

## Ascorbic Acid Levels in Maternal and Cord Serum

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Man and primates have an inborn error in metabolism which renders them incapable of synthesizing ascorbic acid. Clemetson and Anderson reported premature deliveries to vitamin C deficient mothers(1). Vitamin C deficiency in the mother has also been associated with increased morbidity, mortality, still birth, premature and low birth weight(2). Paucity of studies on Indian women and neonates led us to conduct this study.

### Material and Methods

Estimation of ascorbic acid has been done in various ways, though buffy coat estimation is more valid for tissue levels. In subvitaminosis C, ascorbic acid disappears more rapidly from plasma, hence estimation of serum ascorbic acid was carried out in this study.

Two hundred neonates born of normal vaginal delivery in the State Zenana

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Hospital and Mahila Chikitsalaya S.M.S. Medical College, Jaipur and their mothers were randomly selected for the study. They belonged to different socio-economic status. Details regarding pregnancy, diet and physical examination of mother, delivery history, physical examination of newborn were recorded on a preformed pretested proforma. Gestational age was assessed by Ballard Scoring Method.

Paired maternal and cord samples collected aseptically were subjected to seroanalysis for ascorbic acid estimation by Dinitro Phenyl Hydrazine Method(3). All the newborns included in the study were followed for the first week to detect early neonatal morbidity and mortality.

### Results

Majority of mothers were Hindu, house-wives with a mean  $\pm$  SD age of  $22.9 \pm 3$  years (18-32 years), belonging to urban and rural areas and coming evenly from each socio-economic status. Mean gravidity was  $2.3 \pm 1.2$  (range 1-7) and 73% were well nourished with 53.5% of them having hemoglobin level above 10 g/dl.

Neonates were equally distributed for sex. The mean birth weight was  $2.29 \pm 0.7$  Kg (range 1.0-4.04 Kg); 51% were preterm while term and borderline preterm constituted 27.5% and 21.5%, respectively. The mean maternal serum ascorbic acid (SAA) level was  $0.542 \pm 0.448$  mg/dl (range 0.014-2.110 mg/dl) while cord serum level was  $0.848 \pm 0.485$  mg/dl (range 0.121-2.220 mg/dl). Cord serum ascorbic acid levels were significantly higher than their maternal levels. There was no significant

difference in SAA levels with maternal age, gravidity, religion, level of occupation or rural/urban residence. A gradual but insignificant rise in levels of maternal SAA was seen with higher socio-economic status; mothers, with good nourishment and higher hemoglobin.

Low levels of serum ascorbic acid were associated with prematurity, low birth weight and increased early neonatal morbidity and mortality (*Tables I & II*).

### Discussion

Ascorbic acid (vitamin C) is impr-

TABLE I- *Serum Ascorbic Acid Levels of Maternal and Cord Serum According to Gestational Age of Newborns*  
(Vide Ballard Scoring, 1977)

Gestational age (weeks)	No. of cases	Maternal SAA (mg/ dl)		Cord Blood SAA (mg/ dl)	
		Mean $\pm$ SD (range)	SE	Mean $\pm$ SD (range)	SE p value
<37	102	0.296 $\pm$ 0.290 (0.0141-1.642)	0.028	0.611 $\pm$ 0.356 (0.121-2.035)	0.035 <0.05
37-40	43	0.628 $\pm$ 0.416 (0.015-2.004)	0.063	1.016 $\pm$ 0.524 (0.126-2.183)	0.079 <0.05
>40	55	0.932 $\pm$ 0.412 (0.014-2.110)	0.055	1.173 $\pm$ 0.407 (0.318-2.220)	0.054 <0.05
Total	200	0.542 $\pm$ 0.448 (0.014-2.110)	0.031	0.848 $\pm$ 0.485 (0.121-2.220)	0.034 <0.05

SD - Standard deviation; SE - Standard error; SAA - Serum ascorbic acid

TABLE II- *Serum Ascorbic Acid Levels of Maternal and Cord Serum According to Early Neonatal Morbidity and Mortality*

Category	No. of cases	Maternal SAA (mg/dl)		Cord Blood SAA (mg/dl)	
		Mean $\pm$ SD (range)	SE	Mean $\pm$ SD (range)	SE P value
Healthy newborn	100	0.737 $\pm$ 0.459 (0.128-2.110)	0.045	1.033 $\pm$ 0.494 (0.309-2.220)	0.049 <0.05
Sick newborn	100	0.347 $\pm$ 0.339 (0.014-1.120)	0.033	0.672 $\pm$ 0.396 (0.121-1.981)	0.039 <0.05
Expired	16	0.133 $\pm$ 0.254 (0.014-0.986)	0.063	0.441 $\pm$ 0.249 (0.121-1.016)	0.062 <0.05

SD - Standard deviation; SE - Standard error; SAA - Serum ascorbic acid

tant for vitality of various enzymatic reactions. Pregnancy and newborn periods are both metabolically high demand periods for the human being. This study showed that irrespective of vitamin C status of mother, the ascorbic acid levels among newborns were generally well maintained.

The levels of maternal SAA are lower than those in previous studies(4-6), although no clinical deficiency was encountered. Seasonal variation affects the availability of citrus fruits and vegetables. The lower levels of SAA can be explained with seasonal variation.

Cord blood SAA was  $0.848 \pm 0.485$  mg/dl. Various authors have reported as high as  $1.4 \pm 0.4$  and as low as  $0.68 \pm 0.07$  mg/dl(6,7). These levels are generally well preserved in neonates. Pramodini *et al.* reported a significant relationship between maternal and cord blood SAA levels. They reported mean levels of  $0.66 \pm 0.06$  mg/dl (range 0.2-1.0 mg/dl) in mothers and  $0.68 \pm 0.07$  mg/dl in cord blood (range 0.2-2 mg/dl). Similar observations have been made by others(4-6). This has been explained by phenomenon of selective transplacental transfer of dehydro ascorbic acid and selective retention(4).

Levels of SAA increased with increasing gestational maturity. A similar correlation was also seen with birth weight.

Low serum ascorbic acid levels were associated with increased early neonatal mortality and morbidity. Newborns who died in the first week of life had very low levels of SAA in maternal and cord blood ( $0.133 \pm 0.254$  mg/dl and  $0.441 \pm 10.249$  mg/dl, respectively, com-

pared to  $0.737 \pm 0.459$  mg/dl and  $1.033 \pm 0.494$  mg/dl in healthy newborns). Wideman *et al.* found a similar increase in morbidity and mortality with low SAA levels(2).

It is concluded that irrespective of maternal ascorbic acid status, newborns begin life with an abundant supply of vitamin C. Low levels of serum ascorbic acid were associated with an increased incidence of prematurity, low birth weight and early neonatal morbidity and mortality.

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