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Research Article

Haematological Parameters of Pregnant Women Attending Antenatal Care at Nakaseke Hospital, Central Uganda

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Abstract

Introduction

Establishment of haematological ranges is key to laboratory diagnoses and management of pregnancy related complications. The parameters to a large extent ought to be population based, never the less, there are limited studies on the reference ranges of pregnant women for the local population. This study reports on the haematological parameters of pregnant women attending antenatal care at Nakaseke Hospital, central Uganda.

Materials and Methods

A cross sectional study involving pregnant women was conducted from the month of May to August, 2018. Ethylene di-amine tetra acetic acid (EDTA) venous blood samples were collected and a full blood count (FBC) was run. Data for the haematological parameters was presented in tabular form as mean ± SD in reference to 95% reference intervals.

Results

One hundred and thirty five adult (18 years, and above) consented pregnant women were enrolled. The red blood cells (RBCs) counts and haemoglobin concentration showed a gradual decrease during the first two trimesters, and a slight increase during the third trimester. There was no significant change in MCV. The white blood cells (WBCs) did not show a significant change in the total count from the first to the second trimesters, and there was a significant rise during the third trimester. The granulocytes were affected by the increase in numbers. Platelet count decreased during the first to the third trimesters.

Conclusion

This study has explored a variance in the haematological parameters. This necessitates incorporation of specific reference ranges for clinical care and management of gestational disorders.

Introduction

Pregnancy is associated with changes in red blood cells (RBCs), haemoglobin concentration (Hb), haematocrit (HCT), platelets (PLTs), and white blood cells (WBCs) [1-3]. Physiological changes alter the haematological parameters mainly as a result of plasma accumulation, hemodynamic and haematological demands [4-7]. These changes lead to a drop in haematological parameters by a specific unit, and this stabilizes in the third trimester, when maternal plasma volume reduces [6]. As pregnancy is associated with numerous obstetric emergencies, establishing haematological reference ranges is a key aspect to the interpretation of results and a guide to make informed decisions regarding their care and management [5]. Unfortunately, most laboratories do not establish reference ranges for the local populations; rather they adopt those given by equipment manufacturers or use conventional ranges of the health population [8,9]. Yet reference standards are population based and selected on the basis of as age, dietary habits, ethnicity, and the environment changes [6]. This makes apt diagnosis rather difficult, and may aggravate the complications associated with pregnancy [3,10]. This leads to mismatched clinical and therapeutic interventions [3], which aggravates severe outcomes [10]. To this, this study established the haematological parameters among pregnant women in Nakaseke Hospital, Central Uganda.

Materials and Methods

Study Design, Area and Duration

The study was a cross sectional study, conducted in Nakaseke district from May to August 2018. Nakaseke district is located in central Uganda, and it borders Nakasongola district to the North and North East, Luwero district to the South east, and Wakiso district to the South.

Study Population, Sample Size Estimation and Enrolment Criteria

This consisted of the pregnant women attending antenatal care in Nakaseke hospital. The sample size was estimated using Slovin's formula [11]: $n= N/1+N (e)^2$. Given n as the sample size, N as the antenatal clinic monthly (estimated at 211); thus a total of 135 pregnant women were considered. Eligible participants were enrolled using simple random sampling technique, provided they did not present with any illness, anomalies in pregnancy and were above 18 years of age. The study excluded pregnant women who had chronic illness, infections like malaria, urinary tract infections, those mothers that were not taking folic acid, Vitamin B12, Ferrous supplements and pregnant women with obstetric emergency.

Study Variables

Full blood count parameters were used. These comprised: RBCs, WBCs and platelet counts; Hb, HCT and red cell indices.

Sample Collection and Analysis

Four millilitres (4mLs) of blood were collected in a single EDTA vacutainers, well mixed by inversion and tested for full blood count using Humacount 60^{TS}-3part Hematology analyzer (Sant Nagar, Delhi, India). Samples were analyzed immediately after collection within 2-hours. The standard operating procedure for sample analysis was strictly adhered to [12]. Results were obtained and the mean calculated to establish the lower and upper reference ranges.

Data Management and Analysis

Data was entered in spread sheet (Microsoft Office Excel, version 2010). This data was then transferred for analysis to SPSS version 16.0, and presented in tabular form as mean ± SD in reference to 95% reference intervals. Three control levels were tested on the CBC machine daily to ensure accurate results.

