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LEUCOCYTE AND SERUM ASCORBIC ACID LEVELS IN MOTHERS AND THEIR NEWBORN IN SEMI-ARID WESTERN INDIA

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Abstract : Leucocyte ascorbic acid (LAA) and serum ascorbic acid (SAA) have been estimated in 50 pregnant women, their newborn infants, and 14 non-pregnant women living in the semi-arid region of western India. LAA was significantly higher in the newborn as compared to their mothers, the mean values being 35.52±6.85 and 23.94±5.84 $\mu g/10^8$ cells, respectively ($P<0.01$). The sex and birth weight of the infant, however, did not influence its ascorbic acid status. Pregnant women had relatively lower SAA (0.81±0.22 mg/dl) and LAA (23.94±5.84 $\mu g/10^8$ cells) as compared to the matched non-pregnant group (1.01±0.26 mg/dl and 29.98±8.45 $\mu g/10^8$ cells). But despite the semi-arid, draught prone geographical region and the hemodilution which accompanies pregnancy, none of the mothers had a clearly subnormal vitamin C status.

Key words : LAA SAA pregnancy mothers newborn

INTRODUCTION

It is well known that malnutrition can affect the outcome of pregnancy and compromise the physical and mental status of the newborn (1, 2). In this context vitamin C deficiency has been reported to be associated with increased neonatal mortality, decreased birth weight and pre-eclampsia (3, 4). During pregnancy the concentration of ascorbic acid in the serum decreases (5). This may reflect an increased metabolic demand, diminished intake, hemodilution or a combination of these. On the other hand few workers have reported higher levels of the vitamin in pregnant women (6). There are also reports according to which the levels are essentially the same in both pregnant and non-pregnant women (7).

The role of vitamin C in maternal nutrition becomes all the more relevant in arid and draught prone areas where the availability of fresh green foods is limited. We have therefore studied the vitamin C status of mothers and their newborn in the western region of India which borders on the Thar desert. We have laid greater emphasis on leucocyte ascorbic acid (LAA) because this is a better index of vitamin C status than serum ascorbic acid (SAA) and does not fluctuate with recent dietary intake.

METHODS

The study is based on 50 pregnant women and their newborn, and 14 matched non-pregnant controls in western India which borders on the Thar

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desert. The subjects were randomly selected from amongst those attending the department of obstetrics and gynaecology, Sampurnanand Medical College, Jodhpur (Rajasthan). The women were all non-smoker, lactovegetarian, normotensive, within± 15% of ideal body weight and not taking any drugs for preceding one month, patients with any obstetrical abnormality or disease complicating pregnancy were excluded.

Blood samples were collected from the antecubital vein of mothers immediately after delivery of the infant. For the newborn cord blood was taken from the maternal end of umbilical cord. LAA was determined by the modified method of Denson and Bowers (8) and results were expressed as $\mu g/10^8$ leucocytes. SAA was determined colorimetrically (9).

RESULTS

Both serum and leucocyte ascorbic acid levels have been found to be consistently higher in the newborn as compared to their mothers and the difference is statistically significant (Table I). The relationship is more impressive in the case of LAA where the coefficient of correlation between the LAA levels of mother and newborn is +0.567. On the other hand, the value of r between SAA of mother and newborn is only +0.133 which is statistically not significant.

TABLE I : SAA and LAA levels in mothers and newborn.

	SAA (mg/dl) Mean±SD	*LAA ($\mu g/10^8$ cells) Mean±SD*
Mothers n=50	0.81±0.22	23.94±5.84
Newborne n=50	1.35±0.28	35.52±6.85
P value	<0.001	<0.01

The sex of the newborn has not been found to make any difference in the ascorbic acid levels. The mean LAA values were 35.94±6.13 $\mu g/10^8$ cells in the boys and 35.09±7.60 $\mu g/10^8$ cells in the girls. Similarly SAA was 1.36±0.22 and 1.43±0.35 mg/dl in boys and girls respectively. Similarly, no difference was observed between the SAA and LAA levels of underweight (Less than 2500 g) and normal (2500 g and above) babies.

