

Physiological changes in some hematological and coagulation profile among Sudanese healthy pregnant women

Alkhansa Osama Mohamed¹, Khalda Mirghani Hamza¹, Asaad Mohammed Ahmed Babker²

¹Department of Hematology and Immunohaematology, College of Medical Laboratory Science, Sudan University of Science and Technology, Khartoum, Sudan.

²Department of Medical Laboratory Science, Al-Ghad International College for Applied Medical Science, Al-Madinah Al-Munawarah, Saudi Arabia.

Correspondence to: Alkhansa Osama Mohamed, E-mail: alkhansaosama@gmail.com

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Abstract

Background: Pregnancy is a period of reproduction during which a woman carries one or more live offspring from implantation of a fertilized zygote in the uterus throughout gestation. There are several physiological changes that occur in pregnancy. Physiology of a normal pregnancy involves major changes in both the coagulation system and hematological parameters. These changes appear to be related to the development of the uteroplacental circulation and provide a protective mechanism during delivery.

Objective: To study the normal changes that occur to red blood cells (RBCs), white blood cells (WBCs), hemoglobin (Hb), platelets, and hemostatic profile (prothrombin time [PT] and partial thromboplastin time [PTT]) among pregnant Sudanese women and compare it within the three different trimesters.

Materials and Methods: A total of 50 apparently healthy pregnant women (gestational age 6–40 weeks) with age range between 20 and 40 years were recruited into the study. They were attending Khartoum teaching hospital, Khartoum, Sudan. There were no special preparation for subjects or questionnaires, and direct interviews were used to collect demographic and clinical data. After informed consent was obtained from the participants, 5 mL of venous blood was subsequently collected from an antecubital vein, with the subject comfortably seated, into ethylenediaminetetraacetic acid and citrate vacuum tubes. Hematological parameters including WBC, RBC, Hb, packed cell volume, and platelets were measured by Sysmex. The plasma clotting time, PT, and PTT were measured manually.

Results: The hematological parameters were represented as follows: mean value of WBCs was 7.580 cell/mm³, RBCs was 4.1 × 10¹²/L, Hb was 11.79 g/dL, platelets was 256 × 10⁹/L, PT mean value of the study group was 13.40 s, and PTT was 36.20 s.

Conclusion: There was no statistical significance in RBCs, Hb, platelets, PT, and PTT between pregnant women in the three different trimesters, whereas WBCs count showed significant differences among the three groups, the highest value was found in the second group followed by the third group and the lowest value found in the first group.

KEY WORDS: Sudanese pregnant women, hematological parameters, PT, PTT

Introduction

Pregnancy, also known as gravidity or gestation, is the time during which one or more offspring develops inside a woman's womb.^[1] In a pregnancy, there can be multiple gestations, as in the case of twins or triplets. Childbirth usually occurs approximately 38 weeks after conception. In case of women who have a menstrual cycle length of 4 weeks, this is approximately 40 weeks from the last normal menstrual

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period.^[2] The World Health Organization defines normal term for delivery as between 37 and 42 weeks.^[3] Pregnancy is associated with profound anatomical, physiological, biochemical, and endocrine changes that affect multiple organs and systems.^[4] These changes are essential to help the woman adapt to the pregnancy state and to aid fetal growth and survival. The hematologic system must adapt in a number of ways, such as provision of vitamins and minerals for fetal hematopoiesis (iron, vitamin B12, folic acid), which can exacerbate maternal anemia and preparation for bleeding at delivery, which requires enhanced hemostatic function.^[5] The most significant hematological changes are physiologic anemia, neutrophilia, mild thrombocytopenia, increased procoagulant factors, and diminished fibrinolysis.^[6] Red blood cell (RBC) mass begins to increase at 8–10 weeks of gestation and steadily rises by 20%–30% (250–450 mL) above normal pregnant levels by the end of the pregnancy in women taking iron supplements.^[7] Among women not on iron supplements, the RBC mass may only increase by 15%–20%. Plasma levels of factors VII, VIII, IX, and XII, together with fibrinogen and fibrin degradation products, increase during pregnancy. Pregnancy is also associated with enhanced platelet turnover.^[8] Coagulation factors remain elevated for up to 8–12 weeks postpartum and assays for them may be falsely negative during this period. Thus, pregnancy is a prothrombotic state. Activated partial thromboplastin time (APTT) is usually shortened in pregnancy, by up to 4 s in the third trimester, largely due to the hormonally influenced increase in factor VIII. However, no marked changes in prothrombin time (PT) or thrombin time occur.^[9] Thrombocytopenia (platelets $100 \times 10^9/L$) occurs in 0.8%–0.9% of normal pregnant women, while increases in platelet factor and thromboglobulin suggest elevated platelet activation and consumption.^[10] The RBC indices change little in pregnancy. However, there is small increase in mean corpuscular volume, of an average of 4 fl. oz in an iron-replete woman, which reaches a maximum at 30–35 weeks gestation and does not suggest any deficiency of vitamins B12 and folate.^[11] Also in white blood cells (WBCs) pregnancy is associated with leukocytosis, primarily related to increased circulation of neutrophils. The neutrophil count begins to increase in the second month of pregnancy and plateaus in the second or third trimester, at which time the total white blood cell (TWBC) counts range from 9,000 to 15,000 cells/micro liter.^[12]

