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The Assessment of Cord Blood Selenium Level in Preterm and Full-Term Neonates

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ABSTRACT

Background: Low selenium concentrations in the mother or her fetus can affect on infection risk, a major cause of preterm birth. Selenium status is also important in the group of hospitalized neonates and infants.

Objective: This study aimed to measure cord blood selenium levels in full term and preterm neonates.

Subjects and Methods: A total of 120 full and preterm neonates and their mothers included in this study. They were admitted to delivery room, Pediatric Department at Benha Teaching Hospital, Egypt. The study was conducted through the period from February 2020 to December 2020. They were subjected to full history taking, routine, physical examination and cord blood selenium was measured.

Results: Full-term neonates had significantly higher GA, Wt., Lt and selenium levels than pre-term neonates. Also, there was no significant differences between full-term neonates and pre-term neonates regarding CRP, TLC and PLT. Also, selenium supplementation didn't show any significant effect on several clinical parameters as gestational age, weight, height, circumference, mother age, C-reactive protein, TLC and PLT among full-term neonates. On contrast, selenium supplementation showed a significant improved serum selenium level among preterm and full-term neonates.

C**onclusions:** Full-term neonates had significantly higher selenium levels than pre-term neonates. Selenium concentrations are reduced in neonates, especially in those with lower gestational age and birth weight. Supplementation significantly affected serum selenium levels as compared to non- supplemented.

Keywords: Cord blood selenium, Full-term, Neonates, Preterm, Supplementation.

INTRODUCTION

Pregnancy is a period of increased metabolic demands and deficiency of trace elements during pregnancy is closely related to mortality and morbidity in the newborn [(1)]. Deficiencies of specific antioxidant activities associated with the micronutrients selenium, copper, zinc, and manganese can result in poor pregnancy outcomes, including fetal growth restriction and preeclampsia [(2)].Most selenium is in the form of selenomethionine in animal and human tissues, where it can be incorporated nonspecifically with the amino acid methionine in body proteins. Skeletal muscle is the major site of selenium storage, accounting for approximately 28% to 46% of the total selenium pool. Both selenocysteine and selenite are reduced to generate hydrogen selenide, which in turn is converted to selenophosphate for selenoprotein biosynthesis [(3)].

Selenium deficiency has also been associated with a greater number of diseases and clinical complications. **Klinger *et al.*** [(4)] found selenium deficiency in most premature infants however, there was not a significant correlation between selenium levels and thyroid hormones. **Freitas *et al.*** [(5)] found no relationship between the incidence of bronchopulmonary dysplasia and selenium status. Available studies suggest that this is the case. Earlier research has also demonstrated that supplements of selenium yeast may help make the pregnancy and birth safer [(6)]. In the pediatric population, selenium deficiency is most commonly found in preterm infants, associated with gestational age, feeding after birth and clinical status [(7)]. According to the National Health and Medical Research Council **(NH & MRC)** [(8)]. Pregnant women who took supplements of selenium yeast had a lower rate of preeclampsia, which is the leading cause of preterm birth. Preeclampsia causes symptoms such as hypertension, oedema, and proteinuria (excess protein in the urine) and may also lead to rare but potentially life-threatening conditions like eclampsia [(9)].

Selenium deficiency has also been associated with the use of oral infant formula, enteral and parenteral nutrition (with or without selenium addition). The optimal dose and length of selenium supplementation is not well-established, since they are based only on age group and selenium ingestion by breastfed children. Furthermore, the clinical status of the infant affected by conditions that may increase oxidative stress, and consequently, selenium requirements is not considered [(10)]. They concluded that prematurity and low birth weight can contribute to low blood selenium in premature infants. Selenium supplementation seems to minimize or prevent clinical complications caused by prematurity. The few studies of plasma selenium status in parenterally fed neonates have shown that plasma selenium concentration decreased during parenteral feeding and tended to increase when oral feedings were introduced [(11)].

