Association of cord blood and maternal lipid profiles

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ABSTRACT

Objectives: The objectives of this study were to study the cord blood lipid profile in neonates in relation to maternal preconceptional body mass index (BMI), maternal glucose intolerance, maternal lipid profile, family history of metabolic syndrome, intrauterine fetal growth, and birth weight of baby. **Methodology:** It was a prospective cohort study and was carried out in Pondicherry Institute of Medical Sciences over a period of 1 year. The sample size estimated was 150 mother-infant pairs. Informed consent was obtained from mothers fulfilling the criteria and a structured pro forma was filled with details of the mother and baby. Samples were drawn for the determination of lipid profile of the baby and mothers. Independent t-test was used to compare the lipid profile parameters in mother and in cord blood. $p<0.05$ was considered statistically significant. **Results:** A total of 150 babies and mothers were included in the study. 78 (52%) were male and 72 (48%) were female. The mean birth weight of babies was 3009±0.391 g; 133 (89%) were appropriate for gestational age, and 17 (11%) were small for gestation. Among the mothers, 36 (24%) had gestational diabetes, 18 (12%) were obese, and 86 (58%) women had family history of diabetes, dyslipidemia, or hypertension. No statistically significant difference was noted in the cord lipids of babies born to mothers with gestational diabetes ($p=0.033$). Comparison of lipid values with gestational maturity did not reveal any statistical significance ($p=0.24$). High-density lipoprotein was significantly low for low birth weight babies compared to normal weight babies ($p=0.03$). Positive family history did not show any statistically significant difference in the lipids of the baby. BMI of the mother did not show any significant effect on the cord lipids. **Conclusion:** There was no association of cord blood and maternal lipid profiles. BMI of the mother did not show any significant effect on the cord blood lipids. Maternal gestational diabetes, family history of hypertension, diabetes, or dyslipidemia had no effect on the cord blood lipids.

Key words: *Body mass index, Gestational diabetes mellitus, High-density lipoprotein, Lipid profile, Neonate*

Cholesterol is an important component of the cell membrane and is required to maintain the membrane stability and nerve conduction. However, excess cholesterol levels can lead to coronary heart diseases [1]. In India, coronary artery diseases have increased in the past 30 years [2]. Unhealthy lifestyles and behaviors can contribute to this, but the true origins of the disease may be found *in utero*. Fetal programming happens *in utero* where nutritional and hormonal changes cause changes in the structure, leading to long-term consequences of cardiovascular diseases, hypertension, and diabetes mellitus in their babies [3]. Lipid profile is a marker of underlying cardiovascular problem [4]. Cord blood analysis is a simple as well as feasible method and may be viewed as an opportunity to assess lipid parameters early in life when there is no risk of cardiovascular diseases [5]. Early diagnosis and prudent diet supplementation in these high-risk babies may provide an opportunity for the reduction of risk factors contributing to the development of cardiovascular disease. Hence, we aimed to study the maternal influences on the cord blood lipid profile of the neonates.

METHODOLOGY

The study protocol was presented to the institutional review board and after the ethics committee approval was conducted at the Department of Pediatrics at Pondicherry Institute of Medical Sciences, Pondicherry, during the period from February 2016 to January 2017. The sample size estimated was 150 mother-infant pairs. 150 inborn term neonates with 5 min APGAR>7 were included in the study excluding those newborns with major congenital deformity. Mothers fulfilling the selection criteria were informed about the nature of the study, collection of cord blood samples, advantages, and need for follow-up. Written informed consent was obtained from mothers admitted for safe confinement of all cases for using theirs and their baby's cord blood. Gestational age of the mother was determined by dating scan if available or according to the 1st day of mothers last menstrual period or as decided by the treating obstetrician. A structured pro forma was filled with details of maternal clinical obstetric data, information about comorbidities such as hypercholesterolemia, diabetes, hypertension, and obesity in the family. A mother was

considered to have gestational diabetes mellitus (GDM) based on the history and medical records. Family history was noted based on the history obtained with details of hypertension, diabetes, or hypercholesterolemia in the immediate family members. Body mass index (BMI) was calculated with mother's pre-pregnancy weight if she was aware or by recording her weight during her first antenatal visit.

