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Comparison of maternal and umbilical cord blood selenium levels in term and preterm infants

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Abstract: **Objective** Selenium is an essential trace element and has a main role in cellular antioxidant defense system. In very preterm babies, low selenium is associated with an increased risk of complications such as chronic neonatal lung disease and retinopathy of prematurity. This study was designed to determine and compare maternal and umbilical cord blood selenium levels in term and preterm infants. **Methods** From February 2008 to April 2008, 30 term (gestational age >37 weeks) and 30 preterm infants (gestational age < 34 weeks) and their mothers were enrolled. Selenium concentrations in umbilical cord and maternal venous blood were measured by atomic absorption spectrometry. **Results** The mean selenium concentration in term infants was higher than in preterm infants (124.80 ± 13.72 μg/L vs 100.30 ± 11.72 μg/L, $P=0.0001$). The mean selenium concentration in mothers of term and preterm infants was not significantly different (117.03 ± 17.15 μg/L vs 110.56 ± 17.49 μg/L, $P=0.15$). Cord selenium concentrations were strongly correlated with gestational age and birth weight ($r=0.66$, $P<0.0001$ and $r=0.59$, $P<0.0001$, respectively) when the data of all infants were analyzed together. None of the 60 women had a serum selenium level below the laboratory lower limit of normal (70.0 μg/L). Maternal selenium levels were correlated with cord selenium levels in their infants ($r=0.40$, $P<0.001$) when data of all newborn infants and mothers were considered together. **Conclusions** Mothers have a relatively good selenium status and serum selenium is not a significant predictor of preterm delivery in Isfahan. The cord selenium concentration in term infants is significantly higher than in preterm infants, but the cord selenium concentrations in both groups are in a suggested normal range. [**Chin J Contemp Pediatr**, **2009**, **11** (**7**):**513 – 516**]

Key words: Selenium; Umbilical cord blood; Preterm infant; Term infant

早产儿和足月儿脐血及母亲静脉血硒含量的比较

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[**摘　要**] **目的**　硒是一种人体必需的微量元素,在细胞抗氧化防御系统中发挥着主要的作用。在早期早产儿中,低水平的硒会增加诸如慢性新生儿肺疾病、早产儿视网膜病等并发症的发生。该研究旨在检测并比较早产儿和足月儿脐血及母亲静脉血硒含量。**方法**　选取 2008 年 3 ~ 7 月间 30 个足月儿(胎龄 >37 周)和 30 个早产儿(胎龄 < 34 周)及他们的母亲作为研究对象。用原子吸收光谱法测定脐血和母亲静脉血的硒含量。**结果**　足月儿的脐血硒平均含量高于早产儿,差异有非常显著性(124.80 ± 13.72 μg/L vs 100.30 ± 11.72 μg/L, $P=0.0001$)。足月儿母亲与早产儿母亲的的平均硒含量差异无显著性 (117.03 ± 17.15 μg/L vs 110.56 ± 17.49 μg/L, $P=0.15$)。将所有婴儿的资料一起分析时,发现脐血硒含量与胎龄和出生体重显著正相关($r=0.66$, $P<0.0001$; $r=0.59$, $P<0.0001$)。60 例婴儿母亲中,无一例的血硒含量低于正常参考值的下限(70.0 μg/L)。将所有婴儿及其母亲的资料一起分析时,发现母亲血硒含量与其婴儿脐血硒含量呈显著正相关 ($r=0.40$, $P<0.001$)。**结论**　在伊斯法罕地区,孕母的血硒水平处于一个良好的状态,血硒水平不是早产的预测指标。足月儿的脐血硒含量高于早产儿,但足月儿和早产儿的脐血硒含量均在正常参考范围。 [**中国当代儿科杂志,2009,11(7):513 – 516**]

[**关　键　词**] 硒;脐血;早产儿;足月儿

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Selenium is an essential micronutrient for life because of its biological functions in human through several selenoproteins[1]. Glutathione peroxidase, one of the important selenoproteins, is an antioxidant enzyme which appears to protect tissues against oxidative damage through catalyzing the breakdown of hydrogen peroxide and lipid hydroperoxides[2,3]. Therefore, selenium plays an important role in scavenging free radicals and in the cellular antioxidant defense system.

