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Haemorrheologic profiles in apparently healthy pregnant women in Calabar, Nigeria

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Rheological properties can be influenced by packed cell volume, plasma viscosity, red cell aggregation and red cell deformability. In order to assess haemorrheologic activity in pregnancy, 100 pregnant and 100 non-pregnant subjects (controls) of age range 18 - 40 years were studied to estimate packed cell volume (PCV), relative whole blood viscosity (RWBV), relative plasma viscosity (RPV) and plasma fibrinogen concentration (PFC) using standard manual techniques. PVC and RWBV were significantly lower in pregnant women than non-pregnant subjects (P< 0.001 and P< 0.02 respectively) while RPV and PFC were significantly higher in pregnant women than non-pregnant subjects (P< 0.001 and P< 0.001 respectively). RWBV had no correlation with the plasma fibrinogen concentration (r = 0.671, P > 0.05) while PFC and PCV in pregnant women had significant positive correlation with RPV and RWBV, respectively (r = 0.5149, P< 0.05 and r = 0.544, P< 0.05 respectively). There were significant differences in the values of RPV which increased with age (P < 0.01) while there were no significant differences in the values of PCV, RWBV and PFC with age groups (P> 0.05). In conclusion, haemorrheologic activity differs significantly in pregnancy due to decreased values of PCV, RWBV and increased values of RPV and PFC.

Key words: Haemorrheology, pregnancy, Calabar.

INTRODUCTION

Viscosity of blood reflects its rheological properties which can be influenced by packed cell volume, plasma viscosity, red cell aggregation and red cell deformability with plasma viscosity primarily depending on the concentration of plasma proteins especially fibrinogen (Lewis, 2002). The most critical determinant of blood viscosity is the haematocrit even through this may be less important in vivo (Dormand, 1981) while proteins other than fibrinogen, due to their smaller and more symmetrical shape, have much lesser effect on blood viscosity (Chien et al., 1970) but if they are present in abnormal quantities as in macro-globulinaemia, the effect may be significant (Somer, 1996).

Contradictory reports were made by earlier authors (Harkness and Whittington, 1971; Tommaso et al., 1991; Kametas et al., 2001) with regard to plasma viscosity during pregnancy as these authors (Harkness and Whittington, 1971; Kametas et al., 2001) reported increase in plasma viscosity while reduced viscosity was observed by Tommaso et al. (1991). However, many studies have shown increase in fibrinogen concentration during pregnancy (Akinsete and Uyanwah, 1989; Adediran et al., 1999; Choi and Pai, 2002).

This study was undertaken to determine haemorrheologic activity in pregnancy using relative whole blood viscosity (RWBV), relative plasma viscosity ((RPV), plasma fibrinogen concentration (PFC) and packed cell volume (PCV).

MATERIALS AND METHODS

The study was carried out with the approval of the Ethical Committee of the University of Calabar Teaching Hospital, Calabar between January and June, 2007. Informed consent of each of the randomly selected One hundred (100) apparently healthy pregnant subjects who attended the antenatal clinic of the hospital and one hundred non-pregnant subjects (controls) of similar age of 18 – 40

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Table 1. Haemorrheologic parameters in pregnant and non–pregnant subjects.

Parameter	Pregnant women (n = 100)	Non-pregnant women (n = 100)	P – value
PCV (l/l)	0.32 ± 0.04	0.36 ± 0.03	< 0.001
RWBV	4.06 ± 0.64	4.23 ± 0.45	< 0.02
RPV	1.70 ± 0.2	1.58 ± 0.17	< 0.001
PFC (g/l)	3.2 ± 0.8	2.3 ± 1.2	< 0.001

Table 2. Changes in haemorrheologic activity with age in pregnancy.

