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Research Article

EXPLORING LIPID VARIATIONS IN UMBILICAL CORD BLOOD ACROSS DIFFERENT DELIVERY MODES

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ABSTRACT

Objective: The mode of delivery (vaginal or cesarean) may affect the lipid profile of the newborn, which has implications for their future health.

Methods: The study included 150 mothers who gave birth vaginally and 50 mothers who underwent elective cesarean sections. All mothers were aged between 21 and 44 years. The main outcome measures were the serum lipid levels of umbilical cord blood of newborns. The lipid levels included total cholesterol (TC), triglycerides, high-density lipoprotein cholesterol, very low-density lipoprotein (VLDL-D), and low-density lipoprotein (LDL-C). The study compared the obstetric variables and the serum lipid levels between the two groups of mothers.

Results: The two groups did not differ significantly in terms of maternal age, neonatal weight, gestational duration, placental weight, and neonatal gender distribution. The newborns delivered by normal vaginal delivery had higher levels of total cholesterol, triglycerides, high-density lipoprotein cholesterol, VLDL-D, and LDL-C than those delivered by cesarean section, but the difference was not statistically significant.

Conclusions: This study suggests that the mode of delivery does not have a significant impact on umbilical cord serum lipid levels. However, the sample size was small, and the results may not be generalizable to other populations.

Keywords: Umbilical cord blood, Lipid profile, Delivery modes.

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INTRODUCTION

Lipoprotein levels in the blood of children can indicate their future levels as adults [1], and some studies show that this link may start from birth [2]. Cord blood lipoproteins, which are the molecules that carry fats in the blood, can be affected by different factors, such as how well the placenta works, how the baby grows before birth, and how the baby is delivered [3]. It is possible that stressful conditions for the fetus may raise the lipid levels in the blood, and this could mean that babies born by vaginal delivery have higher lipid levels than those born by cesarean section [4].

During labor, the fetus experiences stress that affects its hormonal and metabolic levels. Previous studies have shown that fetal serum sex steroid and glucocorticoid levels increase under stress during labor, but the impact of stress on fetal serum lipid levels is less clear [5]. Ose *et al*. proposed that stress induces the release of free fatty acids from adipose tissue and the synthesis of triglyceride in the liver, but they did not specify which fatty acids are involved [6]. Moreover, it is unknown whether fetal serum lipid levels vary depending on the mode of delivery, which may reflect different degrees of stress. In this study, we compared umbilical cord serum lipid levels between vaginal delivery and elective cesarean sections, which are expected to have different levels of fetal stress.

METHODS

The research was conducted at Government Medical College, Nagpur, Maharashtra, India. The aim of the research was to compare the lipid profile of the umbilical cord blood of newborns delivered by cesarean section and normal vaginal delivery. The research was conducted from January 2011 to December 2012. It was a prospective, cross-sectional study. The mothers gave informed consent, and the study protocol was approved by the institutional ethics committee. The mothers were healthy and only took iron, folic acid, and calcium supplements. The mothers were excluded if they had any of the following conditions or histories: alcoholism, smoking, hypertension, thyroid disorders, diabetes mellitus, renal diseases, hypercholesterolemia, twins or liver diseases, history of tuberculosis and asthma, positive TORCH screening results, recent pregnancy, and history of celiac disease. The exclusion criteria for mothers are: history of hypertension, history of thyroid disorders, history of diabetes mellitus, history of renal diseases, history of hypercholesterolemia, history of twins, and history of liver diseases. The inclusion criteria for newborns are: gestational age between 35–42 weeks; one-minute Apgar score >7; and absence of any congenital anomalies. The exclusion criteria for newborns are: congenital malformations; neonates born to mothers with maternal illness, which is already excluded in the exclusion criteria for mothers; neonates with perinatal problems like hypoglycemia, pathological jaundice, instrumental delivery, including extraction; neonates with hypoxic-ischemic encephalopathy, sepsis, respiratory distress, and multiple gestations.

We selected the neonates based on their gestational age (37–42 weeks) and birth weight (2500–3800 g). We used an electronic scale to measure the birth weight within 24 h of delivery. We used the New Ballard *et al*. scoring system to verify the gestational age within 24 h of birth.

We divided the newborns into two groups: term newborns delivered by normal delivery and those delivered by cesarean section. The term group included babies with 37–42 weeks of gestation. The Obstetrics and Gynecology Department of GMC Nagpur confirmed the gestational age by history, physical examination, and ultrasound.

We collected data on obstetric factors such as maternal age, neonatal weight, gestational age, and neonatal sex for each participant. We also drew blood samples from the mother and the umbilical cord right after birth. We measured serum lipid levels, including total cholesterol, triglycerides, high-density lipoprotein (HDL)-cholesterol (high-density lipoprotein cholesterol), LDL-cholesterol and VLDL-cholesterol in both samples. The study compared the obstetric factors and cord blood lipid concentrations of women who delivered vaginally and those who had planned cesarean sections. It also examined the relationship between maternal and cord blood lipid levels in each group. The results showed that cord blood lipid levels were higher in planned cesarean sections than in vaginal deliveries and that there was a positive correlation between maternal and cord blood lipid levels in both groups.

We collected and analyzed specimens from the umbilical cord blood of newborns. After the placenta was delivered and the cord was clamped, we took 5 mL of blood from the placental side under sterile conditions. We let the blood clot for a few minutes and then spun it at 3000 rpm for 30 min to separate the serum. We used an automated biochemical analyzer with an enzymatic method to measure the serum levels of total cholesterol (TC), total triglyceride (TG), HDL-C, low-density lipoprotein (LDL-C), and very low-density lipoprotein (VLDL-C).

