

ORIGINAL ARTICLES

Initial research of cord blood leptin, adiponectin and IGF-I with fetus growth and development

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Abstract

Objective: In order to reveal the relationship between cord blood leptin, adiponectin and insulin-like growth factor-I (IGF-I) and the fetus growth and development, and discuss the interaction and clinical significance on fetus growth and development.

Methods: The levels of cord blood leptin, adiponectin, IGF-I in 86 newborns were examined by radio immunoassay, according to gestation age and birth weight percentile relation, the objects were divided into the SGA group (n = 16), the AGA group (n = 41), the LGA group (n = 29), meanwhile, neonatal birth weight, body length, head circumference, foot length, and placental weight were measured, and body mass index (BMI) was computed. Dependability analysis was taken.

Results: The levels of cord blood leptin, adiponectin and IGF-I were as follows: LGA group > AGA group > SGA group. The level of cord blood adiponectin was positively correlated with birth weight, placental weight and BMI ($p < .05$). Cord blood leptin and IGF-I concentrations were positively correlated with their birth weight, body length, head circumference, foot length, placental weight and BMI, respectively ($p < .01$), cord blood leptin was positively correlated with adiponectin and IGF-I ($p < .01$). The levels of cord blood leptin and adiponectin had no statistical significance with neonatal sexuality and deliver style ($p > .05$); the levels of cord blood IGF-I had no statistical significance with neonatal sexuality ($p > .05$), but had statistical significance with deliver style ($p < .05$).

Conclusions: Cord blood leptin, adiponectin and IGF-I played an important part in adjusting fetus growth and development as well as participating in the process of fetus growth and development, and could be regarded as one of the clinical indexes to evaluate fetus growth and development or state of nutrition. The abnormal level of cord blood leptin and IGF-I might be one of the reasons to cause intrauterine growth retardation and fetal macrosomia.

Key Words: Leptin, Adiponectin, Insulin-like growth factor I, Cord blood, Fetus, Growth and development

Fetus growth and development is influenced by various factors. Leptin is a peripheral signal of network connection between adipose tissues and the central nervous system, and it can participate in the homeostatic regulatory mechanism that keeps body fat mass in a constant state; adiponectin is an important regulatory factor in the regulatory network of body lipid metabolism and glucose homeostasis; insulin-like growth factor-I (IGF-I) contributes to mitosis and peptide synthesis and metabolism. Thus they are considered to be related to fetus growth and development, and play important roles in disorders of fetus growth and development.

On that account, this research is intended to reveal the relationship of cord blood leptin, adiponectin and IGF-I and fetus growth and development, and discuss the interaction and clinical significance on fetus growth and development.

1 Objects and methods

1.1 Objects

The newborns delivered in our hospital from November of 2006 to July of 2007 were chosen as research objects.

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Pathological factors such as fetal distress, fetal anomalies and metabolic disorders, were excluded and Apgar scores were all above 7. By use of the above methods, 86 cases of the newborns were screened out. In conformity to “Standards of Neonatal Physical Development Measurements” in 15 cities of China in 1987,^[1] the objects were divided into: the SGA group (n = 16), the AGA group (n = 41) and the LGA group (n = 29) according to the relationship between gestation age and birth weight percentile.

1.2 Methods

(1) Specimen collection: After delivery and cord-cutting, 10 ml of umbilical venous blood was taken from the newborns respectively, and the serum was separated and placed in the refrigerator at -25°C for detection. Neonatal birth weight, body length, head circumference, foot length and placental weight were measured respectively to calculate body mass index (BMI), in order to evaluate the state of nutrition for the newborns.

(2) The levels of adiponectin, leptin and IGF-I were measured by radio immunoassay.

1.3 Statistical analysis

SPSS software was applied to rank sum test, correlation analysis, one-way ANOVA and multiple stepwise regression analysis of experimental data. Values of natural logarithm were derived from non-normally distributed variables (leptin, IGF-I) for statistical analysis, and the difference $p < .05$ was of statistical significance.

2 Results

(1) Comparison of the levels of cord blood adiponectin, leptin and IGF-I in three groups of the newborns were shown in Table 1.

(2) Measurements of neonatal birth weight, body length, head circumference, foot length, BMI and placental weight were compared in three groups of the newborns (see Table 2).

(3) The correlation of the levels of cord blood adiponectin, leptin and IGF-I with neonatal birth weight, body length, head circumference, foot length, BMI and placental weight was shown in Table 3.