The 50 pregnant women were also compared with a suitably matched non-pregnant control group. The mean SAA and LAA levels were both significantly lower in the pregnant (Table II) although still falling within the normally accepted range (0.40 to 1.6 mg/dl of SAA; 21 to 53 $\mu g/10^8$ cells of LAA).

DISCUSSION

The blood of newborn infants has been found to contain ascorbic acid in concentrations significantly higher than their mothers. We have confirmed this by estimating LAA also which is a better index of the vitamin C status of an individual since it does not fluctuate with recent dietary intake (10). In all the 50 cases studied, the LAA in the infant at birth was higher than in the mother. It has to be borne in mind that we have estimated the mother's ascorbic acid at the time of delivery to coincide precisely with the moment the infant's venous cord blood was sampled. The coefficient of correlation between the LAA of mother and infant is 'mother-infant= +0.567 ($P<0.001$). It shows that maternal ascorbic acid status does influence the ascorbic acid level of the newborn and mothers with high ascorbic acid tend to produce infants with correspondingly higher ascorbic acid levels (Fig. 1).

Amongst the other possible determinants of the neonatal ascorbic acid blood level, we have found that sex and birth weight have practically no influence. Infants weighing less than 2500 g have almost the same SAA and LAA as infants weighing

more than 2500 g. Heinonen et al (11) have also found no significant difference in the SAA of premature and full term infants.

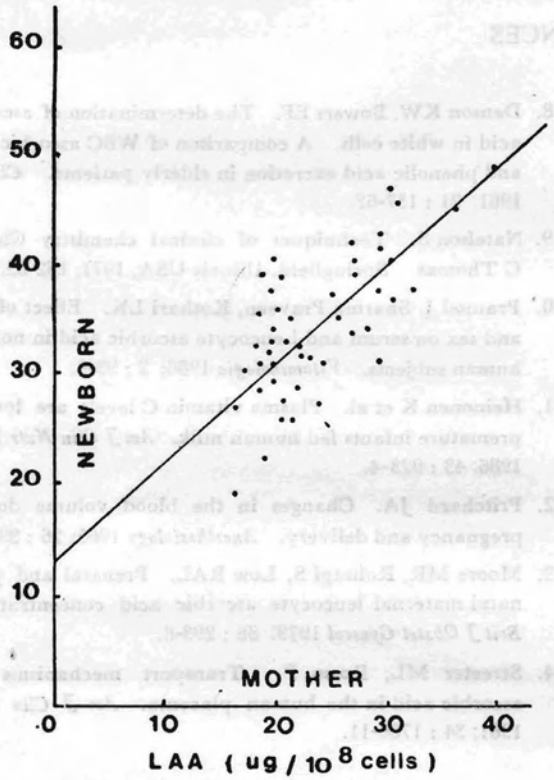

Fig. 1 : Correlation between the leucocyte ascorbic acid of mothers and their newborn. Value of r is+0.567, which is significant (P<0.001).

Focussing our attention now on the mother's vitamin C status, we find that all the 50 have SAA above the normally accepted minimum which is 0.4 mg/dl. Similarly LAA values in these women were also above 21 $\mu g/10^8$ cells. Accordingly we can say that none of the pregnant women were deficient in vitamin C. This is despite the fact that western Rajasthan where this study was conducted, is a semi-arid region on the Eastern fringe of the Thar desert and one can expect an inadequate vitamin C intake. But, atleast in the months when the samples were collected (September to March next) there was no clear evidence of any vitamin C deficiency.

However when the 50 pregnant women are compared with a suitably matched control we find that the difference between the two groups becomes statistically significant (Table II). Since the normal range for ascorbic acid is fairly wide, pregnant women are relatively deficient in both LAA and SAA although still not falling below minimal cut off point. Actually in clinical study, SAA practically disappears.

