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RESEARCH PAPER

EVALUATION OF SOME SELECTED HAEMORRHEOLOGICAL PROFILE DURING DIFFERENT PHASES OF MENSTRUAL CYCLE: A STUDY ON APPARENTLY HEALTHY FEMALES IN EKPOMA, EDO- NIGERIA.

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ABSTRACT

Various changes during pregnancy and lactation have been extensively documented. However, there is still a need for more extensive studies on menstruation -an important reproductive phenomenon. Considering the clinical relevance of hematological parameters, this study therefore, investigates some selected haemorrheological parameters at different phases of menstrual cycle. Involved in the study are 50 apparently healthy female subjects who met the inclusion criteria and resident in Ekpoma, Edo State- Nigeria. The parameters in focus were analysed using standard laboratory procedures and the data obtained, were subjected to statistical analysis. Results showed variations in the studied parameters before, during and after menses. Specifically, whole blood and plasma viscosity were significantly reduced during menses when compared to the values before and after menses. Erythrocytes sedimentation rate was significantly higher after menses than the values obtained before and during menses. Also, the changes observed for pack-cell volume remained statistically insignificant at the different phases of menstrual cycle with age having no significant influence on the parameters before, during and after menses. Thus, in reproductive females, there are fluctuations in haemorrheological parameters before, during and after menses and this is of clinical relevance to physicians and medical laboratory scientists.

Keywords: **Menstrual cycle**, **Reproductive life**, **Female, Haemorrheological parameters**.

INTRODUCTION

Menstrual cycle is a repetitive phenomenon occurring during the reproductive life of a female. It involves structural, functional and hormonal changes in the reproductive system (Guyton and Hall, 2006; Sadiqua and Ashwini, 2012) with the periodic vaginal discharge of blood containing degenerated endometrial parts, as the only visible external sign (Rajnee et al., 2010). The active reproductive life of female starts with the onset of this cyclical phenomenon otherwise called '*menarche'* and ceases with the onset of '*menopause*'. It is associated with the secretion of estrogen and progesterone from the ovaries under the influence of the hypothalamus and pituitary gland (Guyton and Hall, 2006; Sembuligam and Sembuligam, 2006). Several studies have shown that the periodicity of the menstrual cycle ranges from 25 to 35 days with the recurrent discharge of blood lasting 3 - 5 days (Rajnee et al., 2010).

The hematological profile of individuals to a large extent reflects their general health (WHO, 2004). However, several factors can influence the cellular constituents and serum biochemistry of the blood. For example, normal pregnancy is known to induce profound changes in maternal anatomy and physiology (Ghate et al., 2011). Several

other studies have documented the fact that hematological changes in pregnant women, is amongst the factors that affect pregnancy and its outcome (Bothwell and Charlton, 1981; Klebanoff et al., 1991; Allen, 2000).

Of particular interest, are the changes associated with haemorrheological parameters, which, according to Klabunde (2005), includes the deformation and flow properties of the cellular/plasma components of blood, and the rheological properties of blood vessels. It is worthy to note that despite the significance of menstruation in human reproduction, there is paucity of information on the associated haemorrheological changes that may occur during this process. This study therefore, investigates the possible variations in some haemorrheological parameters in diffenct during menstrual cycle.

MATERIALS AND METHODS

Study Area, Sample Population, and Inclusion Criteria: This study was carried out on 90 healthy female subjects randomly selected form Esan West Local Government Area of Edo State, Nigeria. This community lies between latitudes 60 43′ and 60 45′ North of the Equator and longitudes 60 6′ and 60 8′ East of the Greenwich Meridian (Aziegbe, 2006). The subjects recruited for this study were subdivided into three groups of thirty (30) each, based on their age (15-20 years; 21 – 25 years; and 26 – 30 years), and with a regular menstrual cycle ranging from 25 to 32 days. The study protocol was explained to the subjects upon which, an informed consent was granted by each of them.

Exclusion criteria's: For this study, pregnant and lactating women, women on oral contraceptives, and women with irregular cycles, gynecological disorders, history of drug intake that has affected the menstrual cycle, or history of chronic disease, were excluded.

Study period: The study lasted for 5 months (August 2010 to December, 2010).