Parameter	19 – 25 years(n = 27)	26-32 years (n = 57)	33 - 39 years(n = 16)	P – value
PCV (l/l)	0.32 ± 0.04	0.32 ± 0.04	0.32 ± 0.03	> 0.05
RWBV	3.97 ± 0.46	4.0 ± 0.60	4.32 ± 1.0	> 0.05
RPV	1.64 ± 0.19	1.71 ± 0.17	1.77 ± 0.12	< 0.01
PFC (g/l)	3.22 ± 0.73	3.18 ± 0.89	3.44 ± 0.63	> 0.05

years drawn from Calabar metropolis were obtained.

7.0 ml of venous blood was withdrawn into a disposable plastic syringe from each subject and 4.5 ml of it was mixed with 0.5 ml of 31.3 g/l trisodium citrate solution for plasma fibrinogen assay and plasma viscosity while 2.5 ml of blood was added to dispotassiumethylene diamine tetra-acetic acid (EDTA) bottle to the final concentration of 1.5 mg/ml for the determination of packed cell volume using standard micro-haematocrit method (Bain and Bates, 2002). Whole blood viscosity (WBV) and plasma viscosity (PV) were determined using Reid and Ugwu method (Reid and Ugwu, 1987). In the calculation of relative plasma viscosity (RPV) and relative whole blood viscosity (RWBV), the mean values of the flow rates of whole blood (Tb), plasma (Tp) and distilled water (Tw) in seconds were applied using the following equations:

$$RPV = Tp_{(s)} / Tw_{(s)}$$

$$RWBV = Tb_{(s)} / Tw_{(s)}$$

Citrated blood was centrifuged at 2, 500 g for 10 min to separate the plasma which was used for the determination of plasma fibrinogen concentration using dry clot weight method of Ingram (1961).

Statistical evaluation

Data were expressed as mean ± standard deviation. Students't – test and One Way Analysis of Variance (ANOVA) were used with the differences of $P \leq 0.05$ considered as significant. Correlations were determined by linear regression analyses.

RESULTS

Table 1 shows the haemorrheologic parameters in pregnant and non-pregnant subjects. Pregnant women had lower values of 0.32 ± 0.04 l/l and 4.06 ± 0.64 for packed cell volume (PCV) and relative whole blood viscosity (RWBV) respectively compared to the values for non–pregnant subjects of 0.36 ± 0.03 l/l and 4.23 ± 0.45, respectively (P < 0.001 and P < 0.02). Higher values of 1.70 ± 0.2 and 3.2 ± 0.8 g/l were observed for relative

plasma viscosity (RPV) and plasma fibrinogen concentration ((PFC) as against 1.58 ± 1.7 and 2.3 ± 1.2 g/l for non-pregnant subjects (P < 0.001 and P < 0.001), respectively.

Table 2 shows the changes in haemorrheologic activity with age in pregnancy. The differences in the values of PCV, RWBV and PFC in the three age groups (19 – 25 years, 26 – 32 years and 33 – 39 years respectively) were not statistically significant (P > 0.05) while the significant differences in the values of RPV which increased with age were 1.64 ± 0.19, 1.71 ± 0.17 and 1.77 ± 0.12 for 19 -25 years, 26 – 32 years and 33 – 39 years (P < 0.01).

Linear regression analyses showed that RWBV in pregnancy had no correlation with the PFC (r = 0.0671, P > 0.05) in Figure 1 while Figures 2 and 3 showed that PFC and PCV in pregnant women had significant moderately positive correlation with RPV and RWBV respectively (r = 0.5149, p < 0.05 and r = 0.544, p < 0.05 respectively).

