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Relationship between Serum Umbilical Cord and Maternal Leptin and Adiponectin Concentrations with Fetal Growth Parameters

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Abstract

Background: Pregnancy and accelerated fetal growth always are related with major metabolic changes and body fat redistribution and adiponectin is one of principle adipocyte hormones, so studying adiponectin changes during pregnancy may reveal some hidden parts of fetal metabolism. The aim of this study was to assess adiponectin and leptin levels in umbilical cord and maternal serum, their relation with each other and with neonatal weight, birth length and other fetal growth markers.

Methods: The study was carried out with 72 appropriate for age newborns (36 female, 36 male) and their mothers. The anthropometric variables of the newborns studied were birth weight, birth length, and birth weight/birth length and ponderal index. Maternal and umbilical cord adiponectin and leptin levels were measured by ELISA and compared.

Results: The median of cord blood adiponectin concentration were 3 fold higher than those of maternal group. Umbilical cord blood leptin levels were significantly correlated with neonatal birth weight and birth weight/ birth length (r= 0.29, *P*= 0.01 and r= 0.24, *P*= 0.04, respectively). No statistical difference has been demonstrated between both groups of male and female neonates regarding birth weight, birth length, maternal and neonatal leptin levels, ponderal index and maternal and neonatal adiponectin levels.

Conclusion: Neonatal leptin is related to birth weight. Adiponectin has no relation with birth weight. Neither leptin nor adiponectin correlated with gender difference.

Keywords: *Serum umbilical, Maternal leptin, Fetal growth*

Introduction

Adiponectin is a plasma protein that has been recently discovered and could be found in high levels in blood circulation (1-3). This protein is secreted exclusively and in large amounts by adipose tissue (4). It is demonstrated that adiponectin increases insulin sensitivity. Low levels of adiponectin are related with high fasting insulin glucose, triglyceride and obesity (5). Pregnancy and accelerated fetal growth always are related with major metabolic changes and body fat redistribution (6) and as mentioned earlier adiponectin is one of the principle adipocyte hormones, so studying adiponectin changes during pregnancy may reveal some hidden parts of fetal metabolism.

Leptin is a protein consisted of 167 amino-acids, which excreted by adipocytes and through its effects on hypothalamic centers, plays a considerable role on energy expenditure regulation and body fat mass (7).

Direct relation of this protein with fat mass, percentage of body fat and body mass index (BMI) has been shown in adult individuals (8). Interestingly, a reverse relation between plasma levels of leptin and adiponectin has been illustrated (9). From 34^{th} gestational week, leptin level in umbilical cord increases sharply (10) and a strong significant relation between umbilical leptin level and neonatal birth weight was proposed in previous studies (11, 12). In addition, female neonates have a higher leptin level than male ones (13).

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The aim of this study was to assess adiponectin and leptin levels in umbilical cord and maternal serum, their relation with each other and with neonatal weight, birth length and other fetal growth markers.

Materials and Methods

A cross sectional study was carried out with 72 appropriate for gestational age newborns (36 females, 36 males), born at delivery rooms of Tehran university hospitals, between Sep 2005-Jan 2006. The study was conducted in following order:

First, maternal data were collected in special questionnaires, umbilical cord and maternal sample were taken and the newborns were evaluated. Secondly, laboratory measurements were performed.

In the first stage, information about maternal medical history and habits, clinical examinations and measurements and pregnancy events were collected in special forms.

Newborns were selected regarding following criteria:

1- Gestational age between 37-42 wk.
2- Singleton pregnancy
3- Appropriate for gestational age.
4- Newborns without congenital malformations.
5- Infants of mothers who didn't have cigarette smoking or alcohol consumption history.
6- Absence of any major maternal disease, such as hypertension, diabetes mellitus, thyroid dysfunction, renal, liver and cardiac illnesses and hypercholesterolemia.
7- Apgar score at 5 min equal to or greater than 7.
8- Mothers with the history of gestational diabetes mellitus, eclampsia and preclampsia were excluded.

Under sterile conditions and without any contaminations 5cc of maternal blood and 5cc of umbilical vein was obtained after double clamping of the umbilical cord at birth, sera for assays were obtained by centrifugation and immediately frozen. Neonatal information such as gender, gestational age, birth weight, birth length, weight to length ratio and ponderal index was calculated as, weight in grams divided by the cube of length in centimetres multiplied by 100.

In the second stage, laboratory measurements were done. Adiponectin was measured by ELISA methods (AdipoGen Inc. Seoul, Korea). The sensitivity of the adiponectin was 100 pg/ml. The intra and inter assay coefficient of variation (CV) were <3.5% and <5% respectively. Leptin measurements were also done by ELISA methods (DRG Instruments Gmbh, Germany). The sensitivity of the ELISA was 1.0 ng/ml. The intra and inter assay CV was <6% and <9% respectively. All data were expressed as means± SD, median and range, and $P<0.05$ was considered statistically significant. Pearson's correlation coefficient was used to determine the relationship between variables. Comparison of baseline characteristics between groups was done using a nonparametric Mann-Whitney *U*-test. Statistical analysis was performed with SPSS 11.5 (SPSS Inc. Chicago, IL, USA). This study was approved by the local Ethics Committee, and informed consent was obtained from all participants.