Different factors such as gestation age, habitat, mother's age and nutritional index can effect selenium concentration in maternal blood, umbilical cord (UC) blood and placenta [(12)]. The maternal trans-placental transfer of Se to fetus is limited. Selenium is stored in fetal liver between 20th and 40th week. The average cord blood selenium level is reported to be 35–107 µg/l related to some factors like selenium content of soil in the different geographic region, gestational age, and serum Selenium concentration after 36 weeks [(13)]. The aim of this study was to measure cord blood selenium levels in full term and preterm neonates.

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SUBJECTS AND METHODS

A total of 120 full and preterm neonates and their mothers included in this study. They were admitted to delivery room, Pediatric Department at Benha Teaching Hospital, Egypt through the period from February 2020 to December 2020.

All neonates and their mothers included in this study were divided into two groups:

Group A (full term): included 60 full-term neonates their mothers were supplementand or non-supplemented by selenium.

Group B (preterm): included 60 pre-term neonates, their mothers were supplementand or non-supplemented by selenium.

Ethical consideration:

The study was approved by The Ethical Committee of Benha Teaching Hospital. Written informed consent was obtained from every patient's guardian after a simple and clear explanation of the research objectives. The approval form was developed in accordance with the quality and improvement system standards of the Ministry of Health in Egypt and in accordance with the Declaration of Helsinki.

Inclusion criteria included full term neonate (37wk-40wk), preterm neonate < 37weeks of gestation and vaginal and caesarian section delivery.

Exclusion criteria included any babies with any congenital anomalies or any brain insult. Any babies of mothers having diabetes mellitus, hypertension or any other medical problems. Mother suffering from any chronic disease as liver dieses, hypertension and diabetes mellitus.

All cases were subjected to the following:

Complete history: age of mother, mode of delivery and gestational age.

Clinical examination including anthropometric measurements such as, height, weight, body mass index (BMI), head circumference, chest examination, cardiovascular examination, abdominal examination and neurological examination.

Complete blood count (CBC) including total leucocytic count and platelets count that were assayed by the Sysmex SF-3000 autoanalyzer system.

C-reactive protein (C-rp): It is an acute phase reactant protein made by liver. This test is based on latex agglutination when latex particles are mixed with patient's serum and an agglutination reaction will take place within 2 minutes [(14)].

Determination of serum selenium: Serum selenium was determined by electrothermal atomic absorption spectrometry with Zeeman background correction using a palladium chloride chemical modifier (PERKIN-ELMER100, USA). The sample solutions were sucked directly into the burner by a capillary tube and readings in microgram per deciliter were taken directly from the digital display [(15)].

Statistical Analysis

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for Social Sciences) version 22 for Windows® (IBM SPSS Inc., Chicago, IL, USA). Data were tested for normal distribution using Shapiro Walk test. Qualitative data were represented as frequencies and relative percentages. Chi square test (χ^2) was used to calculate difference between two or more groups of qualitative variables. Quantitative data were expressed as mean ± SD (Standard deviation). Independent samples t-test was used to compare between two independent groups of normally distributed variables (parametric data). P value ≤ 0.05 was considered significant.

RESULTS

A total of 120 full and preterm neonates and their mothers were included in this study. GA, Wt., and Lt of full-term neonates were significantly higher than pre-term neonates. While, the other clinical and laboratory parameters (HC, mothers' age, C-rp, TLC and PLTs did not show any significant difference among the two studied groups (p > 0.05). On the other hand, full-term neonates had significantly higher selenium levels (72.67 ± 10.26 µg/l) than pre-term neonates (58.41 ± 11.60 µg/l) as shown in table (1).