Materials and Methods

Subjects

This is a cross-sectional descriptive and analytical study conducted at Khartoum teaching hospital, department of gynecology and obstetrics, Sudan. The study population comprised 50 apparently healthy pregnant women aged between 20 and 40 years were recruited into the study while attending for monitoring of their pregnancy. Only women, whose last menstrual date, Human chorionic gonadotropin (HCG), and ultra sound determinations were congruent, were enrolled in this study. No subject had a history of disease,

vaginal bleeding during course of the present pregnancy, or received any form of blood transfusion within the past 7 months. Subjects were divided into three pregnancy groups, depending on the duration of pregnancy in to the first, second, and third trimester of pregnancy. We used reference values of the health status of normal pregnant women as controls and comparison. Informed consent was obtained from each subject before recruitment into the study. A meeting interview was used for filling in a questionnaire that designated for matching the study need and all interviews were conducted face-to-face by the researcher in person.

Sample

About 5 mL of venous blood divided in two vacutainer tubes, 2.5 mL of whole blood in K2 ethylenediaminetetraacetic acid for complete blood counts and other (2.5 mL) of whole blood with 1:9 ratio of trisodium citrate, were collected and then centrifuged in order to obtain platelets poor plasma for performing PT and APTT. All blood samples were collected between 9 am and 12 noon each day and analyzed within 2 h of collection. Hematological and coagulation analysis were done at room temperature ($27.5 \pm 0.5^\circ C$).

Method

Sysmex KX-21 (hematology analyzer) was used for complete blood counts. Hemoglobin (Hb), RBCs, TWBCs, and PLTs were considered to be measured directly, three hydraulic subsystems were used to determine the hemogram; the WBC channel, the RBC channel, the platelets channel, and a separate Hb channel. All automated analysis was done after proper bar coding to ease identification. PT and APTT were determined by manual method that based on fibrin clot formation in glass tube. The test measures the plasma clotting time in addition of tissue extract thromboplastin (PT) and activation of contact factors (partial thromboplastin time [PTT]) depend on normal values of PT (12–16 s) and APTT (20–40 s).

Statistical Analysis

Data were entered and analyzed by SPSS program. All demographic data of the study population were presented as mean \pm SD in the text and odds ratio was used for detecting the power of relationship between the determinant and the outcome and 95% confidence interval was calculated.

Result

A total of 50 apparently healthy pregnant women attending Khartoum teaching hospital, department of gynecology and obstetrics were enrolled in this study. According to the age, the study group was divided into four groups first group, the highest percentage (48%) of the pregnant women was between the age of 26 and 30, second group (28%) between 20 and 25, third group (22%) between 31 and 35, and finally the fourth group showed lowest percentage (4%) in the age above 35 years [Table 1]. Also, according to the gestation

period time that divided into three groups, 30% in their first trimester, 32% in second trimester, and 38% in third trimester [Table 2]. The hematological parameters were represented as follows: the mean value of WBCs was 7.580 cell/mm³, RBCs was 4.1 × 10¹²/L, Hb was 11.79 g/dL, platelets was 256 × 10⁹/L, PT mean value of the study group was 13.40 s and PTT was 36.20 s [Table 3].

Discussion

The physiology of a normal pregnancy involves major changes in the hematological parameters and biochemical coagulation system. These changes appear to be related to the development of the uteroplacental circulation and provide a protective mechanism during delivery. In this study, we focus in the primary hematological changes during pregnancy related to Hb, RBCs, TWBCs, PLTs, PT, and PTT among Sudanese healthy pregnant women. In our finding, the RBCs were within normal value and showed no significant differences among the three groups of subjects. This finding supported that during pregnancy, the total blood volume increases by about 1.5 L, mainly to supply the demands of the new vascular bed and to compensate for blood loss occurring at delivery.^[9] The result of the blood Hb showed no significant difference between those groups. Also, this may be due to supplementary intake. We found that the TWBCs count showed differences

