INTERNATIONAL JOURNAL OF ADVANCES IN PHARMACY, BIOLOGY AND CHEMISTRY

Research Article

The Effects of Different Stages of Pregnancy on some Biochemical Indices

A.T Ogundajo[1,2], S.K Adeboye[1], I.O Baderinwa[1] and O.O Ajayi[1].

[1]Department of Chemical Pathology,

Obafemi Awolowo University TeachingHospital Complex,

Wesley Guild Hospital Unit, Ilesa, Osun State, Nigeria.

[2]Department of Biochemistry, Ekiti State University, Ado Ekiti, Ekiti State.

ABSTRACT

This study was to investigate some pregnancy induced physiological and biochemical changes among pregnant women using non-pregnant women as control. 100 subjects were involved in this study out of which 25 pregnant subjects belong to each of the trimesters while 25 non-pregnant subjects served as control. Flame photometric technique was used to analyze blood electrolytes while other analytes were analyzed using spectrophotometric technique. The mean value of TG, LDL-C and ALP for 1st trimester, TG, LDL-C and ALP for 2nd trimester, TC, TG, HDL-C, LDL-C and ALP for 3rd trimester were found to be significantly increased (P<0.0001) when compared with non-pregnant subjects while other biochemical indices tested were found to be significantly decreased (P<0.0001) irrespective of the stage of pregnancy. Pregnancy associated biochemical alterations must be monitored in order to differentiate it from a pathological case.

Keywords: Pregnancy, physiological and biochemical changes, Triglycerides, lipoprotiens

INTRODUCTION

Pregnancy is a unique physiological phenomenon with inherent biochemical changes ranging from alterations in electrolyte concentrations to more complex changes in metabolic activities[1].It has been reported that many inherent metabolic and biochemical changes occur at the time of and after conception. The body changes its physiological and homeostatic mechanisms in pregnancy to ensure the fetus is provided for which include increases in blood sugar, breathing and cardiac output[2]. Levels of progesterone and estrogens rise continually throughout pregnancy, suppressing the hypothalamic axis and subsequently the menstrual cycle. The womb and the placenta also produce many hormones. These changes begin in the first trimester (up to 13 weeks after conception) where the foetus weighs approximately 13g and it is up to 8cm long[3]. During the second trimester (13 to 26 weeks), rapid foetus growth occurs and by the end of the second trimester, the foetus weighs approximately 70g and is 30cm long while the foetal organs would have begun to mature[3].During the third trimester (26 to 40 weeks), the fetal organs complete maturation[4].The implantation of the fertilized ovum causes the regulatory and functional mechanism of the body to be thrown out of balance and results in a disturbed physiological and metabolic state which may be seen in the level of the distribution of blood components[5]. Due to this biochemical and metabolic alteration potential of pregnancy on physiological system, this work investigate some biochemical changes induced by pregnancy on physiological system in different trimesters using non pregnant women as control in other to differentiate the biochemical pattern in pregnancy from a pathological biochemical changes.

MATERIALS AND METHODS

Subjects

This experimental study was carried out at the Department of Chemical Pathology, Wesley Guild Hospital Unit of Obafemi Awolowo University Teaching Hospitals Complex, Ile-ife, Nigeria. Obafemi Awolowo University Teaching Hospital Complex serves as teaching hospital to the south western people and referralcentre to the country.100 subjects were involved in this study out of which 25 pregnant subjects belong to each of the trimester while 25 non pregnant subjects served as control. Exclusion criteria include evidence of eclampsia and any pathological case. Informed consent was obtained from the subjects after the study guidelines had been explained to them. Reagent kits were obtained from Randox laboratory, USA. All other materials used were obtained from other standard commercial suppliers. After an overnight fast, venous blood samples were collected into lithium heparinized bottles for biochemical analysis which include total cholesterol (TC), high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C) and triglycerides (TG), electrolytes, urea, creatinine (Cr), aspartate aminotransferase (AST), alanin aminotransferase (ALT), alkaline phosphatase (ALP), albumin and uric acid.The total cholesterol was determined using the enzymatic method[6], HDL-C was determined using the precipitation method[7]and triglycerides was determined using the enzymatic method[8]. LDL-C was determined using the Freidwald's formula[9]. Electrolytes were analysed using flame photometric technique[10], urea was analysed colorimetrically using diacetylmonoxime method[11] and albumin (ALB) analysed colorimetrically using bromocresol green method while creatinine was analysed by Jaffe method[11]. Aspartate aminotransferse, alaninaminotransferase, alkaline phosphatase and uric acid were analysed colorimetrically as described by Monica Cheesbroughs[11].