(4) The correlation of cord blood adiponectin, leptin and IGF-I. The level of cord blood leptin was positively correlated with the levels of adiponectin and IGF-I ($p < .01$), but the level of adiponectin had no apparent correlation with the level of IGF-I ($p > .05$).

Table 1: Comparison of the levels of cord blood adiponectin, leptin and IGF-I in three groups ($\bar{x} \pm s$, ng/ml)

Group	n	Adiponectin	Leptin	IGF-I
SGA	16	74.64 ± 16.01	0.59 ± 0.72	3.05 ± 0.82
AGA	41	83.08 ± 14.94	1.26 ± 0.77	3.41 ± 0.98
LGA	29	90.54 ± 22.19	1.59 ± 0.81	4.38 ± 0.97
F-value		4.183	8.647	13.16
p-value		.019	.000	.000

Table 2: Comparison of measurements of neonatal birth weight, body length, head circumference, foot length, BMI and placental weight in three groups of the newborns ($\bar{x} \pm s$)

Indexes	n	Birth Weight (kg)	Body Length (cm)	Head Circumference (cm)	Foot Length (cm)	BMI (kg/m ²)	Placental Weight (g)
SGA	16	2.487 ± 0.238	47.3 ± 1.5	32.4 ± 0.9	7.8 ± 0.4	11.110 ± 1.000	459.4 ± 85.8
AGA	41	3.282 ± 0.276	49.9 ± 2.3	34.0 ± 1.2	7.9 ± 0.3	13.240 ± 1.240	674.4 ± 85.5
LGA	29	3.925 ± 0.253	52.0 ± 2.4	34.1 ± 1.5	8.6 ± 0.6	14.560 ± 1.210	777.9 ± 70.3
F-value	-	158.256	24.226	35.662	24.121	43.524	80.394
p-value	-	.000	.000	.000	.000	.000	.000

Table 3: The correlation of the levels of cord blood adiponectin, leptin and IGF-I with neonatal birth weight, body length, head circumference, foot length, BMI and placental weight in 86 cases of the newborns

Indexes	Adiponectin		Leptin		IGF-I	
	r	p	r	p	r	p
Birth Weight	0.287	.007	0.507	.000	0.465	.000
Body Length	0.080	.446	0.316	.003	0.337	.001
BMI	0.336	.002	0.434	.000	0.350	.001
Head Circumference	0.274	.011	0.402	.000	0.282	.009
Foot Length	0.232	.032	0.392	.000	0.354	.001
Placental Weight	0.203	.061	0.356	.000	0.448	.000

3 Discussions

3.1 The level of cord blood leptin and fetus growth and development

Leptin, as an intermediary agent to connect fetal neuroendocrine system and adipose tissues, participates in modulating the increase of fetus birth weight during pregnancy, especially the second and the third trimesters of pregnancy. In this research, the level of cord blood leptin was gradually ascending with the increase of gestation age and birth weight, which indicated that leptin played an essential part in modulating fetus birth weight. The level of plasma leptin reflects reserves of adipose tissues in the human body to some extent, and reflects fetus weight indirectly.^[2] The results showed that leptin was positively correlated with birth weight, body length, head circumference, foot length, BMI and placental weight. It shows that fetus leptin partially comes from placenta, and the change in the level of fetal cord blood leptin has a certain relationship with fetus physical condition. Therefore, it is indicated that leptin is an important factor of fetus growth regulatory system, and can be regarded as an index of the development condition of fetal adipose tissues.

3.2 The level of cord blood IGF-I and fetus growth and development

The research results showed that, with the increment of pregnant weeks, fetus weight and the level of cord blood IGF-I were increased gradually, which conformed to reports proposed by Chen RL et al.^[3] It is indicated that the change pattern is in accordance with the increase of birth weight, suggesting IGF-I plays an important part in fetus growth and development. Meanwhile, it was positively correlated with fetus birth weight, body length, head circumference, foot length, BMI and placental weight, which conformed to reports proposed by Liu H et al.^[4] It is indicated that IGF-I in fetal circulation comes from fetal tissues and placenta, and it can regulate cell differentiation and growth, enhance the synthesis of protein and glucose metabolism, improve the placental function of absorbing nutrient substances and facilitate fetus growth and development by autocrine and paracrine mechanisms.^[5,6] The research showed that, placental weight and the level of IGF-I detected in the venous blood became lower as gestation age and birth weight went down. The low level of IGF-I will degrade placental metabolism and nutrient transfer and delay the assimilating process of fetal tissues. It is probably one of pathological factors that cause intrauterine development retardation.

