Plasma Zinc Level and Intrauterine Growth Retardation : A Study in Pregnant Women in Ramathibodi Hospital

RASIG ROUNGSIPRAGARN, M.D.*,
STREERUT BORIRUG, B.Sc., M.Sc. (Nutrition)**,
YONGYOTH HERABUTYA, M.B., B.S., M.R.C.O.G.*

Abstract

The study was designed to establish the relationship between plasma zinc level and intrauterine growth retardation in 405 normal pregnant women with an age range from 20 to 35 years, who attended and delivered at Ramathibodi Hospital The data were gathered from October 1994 to April 1995. The zinc levels were obtained from blood plasma collection and the assessment of fetal status was made after birth. Using criteria of babies with a birthweight of less than the 10th centile at delivery. Plasma zinc level in mother was collected during antenatal care and labour. Plasma zinc level was determined by Atomic Absorption Spectrophotometry.

The plasma zinc levels in mothers during antenatal care, labour and infant birthweight were 66.73 μg/dl, 69.91 μg/dl and 3152.25 g respectively. Maternal plasma zinc levels during antenatal care, labour and infant birthweight in the intrauterine growth retardation infant group were significantly lower than that in normal growth infants ($P< 0.05$)

In conclusion, our study shows that measurement of maternal plasma zinc concentration in the third trimester would highly suggest mothers at risk of delivering intrauterine growth retardation babies. Mothers selected in this way might benefit from dietary advice and zinc supplementation during the remaining pregnancy.

Key word : Intrauterine Growth, Plasma Zinc Level, Pregnant Women, Ramathibodi Hospital

Zinc is an essential element which is universally required by plants and animals for many physiological processes including nucleic acid and protein synthesis(1). It is necessary for growth and zinc deficiency is associated with short stature and dwarfism. Animals fed zinc deficient diets during pregnancy have shown an increased rate of pregnancy complications such as fetal loss, neonatal death, abnormal deliveries, a high incidence of fetal malformation and growth retardation(1,2). Low

* Department of Obstetrics and Gynecology,
** Division of Obstetrics and Gynecology, Department of Nursing, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok 10400, Thailand.

maternal mid gestation plasma or term leucocyte zinc concentrations have been reported in women giving birth to infants with congenital malformations or intrauterine growth retardation although many other studies have failed to find such a relationship[3-9].

This study was designed to establish the relationship between plasma zinc level and intrauterine growth retardation.

MATERIAL AND METHOD

All healthy pregnant women aged between 20 and 35 years who booked for antenatal care between October 1994 and April 1995, and subsequently attended at least 4 visits were included. This prospective study of maternal blood samples were taken in the third trimester, during labour and were analyzed for zinc level using Atomic Absorbtion Spectrophotometry by direct dilution sample method. Infant birthweights were recorded and evaluated for intrauterine growth retardation using the 10th centile cut off level according to Ramathibodi intrauterine growth chart[10].

RESULTS

Demographic data of the 405 women are shown in Table 1. Intrauterine growth retardation infants were found in 22 infants (5.4%) (Table 2). The mean plasma zinc level in mothers during antenatal care, labour and the mean infant birthweights were 66.73 ± 26.06 μg/dl, 69.91 ± 24.65 μg/dl and 3152.25 ± 432.41 g respectively (Table 3). Mean maternal plasma zinc concentration during antenatal care and labour were significantly lower in the groups of women who gave birth to intrauterine growth retardation infants than that in normal growth infants ($P < 0.05$). The weight of infants with intrauterine growth retardation was lower than that in normal growth infants ($P < 0.05$) (Table 4).

Table 1. Characteristics of the mothers. (N = 405)

Character	Mean ± SD
Age (yr)	28.08 ± 4.27
Weight (kg)	51.48 ± 8.20
Height (cm)	155.30 ± 4.84
BMI	21.65 ± 2.7
Parity	1.6 ± 0.8

Table 2. Per cent distribution of normal growth infants and intrauterine growth retardation infants.

Character	N	%
Normal growth infants	383	94.6
Intrauterine growth retardation infants	22	5.4
Total	405	100

Table 3. Zinc values in plasma of mothers during antenatal care, during labour and infant weight.

Character	Mean ± SD
Zinc values during ANC (μg/dl)	66.73 ± 26.06
Zinc values during labour (μg/dl)	69.91 ± 24.65
Infant weight (g)	3152.25 ± 432.41

DISCUSSION

This study confirms that in pregnancy maternal plasma zinc concentration in third trimester and at term was significantly lower in those

Table 4. Zinc values in plasma of mothers during antenatal care during labour and infant weight between normal growth infants and intrauterine growth retardation infants.