Statistical analysis: Results are presented as mean± SEM. Statistical significance and difference from control and test values evaluated by Student's t-test. Statistical difference at probability of $p < 0.05$ were considered to be significant.

RESULTS

The results of this study are presented in tables 1 to 3 representing each trimester of pregnancy. Blood total cholesterol (TC), high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C), triglycerides (TG), urea, sodium(Na), potassium(K), aspartate aminotransferase (AST), alanin aminotransferase (ALT), alkaline phosphatase (ALP), albumin(ALB), uric acid, creatinine (Cr) profiles among pregnant women in 1st, 2nd and 3rdtrimester.In 1st trimester, the mean values of these biochemical indices when compared with mean values of non pregnant subjects were found to be significantly decreased($p<0.0001$) with the exception of TG, LDL-C and ALP that were found to be significantly increased ($p<0.0001$). For 2ndtrimester, the mean values of these biochemical indices when compared with mean values of non pregnant subjects were found to be significantly decreased ($p<0.0001$) with the exception of TC, TG, LDL-C and ALP that were found to be significantly increased ($p<0.0001$). In 3rd trimester, the mean values of these biochemical indices when compared with mean values of non pregnant subjects were found to be significantly decreased ($p<0.0001$) with the exception TC, TG, LDL-C, HDL-C and ALP were found to be significantly increased ($p<0.0001$).

DISCUSSION

The findings from the above study showed that pregnancy influence biochemical and physiological parameters irrespective of the stage of pregnancy. The lipid profile comprising of TC, LDL, HDL and TG were observed to be significantly different from 1st trimester to 3rd trimester of pregnancy. ($p<0.0001$) (table 1-3) when compared with non pregnant subjects. The above might be as a result of higher concentration of oestrogen and insulin resistance which during pregnancy usually increase physiological triglycerols, fatty acids, cholesterol, lipoprotein and phospholipids starting from the first trimester and the effect is observed until delivery[12]. The observable change in plasma total cholesterol especially from 2nd stage of the pregnancy is responsible for various changes in the lipoprotein fraction. The HDL- cholestrol of a pregnant subject when compared with non pregnant subject was found to be significantly decreased in 1st trimester (1.252± 0.064/ 1.472±0.040) but there was an increase beginning at the 2nd trimester and the increase became more significant in 3rd trimester (1.640±1.22/1.472±0.040). These observable changes suggest that HDL increases in response to estrogen level which is in line with other findings[13]. The plasma level of the TC in pregnant subjects was observed to be significantly decreased ($p<0.0001$) when compared with the pregnant subject but significantly increase in 2nd trimester (table 2) and this increase continues till delivery. LDL-cholesterol of pregnant subjects compared with control showed a steady significant increase right from the first trimester to 3rd trimester which may be as a result of

oxidative activity of the placenta where cholesterol is used by placenta for steroid synthesis and fatty acid are used for placental oxidation and membrane formation thereby leading to generation of more LDL- cholesterol[13]. Renal function was assessed by monitoring the blood electrolytes (Na^+, K^+) urea and creatinine in each of the stages of pregnancy. The mean value of the sodium and the potassium (table 3) were found to be significantly decreased when compared with control subject irrespective of the stage ($p<0.0001$) of pregnancy. Also, both urea and creatinine significantly decreased from the 1st trimester (table 1-3) ($p<0.0001$) when compared with non pregnant woman. This significant decrease in this renal function indices suggest increase in glomerular filtration rate that occur immediately after conception and last all through the period of pregnancy may be responsible which result in significant hyperfiltration coupled with enhance renal plasma flow which is a common future of pregnancy leading to significant decrease in blood urea and creatinine[14]. When serum creatinine concentration is above 0.8 mg/dl during pregnancy, it may indicate an underlying renal dysfunction[15].