3.3 The level of cord blood adiponectin and fetus growth and development

Adiponectin, a protein secreted by adipose tissues, has a function of enhancing insulin sensitivity. It can pre-

vent from insulin resistance and has various biological effects on promoting lipid oxidation, regulating glucose transport and keeping organic metabolism and energy balanced. The research results showed that the level of cord blood adiponectin appeared to be of significant difference in each group (divided by body weight). Among obese adults, the concentration of adiponectin became lower obviously, and the loss of body weight could make the level of serum adiponectin ascend; a similar conclusion was drawn in obese children. It is analyzed that the negative feedback regulation lies in the deficiency of large adipocytes in newborns, the low weight percentile and the absence of adiponectin caused by difference of adipose distribution from adults. The research showed that the level of cord blood adiponectin was positively correlated with body weight, gestation age, head circumference, foot length and BMI, indicating the change in the level of fetal cord blood adiponectin has a certain relationship with fetus physical condition. With the increment of gestation age, adiponectin synthesized by adipose tissues will be released more into the blood and thus the level of adiponectin will also be increased. It is indicated that adiponectin probably participates in the process of neonatal growth and development. Adiponectin can be regarded as an index to evaluate fetus adipose reserves and fetal or neonatal state of nutrition.

3.4 The interaction of adiponectin, leptin and IGF-I and its significance

The main factor influencing fetus growth and development is absorption and utilization of nutrient substances, and it can be regulated by insulins and various cytokines. Some scholars proposed the interaction of leptin and IGF-I metabolic axis, nutrient substances-insulin-IGF-I-growth hormone is a main pathway of regulating fetal and neonatal growth and development. Leptin and adiponectin are involved in the secretion of insulin. Then, insulin stimulates adipose synthesis, as well as the secretion of leptin and adiponectin. The two-way regulations of insulin to leptin and adiponectin have mutual effects on fetal body weight. Currently, the relationship of leptin and adiponectin with insulin and IGF-I is unknown. Christo considered the positive correlation of leptin with birth weight to be dependent on insulin and IGF-I system. In this study, the level of cord blood leptin was positively correlated with the levels of adiponectin and IGF-I, and the levels of cord blood leptin, adiponectin and IGF-I were correlated with birth weight, indicating that leptin could probably regulate fetal intrauterine growth by direct or indirect use of adiponectin, insulin and IGF-I. The levels of serum leptin and adiponectin mainly depend on the total of subcutaneous fat, and IGF-I influences the development of adipose tissues by facilitating proliferation and differentiation of preadipocytes. Hence, leptin, adiponectin and IGF-I are all involved in regulating of fetus growth and development.

The fetus growth and development is a multi-factor-involved process, which is influenced by various endocrine factors. The measurements of cord blood leptin, adiponectin and IGF-I concentrations can reflect the condition of fetus growth and development. The abnormal levels of cord blood leptin, adiponectin and IGF-I can all result in intrauterine development retardation and fetal macrosomia. Therefore, discussions on the relationship of cord blood leptin and IGF-I with neonatal birth weight and energy metabolism

provide a new way to the treatment of intrauterine development retardation, SGA, prematurity and fetal macrosomia, as well as present more possibilities for prenatal aristogenesis.

Conflicts of Interest Disclosure

The authors have no conflicts of interest related to this article.

References

- [1] Jin HZ, Huang DM, Guan XJ. Practice of Neonatology. The Third Edition. Beijing: People's Medical Publishing House; 2003. 1018 p.
- [2] Ramanan AV, Schneider R. Macrophage activation syndrome – what's in a name! *Rheumatol*. 2003; 30(120): 2513-2516.
- [3] Chen RL, Chen XJ. Levels of umbilical IGF-I and IGFBP-3 in human fetal growth and development. *Journal of Clinical Pediatrics*. 2007; 25(2): 125-127.
- [4] Liu H, Liang XW, Wang YD. Relationship between fetal growth restriction and levels of leptin and insulin-like growth factor-I. *Chinese Journal of Practical Gynecology and Obstetrics*. 2004; 20(6): 361-364.
- [5] Ou-yang SX, Li T, Bai D. Study on the relationship between intrauterine growth retardation and serum insulin-like growth factor-1 (IGF-1) and insulin-like growth factor binding protein-3 (IGFBP-3). *Journal of Applied Clinical Pediatrics*. 2002; 17(6): 605-606.
- [6] Jiang XM, Tao FB. Insulin-like growth factor system and fetus development and its intrauterine programming. *Maternal and Child Health Care of China*. 2008; 23(17): 2468-2470.