Maternal blood samples were withdrawn at fasting during their admission for safe confinement and not in labor. 5 ml of cord blood was collected from the placental end of the umbilical vein soon after birth after complete delivery of the fetus and before expulsion of the placenta for the determination of lipid profile in the baby. Serum was separated by centrifugation and serum triglyceride (TG), total cholesterol (TC), low-density lipoprotein (LDL), and high-density lipoprotein (HDL). Measurements were done using Cobas Integra 400 plus analyzer and were analyzed on the same day. The normal cutoff for cord lipid parameters was taken as follows (5): TC - 73.83 mg/dl, TG - 49.38 mg/dl, LDL - 36.63 mg/dl, and HDL - 21.13 mg/dl. The cutoff values for mothers were as follows [6]: TG - 131–453 mg/dl, TC - 219–349 mg/dl, LDL - 101–224 mg/dl, and HDL - 48–87 mg/dl.

Intrauterine fetal growth was noted from the antenatal ultrasound scan. Birth weight was documented within the 1st h of life using a standard electronic weighing scale. Low birth weight (LBW) was defined as weight <2.5 kg. The TC and serum TG values were compared between those falling in the appropriate for gestational age (AGA), small for gestational age (SGA), and large for gestational age category. Babies' lipid profile values were also assessed within maternal nutritional status.

Data were analyzed by the SPSS software Version 20 and results were expressed as mean and standard deviation (SD). The number and percentage for categorical variable was determined. Independent t-test was used to compare lipid profile parameters in mother with cord blood. $p<0.05$ was considered as statistically significant. Multivariate regression analyses for maternal and neonatal factors were run on cord lipid profile.

RESULTS

A total of 150 babies and mothers were included in the study. Among the babies, 78 (52%) were male and 72 (48%) were female. No significant difference in the lipid profile was noted between male and female babies. The birth weight of babies ranged from 1620 to 3920 g (mean = 3009±0.391) and majority of the babies had normal weight 91% (n=135) and 9% (n=15) were LBW babies. Of the 150 babies, 133 (89%) were AGA and 17 (11%) were SGA babies. The mean GA of the study population was 39 weeks (Table 1). Table 2 summarizes the mean values and SDs of the concentration of TG, TC, LDL, and HDL according to the maternal lipid profile whether altered or not. Independent t-test was used to study the relation of cord lipids with maternal preconceptional BMI, maternal glucose intolerance, maternal lipid profile, and neonatal factors such as birth weight, intrauterine gestation, and family history of metabolic syndrome.

There were higher values of TG, TC, LDL, and HDL noted in babies of GDM mothers compared to babies of normal pregnant women, but it was not statistically significant (p=0.824). There was no significant difference in the plasma lipid concentration in the newborns in relation to the maternal lipid profile except for LDL (p=0.033) and HDL (p=0.037). A comparison was made based on the gestational maturity showed near equal lipid values in both the AGA and SGA group suggesting no statistical difference in lipid values in the two groups (p=0.325). When lipid parameters were compared based on the birth weight, there was no statistically significant difference in any of the values except

Table 1: Demographic characteristics of the study population

Parameter	Number of patients 150 (%)
Maternal characteristics	
BMI distribution	
Normal (18.5–24.9)	72 (48)
Underweight (≤18.4)	20 (13.3)
Overweight (25.0–29.9)	40 (26.7)
Obese (≥30)	18 (12)
Glucose intolerance	
Present	36 (24)
Absent	114 (76)
Family history of metabolic syndrome	
Present	87 (58)
Absent	63 (42)
Neonatal characteristics	
Sex	
Male	78 (52)
Female	72 (48)
Birth weight	
Normal (≥2.5kg)	136 (91)
Low (<2.5kg)	14 (9)
Intrauterine gestation	
AGA	133 (89)
SGA	17 (11)