Character	Normal growth infants (Mean ± SD)	Intrauterine growth retardation infants (Mean ± SD)	P-value
Zinc values during ANC (μg/dl)	67.50 ± 24.68	50.10 ± 15.96	<0.05
Zinc values during labour (μg/dl)	77.63 ± 23.71	59.15 ± 12.18	<0.05
Infant weight (g)	3100.90 ± 432.85	2359.54 ± 269.06	<0.05

mothers who produced intrauterine growth retardation babies as compared to that from mothers with normal growth babies. The mechanism of zinc depletion of mothers in pregnancy is unknown, but is likely to be dietary. Zinc, like iron, is mainly present in dietary protein, and the intake of both may therefore be decreased as a result of dietary protein deficiency. There is evidence of suboptimal zinc intake in several populations[11]. The normal body stores of zinc are half those of iron, and Hurley has suggested that zinc in the fetus is only in dynamic equilibrium with the maternal plasma pool[12]. If the maternal plasma pool of zinc was transiently depleted due to decreased dietary intake of zinc, and influx into it from the main stores of zinc in muscle and bone were slow, then transient fetal zinc depletion might occur at an important time in development. Unlike iron, zinc transport across the placenta is rapid and bidirectional[13,14] and so if maternal tissue zinc depletion occurs during pregnancy not only will maternal plasma zinc levels decline, but also even reversal of net transport of zinc across the placenta could occur in order to maintain maternal tissue zinc status.

The positive correlation between birthweight and maternal plasma zinc concentration suggests that in response to an increased fetal requirement proportionate to fetal size, there is a redistribution of the maternal zinc level resulting in a relative increase in plasma zinc concentration to facilitate passive zinc diffusion to the fetus[15]. From the observed positive correlation between fetal weight and maternal plasma zinc level one can postulate that in the presence of lower plasma zinc the fetal growth will be impaired and this effect will be more pronounced in the later part of pregnancy when the fetoplacental requirement is greatest and a state of relative zinc deficiency may develop particularly if there is inadequate zinc intake.

In conclusion, our study has shown that measurement of maternal plasma zinc concentration in third trimester would highly select mothers at risk of delivering intrauterine growth retardation babies. Mothers selected in this way might benefit from dietary advice and zinc supplementation during the remaining pregnancy, and withholding of iron and folate supplementation if they were not iron deficient.

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REFERENCES

1. Dreosti IE, Record IR, Manuel SJ. Zinc deficiency and the developing embryo. Biol Trace Element Res 1985; 7: 103-22.
2. Golub MS, Gershwin ME, Hurley LS, Baly DL, Hendricks AG. Studies of marginal zinc deprivation in rhesus monkeys: II Pregnancy outcome. Am J Clin Nutr 1984; 39: 879-87.
3. Apgar J, Zinc and reproduction. Ann Rev Nutr 1985; 5: 43-68.
4. Campbell BM, Ward RJ, Haine AP, North WRS, Abraham R, Fadyen IR. Zinc and copper in Asian pregnancies - is there evidence for a nutritional deficiency?. Br J obstet Gynecol 1985; 92: 875-85.
5. Nasrat H, Bloxam D, Nicolini U, et al. Midpregnancy plasma zinc in normal and growth retarded fetuses - a preliminary study. Br J Obstet Gynecol 1992; 99: 646-50.
6. Frkovic A, Medugorac B, Alebic JA. Umbilical cord blood zinc levels in normal and pathological pregnancies. Int J Gynecol Obstet 1997; 57: 181-2.
7. Frkovic A, Medugorac B, Alebic JA. Zinc levels in human milk and umbilical cord blood. Sci Total Envison 1996; 192: 207-12.
8. Ghebremeskel K, Burns L, Burden TJ, et al. Vitamin A and related essential nutrients in cord blood: relationship between anthropometric measurements at birth. Early Hum Dev 1994; 39: 177-88.
9. Wasowicz W, Wolkanin P, Bednarski J, Gromadzinska J, Sklodowska M, Grzybowska K. Plasma trace elements (Se, Zn, Cu) concentrations in maternal and umbilical cord blood in Poland. Biolog Trace Elem Res 1996; 38: 205-15.
10. Chanrachakul B, Herabutya Y, Suthutvoravut S. Ramathibodi Hospital standard growth for birthweight from 28 to 42 gestational weeks. Thai J Obstet Gynecol 1997; 9: 7-11
11. Hambidge KM, Nicholls BC. Zinc and copper in clinical medicine. New York: Spectrum Publication, 1978.
12. Hurley LS. Teratogenic aspects of manganese, zinc and copper nutrition. Physiol Rev 1981; 61:

249-95.
13. Mansour MM, Schulert AR. Mechanisms of placental iron transfer in the rat. Am J physiol 1972; 222: 1628-33.
14. Terry CW, Boyd E. Transfer of zinc across the placenta and fetal membranes of the rabbit. Am J physiol 1960; 198: 303-8.
15. Henkin RI, Marshall JR, Meret S. Maternal fetal metabolism of copper and zinc at term. Am J Obstet Gynecol 1971; 110: 131-4.

ปริมาณสังกะสีในพลาสมากับภาวะการเจริญเติบโตช้าของทารกในครรภ์: ศึกษาเฉพาะกรณีหญิงตั้งครรภ์ที่ฝากครรภ์และคลอดในโรงพยาบาลรามาธิบดี

รสิก รังสิปราการ, พ.บ.,*
*สตรีรัตน์ บริรักษ์, วท.บ., สม. โภชนวิทยา)**,*
*ยงยุทธ เหราบัตย์, M.B., B.S., M.R.C.O.G.**

การศึกษามีวัตถุประสงค์เพื่อหาความสัมพันธ์ระหว่างระดับสังกะสีในพลาสมาในหญิงตั้งครรภ์กับภาวะการเจริญเติบโตช้าของทารกในครรภ์ โดยทำการศึกษากับหญิงตั้งครรภ์ที่ฝากครรภ์และคลอดในโรงพยาบาลรามาธิบดี จำนวน 405 คน ที่มีสุขภาพแข็งแรงไม่มีภาวะแทรกซ้อน อายุ 20–35 ปี เก็บข้อมูลในช่วงเดือนตุลาคม พ.ศ.2537 ถึงเดือนเมษายน พ.ศ.2538 โดยการเก็บตัวอย่างเลือดเพื่อหาระดับสังกะสีในพลาสมาในหญิงตั้งครรภ์ ขณะฝากครรภ์และขณะคลอดทำการประเมินภาวะการเจริญเติบโตช้าของทารกในครรภ์ โดยน้ำหนักแรกคลอดต่ำกว่า 10th centile การตรวจหาสังกะสีในพลาสมาโดยใช้เครื่อง Atomic Absorption Spectrophotometry

ผลการศึกษาพบว่าระดับสังกะสีในพลาสมาของหญิงตั้งครรภ์ ขณะฝากครรภ์ ขณะคลอดและน้ำหนักของทารกแรกคลอด มีค่าเท่ากับ 66.73 μg/dl, 69.91 μg/dl และ 3152.25 g ตามลำดับ ในทารกที่สภาวะการเจริญเติบโตช้าในครรภ์พบว่าระดับสังกะสีในพลาสมาของหญิงตั้งครรภ์ขณะฝากครรภ์และขณะคลอด รวมทั้งน้ำหนักทารกแรกคลอดมีระดับต่ำกว่าในทารกที่มีสภาวะการเจริญเติบโตปกติในครรภ์อย่างมีนัยสำคัญทางสถิติ ($P < 0.05$)

จากการศึกษาครั้งนี้ สรุปได้ว่าการหาค่าระดับสังกะสีในพลาสมาของหญิงตั้งครรภ์ในไตรมาสที่สามนั้น สามารถคัดกรองหญิงตั้งครรภ์ที่มีอัตราเสี่ยงต่อภาวะการเจริญเติบโตช้าของทารกในครรภ์ได้ และหญิงตั้งครรภ์ในส่วนนี้ควรที่จะแนะนำอาหารที่มีปริมาณสังกะสีมากพอหรือให้ยาบำรุงที่มีสังกะสีทดแทนให้เพียงพอต่อไป

คำสำคัญ : การเจริญเติบโตของทารกในครรภ์, ปริมาณสังกะสีในพลาสมา, หญิงตั้งครรภ์, โรงพยาบาลรามาธิบดี

* ภาควิชาสูติศาสตร์–นรีเวชวิทยา,
** หน่วยสูติศาสตร์–นรีเวชวิทยา, ภาควิชาพยาบาลศาสตร์, คณะแพทยศาสตร์ โรงพยาบาลรามาธิบดี, มหาวิทยาลัยมหิดล, กรุงเทพ ฯ 10400