Table (1): Clinical and laboratory data among full terms and pre-terms

Parameters	Pre-Terms	Full-term	Sig. test	
	Mean ±SD	Mean ±SD	t test	P
GA (wks.)	33.5±1.73	38.53±1.07	7.849	0.000*
Wt.(kg)	2.658±0.75	3.221±0.67	3.563	0.000*
Lt.(cm)	48.97±3.58	50.45±2.05	5.348	0.001*
HC (cm)	33.39±2.98	34.10±1.13	1.800	0.072
Mother age (years)	29.92±2.70	30.49±3.13	1.328	0.184
C-rp (mg/L)	3.583±0.821	5.470±1.35	1.653	0.098
TLC (mm^3)	13.83±3.41	12.94±2.53	0.862	0.389
PLT (mm^3)	271.0±6.21	262.05±6.43	0.196	0.845
Selenium (µg/l)	58.41±11.6	72.67±10.26	3.685	0.007*

GA: gestational age, Wt. Weight, Lt Length, HC: Head circumference, CRP C-reactive protein, TLC: total Leukocytic count, PLT: platelets, Se. selenium level. SD: stander deviation

Selenium supplementation didn't show any significant effect on several clinical parameters as gestational age, weight, height, circumference, mothers' age, C-rp, RP, TLC and PLT among preterm neonates. On contrast, selenium supplementation improved significantly serum selenium level among preterm neonates (Table 2).

Table (2): Clinical and laboratory data of full-term neonates for supplemented and non-supplemented mothers

Parameters	Full-term		Sig. test	
	Supplement	Un supplement	t test	P value
GA (wks.)	38.53±1.079	38.07±2.11	0.56	0.88
Wt.(kg)	2.921±0.367	3.03±0.245	0.58	0.47
Lt.(cm)	48.45±2.005	49.12±3.45	1.30	0.563
HC (cm)	32.10±1.136	34.00±1.50	0.004	0.12
Mother age (years)	34.49±3.123	30.16±4.98	0.071	0.965
CRP (mg/l)	4.87±0.354	5.01±0.30	0.115	0.465
TLC (mm^3)	12.94±3.11	11.89±4.20	0.190	0.066
PLT (mm^3)	252.05±31.4	258.76±16.21	1.67	0.076
Selenium (µg/l)	75.67±13.09	67.33±15.88	5.09	0.004*

GA: gestational age, Wt. Weight, Lt Length, HC: Head circumference, CRP C-reactive protein, TLC: total Leucocytic count, PLT: platelets, Se: selenium level. SD: stander deviation

Additionally, Pearson correlation coefficient analysis indicated that selenium level wasn't significantly correlated with all of the clinical and laboratory data under study ($p > 0.05$) (Table 3).

Table (3): Selenium levels in relation clinical and laboratory data among the studied patients

Parameters	Selenium level		Significance
	r	P value	
CRP (mg/l)	0.174	0.216	NS
Wt.(kg)	0.007	0.927	NS
Lt.(cm)	-0.070	0.323	NS
HC (cm)	0.062	0.382	NS
GA (wks)	-0.050	0.475	NS
TLC (mm3)	0.102	0.470	NS
Mother age(years)	0.022	0.758	NS

GA: gestational age, Wt. Weight, Lt Length, HC: Head circumference, CRP C-reactive protein, TLC: total Leukocytic count. r: Pearson correlation coefficient.

DISCUSSION

Studies showed that poor diet in pregnancy was associated with higher incidence of miscarriages, stillbirths and early neonatal mortality in comparison with good diet [16]. Intake of food supplements in women with poor diet lead to reduction of frequency of pregnancy complications and the predicted frequencies of birth defects [17]. Several micronutrient deficiencies especially multiple micronutrient deficiencies, rather than single deficiencies have been postulated to result in pregnancy complications and the anthropometric disorders of the newborns. Thus, the effect of good and poor diets on pregnancy outcome and newborns cannot be attributed to a single nutrient [18]. The risk of oxidative stress in neonates depends majorly on the maternal antioxidant status, which is important for the protection of the maternal–fetal unit against free radicals. Maternal selenium deficiency is considered to be a contributory factor to the causation of oxidative stress in the neonate [11].