ASA: Appropriate for gestational age, SGA: Small for gestational age

Table 2: Mean plasma lipid concentrations of mothers and newborns

Parameter	Mean (mg/dl)±SD
Mother	
TG	205.2±53.2
TC	220.3±47.9
LDL	142.±47.1
HDL	49.3±11
Newborn	
TG	37.9±17.5
TC	63±16.2
LDL	28.2±10.6
HDL	24±8.6

TG: Triglyceride, TC: Total cholesterol, LDL: Low-density lipoprotein, HDL: High-density lipoprotein, SD: Standard deviation

HDL (p=0.08) which was lower for LBW babies compared to normal weight babies.

Further, subgroup analysis was done and the SGA babies were studied and comparison of their mother, and cord blood profile was done which did not show any statistical significance (p=0.513). Similar comparison was made between the lipid profiles of mothers with GDM and their babies which also did not reveal any significant result (p=0.403). On comparing, lipid profile of mother and babies with family history did not reveal any significant result. However, the lipid profile of mothers whose BMI was >25 with their babies we could find a significant increase in the baby's TC and LDL levels. A multivariate regression analysis was done to study the association of various risk factors on cord blood lipid parameters which showed no statistical significance (Table 3).

DISCUSSION

Cardiovascular disease is the most common cause of death among adults around the world. In recent times, the prevalence of risk factors for the cardiovascular disease like obesity is increasing among the children. Several intrauterine factors are found to have effect on these risk factors [7]. There is less knowledge of data on the association between blood lipids in pregnancy and infant outcomes [8]. There is hardly any study done in South India about this association, and hence, this study was done.

In the present study, the cord samples were taken from term babies who were born without any complications so that it did not interfere with the results. Maternal adiposity has been shown to have role in fetal programming and in cord lipid profile levels [9]. In our study, the cord lipid values were found to be higher in babies with obese mothers, but it was not statistically significant. No differences were observed in the lipids of babies from women who were classified as normal, overweight, and obese before pregnancy as in the study conducted by Solis-Paredes *et al.* On the other hand, Lemas *et al*. found an inverse relationship between cord HDL levels and maternal BMI [10]. In the study conducted by Kelishadi *et al*., low BMI was found to correlate with low HDL levels [11]. This study showed that the lipid profile differences in male and female newborns were not statistically significant, but the mean levels of lipid parameters were higher in the girls than the boys. Similar results were seen in the study conducted by Andersen and Friis-Hansen and Tohmaz, which showed no significant changes in the cord lipid profile in terms of gender [12,13]. In contrast, Kelishadi *et al*. showed that lipid levels in female newborns were higher than males with statistically significant difference of TC and HDL in female newborns [14].

Our study showed an increase in all lipid profile values in infants of diabetic mothers (IDM) when compared to non-IDM babies. Similar results were obtained in the study conducted by Ghalia *et al.* who found slightly higher TC, HDL, LDL, and LDL values in IDM babies; however, they showed low value of TG which was contradictory to our results [15]. Couch *et al*. in his study found an increase in LDL but noticed a fall in HDL, TC, and TG levels [16]. Almusavi in his study on babies in Iraq too noticed a significant rise in TC, TG, and LDL in infant of diabetic mothers [17]. These results could be varied due to difference in criteria for diagnosis and difference in time of collection of the blood samples [18].

Birth weight measures the fetal growth which includes the head size, length of the body, and the subcutaneous fat. Studies have shown that babies with LBW tend to develop metabolic syndrome which is a combination of hypertension, dyslipidemia, diabetes, and obesity [19]. In our study, the cord blood lipids did not have any significant association with birth weight except for HDL levels which were significantly low in the LBW group. This finding was similar to studies conducted by Magon *et al*. [19] and Donegá *et al*. [20] who also reported no significant association with birth weight. Contradictory to this, Aletayeb *et al*. showed higher values of TC, TG, and LDL levels in LBW and high birth weight neonates than normal weight newborns [7]. Significant association with birth weights was also noticed in the studies conducted by Nayak *et al*. [21] and Kenchappa and Behera *et al*. [22] in which LBW babies had higher TG levels and higher values of LDL and TC, respectively. In the present study, majority of the study population were AGA; this could be due to better antenatal care at the hospital where all were given proper counseling about health during pregnancy.

