelet count was 196.07 ± 48.88 x 10^9/L in the pregnant women group and 249.36 ± 62.73 x 10^9/L in the non-pregnant group. MPV was found to be higher in the pregnant patients (10.49 ± 0.95 fL) than in the non-pregnant group (10.06 ± 1.18 fL).[17] Only PDW and mean platelet count were statistically significantly different in the three trimesters in our study. An increase in the MPV and a decrease in PCT were observed as the pregnancy progressed, but that was not statistically significant (p = >0.05). Vagdatli *et al*, revealed that MPV and PDW were higher in pregnant women in their third trimester compared to early pregnancy.[18]

PDW corresponds to the variation in the size of platelets referred to as platelet anisocytosis. This depends upon the degree of platelet activation and depicts the changes in the morphology of platelets as well. The PDW was significantly higher in the non-pregnant group than in the pregnant females group in our study. Similar results were depicted by Raychaudhuri *et al*, with PDW value in the non-pregnant females' group (16.66 ± 4.37) higher than the pregnant females' group (16.16 ± 3.82).[10] However, there was no consistent trend seen in PDW values among the three

trimesters in our study. It was higher in the first and third trimesters and slightly decreased in the second trimester. This inconsistent trend needs further investigation on larger sample size. Similar results were shown by Babah *et al,* He concluded that as the pregnancy advances, there is an increase in the MPV and PDW observed.[19] Similar trends were observed in the studies conducted by Boehlen *et al,* and Chandra *et al*.[20,21]

Clinically, the changes in the haematological parameters during pregnancy and their trend during the three trimesters of pregnancy can be significant in the early diagnosis and management of various adverse conditions affecting the pregnancy outcomes such as eclampsia, pre-eclampsia, prediction of post-partum haemorrhage, gestational diabetes and various thromboembolic conditions.[22] Platelet indices and assessment of their variability can serve as an important and cost-effective tool for identifying various antenatal conditions and managing adverse pregnancy outcomes.

CONCLUSION

Pregnancy brings along many physiological changes in the female body. Various haematological and biochemical changes accompany these changes. Mean Platelet counts, PDW and PCT values were decreased in the pregnancy group. However, MPV was found to be increased compared to the non-pregnant females' group. Only Mean Platelet count among the four platelet indices showed a statistically significant difference (with decreasing trend) across the three trimesters. In contrast, no consistent trend was observed in PDW values across the three trimesters in our study.

Conflict of Interest: None.

Author's Contribution

AWN: Conception of idea, Sample collection, data collection. AM: Review and collection, SZ: Sampling and provision of clinical data, AK: Discussion and literature review, SA: Statical review, SZ: Data analysis and literature review.

REFERENCES

1. Boscher J, Guinard I, Eckly A, Lanza F, Léon C. Blood platelet formation at a glance. J Cell Sci 2020; 133(20): 1-5.
2. Jamshidi L, Seif A. Association between obesity, white blood cell and platelet count. Zahedan J Res Med Sci 2017; 19(2): 2-4.
3. Babker AM, Di Elnaim EO. Haematological Changes During All trimesters in Normal Pregnancy. J Drug Del Ther 2020; 10(2): 1-4.
4. Ahenkorah B, Nsiah K, Baffoe P, Anto EO. Biochemical and haematological changes among anemic and non-anemic pregnant women attending antenatal clinic at the Bolgatanga regional hospital, Ghana. BMC Hematol 2018; 18(1): 1-7.
5. Smith JR, Smith KF, Brainard BM. Platelet parameters from an automated hematology analyzer in dogs with inflammatory clinical diseases. Vet J 2014; 201(3): 406-411.
6. Walinjkar RS, Khadse S, Kumar S, Bawankule S, Acharya S. Platelet indices as a predictor of microvascular complications in type 2 diabetes. Indian J Endocrinol Metabol 2019; 23(2): 206.
7. Korniluk A, Koper-Lenkiewicz OM, Kamińska J, Kemona H, Dymicka-Piekarska V. Mean platelet volume (MPV): new perspectives for an old marker in the course and prognosis of inflam-matory conditions. Mediat Inflam 2019; 2019(1): 2-6.
8. Ustaoglu G, Erdal E, İnanır M. Does periodontitis affect mean platelet volume (MPV) and plateletcrit (PCT) levels in healthy adults? AMB Rev Assoc Méd Bras 2020; 66(2): 133-138.
9. Tesfay F, Negash M, Alemu J, Yahya M, Teklu G, Yibrah M, et al. Role of platelet parameters in early detection and prediction of severity of preeclampsia: A comparative cross-sectional study at Ayder comprehensive specialized and Mekelle general hospitals, Mekelle, Tigray, Ethiopia. PLoS ONE 2019; 14(11): 8.
10. Raychaudhuri S, Sharma N, Arora S, Pujani M, Rana D, Lukhmana S. Comparative Study of Platelet Indices in Normal Pregnant and Non-Pregnant Women in a Tertiary Care Hospital in Northern India. Pac J 2018; 5(8): A679.
11. Fogerty AE. Thrombocytopenia in pregnancy: mechanisms and management. Transfus. Med Rev 2018; 32(4): 225-229.
12. Reese JA, Peck JD, Deschamps DR, McIntosh JJ, Knudtson EJ, Terrell DR, et al. Platelet counts during pregnancy. N Engl J Med 2018; 379(1): 32-43.
13. Bakrim S, Motiaa Y, Ouarour A, Masrar A. Hematological parameters of the blood count in a healthy population of pregnant women in the Northwest of Morocco (Tetouan-M'diq-Fnideq provinces). Pan Afr Med J 2018; 29(1): 1-2.
14. Reese JA, Peck JD, McIntosh JJ, Vesely SK, George JN. Platelet counts in women with normal pregnancies: A systematic review. Am J Hematol 2017; 92(11): 1224-1232.
15. Mutua D, Nyaga E, Njagi M, Orinda G. Hematological profile of normal pregnant women. J Blood Lymph 2018; 8(2): 1-6.
16. Tygart SG, McRoyan DK, Spinnato JA, McRoyan CJ, Kitay DZ. Longitudinal study of platelet indices during normal pregnancy. Am J Obstet Gynecol 1986; 154(4): 883-887.
17. Alemu A, Abebe M, Terefe B, Yesuf M, Melku M, Enawgaw B, et al. Hematological indices of pregnant women at the university of gondar referral hospital, Northwest Ethiopia: a comparative cross-sectional study. Clin Lab 2019; 65(8): 1435-1436.
18. Vagdatli E, Gounari E, Lazaridou E, Katsibourlia E, Tsikopoulou F. Platelet distribution width: a simple, practical and specific marker of activation of coagulation. Hippokratia 2010; 14(1): 28.
19. Babah OA, Oluwole AA, Amaeshi LC. Platelet indices in healthy pregnant and nonpregnant Nigerian women. S Afr J Med 2018; 5(4): 117.
20. Boehlen F, Hohlfeld P, Extermann P, Perneger TV, de Moerloose P. Platelet count at term pregnancy: A reappraisal of the threshold. Obstet Gynecol 2000; 95(1): 29-33.
21. Chandra S, Tripathi AK, Mishra S, Amzarul M, Vaish AK. Physiological changes in hematological parameters during pregnancy. Indian J Hematol Blood Transfus 2012; 28(3): 144-146.
22. Budak YU, Polat M, Huysal K. The use of platelet indices, plateletcrit, mean platelet volume and platelet distribution width in emergency non-traumatic abdominal surgery: a systematic review. Biochem Med (Zagreb) 2016; 26(2): 178-193.