Ethical Considerations

This study obtained ethical approval from the Research and Ethics Committee of Clarke International University (Formerly, International Health Sciences University). Further permission was obtained from Nakaseke hospital and informed consent form the pregnant women who participated in the study.

Results

Socio-Demographic Factors of Study Participants

A total of 135 pregnant women were enrolled. Their mean age was 28.1 (range, 18-39). Most participants (51.9%) were aged 18-25 years, and were in different gestation stages. Details of socio-demographic factors are given in table 1.

Table 1: *Showing the participants socio-demographic factors*

Variable	Frequency	Percentage
Age category (Years)		
18-25	70	51.9
25-35	56	41.5
Above 35	9	6.7
Gestation age (trimester)		
First	43	31.9
Second	64	47.4
Third	28	20.7
Commonest type of food		
Animal products like beef	81	60.0
Poultry products	48	35.6
Mostly vegetarian	6	4.4
Alcohol drinking or smoking history		
Yes	14	10.4
No	121	89.6

Variations in Haematological Parameters in Relation to Trimester Changes

Blood count parameters (namely: RBCs, WBCs, platelets (PLT), Hb, HCT, granulocytes and red cell indices were analysed in relation to the three gestation trimesters as shown in table 2.

Table 2: *Showing established reference ranges in relation to trimester changes*

Haematological Parameters	1st trimester (±Mean)	2nd trimester (±Mean)	3rd trimester (±Mean)	Overall (±Mean)
WBC X 10^9/L	6.66±2.09	6.63±2.22	7.0±2.2	6.65±2.14
Range (min-max)	(4.57-8.75)	(4.41-8.85)	(4.8-9.2)	(4.51-8.79)
Lymphocyte X 10^9/L	1.94±0.65	1.79±0.66	1.43±0.59	1.73±0.65
Range (min-max)	(1.30-2.58)	(1.13-2.45)	(0.84-2.02)	(1.08-2.38)
Monocyte X 10^9/L	0.51±0.22	0.52±0.24	0.54±0.23	0.51±0.22
Range (min-max)	(0.29-0.73)	(0.28-0.76)	(0.31-0.77)	(0.29-0.73)
Granulocyte X 10^9/L	4.19±1.64	4.36±1.77	4.19±1.49	4.17±1.69
Range (min-max)	(3.55-5.83)	(2.59-6.13)	(2.7-5.68)	(2.48-5.86)
Lymphocyte%	30.37±9.46	28.42±8.46	24.41±8.48	28.22±8.69
Range (min-max)	(20.91-39.83)	(19.96-36.8)	(15.93-32.89)	(19.53-36.91)

Monocyte% Range (min-max)	7.70±1.98 (5.72-9.68)	7.78±2.67 (5.11-10.45)	8.74±2.10 (6.64-10.84)	8.04±2.26 (5.78-10.3)
RBC ($\times 10^{12}$/L) Range (min-max)	4.55±0.51 (4.04-5.02)	4.22±0.45 (3.77-4.67)	4.31±0.39 (3.92- 4.7)	4.35±0.49 (3.86-4.84)
Hb (g/dl) Range (min-max)	12.46±0.86 (11.6-13.32)	11.50±0.79 (10.71-12.29)	11.75±0.9 (10.85-12.65)	11.79±1.00 (10.79-12.79)
Hct (%) Range(min-max)	41.12±4.18 (36.94- 45.3)	38.01±3.34 (34.67-41.35)	38.63±6.16 (32.47-44.79)	39.25±4.41 (34.84-43.66)
MCV (fL) Range(min-max)	90.95±7.89 (83.06-98.89)	90.40±6.69 (83.71-97.09)	89.56±7.87 (81.69-97.43)	89.84±7.32 (82.52-97.16)
MCH (pg) Range(min-max)	27.48±2.52 (24.96-30)	27.40±2.54 (24.86-29.94)	26.38±2.43 (23.95-28.81)	27.25±2.53 (24.72-29.78)
MCHC (g/dL) Range(min-max)	30.22±0.76 (29.46-30.98)	30.31±0.82 (29.49-31.13)	30.15±0.78 (29.37-30.93)	30.27±0.80 (29.47-31.07)
Platelet($\times 10^{9}$ Range(min-max)	209.81±57.43 (152.38-267.24)	185±39.59 (145.41-224.59)	174.71±46.23 (128.48-220.94)	199±50.12 (148.88-249.12)
MPV (fL) Range(min-max)	7.04±0.76 (6.28-7.8)	7.03±0.63 (6.4-7.66)	7.09±0.80 (6.29-7.89)	7.04±0.71 (6.33-7.75)