SGA babies are more hypertriglyceridemic and hypercholesterolemic compared to normal weight babies. On comparing lipid profile of neonates on the basis of gestational age, no significant difference was noted in our study. This was similar to the finding in the study by Kenchappa and Behera [22] who also noted no significant difference. Magon *et al*. [19] showed the lower levels of mean cholesterol in SGA babies and other parameters though not statistically significant. Nayak *et al*. [21] also showed that only TG levels were statistically significant in SGA babies with no statistically significant variations in other parameters.

The relationship of maternal lipid profile to the lipid profile of the newborn is not well understood. There are studies which say that lipid transport occurs through the placenta, but this may not influence the lipids in the newborn. Some studies say that placenta

Table 3: Multiple regression of neonatal cord lipids with various maternal and neonatal factors

Risk factors	Neonatal lipid parameters (p)			
	TG	TC	LDL	HDL
Intercept	0.002	0.005	0.053	0.072
Birth weight	0.100	0.091	0.030	0.175
Intrauterine gestation	0.728	0.694	0.261	0.914
Gestational diabetes	0.453	0.179	0.250	0.550
BMI of mothers	0.648	0.137	0.262	0.325
Family history	0.259	0.540	0.613	0.920
Medium TG	0.529	0.983	0.795	0.804
Medium TC	0.638	0.267	0.073	0.850
Medium LDL	0.501	0.998	0.597	0.227
Medium HDL	0.695	0.999	0.164	0.270

BMI: Body mass index, TG: Triglyceride, TC: Total cholesterol, LDL: Low-density lipoprotein, HDL: High-density lipoprotein

presents membrane receptors to lipoprotein and triglycerides bind to these receptors and become available to the fetus [23]. Despite this occurrence of transport, the maternal concentration of TC, HDL, and TG levels did not affect the lipid profile of newborns as in our study. However, there was a significant association between maternal and newborn LDL levels. This has also been reported by others [6]. In the study conducted by Sales *et al*., no significant association was noted between altered maternal lipids and cord lipids [23]. However, Murthy *et al.* in his study noted significantly high level of TC in newborn of mothers with high TG levels [6].

This was a hospital-based study with many high-risk mothers being referred to this tertiary care center; hence, it may not be a representative of the general population. Increasing the sample size may have yielded a more definite result. Furthermore, the mothers in each risk group were low.

CONCLUSION

BMI of the mother, maternal diabetes, family history of hypertension, diabetes, or dyslipidemia had no effect on the cord blood lipids. SGA babies had elevated TG levels. LBW babies had high TG levels. Hence, cord blood may not be a reliable screening tool for the early detection of cardiovascular diseases.

