Cord blood lipid profile in relation to anthropometric measures of newborns

Nermin Ramy[a], Mostafa Zakaria[a], Mona El Kafoury[b], Manar Kamal[c]

[a]Department of Pediatrics, Faculty of Medicine, Cairo University, [b]Department of Clinical and Chemical Pathology, National Research Institute, [c]Department of Pediatrics, Ministry of Health Hospitals, Cairo, Egypt

Correspondence to Nermin Ramy, MD, New Children Hospital, Abu El Rish, Cairo University Hospitals, Ali Basha Ebrahim, PO Box 11562, Zip code: +02, Cairo, Egypt; Tel: +20 0100 1525 654; e-mail: nerminramy74@gmail.com

Received 24 January 2017
Accepted 26 February 2017

Kasr Al Ainy Medical Journal
2017, 23:54–58

Background
Elevated serum lipid is a contributing factor in cardiac diseases. Exposure to stress *in utero* may affect lipid metabolism and anthropometric measures at birth.
Objective
The aim of the study was to assess cord blood lipid profile of newborns and its possible effect on newborn body measurements.
Patients and methods
This prospective cross-sectional study was conducted on 100 newborns. They were divided into three groups: small for gestational age (SGA), appropriate for gestational age (AGA), and large for gestational age (LGA) groups. Maternal data were recorded, and BMI was calculated. Cord blood lipids, namely, total cholesterol, triglycerides (TGL), low-density lipoproteins (LDL), and high-density lipoproteins, were assessed.
Results
Mean levels of TGL and LDL were significantly higher in the SGA group compared with the AGA group, and significantly higher in the AGA group compared with the LGA group, whereas mean total cholesterol levels were significantly higher in the SGA group, with no difference between AGA and LGA groups. There was a strong negative correlation between TGL and each of birth weight, abdominal circumference, and ponderal index. The same was reported for LDL. Furthermore, maternal BMI did not affect neonatal lipids.
Conclusion
Variation in lipid profile at birth can affect anthropometric measures of the newborn.

Keywords:
anthropometric measures, cord blood, lipid profile, neonates

Kasr Al Ainy Med J 23:54–58

1687-4625

Introduction

Cardiovascular diseases (CVD) are a common cause of death, with younger age of onset, especially in developing countries [1]. There are many risk factors for the development of CVD including hyperlipidemia, hypertension, sedentary lifestyle, early childhood obesity, and others that mediate their effect through atherosclerosis [2]. As documented in the literature, atherosclerosis is a process that starts early in life to reach adult levels, a process that may be start from birth [3]. Therefore, it might be of benefit to measure cord blood lipid profile at birth.

Small birth weight is one of the risk factors for the development of CVD later in life [4], where alteration in serum lipids of these small babies together with insulin intolerance bears high chances of developing CVD later in life [5,6]. This implies that there might be some relation between birth weight and adulthood cardiac disease. Similarly, large babies may have alteration in their lipoprotein levels, which are as well related to cardiac problems later in life [7].

The association between cord blood lipids/lipoproteins, with their implication on anthropometric measures at birth, and further development of adult cardiac diseases are not fully understood. In this study, we aimed to assess cord blood lipid profile of neonates at birth and their relation to different anthropometric measures.

Patients and methods

This prospective cross-sectional study was conducted at the Obstetrics and Gynaecology/Neonatology departments of Cairo University hospitals over a period of 6 months. One hundred newborns were included in the study (40 boys and 60 girls). Those with suspected hypoxic insult or congenital malformations were excluded from the study. Gestational age was assessed using the Ballard system, and the cases were grouped according to gestational age and birth weight into three groups: the appropriate for gestational age (AGA) group, where the baby's weight was between the 10th and the 90th percentile; the small for gestational age (SGA) group, where weight was below the 10th percentile; and the large

DOI: 10.4103/kamj.kamj_5_17

for gestational age (LGA) group, where the weight was above the 90th percentile after being plotted on Fenton growth curves. An informed consent was obtained from the caregivers of each patient. Maternal age, height, and postdelivery weight were also documented and BMI was calculated. The Ethical Committee of the hospital approved this study.