TABLE II : SAA and LAA in pregnant and non-pregnant women.

	Non-pregnant n=14	*Pregnant n=50*
Age (years) ±SD	21.43±4.11	23.26±4.77
SAA (mg/dl) ±SD	1.01±0.26	0.81±0.22*
LAA ($\mu g/10^8$ cells) ±SD	29.98±8.45	23.94±5.84*

* P <0.01

A relative fall in ascorbic acid during pregnancy can partly be due to hemodilution since the blood volume increases by approximately 48% by the end of the third trimester (12). Another contributing factor can be the increased demand of the foetus in the face of a constant maternal intake. Moore et al (13) have suggested that any type of stress including the stress of childbirth can lower blood ascorbic acid level. Therefore it can be said that 3 factors could be contributing to the relatively lower blood ascorbic acid in the mothers : (i) a semi-arid geographical region poor in fresh greens and fruits, (ii) pregnancy (iii) the stress of childbirth But despite this both SAA and LAA levels still remained within normal limits and newborn infants started life with a physiological hyperascorbic acidemia.

Several mechanism have been suggested to explain how the newborn acquires an ascorbic acid level higher than its mother, perhaps the highest it will have any time later in life (14). Its biological purpose if any, remains obscure and the ascorbic acid falls rapidly within the first 2-3 weeks of life.

REFERENCES

1. Naeye R, Blanc W, Paul C. Effects of maternal nutrition on the human fetus. *Pediatr* 1973; 52 : 494-503.
2. Ademowore AS, Courey NG, Kime JS. Relationships of maternal nutrition and weight gain to newborn birth weight. *Obstet Gynecol* 1972; 39 : 460-64.
3. Wideman GL, Biard GH, Bolding OT. Ascorbic acid deficiency and premature rupture of fetal membranes. *Am J Obstet Gynaecol* 1964; 88 : 592-5.
4. Clemetson CAB, Anderson L. Ascorbic acid metabolism in pre-eclampsia. *Obstet Gynecol* 1964; 24 : 774-82.
5. Morse EH et al. Comparison of nutritional status of pregnant adolescents with adult pregnant women. I. Biochemical findings. *Am J Clin Nutr* 1975; 28 : 1000-3.
6. Ibeziako PA, Ette SI. Plasma ascorbic acid levels in Nigerian mothers and newborn. *J Trop Pediatr* 1981; 27 : 263-6.
7. Khattab AK et al. Foetal maternal ascorbic acid gradient in normal Egyptian subjects. *J Trop Pediatr* 1970; 17, 16 : 112-5.
8. Denson KW, Bowers EF. The determination of ascorbic acid in white cells. A comparison of WBC ascorbic acid and phenolic acid excretion in elderly patients. *Clin Sci* 1961; 21 : 157-62.
9. Natelson S. Techniques of clinical chemistry Charles C Thomas. Springfield, Illinois USA, 1971; 162-65.
10. Pramod J, Sharma Praveen, Kothari LK. Effect of age and sex on serum and Leucocyte ascorbic acid in normal human subjects. *Vitaminologia* 1986; 2 : 93-9.
11. Heinonen K et al. Plasma vitamin C levels are low in premature infants fed human milk. *Am J Clin Nutr* 1986; 1986; 43 : 923-4.
12. Pritchard JA. Changes in the blood volume during pregnancy and delivery. *Anesthesiology* 1965; 26 : 393-9.
13. Moore MR, Rohatgi S, Low RAL. Prenatal and postnatal maternal leucocyte ascorbic acid concentrations. *Brit J Obstet Gynecol* 1979; 86 : 293-8.
14. Streeter ML, Rosso P. Transport mechanisms for ascorbic acid in the human placenta. *Am J Clin Nutr* 1981; 34 : 1706-11.