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Role of trace elements in anemia in pregnancy

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OBJECTIVE(S) : To study the role of trace elements in anemic pregnant women in their second and third trimester.

METHOD(S) : One hundred and fortyfive pregnant women in their second and third trimester were enrolled in this prospective study and serum trace elements estimation for iron, copper and zinc was done using atomic absorption spectrophotometry.

RESULTS : There were significantly lower levels of serum iron and zinc ($P<0.001$) in anemic women as compared to those in nonanemic pregnant women in second and third trimester. Copper and hemoglobin levels were found inversely correlated and serum copper was significantly higher ($P<0.001$) in anemic pregnant women than in nonanemic ones in second and third trimester.

CONCLUSION(S) : There appears to be an intriguing interrelation between iron, copper and zinc in absorption and utilization. Therefore combined zinc and iron supplementation should be recommended to pregnant women, especially those with anemia.

Key words : trace elements, pregnancy with anemia

Introduction

Vitamins and minerals collectively referred to as micronutrients have important influence on the health of pregnant women and the growing fetus. Pregnancy is associated with increased demand for all the nutrients like iron, copper, zinc, vitamin-B_{12}, folic acid and ascorbic acid, and deficiency of any of these could affect pregnancy, delivery and outcome of pregnancy [1].

Zinc and copper deficiency is associated with anemia or iron deficiency and affects fetal growth and women during pregnancy [2].

Iron deficiency results in anemia, which may increase the risk of death from hemorrhage during delivery. It is a common experience that anemia of pregnancy is sometimes not corrected despite iron supplementation.This may be due to underlying deficiency of other micronutrients, which affect pregnancy, fetal development, and childbirth.

Supplementation of zinc alone with iron improves hemoglobin and is beneficial in iron deficiency anemia. In this context the present study was conducted to examine serum iron, copper, and zinc status in anemic pregnant women in second and third trimester of pregnancy.

Methods

The study was carried out on 145 pregnant women, both outdoor and indoor ones, in their second and third trimester of pregnancy. The indoor women numbered 37 and they all were admitted for severe anemia. The study period was 1 year (2005-2006).

The enrolled women were divided in control group (n=45) and study group (n=100) on the basis of hemoglobin concentration i.e. Hb>10 g/dL and Hb $\leq$ 10 g/dL respectively. The study group was further categorized on the basis of gestational age, as study group A (n=45) i.e. pregnant women

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between 13-28 weeks gestational age and study group B (n=55) i.e. pregnant women between 29-40 weeks gestational age. Pregnant women with hypertension, diabetes mellitus, tuberculosis, cardiovascular disease, respiratory problem, liver disease, renal disease and metabolic disorders were excluded from the study.

Five mL of venous blood samples were taken in disposable syringes from the women's antecubital vein and immediately refrigerated at 4^0C for the separation of serum. Samples were then centrifuged to take out the clear serum which was then transported to laboratory for analysis of serum iron, copper, and zinc by atomic absorption spectrophotometry.

Student paired t test was used for statistical analysis.

Results

Out of the total 145 pregnant women studied 45 were nonanemic, and 100 anemic in their second and third trimester. The two groups were compared for mean age, mean parity and mean hemoglobin concentration.

Table 1 shows an insignificant association for mean age (P>0.05) while a significant association was observed for mean gestational age (P<0.001), mean parity and mean hemoglobin concentration (P<0.001) between nonanemic and anemic pregnant women.

Table 1 shows no significant difference in mean age and mean gestational age in study group A and B when compared to respective controls. However, the mean hemoglobin concentration was significantly lower in study group A and in study group B when compared to controls.

Table 2 shows statically significant low mean serum iron and serum zinc levels in anemic counterparts.

Serum copper level showed a steady rise as the pregnancy advanced from second trimester to third trimester in nonanemic women, but the rise in serum copper level in anemic subjects was observed to be significantly more when compared to controls.

Table 1. Mean age, mean gestational age and mean hemoglobin concentration of nonanemic and anemic pregnant women.

