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Research Article

ASSESSMENT OF LEVELS OF LIPID PROFILE, APOLIPOPROTEINS, AND ATHEROGENIC INDEX IN CORD BLOOD OF NEONATES ACCORDING TO GESTATIONAL AGE

RAJKUMARI SAMAR[1], SEEMA MEHTA[1], AKANKSHA PALIWAL[2], CHITRA PUROHIT[3], SUMAN JAIN[4]*

[1]Department of Obstetrics and Gynaecology, Geetanjali Medical College and Hospital, Udaipur, Rajasthan, India. [2]Department of Biochemistry, RNT Medical College, Udaipur, Rajasthan, India. [3]Department of Biochemistry, Government Medical College and hospital, Bhilwara, Rajasthan, India. [4]Department of Biochemistry, Pacific Institute of Medical Sciences, Udaipur, Rajasthan, India. Email: sumannemijain@gmail.com

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ABSTRACT

Objective: A considerable amount of cholesterol is needed by human body for the maintenance of tissue and various bodily metabolisms. Cardiac disorders are major cause for morbidity and mortality in recent years. Cord blood lipoprotein is influenced by factors such as placental insufficiency, mode of delivery, and conditions affecting fetal growth. The present study was planned to analyze cord blood lipid profile, apolipoproteins, and atherogenic index in different gestational age and compare them gender wise.

Methods: A cross-sectional study was conducted in the Department of Obstetrics and Gynaecology, Geetanjali Medical College and Hospital, Udaipur. The study group included 640 neonates, divided into two groups on the basis of gestational age into near-term neonates (34–37 weeks) and term neonates (>37 weeks). The cord blood samples were taken from placental side of umbilical cord at birth. The blood was tested to determine lipid profile, apolipoproteins, and atherogenic index.

Results: The results showed total cholesterol, triglyceride, HDL-C, LDL-C, ApoA-1, and Apo B level higher in near-term neonates group than term neonates. TC, TG, HDL-C, VLDL-C, and apolipoprotein A-1 were negatively correlated but LDL-C and apolipoprotein B were positively correlated with gestational age.

Conclusion: The study showed that the gestational age is associated with lipid parameters. Prematurity as a factor was associated with atherogenic index.

Keywords: Cord blood, Atherogenic index, Gestational age, Correlation.

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INTRODUCTION

One of the most dangerous illnesses nowadays is atherosclerosis. The diseases which develop on the basis of atherosclerosis: Cardiac ischemia, cardiac infarction, and stroke are still a big health problem for people in the present-day world. Cardiovascular diseases (CVDs) are the largest single contributor to global mortality and will continue to dominate mortality trends in future; altered lipid levels are the recognized factors. Atherosclerosis is the major cause of CVDs. It is the process which begins *in utero* and progresses silently for decades [1]. Cholesterol in excess is strongly associated with atherosclerosis and coronary heart diseases. Some investigators believe that the atherosclerotic lesion may have its genesis during childhood [2].

Cord blood sera have been demonstrated to contain all well-characterized adult lipoproteins and apolipoproteins [3]. Fetal growth restriction is associated with a chronic pattern of atherogenic lipoprotein metabolism. The relative amount of apolipoprotein A-1 and apolipoprotein B (ApoA1 and ApoB) is important. Atherogenic index (AI) is the ratio of ApoB/apoA1 which is found to track closely during the 1st year of life. Abnormal lipoprotein profile in childhood persists into adult life and elevated ApoB levels in young adult have been linked to atherosclerosis in adult life [4].

It was investigated by Baker *et al.* that low birth weight is correlated with an increase in prevalence of CVDs, hypertension, and type diabetes mellitus. Lipid profile, lipoproteins, and atherogenic index are regarded as markers of risk of cardiac disorders. The study of Jain and Sogani concluded that tribal and non-tribal population also male and female neonates have genetic variation and difference in lipid metabolism [5].

This study was planned to evaluate the possible relationship between near-term and term neonates and future atherosclerosis by determining umbilical cord serum lipid profile and apolipoproteins and calculating AI.

METHODS

The present cross-sectional study was conducted in the Department of Obstetrics and Gynecology, Geetanjali Medical College and Hospital, Udaipur.

A total of 640 neonates (following healthy normotensive pregnancy) were included in the study which were divided on the basis of gestational age into near-term neonates (319) and term neonates (321) and further subdivided according to gender of neonates (male and females).

Inclusion criteria for mothers

Healthy mother only on iron folic acid and calcium supplementation was included in the study.

Exclusion criteria for mothers

History with alcoholism, smoking hypertension, thyroid disorders, diabetes mellitus, renal diseases, hypercholesterolemia, twins, liver diseases, tuberculosis and asthma, and pregnancy-induced hypertension were excluded from the study.

Inclusion criteria for neonates

Gestational age between 35 and 42 weeks and absence of congenital anomalies were included in the study.