Anthropometric measures taken to all enrolled patients included birth weight using a digital scale, birth length from crown to heel using an infantometer, head circumference from the supraorbital ridge to occipital protuberance, abdominal circumference (AC), and calculated ponderal index (PI) according to the equation: weight (g)/length (cm^3)×100.

Samples and laboratory tests

A cord blood sample was obtained after cord clamping following the delivery of the baby and before placental delivery. Samples taken were analyzed for cord blood lipids, including total cholesterol (TC), triglycerides (TGL), high-density lipoproteins (HDL), and low-density lipoproteins (LDL). Cord blood lipid levels of studied groups were compared with references according to 'Prevention of coronary and heart disease – 1983'.

Statistical analysis

Data were statistically described in terms of mean± SD, and range or frequencies and percentages when appropriate. Comparison of numerical variables between groups was carried out using one-way analysis of variance with post-hoc multiple two-group comparisons. Correlation between various variables was carried out using Pearson's moment correlation equation for linear relation in normally distributed variables, and Spearman's rank correlation equation for non-normal variables/nonlinear monotonic relation. Univariate and multivariate analysis models were used to test for the preferential effect of the independent variable(s) on lipids. *P*-values less than 0.05 were considered statistically significant. All statistical calculations were done using the computer program SPSS (statistical package for the social science; SPSS Inc., Chicago, Illinois, USA) release 15 for Microsoft Windows 2006.

Results

In this study, 100 neonates were included and were assigned into three groups: 30 cases were SGA, 53 AGA, and 17 LGA. The anthropometric measures of studied groups are shown in Table 1. There was no significant difference in maternal measurements, age, parity, and BMI between the three groups (Table 2).

TGL and LDL mean levels were significantly different between the three groups, whereas cholesterol and HDL mean levels showed significant difference in the SGA group compared with the other two groups (Table 3).

Correlations between cord blood lipids and anthropometric measurements of all study cases are shown in Table 4. There was a strong negative correlation between birth weight and each of TGL and LDL. AC and PI showed the same strong negative correlations with each of TGL and LDL as birth weight.

Maternal age, parity, and BMI were nonsignificant effectors on cord blood lipid profile in multivariate regression analysis (Table 5).

Table 1 Anthropometric measures of the studied groups

	SGA (*n*=30)	AGA (*n*=53)	LGA (*n*=17)
Gestational age (weeks)	38.03±1.299	38.07±1.193	38.54±1.050
Birth weight (g)	2.092±0.2149	3.280±0.3015	4.246±0.2066
Length (cm)	47.80±1.349	49.05±1.042	50.46±0.877
Head circumference (cm)	33.83±0.950	34.49±0.685	35.62±0.650
Abdominal circumference (cm)	27.22±1.172	30.79±0.861	33.69±0.630
PI (g/cm^3×100)	1.909±0.1174	2.774±0.2112	3.298±0.1071

Data are presented as mean±SD. AGA, appropriate for gestational age; LGA, large for gestational age; PI, ponderal index; SGA, small for gestational age.

Table 2 Maternal data of the studied groups

	SGA	AGA	LGA	*P*-value
Age (years)	28.13±6.061	27.32±6.086	29.69±4.871	0.414
Parity (*n*)	2.90±1.062	2.49±1.227	3.15±0.689	0.086
Height (cm)	163.37±6.921	160.72±7.240	164.08±6.291	0.131
BMI (kg/m^2)	31.334±5.7784	29.401±4.6747	31.214±5.0392	0.185

Data are presented as mean±SD. AGA, appropriate for gestational age; LGA, large for gestational age; SGA, small for gestational age.