Sample collection and analysis: Venous blood samples (5mls) were taken from the subjects that met the inclusion criteria before (secretory phase), during (menstrual phase) and after menses (proliferative phase). The first venous sample was taken on the 2nd or 3rd day of the onset of menses; second sample during 6th to 9th day after menses; and the third sample during 22nd to 24th day of menstrual cycle. All the subjects were followed up, between August and October, 2010 and between October and December.

All the blood samples collected were taken immediately to the laboratory for analysis in order to avoid diurnal variation. The parameters analyzed were whole blood viscosity (WBV) and plasma viscosity (PV) according to the procedure described by Reid and Ugwu (1987), as well as Erythrocytes sedimentation rate (ESR) and pack cell volume (PCV) according to the procedures described by Cheesbrough (2000) and Baker et al., (2001) respectively.

Statistical data analysis: The various parameters were statistically analyzed using SPSS (version 17) and the one way analysis of Varian (LSD test) was applied to determine the significant differences at $p \leq 0.05$.

RESULTS

Only fifty (50) of the recruited subjects completed the study given a response rate of 55.56%. The total number of the subjects who completed the study was 15, 26 and 9 subjects from the age group 15-29, 21 – 25 and 26 – 30 respectively.

Laboratory analysis showed that there were variations in the haemorrheological parameters before, during and after menses. Specifically, whole blood viscosity (WBV) was highest before menses (5.82±1.68 mpa/s) and lowest during menses (4.08±0.96 mpa/s). Also, plasma viscosity (PV) was highest after menses (1.89±0.39 mpa/s) and lowest during menses (1.65±0.34 mpa/s). Statistically, WBV and PV were significantly lower ($P<0.05$) during menses compared to before menses (in both WBV and PV) and after menses (in PV only) (see table 1).

On the other hand, erythrocytes sedimentation rate (ESR) was observed to increase successively and the observed increase was statistically significant ($p<0.05$) after menses (18.14 ± 4.89 mm/hr) as compare to ESR values before (10.30 ± 3.67 mm/hr) and during menses (12.76 ± 4.03 mm/hr). On pack cell volume (PCV), successive reductions that were not statistically significant ($P>0.05$) were observed (see table 1).

Comparatively, the age of the subjects did not significantly influence the distribution of the studied haemorrheological parameters during the menstrual phases. However, between the phases, there were significant differences in whole blood viscosity, plasma viscosity and erythrocyte sedimentation rate (see table 2).

Table 1: Mean of some selected haemorrheological parameter at different phases of menstrual cycle in apparently healthy females.

Haemorrheological parameters	Before menses	During menses	After menses
WBV (mpa/s)	5.82±1.68[b]	4.08±0.96[a]	4.81±0.79[ab]
PV (mpa/s)	1.87±0.42[b]	1.65±0.34[a]	1.89±0.39[b]
ESR (mm/hr)	10.30±3.67[a]	12.76±4.03[a]	18.14±4.89[b]
PCV (l/L)	0.37±5.04[a]	0.32 ±4.02[a]	0.30±3.68[a]

WBV = Whole Blood Viscosity; PV = Plasma Viscosity; ESR = Erythrocytes sedimentation rate; PCV = Pack Cell Volume; Values are mean ±SD. Values in a row having different super scripts are significantly different (p < 0.05).

Table 2: Age distribution of some selected haemorrheological parameter at different phases of menstrual cycle in apparently healthy females.

Haemorrheological parameters		Before menses	During menses	After menses
WBV (mpa/s)	15 – 20 years,	5.84±1.66[b]	3.83±0.98[a]	4.78±0.69[ab]
	21 – 25 years	6.19±1.61[b]	4.03±0.98[a]	5.11±0.76[ab]
	26 – 30 years	5.66±2.04[b]	3.98±0.60[a]	4.98±108[ab]
PV (mpa/s)	15 – 20 years,	1.82±0.32[b]	1.65±0.81[a]	1.95±0.38[b]
	21 – 25 years	1.77±0.48[b]	1.68±0.26[ab]	1.90±0.41[bc]
	26 – 30 years	1.91±0.32[b]	1.64±0.36[a]	1.82±0.33[b]
ESR (mm/hr)	15 – 20 years,	10.22±3.97[a]	13.67±3.81[a]	19.54±4.72[b]
	21 – 25 years	10.00±3.91[a]	11.33±2.83[a]	17.29±5.09[b]
	26 – 30 years	11.22±2.44[a]	12.73±4.46[a]	17.80±5.60[b]
PCV (l/L)	15 – 20 years,	0.37±5.74[a]	0.31 ±3.21[a]	0.31±3.21[a]
	21 – 25 years	0.39±4.86[a]	0.33±3.91[a]	0.31±3.48[a]
	26 – 30 years	0.35±4.82[a]	0.30±3.54[a]	0.29±5.09[a]