REFERENCES

1. Bartels Ä, O'Donoghue K. Cholesterol in pregnancy: A review of knowns and unknowns. Obstet Med 2011;4:147-51.
2. Sharma M, Ganguly NK. Premature coronary artery disease in Indians and its associated risk factors. Vasc Health Risk Manag 2005;1:217-25.
3. Levy-Marchal C, Jaquet D. Long-term metabolic consequences of being born small for gestational age. Pediatr Diabetes 2004;5:147-53.
4. Pardo IM, Geloneze B, Tambascia MA, Barros-Filho AA. Atherogenic lipid profile of Brazilian near-term newborns. Braz J Med Biol Res Rev Bras Pesqui Medicas E Biol 2005;38:755-60.
5. Murthy KA, Bhandiwad A, Murthy KV, Aggarwal S. Neonatal lipid levels – Can they be a benchmark for lipid lowering in adults? Asian J Pharm Clin Res 2014;7:165-8.
6. Abbassi-Ghanavati M, Greer LG, Cunningham FG. Pregnancy and laboratory studies: A reference table for clinicians. Obstet Gynecol 2009;114:1326-31.
7. Aletayeb SM, Dehdashtian M, Aminzadeh M, Moghaddam AR, Mortazavi M, Malamiri RA, *et al*. Correlation between umbilical cord blood lipid profile and neonatal birth weight. Pediatr Pol 2013;88:521-5.
8. Geraghty AA, Alberdi G, O'Sullivan EJ, O'Brien EC, Crosbie B, Twomey PJ, *et al*. Maternal blood lipid profile during pregnancy and associations with child adiposity: Findings from the ROLO study. PLoS One 2016;11:e0161206.
9. Solis-Paredes M, Espino Y Sosa S, Estrada-Gutierrez G, Nava-Salazar S, Ortega-Castillo V, Rodriguez-Bosch M, *et al.* Maternal and fetal lipid and adipokine profiles and their association with obesity. Int J Endocrinol 2016;2016:7015626.
10. Lemas DJ, Brinton JT, Shapiro AL, Glueck DH, Friedman JE, Dabelea D, *et al.* Associations of maternal weight status prior and during pregnancy with neonatal cardiometabolic markers at birth: The healthy start study. Int J Obes (Lond) 2015;39:1437-42.
11. Kelishadi R, Badiee Z, Adeli K. Cord blood lipid profile and associated factors: Baseline data of a birth cohort study. Paediatr Perinat Epidemiol 2007;21:518-24.
12. Andersen GE, Friis-Hansen B. Neonatal hypertriglyceridemia: A new index of antepartum-intrapartum fetal stress? Acta Paediatr Scand 1976;65:369-74.
13. Tohmaz UR. Cord blood lipid profile in premature, near-term and term Newborn infants. Iran J Neonatol 2014;4:8-10.
14. Kelishadi R, Pour MH, Zadegan NS, Kahbazi M, Sadry G, Amani A, *et al*. Dietary fat intake and lipid profiles of Iranian adolescents: Isfahan healthy heart program--heart health promotion from childhood. Prev Med 2004;39:760-6.
15. AbouGhalia AH, Khater LM, Abd El-Wahed MA, El-Badrawy MF. Lipoprotein (a) and lipid profile in neonates from mothers with three different types of diabetes mellitus. Clin Biochem 2003;36:563-9.
16. Couch SC, Philipson EH, Bendel RB, Wijendran V, Lammi-Keefe CJ. Maternal and cord plasma lipid and lipoprotein concentrations in women with and without gestational diabetes mellitus. Predictors of birth weight? J Reprod Med 1998;43:816-22.
17. Almusawi J. Cord serum lipid profile of infants of diabetic mothers. Iran J Neonatol 2015;6:7-14.
18. Vaishnavi DM, Kumari KL, Sethupathy S. Impact of gestational diabetes mellitus on cord serum lipids. Int J Comput Res Dev 2016;4:125-9.
19. Magon P, Bharatwaj RS, Verma M, Chatwal J. Cord blood lipid profile at birth among normal Indian Newborns and its relation to gestational maturity and birth weigh-a cross sectional study. Paripex Indian J Res 2013;2:215-7.
20. Donegá S, Oba J, Maranhão RC. Concentration of serum lipids and apolipoprotein B in newborns. Arq Bras Cardiol 2006;86:419-24.
21. Nayak CD, Agarwal V, Nayak DM. Correlation of cord blood lipid heterogeneity in neonates with their anthropometry at birth. Indian J Clin Biochem 2013;28:152-7.
22. Kenchappa Y, Behera N. Assay of neonatal cord blood lipid levels and its correlation with neonatal gestational age, gender and birth weight: A single center experience. Int J Contemp Pediatr 2016;3:718-24.
23. Sales WB, Junior S, Dias J, Kroll C, Mastroeni SS, Silva JC, *et al*. Influence of altered maternal lipid profile on the lipid profile of the newborn. Arch Endocrinol Metab 2015;59:123-8.

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