Exclusion criteria for neonates

Congenital malformations, neonates born to mother with maternal illness, neonates with perinatal problems such as hypoglycemia and pathological jaundice, instrumental delivery, including extraction, and neonates with hypoxic ischemic encephalopathy and sepsis were excluded from the study.

Sample collection

After delivery and cord clamping, umbilical venous blood was taken from maternal umbilical end. Serum was separated and analyzed for lipid profile (total cholesterol, triglyceride, HDL-C, LDL-C, and VLDL-C) and apolipoproteins (ApoB and ApoA-1) [6].

Estimations

The levels of triglyceride, total cholesterol, and HDL-C were assayed with reagent by Roche [7]. The concentrations of LDL-C and VLDL-C were defined using the formula given by Friedewald [8]. Apolipoproteins were assayed by immunoturbidimetric method [9]. The assay was performed with cobas c311 fully auto-analyzer instrument.

Statistical analysis

The mean and standard deviation have been used to define data range in each group. These data were compared and significance was tested between near-term and term neonates and also between male and female neonates using unpaired t-test. $p<0.05$ was considered as significant and <0.01 was considered as highly significant. Correlation was also calculated. GraphPad prism version 6 software was used for analysis.

RESULTS

Table 1 and Fig. 1 show lipid profile, lipoproteins in neonates divided according to gestational age, neonates with gestational age <37 weeks, and other group with gestational age more than 37 weeks.

Lipid profile and apolipoproteins were higher in near-term neonates than term neonates.

The table reveals that lipid profile and apolipoproteins were higher in neonates with <37 weeks. The values of total cholesterol were 68.90±15.90 mg/dL, triglyceride 52.06±23.28 mg/dL, HDL-C (30.14±10.42 mg/dL), LDL-C (29.00±14.22 mg/dL), and VLDL (10.41±4.65 mg/dL). The apolipoproteins ApoA-1 (54.22±8.80 mg/dL) and Apo B (32.43±6.85 mg/dL) were higher in neonates with gestational age<37 weeks.

Table 2 shows correlation of lipid parameters with neonatal weight and gestational age – (1) TG, HDL-C, and apolipoprotein A-1 were negatively correlated with neonatal weight but TC, LDL-C, and apolipoprotein B were positively correlated with neonatal weight.

TC, TG, HDL-C, VLDL-C, and apolipoprotein A-1 were negatively correlated but LDL-C and apolipoprotein B were positively correlated with gestational age.

Table 2 shows that neonatal weight is negatively related with TG, HDL-C, and apolipoproteins A-I and where positively correlated with lipid profile TC, LDL-C, apolipoproteins B. All were significant except TG, HDL-C, and ApoA-1. The correlation between gestational age and parameters showed negative correlation with total cholesterol, triglyceride, HDL-C, and positively related with LDL-C, apolipoprotein B. All were non-significant except triglyceride and VLDL-C.

DISCUSSION

The characteristics of near term and term are presented in Table 1. The results show TC, triglyceride, HDL-C, LDL-C, ApoA-1, and Apo B level higher in near-term neonates group than term neonates. The results are in agreement with reports of Diaz (1989) [9]. The values shown by Sreekarthik (2015) [10] were almost comparable with our

Table 1: Comparison of mean±SD levels of lipid profile lipoproteins and AI in cord blood of neonates divided according to gestational age as near term (34–37 weeks) and term (>34 weeks) and further divided into male and female neonates

Parameters	Near-term neonates (34–37 weeks)				Term neonates (≥37 weeks)				p value
	Male (n=163)	Female (n=156)	p-value	Total (n=319)	Male (n=185)	Female (n=136)	p-value	Total (n=321)	Near term versus term
Total cholesterol (mg/dL)	66.04±15.35	69.96±16.39	0.02	68.90±15.90	71.01±17.99	70.62±16.86	0.84	67.96±15.96	0.45
Triglyceride (mg/dL)	51.85±23.58	52.28±23.05	0.86	52.06±23.28	52.08±24.25	54.25±24.67	0.43	51.06±23.28	0.50
HDL-C (mg/dL)	29.12±10.05	30.16±10.83	0.37	30.14±10.42	28.87±10.54	31.31±10.63	0.04	29.14±10.42	0.22
LDL-C (mg/dL)	30.34±14.15	26.54±14.08	0.01	29.00±14.22	31.52±16.13	28.37±16.69	0.08	28.40±14.42	0.59
VLDL-C (mg/dL)	10.37±4.71	10.45±4.61	0.87	10.41±4.65	10.61±4.90	10.85±4.93	0.66	10.41±4.65	1.00
ApoB (mg/dL)	30.80±6.39	32.94±7.42	0.06	32.43±6.85	32.42±7.55	31.52±8.07	0.47	32.05±7.76	0.65
ApoA-1 (mg/dL)	54.35±8.86	54.04±8.80	0.83	54.22±8.80	50.97±9.86	52.49±9.25	0.32	51.61±9.61	0.01
ApoB/ApoA-1	0.58±0.19	0.57±0.21	0.79	0.58±0.20	0.66±0.23	0.63±0.20	0.39	0.65±0.24	0.006