Results

All newborns were healthy and did not need any special medical care after birth. Neonatal gestational age mean±SD was 39.11±0.95 week and the range was 37-41. Birth weight mean ± SD was 3.30±0.35 kg and its range was 2.50-4. The demographic characteristics of the newborns and mothers are summarized in Table 1. The median of cord blood adiponectin concentration were 3 fold higher than those of maternal group. Umbilical cord blood leptin levels were significantly correlated with neonatal birth weight and birth weight/ birth length ($r= 0.29$, $P= 0.01$ and $r= 0.24$, $P= 0.04$, respectively). A positive correlation between umbilical cord leptin and maternal leptin level and maternal weight was found. ($r= 0.36$, $P= 0.004$ and $r =0.59$, $P< 0.001$ respectively).

No statistical difference has been demonstrated between both groups of male and female neo-

nates regarding birth weight, birth length, maternal and neonatal leptin levels, ponderal index and maternal and neonatal adiponectin levels. In table 2, median and range of adiponectin and leptin levels in both male and female neonates and maternal samples are shown.

No correlation between maternal adiponectin levels were found with the concentrations of neonatal adiponectin, neonatal leptin and birth weight. Also, no correlation was demonstrated between maternal leptin and maternal adiponectin (r= -0.08, *P*= 0.57).

Table 1: Clinical characteristics of the mothers and newborns, Mean ± SD

Maternal age (yr)	26.38±5.27
Maternal weight (kg)	61.34±11.83
Maternal body mass index (kg/m^2)	23.68±4.60
Gestational age (weeks)	39.00±0.92
Birth weight (gr)	3250±350
Birth length (cm)	50.25±2.90
Birth weight/Birth Length (gr/cm)	64.82±6.27
Ponderal Index	2.62±0.72

Table 2: Leptin and adiponectin levels in maternal and umbilical cord blood, Median (Range)

	Adiponectin (µg/ml)	**Leptin (ng/ml)**
Mothers	8.00 (35.20-1.06)	16.00 (96.00-3.50)
Male Neonates	24.40 (206.00-3.40)	16.00 (38.50-3.00)
Female Neonates	26.20 (43.60-10.20)	13.00 (60.00-4.50)
All Neonates	24.70 (206.00-3.40)	14.75 (60.00-3.00)

Discussion

Our results showed that the neonatal adiponectin concentrations are much higher than those of mothers' (Table 2) which is consistent with the results of Pardo et al (14) and Kotani et al (15). It has been shown that in adults most part of adipose tissue is located in visceral compartment (15) and there is a negative correlation between intra-abdominal fat shown by CT scan and adiponectin concentration (16) but in neonates almost 90% of fat is subcutaneous and not visceral (17) and increased fat mass in this region along with growing number of adipocytes can justify high levels of neonatal adiponectin in comparison with adult population (15). Also, it could be postulated that adiponectin increases insulin sensitivity in fetuses (18) to utilize glucose as a major energy source (19). Therefore, high levels of adiponectin signify energy expenditure changes and fat redistribution in late pregnancy months (20).

In our study, we did not find any correlation between neonatal adiponectin and birth weight, this is the same as the findings of Mazaki et al (21) ; however in two previous studies (6, 14) correlation had been shown between these items. This difference between our results and theirs' can be attributed to differences in study population since they included SGA and preterm newborns. It is clear that both gestational age and birth weight can greatly affect adiponectin levels in fetus (20).

There was no significant difference in adiponectin concentration between male and female neonate groups. This finding is in agreement with previous studies (14, 15). According to our results, umbilical cord leptin has a positive correlation with birth weight. Since the main source of leptin production in fetus like adults is adipose tissue (10), with the increase of body weight and fat mass, umbilical cord leptin concentration increases in parallel (13, 14, 22).

Leptin concentration in umbilical cord was positively correlated with maternal serum leptin levels. The relationship between increase in maternal weight during pregnancy and neonatal weight has been demonstrated (23) and on the other hand the positive correlation of maternal leptin with maternal weight and the same for neonatal leptin and neonatal weight was shown in our study, so it could be proposed that leptin level concentration in maternal and neonatal blood are correlated positively.

In our study no correlation between umbilical cord leptin and adiponectin was found, which is in accord with the study of Pardo et al (14).
In conclusion neonatal leptin concentration is related to birth weight while neonatal adiponectin does not show any relationship with birth weight. Maternal and umbilical leptin and adiponectin do not show any neonatal gender difference. Furthermore, leptin and adiponectin of umbilical cord are not related to each other.

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