Keshan disease is an illness that is a direct result of selenium deficiency[4]. Keshan disease was first discovered in Keshan, a county in China, where it was first discovered in children and young women. It was found that the soil is deficient in selenium in that area. This disease has also been reported in New Zealand [5] and Finland[6]. Keshan disease causes an inflammation and necrotic degeneration of liver, pancreas, heart and kidney, mainly presenting cardiomyopathy in human[7]. Although, no other definite diseases in human have been proven to be caused by selenium deficiency, selenium is known to have a vital role in maintaining the integrity of the cell and their organelles from oxidative damage caused by free radicals[8]. Several neonatal diseases especially in preterm infants are believed to be caused by oxygen free radicals. These diseases include bronchopulmonary dysplasia, retinopathy of prematurity, necrotising enterocolitis, patent ductus arteriosus and hypoxic-ischemic encephalopathy[9]. Consequently, a good selenium nutrition has been suggested as an important factor for decreasing mortality and morbidity of preterm infants[10]. There are no available data on the selenium status of neonates and pregnant women in Iran. Considering the importance of selenium in proper treatment of serious disorders in the neonatal period, this study was designed to determine the selenium levels in term and preterm infants and their mothers at delivery in Isfahan, the central state of Iran. This study compared blood selenium levels of maternal-cord pairs in term and preterm infants.

Methods

Subjects

From February 2008 to April 2008, 30 term (gestational age >37 weeks) and 30 preterm infants (gestational age < 34 weeks) and their mothers who delivered at Shahid-Beheshti and Al-Zahra Hospitals, two teaching hospitals affiliated to Isfahan University of Medical Sciences, Iran, were enrolled. The infants selected in the two groups were appropriate for gestational age and had an Apgar score of more than 7 at 1, 5 and 10 minutes after birth. Table 1 shows the basic demographic data of the term and preterm groups. There were no significant differences between the two groups regarding the gender distribution and mothers' age.

Information on estimated gestational age and characteristics of the physical examination were obtained from the medical records. The Research Committee in Isfahan University of Medical Sciences approved the study, and informed written consent was obtained from mothers before their accouchement.

The exclusion criteria for subjects included: 1) The infants had some diseases, such as fetal distress, birth trauma and birth asphyxia; 2) The mothers had a history of selenium supplementation; 3) The mothers had problems relating to pregnancy: pregnancy induced hypertension, antepartum hemorrhage premature or prolonged rupture of membranes or meconium-stained amniotic fluid etc.; 4) The mothers had medical conditions that could cause low birth weight: multiple gestation, preeclampsia, psychiatric, kidney or cardiac disease, gestational diabetes, history of repeated urinary infections, seizures requiring daily medication and ingestion of corticosteroid.

Measurement of serum selenium concentrations

Samples of umbilical cord blood and maternal venous blood (5 mL each) were collected at delivery. Serum was immediately separated and frozen at −20℃ until analysis. Selenium concentrations in umbilical cord and maternal venous blood were measured using an atomic absorption spectrophotometer instrument (Perkins-Elmer 3030, USA) equipped with a graphite furnace at the Clinical Toxicology Laboratory in Emam-Reza Hospital in Mashhad City.

Statistical analysis

Data were stored in a computer data base and were analyzed using SPSS for windows version 10.5 (Chicago Inc. USA). Frequency, mean and standard deviation for demographic data in neonates and mothers were presented. Mean values were compared by independent

Table 1 Characteristics of newborn infants ($\bar{x} \pm s$)

Group	Number	Female/Male	Birth weight (g)	Head circumference (cm)	Length (cm)	Gestational age (week)	mothers' age (year)
Term	30	15/15	3050.33 ± 383.53	34.40 ± 1.24	49.60 ± 1.84	39.51 ± 1.05	25.23 ± 5.45
Preterm	30	12/18	1465.33 ± 501.76	28.53 ± 2.88	40.41 ± 4.55	29.93 ± 2.52	27.96 ± 5.12
P value		0.43	<0.0001	<0.0001	<0.0001	<0.0001	0.050

samples t test. Bivariate correlation between quantitative variables was tested by Spearman's coefficient. Statistical significance was considered to be at $P<0.05$.

Results

Maternal and cord serum selenium concentrations

As shown in Table 2, the mean selenium concentration in preterm infants was significantly lower than in term infants ($P=0.0001$). The mean selenium concentration in mothers of preterm and term infants was not significantly different ($P=0.15$) (Table 3).

Table 2 Serum selenium concentrations in newborn infants ($\bar{x}\pm s$, μg/L)

Group	Number	Mean concentration	Range
Term	30	124.80 ± 13.72	94-148
Preterm	30	100.30 ± 11.72[a]	75-118

a: $P=0.0001$, vs the term infants.