	Group A		**Group B**	
	Control group (n=16) Mean ± SD	**Study group (n=45) Mean ± SD**	**Control group (n=29) Mean ± SD**	**Study group (n=55) Mean ± SD**
Age (in years)	25.57 ± 4.03	23.31 ± 4.39	24.31 ± 4.15	24.50 ± 4.39
	t = 1.804, P < 0.071		t = 0.187, P <0.864	
Gestational age (in weeks)	25.06 ± 3.29	23.35 ± 3.94	34.50 ± 5.71	32.20 ± 2.81
	t = 1.556, P <0.126		t = 1.941, P <0.056	
Hemoglobin (g/dL)	11.06 ± 0.88	07.51 ± 1.68	10.96 ± 0.50	36.89 ± 1.58
	t = 8.033, P<0.000		t = 13.341, P<0.000	

Student paired t test used for statistical analysis.

Table 2. Serum iron, copper and zinc status of nonanemic and anemic pregnant women.

	Group A		**Group B**	
	Control group (n=16)Mean ± SD	**Study group (n=45) Mean ± SD**	**Control group (n=29) Mean ± SD**	**Study group (n=55) Mean ± SD**
Serum Iron (mg/dL)	43.65 ± 6.35	37.02 ± 9.53	38.90 ± 5.10	31.98 ± 6.60
	t = 2.574, P< 0.012		t = 4.916, P <0.001	
Serum copper (ug/dL)	245.50 ± 45.50	318.09 ± 24.99	269.46 ± 44.09	399.66 ± 30.12
	t = 7.702, P <0.001		t = 15.974, P <0.001	
Serum Zinc (ug/dL)	80.42 ± 7.76	58.33 ± 8.09	75.60 ± 9.76	47.52 ± 8.38
	t = 9.472, P<0.001		t = 13.786, P<0.001	

Student paired t test used for statistical analysis

Discussion

Minerals and vitamins play a major role in regulating the metabolic processes of living organisms. In pregnancy, there is an increased requirement of these nutrients to satisfy the needs of the growing fetus and maintain the optimal nutritional status of the mother. Vitamins and minerals cannot be synthesized de novo in human body. Thus, an increased demand can only be met by available reserves or additional supply.

Iron deficiency results in anemia which may increase the risk of death from hemorrhage during pregnancy and delivery.

In our study serum iron and zinc showed a decreasing trend as hemoglobin decreased while an inverse correlation was found between copper and hemoglobin levels. Similar were the observations of other workers[2,3].

The values of serum iron and zinc were significantly lower (P=0.0486 and 0.0188 respectively) while values of serum copper were significantly higher (P=0.0209) in cases of pregnancy with anemia when compared to nonanemic pregnant women of same gestational period. This is in agreement with previous reports[2-5].

Zinc is passively transferred from mother to fetus across the placenta and there is also decreased zinc binding capacity of maternal blood during pregnancy which facilitates efficient transfer of zinc from mother to fetus. The fall in zinc during pregnancy could also be a physiological response to expanded maternal blood volume[1].

Besides various inhibiting factors in the vegetarian diet, over supplementation of iron during pregnancy could also adversely affect absorption of zinc.

Thus several factors contribute to the decrease of serum zinc during pregnancy with anemia viz., hemodilution, decrease of zinc binding proteins (mainly albumin), fetal demands, and endocrine changes such as increase in serum estrogen and corticosteroid concentrations.

Pregnant women had significantly elevated serum copper levels and the levels had further increased in pregnant women with anemia. The increase in copper in anemic women could be a compensatory mechanism to counteract anemia and this is accompanied by increased synthesis of ceruloplasmin which has feroxidase like activity. Amongst various factors affecting copper level, elevated level of estrogen during pregnancy also increases the synthesis of ceruloplasmin by making copper available through mobilization from maternal tissues especially liver[1].

The increase in serum copper during pregnancy is mainly in a bound form due to increase in the carrier protein ceruloplasmin in response to stimulation by elevated maternal estrogen. Moreover, there is also increased copper retention during pregnancy [6].

There appears to be a complex interrelation between iron, copper and zinc in absorption and utilization. In view of this the judicious supplementation of trace elements during pregnancy, especially in iron deficiency anemia, is essential to maintain their optimum blood levels required for proper growth of fetus.

Conclusion

Combined zinc and iron supplementation should be recommended to pregnant women, especially those with anemia.

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