Table 1

The effects of pregnancy on some biochemical indices among pregnant women in 1st trimester.

Parameter	Pregnant Subjects(1st Trimesters) n=25	Control(Non-Pregnant Subjects) n=25	p value
TC (mmol/l)	3.800 ± 0.095	3.896±0.101	< 0.0001
TG (mmol/l)	1.160±0.093	1.156±0.067	< 0.0001
HDL(mmol/l)	1.252±0.064	1.472±0.040	< 0.0001
LDL(mmol/l)	2.048±0.092	1.796±0.055	< 0.0001
UREA (mmol/l)	3.852±0.173	5.584±0.231	< 0.0001
Na^+ (mmol/l)	134.7±0.694	136.3±0.535	< 0.0001
K^+ (mmol/l)	3.420 ±0.095	4.120±0.084	< 0.0001
AST (IU/l)	20.40±2.074	27.16±1.862	< 0.0001
ALT(IU/l)	17.48±0.934	21.52±1.670	< 0.0001
ALP (IU/l)	76.600±3.060	67.120±4.381	< 0.0001
ALB (g/l)	37.20±0.808	43.64±0.846	< 0.0001
URIC ACID(mmol/l)	0.217±0.017	0.342±0.017	< 0.0001
Cr (µmol/l)	58.92±1.551	86.52±3.003	< 0.0001

Values are mean ± SEM. Significant difference between pregnant and non pregnant group determined by student's t-test.

Table 2

The effects of pregnancy on some biochemical indices among pregnant women in 2nd trimester.

Parameter	Pregnant Subjects(1st Trimesters) n=25	Control(Non-Pregnant Subjects) n=25	p value
TC (mmol/l)	5.052±0.166	3.896±0.101	< 0.0001
TG (mmol/l)	1.632±0.107	1.156±0.067	< 0.0001
HDL(mmol/l)	1.436±0.093	1.472±0.040	< 0.0001
LDL(mmol/l)	2.888±0.111	1.796±0.055	< 0.0001
UREA (mmol/l)	3.588±0.522	5.584±0.231	< 0.0001
Na^+ (mmol/l)	134.7±0.694	141.1±2.982	< 0.0001
K^+ (mmol/l)	3.420 ±0.078	4.120±0.084	< 0.0001
AST (IU/l)	20.40±2.074	52.84±4.513	< 0.0001
ALT(IU/l)	21.52±1.670	31.24±5691	< 0.0001
ALP (IU/l)	67.120±4.381	37.80±0.998	< 0.0001
ALB (g/l)	37.20±0.975	43.64±0.846	< 0.0001
URIC ACID(mmol/l)	0.189±0.037	0.342±0.017	< 0.0001
Cr (µmol/l)	58.92±1.551	86.52±3.003	< 0.0001

Values are mean ± SEM. Significant difference between pregnant and non pregnant group determined by student's t-test.

Table 3
The effects of pregnancy on some biochemical indices among pregnant women in 3rd trimester

Parameter	Pregnant Subjects(1st Trimesters) n=25	Control(Non-Pregnant Subjects) n=25	p value
TC (mmol/l)	5.660±0.186	3.896±0.101	< 0.0001
TG (mmol/l)	1.716±0.187	1.156±0.067	< 0.0001
HDL(mmol/l)	1.640±0.122	1.472±0.040	< 0.0001
LDL(mmol/l)	3.312±0.156	1.796±0.055	< 0.0001
UREA (mmol/l)	3.676±0.354	5.584±0.231	< 0.0001
Na^+ (mmol/l)	134.7±0.694	141.1±2.982	< 0.0001
K^+ (mmol/l)	3.296 ±0.042	4.120±0.084	< 0.0001
AST (IU/l)	20.40±2.074	52.84±4.513	< 0.0001
ALT(IU/l)	21.52±1.670	31.24±5691	< 0.0001
ALP (IU/l)	170.5±8.002	37.80±0.998	< 0.0001
ALB (g/l)	37.80±0.998	43.64±0.846	< 0.0001
URIC ACID(mmol/l)	0.140±0.013	0.342±0.017	< 0.0001
Cr (µmol/l)	59.52± 2.108	86.52±3.003	< 0.0001

Values are mean ± SEM. Significant difference between pregnant and non pregnant group determined by student's t-test.