Table 3 Cord blood lipid profile of the studied groups

	SGA	AGA	LGA	*P*-value
TC (mg/dl)	87.047±35.7785	63.988±18.2095	60.500±16.0874	<0.001*
TGL (mg/dl)	69.950±31.0020	32.804±7.7995	15.808±3.9565	<0.001*
HDL (mg/dl)	28.973±24.2710	38.056±18.3117	50.077±15.5412	0.007*
LDL (mg/dl)	44.087±17.5569	19.460±5.5446	7.262±2.7705	<0.001*

Data are presented as mean±SD. AGA, appropriate for gestational age; HDL, high-density lipoprotein; LDL, low-density lipoprotein; LGA, large for gestational age; SGA, small for gestational age; TC, total cholesterol; TGL, triglyceride. *Significant.

Table 4 Correlation between cord blood lipid profile and anthropometric measures of the studied population (total *n*=100)

	TC	TGL	HDL	LDL
Birth weight				
r (correlation coefficient)	–0.398	–0.782	0.347	–0.824
P-value	<0.001	<0.001	<0.001	<0.001
Length at birth				
r (correlation coefficient)	–0.100	–0.431	0.335	–0.446
P-value	0.320	<0.001	<0.001	<0.001
Abdominal circumference				
r (correlation coefficient)	–0.349	–0.730	0.358	–0.774
P-value	<0.001	<0.001	<0.001	<0.001
Ponderal index				
r (correlation coefficient)	–0.463	–0.827	0.314	–0.872
P-value	<0.001	<0.001	<0.001	<0.001

HDL, high-density lipoprotein; LDL, low-density lipoprotein; TC, total cholesterol; TGL, triglyceride.

Table 5 Multivariate regression analysis for maternal effectors on cord blood lipids of the studied cases

	TC	TGL	HDL	LDL
Age	0.839	0.424	0.323	0.532
Parity	0.789	0.667	0.567	0.904
BMI	0.850	0.701	0.390	0.533

HDL, high-density lipoprotein; LDL, low-density lipoproteins; TC, total cholesterol; TGL, triglyceride. *P*-values were nonsignificant.

Discussion

Serum lipid levels in young age may have a reflection on fat disorders and complications in adulthood, as is known that low birth weight is a predictor of cardiac problems later in life, especially in countries with limited resources [8].

This study showed significant differences in lipid profile measurements between the three study groups, with the highest mean TGL, TC, and LDL and lowest mean HDL in the SGA group compared with the other two groups. These findings were previously observed by others [9], where authors reported increased mean serum TGL, TC, and LDL in low birth weight babies compared with normal weight cases, though they also found comparable high levels in high weight newborns. In contrast, another study found highest levels of TC, LDL, and HDL in LGA babies, lower in AGA, and lowest in the SGA group [3]; however, these findings did not reach statistical significance. Moreover, the same study showed significantly higher TGL levels in the SGA compared with the AGA population, which is in agreement with our findings.

In the current study, the mean LDL levels of the three groups were significantly different ($P<0.001$), being highest in the SGA group, lower in the AGA group, and lowest in the LGA group. The same results were reported by other authors [10,11]; some reported significantly higher LDL levels in LGA babies compared with SGA and AGA babies [10], and others stated higher levels of oxidized LDL in growth restricted babies compared with normally grown matches [11]. However, others showed no difference in serum lipid levels at 10 years old between SGA and preterms born with comparably low birth weight [12]. In addition, cord blood LDL levels showed a strong negative correlation with birth weight (r=–0.824), PI (r=–0.872), and AC (r=–0.774). High LDL levels in babies with small AC have been reported in previous studies [3,13]. A possible explanation to this disproportionate somatic growth is reduced blood supply to abdomen and visceral organs during periods of intrauterine stress and more flow of blood to the brain to maintain its growth at the expense of less vital organs.