The mean cell counts for the first, second and third trimesters were: WBCs count (X109/L) 6.66±2.096, 6.63±2.22 and 7.0±2.2; RBCs count (X1012/L) 4.55±0.51, 4.22±0.45 and 4.31±0.39; and platelets were 209.81±57.43, 185±39.59 and 174.71±46.23, respectively. Haemoglobin concentration (g/dL) as a surrogate value for anaemia varied across the three trimesters as; 12.46±0.86, 11.50±0.79 and 11.75±0.9, respectively. The monocyte counts (X109/L) were increased from the first to the third trimesters; 0.51±0.22, 0.52 ±0.24 and0.54±0.23, respectively. The granulocyte (X109/L) were; 4.19±1.64, 4.36±1.77 and 4.19±1.49, respectively. The RBC indices of MCV (fL) and MCH (g/dL) showed a decrease for the different trimesters as: 90.95±7.89, 90.40±6.69 and 89.56±7.87; and 27.48±2.52, 27.40±2.54 and 26.38±2.43, respectively. The MCHC (g/dL) showed an increase in the second trimester, and the different values for the first, second and third trimesters are; 30.22±0.76, 30.31±0.82 and 30.15±0.78, respectively. The MPV (fL) decreased in the second trimester, and the values for the different gestation stages are: 7.04±0.76, 7.03±0.63 and 7.09±0.80, respectively.

Discussion

Reference ranges are pivotal to the interpretation of laboratory diagnoses. This study found that the red blood cell parameters were affected by a gradual decrease as the gestation progressed from the first two trimesters, and slightly increased in the last trimester. This is similar to previous reports [4,5], and is

attributed to physiological variances in plasma volume (50%) that exceeds the maternal erythropoiesis (18-25%) induced due to pregnancy [13]. As there was no significant change in MCV, it is likely that the cellular changes are as a result of plasma accumulation and not due to nutrition deficiencies like insufficient iron of vitamin B12 deficiencies; similar to what was reported [3]. Contrary to the findings of Rayis *et al.* [13], the mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration showed no significant changes in the trimesters; similar to a conclusion reached by Milman *et al.* [1]. The haematocrit value decreased during the first two trimesters, similar to a pattern of variation that was observed by Rayis *et al.* [14]. This is explained by constant HCT value in the in the third trimester as a result of the contraction in the volume of maternal plasma [7]. The heme-dilution is due to increased circulatory demand which causes vasodilatation that further stimulates the renin-angiotensin-aldosterone system [5]. It is very important to correctly interpret these results putting into consideration the fact these maternal changes in the haematological parameters during pregnancy are partly modified by nutrition as earlier reported [14].

There was no significant change in total WBC count from the 1st to the 2nd trimesters, but there was significant rise in the total WBC count in the 3rd trimester. Never the less the total WBC count during pregnancy was higher than in non-pregnant states that is, there was a general increase in WBC count during pregnancy. This is consistent with previous findings [15,16]. The leucocytosis during pregnancy is ascribed to the associated stress [6]. Among the WBCs, the granulocytes (that is, neutrophils, basophils and eosinophils) increased most. This is in line with previous research findings [16], however the lymphocytes population decreased slightly throughout pregnancy; similar to a previous report [13]. The decrease is ascribed to the body's protective function of the foetus against B- Lymphocytes that would perceive the foetus as an alien body and produce antibodies against it [6]. Monocytosis was seen in the early 1st trimester and there was a very slight increase in the percentage of monocytes from 1st to the 3rd trimesters. This is explained by the fact that the immune system of the pregnant woman is adapting to its new state [6], and also the fact that monocytes infiltrates the decidua and prevent foetal allograft rejection [8]. Contrary to our findings, the reference values are slightly low than those in Southwest Nigeria [2]. Many of these variations in the haematological parameters among different people could be an effect of ethnicity, nutrition and genetic differences [17,18].

In the current study, total platelet count decreased from the 1st to the 2nd to the 3rd trimesters. This is supported by previous studies [13,19]. The results of this study were limited by the fact that our research design did not allow to follow up any pregnant woman through all the three-trimesters to establish the physiological changes. In addition, this study did not collect anthropometric data, which may have identified haematological indices due to chronic malnutrition, or iron and micronutrient deficiencies.

Conclusion

This study has established the local haematological among pregnant women, and this is important to the attending obstetricians to manage the pregnant women.

Conflict of Interest

The authors declare no conflict of interest.

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