DISCUSSION

Haemorrheologic properties influenced by packed cell volume, plasma viscosity, red cell aggregation and red cell deformability have been observed to be affected in pregnancy (Harkness and Whittington, 1971; Tommaso et al., 1991; Kametas et al., 2001). Previous studies have shown significantly reduced PCV values in pregnancy (Usanga et al., 1994; Stuart and Christoph, 2000; Salawu and Durosinmi, 2001) and this common finding is evident in this study. The PCV values with regard to different age groups in pregnancy are in agreement with earlier report in Calabar. The reduced PCV values in pregnancy as compared to non-pregnant subjects could be due to marked increase in plasma volume associated with normal pregnancy causing dilution of many circulating
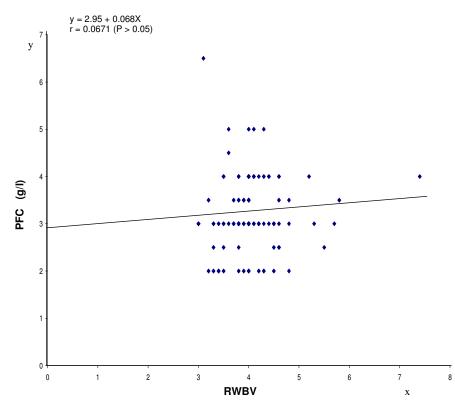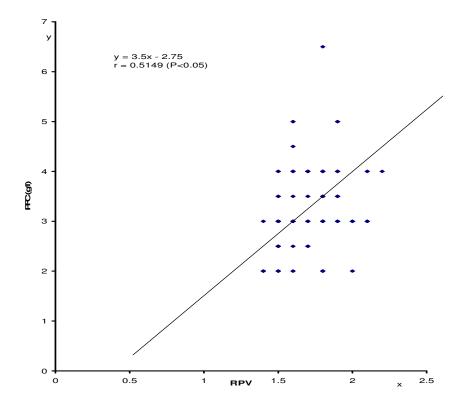
y = 2.95 + 0.068X
r = 0.0671 (P > 0.05)

Figure 1. Correlation between PFC and RWBV in pregnant women in Calabar, Nigeria.

y = 3.5x - 2.75
r = 0.5149 (P<0.05)

Figure 2. Correlation between plasma fibrinogen concentrations (PFC) and relative plasma viscosity in pregnant women in Calabar, Nigeria.
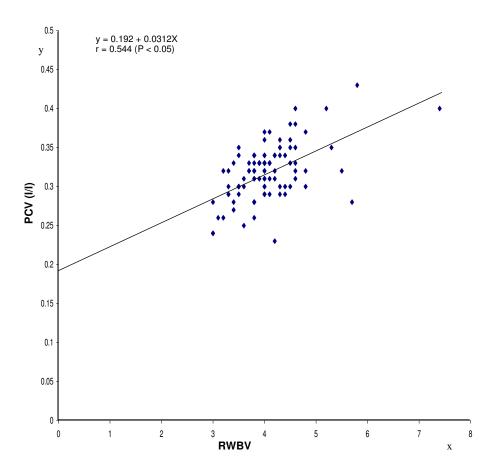
Figure 3. Correlation between PCV and RWBV in pregnant women in Calabar, Nigeria.

factors and cells resulting in physiological anaemia (Stuart and Christoph, 2000; Salawu and Durosinmi, 2001; Koos and Moore, 2003).

Reduced relative whole blood viscosity in pregnancy observed in this study agrees with that of an earlier report (Tommaso et al., 1991). This could be associated with lower PCV values as relative whole blood viscosity correlated with PCV in this study which substantiated previous reports (Tommaso et al., 1991; Famodu et al., 1998).

The findings from different authors (Kametas et al., 2001; Salawu and Durosinmi, 2001) on the increased fibrinogen concentration in pregnancy have been con- firmed in this study. This could be attributed to increased fibrinogen synthesis due to its utilization in the uteropla- cental circulation or as a result of hormonal changes and particularly high levels of estrogen (Koos and Moore, 2003). RPV values increased with age probably due to high fibrinogen levels especially in the age group 33 – 39 years.

In conclusion, this study has shown that in pregnancy, haemorrheologic activity differs significantly due to de- creased values of PCV, RWBV and increased values of RPV and PFC. The determined base-line values for haemorrheologic activity in pregnant women in Calabar can serve as guide to monitoring haemorrhage and thrombo-embolism associated with pregnancy especially as such reports have not been documented in Calabar.

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