among the three groups and was statistically significant. The highest value was found in the second group followed by the third group and the lowest value found in the first group. This finding was contradictory to the fact that WBC count is increased in pregnancy with the lower limit of the reference range being typically 6,000/cumm. Leukocytosis, occurring during pregnancy is due to the physiologic stress induced by the pregnant state.^[12] Also, this finding is contradictory with similar study done by Li *et al.*,^[13] among pregnant women and concluded that there was no significant difference of hemogram changes. Platelets count found to be within normal range in vast majority of the women in all three trimesters. This finding agrees with another similar study done by Babiker *et al.*^[14] among Sudanese women were found that there was no significant value among pregnant women in platelets count. Also, this study agrees with the study done by Amah-Tariah *et al.*,^[15] among Nigerian women in which platelets showed no significant differences among the three study groups. Also this disagrees with the study done by Boehlen *et al.*, reported that there were decreases in platelets count in normal pregnant women.^[16,17] Also, our finding agrees with another study done by Ichipi-Ifukor *et al.*, concluded that pregnancy in women alters hematological indices such as packed cell volume, Hb, lymphocyte, and platelet counts during normal pregnancy.^[16] The result of this study reveals that PT and PTT showed statistically insignificant differences and this indicates that pregnancy is not likely to have any adverse effect on these parameters. This result is consistent with an earlier report by Asaad and Fathelrahman in which the PT and the PTT remains unchanged among pregnant women.^[18] Also, this result is consistent with a study reported by Awwiore *et al.*, who recorded no change in the mean PT values among pregnant women.^[19] Our result disagrees with different studies found that there were prolonged PT, APTT, and statistical significant among pregnant females.^[14,20,21]

The limitations of this study were the fact that we did not investigate the fibrinogen concentration, factor VII, and von Willebrand factor among our study participant, due to cost constraints. Although, several authors reported these parameters found to be increase significantly during pregnancy. In the other hand, we focused on available, fast and low cost parameters that can give insight of the health status required for the delivery and healthy offspring.

Table 1: Distribution of study group according to age

| Age group | Frequency | Percentage |
|-----------|-----------|------------|
| 20–25 | 13 | 26.0 |
| 28–30 | 24 | 48.0 |
| 31–35 | 11 | 22.0 |
| >35 | 2 | 4.0 |
| Total | 50 | 100.0 |

Table 2: Distribution of study group according to trimesters

| Trimester | Frequency | Percentage |
|-----------|-----------|------------|
| First | 15 | 30.0 |
| Second | 16 | 32.0 |
| Third | 19 | 38.0 |
| Total | 50 | 100.0 |

Table 3: Statistical result of cases in three trimesters

| Trimester parameters | First trimester | Second trimester | Third trimester | Normal range | Study range | Normal mean | Significance |
|---------------------------|------------------|-------------------|-------------------|--------------|-------------|-------------|--------------|
| | Mean | Mean | Mean | | | | |
| WBC × 10 ⁹ /L | 6.3467 ± 1.76022 | 8.5188 ± 1.72326 | 7.7632 ± 2.05189 | 4.0–11.0 | 3.50–12.00 | 7000 | 0.008 |
| RBC × 10 ¹² /L | 4.3087 ± 0.49578 | 4.0619 ± .55242 | 4.0111 ± 0.48283 | 3.25–5.76 | 3.9–5.6 | 4.7500 | 0.220 |
| Hb × g/dL | 12.2133 + .62663 | 11.6813 ± 1.87979 | 11.5474 ± 1.31714 | 6.20–14.00 | 11.5–15.5 | 13.5 | 0.359 |
| Plate 10 ⁹ /L | 255.07 + 41.844 | 257.81 + 37.837 | 255.84 ± 70.507 | 146–400 | 150–400 | 256.24 | 0.989 |
| PT/s | 13.13 + .990 | 13.44 ± .512 | 13.58 + .961 | 11–15 | 11–16 | 13.5 | 0.321 |
| PIT/s | 34.13 + 5.817 | 37.69 + 5.351 | 36.58 + 4.670 | 25–46 | 30–40 | 35 | 0.168 |

WBC, white blood cell; RBC, red blood cell; Hb, hemoglobin; PT, prothrombin time; PTT, partial thromboplastin time.

Conclusion

This study concluded that pregnancy in women did not alter in findings of RBCs, Hb, platelets, PT, and PTT and no significant changes among Sudanese pregnant women. WBCs count showed differences and was statistical significant among the three groups, the highest value was found in the second group followed by the third group and the lowest value found in the first group.

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