Table 3 Maternal serum selenium concentrations ($\bar{x}\pm s$, μg/L)

Group	Number	Mean concentration	Range
Term	30	117.03 ± 17.15	89-147
Preterm	30	110.56 ± 17.49	78-144

There was no gender difference in selenium concentrations in preterm infants (100.50 ± 11.46 μg/L vs 100.16 ± 12.22 μg/L in females and males; $P=0.94$) and in term infants (124.33 ± 14.63 μg/L vs 125.26 ± 13.25 μg/L in females and males; $P=0.85$).

Correlation of cord selenium levels with maternal selenium levels

Maternal selenium levels were correlated with cord selenium levels in their neonates ($r=0.40$, $P<0.001$) when the data of all newborn infants and mothers were considered together. A correlation between maternal and cord selenium levels was found in the term group ($r=0.56$, $P=0.001$) but not in the preterm group ($r=0.20$, $P=0.26$).

Correlation of cord selenium levels with gestational age

Cord selenium concentrations were strongly correlated with gestational age ($r=0.66$, $P<0.0001$) when the data of all infants were analyzed together. However, there were no significant relationships between cord selenium levels and gestational age either in the preterm group or the term group ($r=-0.10$, $P=0.58$, and $r=0.13$, $P=0.46$, respectively).

Correlation of cord selenium levels with birth weight

Cord selenium levels were correlated with birth weight ($r=0.59$, $P<0.0001$) when the data of all newborn infants were considered together, but there were no correlations between cord selenium level and birth weight either in the preterm group or the term group ($r=0.01$, $P=0.93$, and $r=-0.13$, $P=0.48$, respectively).

Discussion

This study indicated that cord selenium concentration was different in term and preterm infants with a gestational age of less than 34 weeks. Serum selenium concentration is often used to assess selenium nutritional status. The normal mean serum selenium for 19- to 30-year-old women was reported as 123.6 μg/L (1.56 mol/L) by the National Health and Nutrition Examination Survey (NHANES) III[11]. In the present study, the mean selenium concentration in the mothers of both groups at delivery was near to the NHANES III value. None of the 60 women had a serum selenium level below the laboratory lower limit of normal of 70.0 μg/L (0.89 mol/L). In addition, although the mean maternal selenium concentration was higher in the term group than in the preterm group but this difference was not statistically different. Thus, this study demonstrated that in Isfahan pregnant women had a relatively good selenium status and serum selenium was not a significant predictor of preterm delivery. Despite this, Gathwala et al [12] in India and Dobrzynski et al [13] in Poland found that mean serum selenium at delivery was significantly higher in term infants' mothers than in preterm infants' mothers. The variations among the results of this study and the other investigations may be due to differences in the study design and the sample size.

Although the cord serum selenium levels in both groups (term and preterm neonates) were in the suggested normal range of 50 to 150 μg/L[14], but the mean selenium concentration in preterm infants was significantly lower than in term infants. This finding is consistent with some previously published data which demonstrated low selenium concentrations in cord blood of preterm versus full-term deliveries[13, 15].

The cord selenium level seemed to be higher than maternal selenium level in the term group in this study. This study also found a significant correlation between cord selenium level and maternal selenium level in the term group. Different studies have yielded conflicting results about the relationship of cord selenium level and maternal selenium concentration. However, there is a report similar to the findings of this study[16]. The ma-

jority of studies confirmed that infant cord serum selenium concentration is lower than maternal serum concentration[9, 17-19]. These controversial results suggest that the control mechanisms of transplacental transfer of selenium have not been exactly identified yet and further studies are warranted on the relationship between selenium status in preterm and term infants and their mothers.

It was also found that cord selenium concentrations were strongly correlated with gestational age and birth weight when the data of all newborn infants were considered together. Makhoul et al[10] analyzed umbilical cord selenium in newborns with gestational age of 24 to 42 weeks and showed a significant association between cord selenium concentration and gestational age and that a remarkable increase in selenium concentrations after 36 weeks of gestational age.

In conclusion, this study indicated that maternal serum selenium levels in the preterm and term groups were not different and were in a normal range. In addition, the cord serum selenium level in term infants was significantly higher than in preterm infants, but the cord serum selenium levels in both groups were in a suggested normal range. Therefore, selenium supplementation for pregnant women and neonates is not suggested in the population of Isfan. However, this study is the first report on maternal serum and infant cord blood selenium levels in Iran and additional research in this area is needed for a more reliable recommendation.

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