We used mean values and the standard error of the mean to describe the data in each group. We compared the data between 150 normal newborns delivered by vaginal delivery and 50 newborns delivered by cesarean section. We used the student's t-test, or the Mann–Whitney U test, to test the significance between the groups. We considered $p<0.05$ as significant and $p<0.001$ as highly significant. We used GraphPad Prism version 9.00 software for analysis.

RESULTS

The baseline characteristics of the two groups are shown in Table 1. There were no significant differences in maternal age, neonatal weight, gestational duration, or placental weight among the two groups. The gender distribution of the neonates was also similar between the two groups.

Table 2 shows the comparison of lipid profile parameters between normal vaginal delivery and lower segment cesarean section groups. The mean values and standard deviations of total cholesterol, triglycerides, VLDL-cholesterol, HDL-cholesterol and LDL-cholesterol are presented for each group. The 95% confidence intervals and p values are also reported. The results indicate that there is no significant difference in any of the lipid profile parameters between the two groups ($p>0.05$ for all parameters).

DISCUSSION

The results of this study showed that the umbilical cord blood had higher concentrations of TCh, TG, and LDL-C than the neonatal blood after CS delivery. This could be explained by the different ways that lipids are transferred from the mother to the fetus through the placenta. The placenta has specific carriers that transport lipids based on the difference between the maternal and fetal lipid levels, which is higher in late pregnancy due to maternal hyperlipidemia. The placenta also has more factors that facilitate lipid transfer, such as a larger exchange area, a shorter diffusion distance, and a higher metabolic rate [7]. In early pregnancy, the fetus mainly gets lipids from maternal free fatty acids, but in late pregnancy, the fetus can make lipids from other sources [8]. The placenta also takes up maternal lipoproteins and either uses them for energy or hormone synthesis or passes them to the fetus [7].

Fetal stress can affect the lipid profile of the newborn by stimulating the release of fatty acids from adipose tissue and the production of triglycerides in the liver [9]. The mode of delivery may also influence the lipid levels, as vaginal birth is considered more stressful and has been linked to higher triglycerides and fatty acids than a cesarean section [10].

We observed a surprising increase in total cholesterol and LDL-C concentrations in the umbilical cord blood samples of neonates delivered vaginally. We are not sure what causes this phenomenon at the moment. However, a possible cause for the surprising increase in total cholesterol and LDL-C concentrations in the umbilical cord blood samples of neonates delivered vaginally is that the fetal cholesterol synthesis rates are higher than normal. This could be related to intrauterine growth restriction (IUGR), a condition that affects fetal growth and development. A study by Pecks *et al*. showed that cholesterol deficiency in IUGR is due to reduced fetal de novo synthesis rates rather than reduced maternal supply. However, increased oxysterol- and phytosterol-to-cholesterol ratios indicate a lower sterol elimination rate, which could result in higher cholesterol levels in the cord blood [11].

Another study by Parker *et al*. found that the Apo A-1/HDL cholesterol ratio in umbilical cord blood rose progressively from 2.5 (27–28 week gestation) to 3.8 at term, due largely to increased Apo A-1 levels but little change in the mean HDL cholesterol levels, which ranged from 22 to 24 mg/dl at each gestational period. This could indicate a higher HDL production or a lower HDL clearance in the fetus, which could also contribute to the elevated cholesterol. It may warrant further investigation in the future to understand the underlying mechanisms and implications of this finding [12].

Limitations of our study include the small sample size, the lack of data on maternal lipid levels and dietary intake, and the absence of long-term follow-up of the neonates. Future research should aim to enroll

Table 1: Baseline characteristics of the two groups. Values are given as mean (SD) (range)

Characteristics	Normal vaginal delivery (n=150)	Lower segment Cesarean section (n=50)	95% CI	p-value
Maternal age (years)	25.1 (4.7) (18–44)	26.4 (4-7) (21-37)	(−7.99, −0.61)	p=0.223
Neonatal weight (g)	2178 (269) (2500–3680)	2934 (274) (2520–3480)	(−2.6, 150.6)	p=0.175
Gestational duration in weeks	39.2 (0.9) (37.041.0)	37.9 (1–1) (37.640.7)	(38.933, 39.467)	p=0.228
Neonatal gender	Male=134 Female=16	Male=24 Female=26		

Table 2: Umbilical cord serum lipid levels of the two groups. Values are given as mean (SD)

Lipid profile	Normal vaginal delivery (n=50)	Lower segment Cesarean section (n=50]	95% CI	p-value
Total Cholesterol	66.05±0.85	65.15±0.66	(0.31, 1.49)	0.14
Triglycerides	51.23±0.58	50.52±0.34	(0.33, 1.09)	0.08
VLDL-Cholesterol	10.23±8.31	10.78±8.78	(−3.55, 2.45)	0.803.
HDL-Cholesterol	29.18±0.40	28.78±0.91	(0.09, 0.71)	0.20
LDL-Cholesterol	26.64±0.67	26.89±0.89	(−0.38, 0.88)	0.37

a larger and more representative cohort of pregnant women and their offspring, to measure both maternal and fetal lipid levels at different stages of gestation, and to assess the health outcomes of the neonates in relation to their lipid profile at birth.

AUTHOR CONTRIBUTION

The main concept and research question that guided the study: Avinash Jadhao Collecting the samples from the Labor room and analysing them in the Laboratory: Avinash Jadhao ,Trupti Ramteke. Manuscript writing and Proofreading:Amit Barapatre, Statistics and Proofreading: Avinash Jadhao ,Trupti Diwan Ramteke, Amit Barapatre.

CONFLICT OF INTEREST STATEMENT

Nil.

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