In our study, full-term neonates showed that HC, GA, Wt., and Lt were significantly higher than pre-term neonates. While, the other clinical and laboratory parameters did not show any significant difference among the two studied groups. Similar results were stated by **Monteiro *et al.*** [19] who stated that prematurity affects birth weight and that the birth weight is the anthropometric indicator that has the greatest influence on health and newborn survival. Similarly, **Tsuzuki *et al.*** [20] reported that low birth weight infants (LBWIs) had lower serum Se concentrations. Also, other study showed that prematurity affects birth weight [21]. Thus, birth weight is considered to be the anthropometric indicator that has the greatest influence on health and newborn survival [22]. **Makhoul *et al.*** [23] observed that the lower the weight, the lower the concentration of selenium in newborns. While, **Bogye *et al.*** [24] stated that very low birth weight premature infants are obviously susceptible to selenium deficiency.

The current study showed that full-term neonates had significantly higher selenium levels than pre-term neonates. These results agree with the study of **Al-Saleh *et al.*** [25] in which they measured selenium in 300 umbilical cord blood samples collected from healthy pregnant women in Al- Kharj area in Saudi Arabia and reported that serum selenium levels were lower (32 ± 8.029 µg/l) in pre-term neonates than full term neonates

(41.323 ± 8.784 µg/l). Additionally, **Wu *et al.* [26]** analyzed umbilical cord selenium concentration of of 262 term infants (37- 42 weeks) and 248 preterm infants (26 to 36 weeks) and reported similar results. On contrast, **Nassi *et al.* [7]** found that selenium levels were significantly higher in pre-term compared to full term neonates (70.66 ± 11.65 µg/l versus 65.88 ± 10.2665 µg/l). The difference in results could be attributed to enrollment of less pre mature babies with mean gestational age of 34 weeks and the small proportion of pre-term infants in our study.

The current study showed that supplementation significantly affected weight of neonates. Also, supplementation significantly affected serum selenium levels (71.18 ± 10.47 µg/l) as compared to non-supplemented (58.75 ± 11.08 µg/l). On contrast, supplementation didn't affect none of the clinical and laboratory parameters as gestational length, head circumference, mother age (years), C-rp (mg/dl), PLT (mm^3) and TLC (mm^3). These results come in agreement with **Mask *et al.* [27]** who suggested that low selenium values found in preterm infants must be associated with selenium supplementation during gestation. Also, **Freitas *et al.* [28]** found that selenium supplementation didn't affect serum selenium levels in neonates and none of the clinical and other laboratory parameters. Our results disagree with **Boskabadi *et al.* [29]** who found that there is no significant difference in cord blood selenium levels observed between those who were supplemented and those who were not supplemented. This could be explained by the fact that Se. is present in many foods in adequate amount **[30].**

In our study, selenium level wasn't statistically significantly correlated with all of the clinical and laboratory data under study as GA, weight, length, head circumference, mother age, C-rp, TLC and PLT. These results are in agreement with **Freitas *et al.* [5]** who found that there was no correlation between serum selenium levels and birth weight of the neonates. Similarly, **Grover and Avasthi [31]** reported that no correlation was observed between the plasma Se with gestational age, head circumference and CBC. On contrast, our results disagree with **Tsuzuki *et al.* [20]** who observed that the lower the weight, the lower the concentration of selenium in newborns**.** Also**, Bogye *et al.* [24]** stated that very low birth weight premature infants are obviously susceptible to selenium deficiency. While, **Al-Saleh *et al.* [25]** stated that there is a significant positive correlation between selenium levels and birth weight. This finding suggests that low selenium is related to low birth weight.

CONCLUSION

Full-term neonates had significantly higher selenium levels than pre-term neonates. Selenium concentrations are reduced in neonates, especially in those with lower gestational age and birth weight. Supplementation significantly affected serum selenium levels as compared to non- supplemented. Selenium level wasn't correlated with any of the clinical and laboratory data as GA, weight, length, head circumference, mother age, C-rp, TLC and PLT.

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