Similarly, we also found significantly higher TGL levels in SGA population compared with AGA and LGA groups. Again TGL was strongly negatively correlated with weight at birth (r=–0.782), PI (r=–0.827), and AC (r=–0.73). Kumar *et al.* [14] found high TGL levels in small babies, whereas others stated that TGL levels were obviously higher in large babies compared with normally weighing ones [15]. Surprisingly enough, some authors stated that birth weight is not related to lipid profile in cord blood [16]. Our results were in agreement with another study reporting elevated TGL in babies with low PI, where postulated explanations included relative insulin deficiency in these babies, which is a known activator of lipoprotein lipase enzyme, and hence hindering its lipolysis effect, with associated elevation in the TGL level [3].

In the current work, SGA babies had significantly lower mean HDL in comparison with the other two groups, with no significant difference between AGA and LGA groups. The absence of a significant difference in HDL between AGA and LGA babies was also previously reported [17]. In contrast to the findings of the current study, other researchers stated that the mean HDL levels in their LGA group of newborns were significantly lower than that of the SGA and AGA groups [10].

We found a significantly higher TC level in the SGA group compared with the other two groups, which was similarly reported previously [18], and was as well reported in preterm small babies compared with larger full terms [16]. On the other hand, other studies reported reduced levels in the SGA group compared with the AGA group [3,19].

Finally, we found that maternal BMI did not affect cord blood lipid profile. This was controversial, as some authors reported the same findings [3], and others found a relation between maternal BMI and neonatal lipids [20]. This highlights the fact that many parameters during pregnancy may affect fetal lipid measurements [21,22], and can be the focus of further research.

Conclusion

Our study reported than SGA newborns had higher mean TC, TGL, and LDL and lower levels of HDL compared with AGA and LGA groups. TGL and LDL each showed a strong negative correlation with birth weight, AC, and PI. In addition, maternal BMI did not affect cord blood lipid profile. Further studies are recommended to investigate the effect of other pregnancy-related complications on lipids in newborns, and to further follow up these babies into adulthood and assess whether or not they will develop cardiac problems.

Acknowledgements

Authors contribution: Nermin Ramy contributed in conception and designation of the study, literature search, analysis and interpretation of data, drafting the article, manuscript preparation, editing, and final approval of the submitted article. Mostafa Zakaria contributed in the conception and designation of the study, analysis and interpretation of data, revising the draft critically for important intellectual content, manuscript editing, reviewing, and final approval of the submitted article. Manar Kamal contributed in the acquisition of data, analysis and interpretation of data, revising the draft critically for important intellectual content, manuscript editing, reviewing, and final approval of the submitted article. Mona El Kafoury contributed in the conception and designation of the study, analysis and interpretation of data, revising the draft critically for important intellectual content, manuscript editing, reviewing, and final approval of the submitted article.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1 Reddy KS. Cardiovascular diseases in the developing countries: dimensions, determinants, dynamics and directions for public health action. Public Health Nutr 2002; 5:231–237.

2 Santos MG, Pegoraro M, Sandrini F, Macuco EC. Risk factors for the development of atherosclerosis in childhood and adolescence. Arq Bras Cardiol 2008; 90:276–283.

3 Nayak CD, Agarwal V, Nayak DM. Correlation of cord blood lipid heterogeneity in neonates with their anthropometry at birth. Indian J Clin Biochem 2013; 28:152–157.

4 Baker DJ, Hales CN, Fall CH, Osmond C, Phipps K, Clark PM. Type 2 (non-insulin dependent) diabetes mellitus, hypertension and hyperlipidemia (syndrome X): relation to reduced fetal growth. Diabetologia 1993; 36:62–67.

5 Mi J, Law C, Zhang KL, Osmond C, Stein C, Barker D. Effects of infant birth weight and maternal body mass index in pregnancy on components of the insulin resistance syndrome in China. Ann Intern Med 2000; 132: 253–260.

6 Barker DJ, Winter PD, Osmond C, Margetts B, Simmonds SJ. Weight in infancy and death from ischemic heart disease. Lancet 1989; 334:577–580.