Liver function indices which include AST, ALT, ALP, ALB and uric acid were monitored in each of the stages of normal pregnancy and were found to be significantly decreased ($p<0.0001$) with the exception of ALP when compared with non pregnant subjects (table 1-3). This could be said to be as a result of general reduction in liver function observable during pregnancy which is due to the expansion of extracellular fluid[16]. Expansion of extracellular fluid coupled with reduced net tubular reabsoption of amino acids andurate that may account for significant decrease in blood ALB and uric acid level in all stages of pregnancy when compared with non pregnant subjects[16,17].ALP on the order hand was found to be significantly increased in pregnant subjects when compared with non pregnant women(control) irrespective of the stage of pregnancy(table 1-3). This significant increase in blood activity of ALP suggests an increased enzyme activity of placenta origin which is in line with other scientific findings[15]. In conclusion, pregnancy has a characteristic pattern of alteration on physiological and biochemical parameters which must be well understood in order to differentiate it from a pathological case. Furthermore, the above observed pregnancy induced biochemical changes may be monitored in pregnancy for better management.

REFERENCES

1. Ifukor PC, Jacobs J, Ifukor RN, Ewrhe OL. Changes in haematological indices in normal pregnancy. Physiology J., 2013; 1-4.
2. Jiang X, Bar HY, Yan J, West AA, Perry CA, Malysheva OV, Devapatla S, Pressman E, Vermeylen FM, Caudill MA. Pregnancy induces transcriptional activation of the peripheral innate immune system and increases oxidative DNA damage among healthy third trimester pregnant women. Plos One, 2012; 7 (11): 1-10.
3. Oke IT, Awofadeju SO and Oyedeji SO, Haemorheological profile in different trimesters among pregnant woman in south west, Prk J Physio, 2011;7 (2): 17-19.
4. Lawson DB, Starrant TB. Anaemia in pregnancy in obstetrics and gynaecology in the tropics and developing countries. Oxford black well scientific publication, 1988.
5. Trans HA. Biochemical tests in pregnancy. Aust Prescr.2005;98-101
6. Allain CC, Poon LS, Chan CSG, Richmond W. Total cholesterol assay. Clinical chemistry, 1974; 20:470-471.
7. Grave TH. Grove Method of High Density Lipoprotein. Clinical Chemistry,1979; 25,560-562
8. Esders TN, Michira CA. Triglyceride estimation, J. Biol. chem, 1997; 254:710-712.
9. Friedwald WT, Levy RI, Fredrickson DS. Estimation of the concentration of low-density lipoprotein, cholesterol in plasma without use of preparative ultracentrifugation. Clinical Chemistry.1972; 18(6):499-502.

10. Burtis CA, Ashwood ER. Tietz text book of clinical chemistry. 3rd ed. WB. Saunders, USA, 1999.
11. Cheesbrough M. District laboratory practice in tropic countries. Part 1, Cambridge low price Editions, Cambridge Press, UK, 1999.
12. Lesser KB, Carpenter MW, Metabolic charges associated with normal pregnancy and pregnancy complicated by diabetes mellitus. Serum Perinatal, 1994; 18(5):399-406.
13. Halstead AC, Lockitch G, Vallance H, Wadworth L, Withmann B, Handbook of diagnostic biochemistry and haematology in normal pregnancy. Bocareaton FL:CRC press, 1993;3:235
14. Krane NK and Hamrahian M. Core curriculum: pregnancy-kidney diseases and hypertension. Am. J kidney Dis 2007; 49(2):336-345.
15. Pacheco L, Costantine MM, Hankins GDV. “Physiologic changes during pregnancy,” in Clinical Pharmacology during Pregnancy ed. Mattison D. R., editor. (San Diego: Academic Press;) 2013; 5–14.
16. Gaw A, Cowan RA, O'Reilly DStJ, Stewart MJ, Shepherd J. Clinical biochemistry – an illustrated colour text. 2nd edition. Edinburgh: Churchill Livingstone; 1999; 140-3.
17. Dunlop W, Davisan JM. The effect of normal pregnancy upon the renal handling of uric acid. Br J Obstet. Gynaecol, 1977;84(1):13-21.