VITAMIN C LEVELS IN NORMAL PREGNANCY

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Vitamin C or ascorbic acid, popularly known as one of the anti-haemorrhagic vitamins, is extensively used in therapeutics for scurvy and other clinical disorders. Owing to the reliable and fairly easy methods of assay more work has been carried out on the distribution of this vitamin in the body fluids and in food than any other vitamin. Vitamin C is essential for tissue growth and repair. It is neither stored or synthesised in the body and must therefore be supplied in the diet to meet the current needs of the body. A diet adequate in vitamin C is essential to the pregnant woman in order to enable her to meet the needs of the growing foetus and to promote the repair of the tissues in the puerperium.

A study of the diet consumed by the poor class of people, showed that the diet was totally deficient in all vitamins. This prompted us to undertake a study of the vitamin C content of the blood in the normal non-pregnant and in normal pregnancy.

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Method and Material

Vitamin C concentration in the plasma was estimated in 67 pregnant and 42 non-pregnant women. It has not been possible to make a longitudinal study of the vitamin C levels of the plasma from the first trimester to delivery. Hence patients belonging to the hospital class at different periods of pregnancy have been taken for the subject of study.

Blood Studies

5 ml. of heparinised venous blood was used and vitamin C estimated by the method adopted by Roe and Kuether.

The concentration of vitamin C can be estimated in the plasma, whole blood or leucocytic layer. Plasma ascorbic acid levels are extremely variable depending upon the intake of vitamin C in the diet. According to some observers plasma values above 1 mgm/100 ml. may be regarded as indicating normal vitamin C saturation and values below 0.6 mgm/100 ml. as undersaturation. Other workers have described a preascorbutic state when vitamin C level is about 0.8 mgm/100 ml. and by the time clinical symptoms of scurvy become manifest the vitamin C content of the blood is about 0.5 mgm/100 ml. How-

ever since values below 0.4 mgm/100 ml. are obtained so frequently in apparently healthy individuals a diagnosis of subclinical deficiency based on this finding alone cannot be made. Estimation of vitamin C in whole blood and the white cell platelet layer is more reliable. It has been experimentally proved by administration of diets deficient in vitamin C to normal subjects that the plasma is the first and the white cell layer the last to be depleted and therefore estimation of vitamin C in the white cell platelet layer is the most sensitive index of vitamin C deficiency, but owing to difficulties in estimation this method is rarely adopted. Hence a diagnosis of vitamin C deficiency is made when the plasma vitamin C is zero and a diagnosis of preascorbutic state when whole blood ascorbutic acid is zero.

Vitamin C in Urine

The average daily output of vitamin C in the urine in 24 hours is 20 mgm. in normal adults receiving an adequate diet, whereas in scurvy this level falls to zero. The excretion of vitamin C in the urine depends on the degree of saturation of the tissues. In the 'unsaturated individual' about 99% of the ascorbutic acid reaching the kidney is reabsorbed in the tubules, whereas in the 'saturated individual' the excess of the vitamin which cannot be utilised is excreted. A more reliable index of the state of vitamin C nutrition is afforded by the saturation test, where a known quantity of the vitamin is administered and the quantity excreted is measured. 100 mgm. of the vitamin is given intravenously and the amount excreted in the urine in 3 hours measured. A second sample of blood is collected at the end of 3 hours. Following an injection of 100 mgm. of vitamin C intravenously 40 mgm. or 40% should be excreted in the urine in 3 hours in normal subjects. If less than this is excreted it indicates a state of vitamin C deficiency This can be explained by the fact that if the vitamin C content of the tissues is low larger amounts of the administered dose are absorbed and smaller amounts are excreted in the urine than if the vitamin C content of the tissues are normal.

Results

Plasma Vitamin C

The level of vitamin C was estimated in the plasma in 42 normal non-pregnant and 67 normal pregnant women. The average for the 42 non-pregnant group was 1.3 mgm% 0.48 — 3.4 mgm%).

The average blood concentration of vitamin C in the 67 pregnant women was 0.9 mgm; the range was 0.26—3.4 mgm%. Prior to 32 weeks the values obtained were almost similar to those obtained in the non-pregnant group, the average in this group being 1.18 mgm% (0.26 — 3.4 mgm%). The vitamin C levels after the 32nd week appear to be lower than in the previous group; the average obtained was 0.77 mgm%, (0.26 — 1.9 mgm%). As a longitudinal study was not done, it can only be stated broadly that vitamin C levels tend to be lower in the latter half of pregnancy.

Table I shows the blood levels of vitamin C in pregnant and non-pregnant women in this series.

TABLE I

	No. of cases	Average	Maximum	Minimum
Non-pregnant	42	1.3 mgm%	3.4 mgm%	0.48 mgm%
Pregnant	67	0.9 „	3.4 „	0.26 „
16-32 weeks	11	1.18 „	3.4 „	0.26 „
32-40 weeks	56	0.77 „	1.9 „	0.26 „

Vitamin C Saturation Test

This test was carried out in 17 non-pregnant women and 29 pregnant women. In the 17 non-pregnant women, the plasma vitmain C rose from an initial average level of 1.52 mgm% to 1.89 mgm% at the end of three hours. The vitamin C content of the urine ranged from 2.4 — 621.3 mgm%. Eleven of the 17 cases showed less than 40% excretion of the vitamin in the urine, thereby showing that although blood levels were within normal limits, in 64.7% there was undersaturation of the vitamin.

In 8 patients who were 16 — 32 weeks pregnant the average plasma vitamin C level before injection was 1.32 mgm%, this rose to 1.6 mgm% 3 hours later. At the end of 3 hours urinary vitamin C ranged from 5.56 — 212.5 mgm%. Five of the 8 (62.5%) showed a deficiency of vitamin C as per the saturation test.