7 Lombardi G, Colao A, Marzullo P, Ferone D, Longobardi S, Esposito V *et al.* Is growth hormone bad for your heart? Cardiovascular impact of GH deficiency and of acromegaly. J Endocrinol 1997; 155: 33–37.

8 Kelishadi R, Derakhshan R, Sabet B, Sarraf-Zadegan N, Kahbazi M, Sadri GH, *et al.* The metabolic syndrome in hypertensive and normotensive subjects: The Isfahan Healthy Heart Programme. Ann Acad Med Singapore 2005; 34:243–249.

9 Aletayeb SMH, Dehdashtian M, Aminzadeh M, Moghaddam AE, Mortazavi M, Malamiri RA, *et al.* Correlation between cord blood lipid profile and neonatal birth weight. Pediatr Pol 2013; 88:521–525.

10 Kelishadi R, Badiee Z, Adeli K. Cord blood lipid profile and associated factors: baseline data of a birth cohort study. Paediatr Perinat Epidemiol 2007; 21:518–524.

11 Leduc L, Delvin E, Ouellet A, Garofalo C, Grenier E, Morin L, *et al.* Oxidized low-density lipoproteins in cord blood from neonates with intra-uterine growth restriction. Eur J Obstet Gynecol Reprod Biol 2011; 156:46–49.

12 Decsi T, Erhardt E, Márkus A, Burus I, Molnár D. Plasma lipids, phospholipid fatty acids and indices of glycaemia in 10-year-old children born as small-for-gestational-age or preterm infants. Acta Paediatr 1999; 88:500–504.

13 Baker DJP, Martyn CN, Osmond C, Hales CN, Fall CHD. Growth in utero and serum cholesterol concentration in adult life. BMJ 1993; 307:1524–1527.

14 Kumar A, Gupta A, Malhotra VK, Agarwal PS, Thirupuram S, Gaind B. Cord blood lipid levels in low birth weight newborns. Indian Pediatr 1989; 26:571–574.

15 Koklu E, Akcakus M, Kurtoglu S, Koklu S, Yikilmaz A, Coskun A, *et al.* Aortic intima-media thickness and lipid profile in macrosomic newborns. Eur J Pediatr 2007; 166:333–338.

16 Donegá S, Oba J, Maranhão RC. Concentration of serum lipids and apolipoprotein B in newborns. Arq Bras Cardiol 2006; 86:419–424.

17 Cekmez F, Pirgon O, Tanju A, Ipcioglu OM. Cord plasma concentrations of visfatin, adiponectin and insulin in healthy term neonates: positive correlation with birthweight. Int J Biomed Sci 2009; 5:257–260.

18 Lobo LL, Kumar HU, Mishra T, Sundari T, Singh A, Kumar CV, *et al.* Small-for-gestational-age versus appropriate-for-gestational-age: comparison of cord blood lipid profile & insulin levels in term newborns (SAGA-ACT study). Indian J Med Res 2016; 144:194–199.

19 Cianfarani S, Maiorana A, Geremia C, Scirè G, Spadoni GL, Germani D. Blood glucose concentrations are reduced in children born small for gestational age (SGA), and thyroid-stimulating hormone levels are increased in SGA with blunted postnatal catch-up growth. J Clin Endocrinol Metab 2003; 88:2699–2705.

20 Gunes T, Koklu E, Ozturk MA. Maternal and cord serum lipid profiles of preterm infants with respiratory distress syndrome. J Perinatol 2007; 27:415–421.

21 Merzouk H, Madani S, Prost J, Loukidi B, Meghelli-Bouchenak M, Belleville J. Changes in serum lipid and lipoprotein concentrations and compositions at birth and after 1 month of life in macrosomic infants of insulin-dependent diabetic mothers. Eur J Pediatr 1999; 158: 750–756.

22 Merzouk H, Meghelli-Bouchenak M, El-Korso N, Belleville J, Prost J. Low birth weight at term impairs cord serum lipoprotein compositions and concentrations. Eur J Pediatr 1998; 157:321–326.