WBV = Whole Blood Viscosity; PV = Plasma Viscosity; ESR = Erythrocytes sedimentation rate; PCV = Pack Cell Volume; Values are mean ±SD. Values in a row and in a column having different super scripts are significantly different (p < 0.05).

DISCUSSION

The study of haematological parameters has a long history. To a large extent, haematological profile reflects an individual's general health and it is of diagnostic significance in routine clinical evaluation (WHO 2004; Iribhogbe et al., 2010). Many studies have identified the hematological profile of pregnant women as one of the factors affecting pregnancy and its outcome (Bothwell and Charlton, 1981; Klebanoff et al., 1991; Allen, 2000).

The results of this study have shown that some haemorrheological profiles are altered at the different phases of menstrual cycle. Hence, the present findings are in line with the documentation by Malini (2006), who studied haematological profiles in different phases of menstrual cycle in Bangalore. Results from animal and human studies have also suggested that the distribution of immune cells may change at different phases of menstrual cycle (Pehlivanoghu et al., 2001) as well as changes in leukocyte counts during the mid cycle and during secretory phase (Rajnee et al., 2010).

In addition, the observed reduction in whole blood and plasma viscosity is in line with the report by Kim et al., (1993), that mean values of hemoglobin, transferring saturation and serum transferring, were lowest during menses and highest in luteal or late luteal phase. The report by Dusse et al. (2002) is also relevant, considering their observation that there was a significant decrease in platelet count at the first day of menstruation compared to that recorded at the mid-point of the period under study.

Generally, the variations observed in this study -before, during, and after menses, suggests that menstrual cycle is associated with periodic changes in the haemorrheological profile. Recall that the human menstrual cycle involves complex and regular anatomical and physiological changes over an approximate monthly time period. It is said to be under the control of hypothalamic-pituitary-ovarian (HPO) axis (Guyton and Hall, 2006). The endometrium is stimulated and regulated by ovarian steroid hormones, oestrogen and progesterone, which in turn, is controlled by an integrated HPO axis through release of FSH and LH. The associated fluctuations in the levels of these hormones therefore, provide a basis for the variations observed in this study. Chapman et al. (1997) had earlier proposed that ovulation and the presence of corpora lutea during normal menstrual cycle were the key factors associated with systemic and renal hemodynamic changes occurring in the first trimester of pregnancy. This proposition might also account for the variations observed in this study.

Furthermore, blood pressure variation during menstrual cycle has been attributed to progesterone and estrogens fluctuation (Moran et al., 2000) and may also be responsible for the observed variations. Most importantly, estrogens have been reported to promote vasodilatation by stimulating the release of prostacyclin and nitric oxide; and inhibit the production of vasoconstrictors like Angiotensin II and endothelins (Everett et al., 1978; Polderman et al., 2000). Hence, the changes in whole blood and plasma viscosity may be attributed to this effect.

In conclusion, it is obvious that the reproductive life cycles in healthy females, are associated with fluctuations in haemorrheological parameters and as such medical laboratory scientists/ specialists and clinicians should take advantage of this finding especially during routine clinical examination and diagnosis.

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AUTHORS' CONTRIBUTIONS

Dr. Ojieh G.C., and Dr. Uhunmwangho E.J., conceived and supervised this study. Dr. Uhunmwangho E.J. and Anyanwu R.A. were involved in blood sample collection and analysis. Anyanwu R.A., Airhomwanbor K., and Uhunmwangho A. were involved in the recruitment and follow up of the subjects, while all the authors played significant roles towards the publication of this article.