In 21 patients where the pregnancy exceeded 32 weeks the average initial vitamin C level was 0.8 mgm%; this rose to 1.09 mgm% after 3 hours. The urinary vitamin C varied from 5.75 to 31.4 mgm%. In all cases the vitamin C excreted was below 40%. The results are shown in Table 3.

TABLE III

	No. of cases	Blood sample I in mgm%	Blood sample II in mgm%	Vitamin C in urine after 3 hours in mgm%
Normal non-pregnant	17	1.5 (.48-3.4)	1.89 (.72-4.3)	71 (2.4-621.3) 11 (64.7%) showed less than 40% excretion.
Normal pregnancy below 32 weeks	8	1.32 (.48-3.4)	1.6 (.48-3.4)	54.02 (5.56-212.5) 5 (62.5%) showed less than 40% excretion.
Over 32 weeks	21	0.8 (.26-1.9)	1.09 (.48-2.12)	13.11 (5.75-31.4) 100% showed less than 40% excretion.

Discussion

As has been previously stated vitamin C is neither stored nor synthesised in the body, and hence adequate amounts of it must be supplied in the diet in order to meet the daily requirements. An analysis of the vitamin C content of the diet of South Indian women showed that in the poorer class of people the daily intake was 15 mgm. No definite conclusions have been drawn regarding the daily requirements of the vitamin. In 1938 the Technical commission on Nutrition of the League of Nations proposed 30 mgm/day for a normal adult. In 1943 the Food and Nutrition Board of the National Research Council recommended 75 mgm/day and this view they still maintain. In 1948 the Canadian Council of Nutrition recommended a minimum of 30 mgm/day in order to maintain normal health. In 1950 the British Medical Association recommended 20 mgm/day for an adult, 30 mgm for an adolescent and 50 mgm during lactation. The average daily requirement advocated by several workers is about 25 — 50 mgm for an adult, 100 mgm for pregnant women and 150 mgm for lactating mothers.

If a plasma vitamin C below 0.6 mgm% be regarded as a state of undersaturation, in this series of 42 non-pregnant women 3 women, i.e. 7.1%, showed undersaturation. As judged from the results of the saturation test done on 17 non-pregnant women, 11, i.e. 64.7%, showed subnormal saturation although only 2 had blood values below 0.6 mgm%. Among the 67 pregnant women 31, i.e. 46.2%, showed undersaturation, as judged by plasma levels. However, when compared with the results obtained by the saturation test 26 of the 29, i.e. 89.6%, of the patients showed deficient saturation, while of the 21 patients over 32 weeks pregnant all showed deficient saturation. Table IV gives a comparison of results obtained by both methods.

TABLE IV

	No. of cases	Plasma level below 0.6 mgm%	No. of cases	Saturation test below 40% excretion
Non-pregnant	42	3 (7.1%)	17	11 (64.7%)
Pregnant	67	31 (46.2%)	29	26 (89.6%)

This progressive fall in vitamin C content as pregnancy advances has been reported by several workers, Darby et al, Anderson et al, Citti and others. Teel et al stated that even when the intake of vitamin C was constant, the average ascorbutic acid level at delivery was little more than half the average value observed during the first 28 weeks of pregnancy. On the other hand Hoch and Marrack revealed no significant change in serum ascorbutic levels in pregnancy. Young et al were unable to demonstrate any difference in the levels during the first few weeks or the last four weeks of pregnancy. Camara and Concepcion in Phillipines did not detect any significant difference in the plasma levels in the various stages

of pregnancy.

Citti explained this progressive fall in Vitamin C as pregnancy advanced in 3 ways: (1) increased foetal requirements, (2) relative, hypovitaminosis due to hydraemia, (3) a redistribution of the vitamins and its accumulation in the tissues. He considered the most important factor to be the foetal demands. Citti and several workers have found that the vitamin C content of the foetus was higher than in the mother, suggesting the possibility that the foetus is sufficiently supplied while the maternal organism suffers shortage. This shortage of vitamin C may lead to certain clinical manifestations in the mother. The role of vitamin C in anaemia, its use in the absorption of oral iron and the conversion of folic acid to folinic acid is well known. Hence vitamin C deficiency might be a contributary factor in anaemia. Javert and Stander, after studying vitamin C and prothrombin levels in pregnancy and in abortions, concluded that vitamin C or vitamin K may play a role in cases of antepartum bleeding and abortions. Vitamin C deficiency was found in nearly three-fourth of a series of patients with threatened and spontaneous abortion. Lund and Kimble believed retinal haemorrhages, observed in severe hyperemesis gravidarum, to be a manifestation of vitamin C deficiency and that post-partum haemorrhage might on rare occasions be due to deficiency of the vitamin.

Summary and Conclusions

1. Plasma vitamin C was estimated in 42 non-pregnant and 67 pregnant women. A state of under-saturation was observed in 7.1% of non-pregnant women and 46.2% of pregnant women. Values obtained after the 32nd week of pregnancy were lower than those obtained in patients who were below 32 weeks pregnant. Plasma vitamin C in early pregnancy (16-32 weeks) was similar to that obtained in the non-pregnant.

2. The vitamin C saturation test was done in 17 non-pregnant women. 64.7% were found to be under-saturated. In 29 pregnant women 89.6% were under-saturated.

From this it can be concluded that in the non-pregnant women in the hospital class of patients there is a deficiency of vitamin C and the deficiency becomes accentuated as pregnancy advanced reaching a maximum after the 32nd week when 90% of women were found deficient.

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