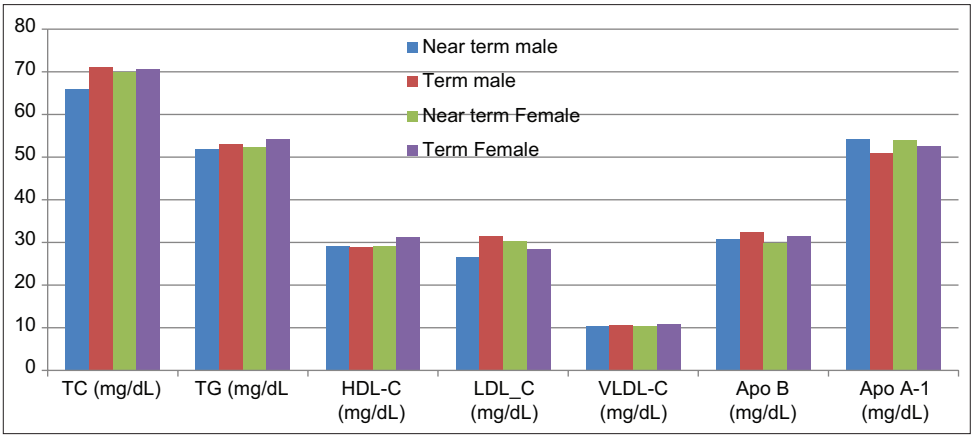

Fig. 1: Comparison of mean±SD levels of lipid profile lipoproteins and AI in cord blood of neonates divided according to gestational age as near term (34–37 weeks) and term (>34 weeks) and further divided into male and female neonates

Table 2: Correlation of birth weight and gestational age with lipid parameters

S. No.	Parameters	Correlation with neonatal weight		Correlation with gestational age	
		r-value	p-value	r-value	p-value
1	Total cholesterol, mg/dL	0.430	0.0004	−0.046	0.427
2	Triglyceride, mg/dL	−0.083	0.205	−0.135	0.019*
3	HDL-C, mg/dL	−0.111	0.134	−0.042	0.46
4	LDL-C, mg/dL	0.259	0.004	0.021	0.71
5	VLDL-C, mg/dL	0.598	0.0001	−0.13	0.024*
6	Apolipoprotein B, mg/dL	0.273	0.0005	0.041	0.34
7	Apolipoprotein A-1, mg/dL	−0.187	0.060	−0.023	0.23
8	AI=ApoB/ ApoA-1	0.304	0.0001	0.061	0.001

values. Their values were TC (64.76 mg/dL), TG (47.73 mg/dL), HDL-C (27.26 mg/dL), and LDL-C (29.6 mg/dL). Spear *et al.* [11] demonstrated that lecithin cholesterol acyl transferase activity was lower in preterm than term neonates. This study result was in accordance with those conducted by Parker *et al.* [12], Pardo *et al.* [13], and Avinash [3].

Cholesterol levels were inversely correlated with gestational age tabulated in Table 2. Furthermore, we had the same results with TG, HDL, and VLDL, that is, negatively correlated. Our findings (Table 2) are in agreement with previously notation by Yonenzawa *et al.* [14] and others (Pecks, 2012, and Pardo, 2005) [13,15]. It is to be noted that fetal growth retardation establishes a lifelong irreversible atherogenic profile and that the history of low birth weight [16] or preterm [17] in individuals is associated with apolipoprotein B levels [18]. The study of Chandrika [19] has also concluded that there is close relationship between lipid profile parameters and anthropometry at birth of neonates.

The HDL, LDL, and TC levels were higher in LGA than AGA and lowest in SGA neonates, however, the changes were found to be statistically insignificant. Liver is the main site for the LDL synthesis in late gestation and the human fetus requires large quantities at this time to sustain metabolic activities which include higher rate of synthesis of steroid hormone by adrenals. Persistent reduction of LDL receptor activity associated with failure of growth of fetal liver is possible explanation for the above finding. In the present study, the mean TG level of SGA group was significantly higher as compared to AGA group and is in agreement with earlier reports of Fosbrooke and Wharton [20] and Huter *et al.* [21]. These changes may be attributed to the maturity of pregnancy and also the nutritional status of the fetus. Various factors during pregnancy are known to have strong influence on fetal lipid metabolism.

CONCLUSION

The results of the study confirmed that the gestational effect on biochemical parameters of pregnant women postpartumly, mainly those related to lipid parameters. Such changes make need for attention and care of near-term neonates after delivery.

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DECLARATIONS

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Conflicts of interest

None declared.

Ethical approval

The study was approved by the Institutional Ethics Committee.

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