Internat. J. Vit. Nutr. Res. *56*
(1986) 3–9
Received for publication
September 23, 1985

Vitamin A
Vitamin E
β-Carotene
Blood vitamin levels
Abruptio placentae
Normal pregnancy

Comparison of Blood Levels of Vitamin A, β-Carotene and Vitamin E in Abruptio Placentae with Normal Pregnancy

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Summary: Levels of vitamin A, β-carotene and vitamin E in peripheral venous blood of women in abruptio placentae and in normal pregnancy have been compared. Chemical methods were used for the estimation of these compounds. The results show that levels of all three compounds in abruptio placentae are lower than those found in the normal pregnancy. We have earlier shown that levels of ascorbic acid in these subjects are low while other studies have indicated that levels of folic acid in them are also low. Based on our present and earlier published work it is suggested that abruptio placentae is a condition with multiple vitamin deficiency. Whether this is its cause or effect is however not clear.

Introduction

The etiology of abruptio placentae (premature separation of the normally situated placentae) is not known but the condition is an important cause of perinatal morbidity and mortality throughout the world. Haematological changes typical of folic acid deficiency are a common characteristic of the condition [4, 9] but a correlation between folic acid deficiency and the occurrence of abruptio placentae has not been definitely established [1, 24, 31].

Its incidence is high in populations with poor socio-economic status both inside [11] and outside [22] Europe. Earlier studies have shown that levels of ascorbic acid in abruptio placentae are lower than levels found in the normal pregnancy [3, 26]. In the present study we have investigated if levels of vitamin A, β-carotene and vitamin E in abruptio placentae are different from those found in the normal pregnancy.

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Subjects and Methods

All the subjects classified as abruptio placentae patients had bleeding from normally situated placentae. Samples of antecubital vein blood were obtained from 44 of these patients and 86 women with normal pregnancies. Single blood samples were collected from 16 women with abruptio placentae and all the women with normal pregnancies. From the rest of the subjects with abruptio placentae the number of samples varied from 2–4 and only one sample per week was collected from each patient. All the subjects in this group were inpatients and had volunteered to participate in the study. All the women included in the normal pregnancy group were subjects attending antenatal clinic but had delivered at term without complications. Further details on subjects with abruptio placentae can be found from an earlier publication [26]. Vitamin A, β-carotene and vitamin E were measured by chemical assays as described earlier [5].

Results

Table I shows that mean plasma vitamin A levels in abruptio placentae vary from 213.5 to 241.9 μg/l. In the group with normal pregnancies the values range from 354.1 to 378.7 μg/l.

Table I: Comparison of Plasma Vitamin A in abruptio placentae with normal pregnancy (Mean ± s.e.m.)

Gestation (Weeks)	Vitamin A (μg/l)		P Value
	Abruptio placentae	Normal Pregnancy	
28–31	241.9 ± 12.04 (n = 24)	378.7 ± 16.83 (n = 25)	< 0.05
32–34	227.1 ± 13.35 (n = 16)	354.1 ± 22.64 (n = 19)	< 0.05
35–37	221.0 ± 10.04 (n = 17)	368.1 ± 27.57 (n = 20)	< 0.05
38–40	213.5 ± 16.62 (n = 14)	366.2 ± 24.66 (n = 22)	< 0.01

Over the whole period of 28–40 weeks' gestation, the values in abruptio placentae are significantly lower than the values in the normal pregnancy (P = < 0.05 or < 0.01). Table II shows plasma β-carotene levels in the two groups. In abruptio placentae the mean values vary from 69.3 to 101.7 μg/l while in normal pregnancy they range from 120.4 to 140.2 μg/l. Unlike vitamin A values, however, a significant difference between the two populations is not found except for the period of 28–31 weeks of gestation.

Table II: Comparison of Plasma Levels of β-Carotene in abruptio placentae with normal pregnancy (Mean ± s.e.m.)

Gestation (Weeks)	β-Carotene (μg/l)		P Value
	Abruptio placentae	Normal pregnancy	
28–31	69.3 ± 10.50 (n = 24)	129.2 ± 13.63 (n = 25)	< 0.05
32–34	88.7 ± 26.14 (n = 16)	131.5 ± 21.76 (n = 19)	> 0.05
35–37	101.7 ± 19.11 (n = 17)	140.2 ± 26.42 (n = 20)	> 0.05
38–40	98.5 ± 18.21 (n = 14)	120.4 ± 12.58 (n = 22)	> 0.05

Table III shows that mean vitamin E values in abruptio placentae are also generally lower than the mean vitamin E values found in the normal pregnancy. In common with β-carotene values, however, a significant difference between the two populations is not found except for the period of 28–31 weeks of gestation.

Table III: Comparison of Plasma Vitamin E in abruptio placentae with normal pregnancy (Mean ± s.e.m.)

Gestation (Weeks)	Vitamin E (mg/L)		P Value
	Abruptio placentae	Normal pregnancy	
28–31	6.0 ± 0.65 (n = 24)	8.9 ± 0.54 (n = 25)	< 0.05
32–34	8.5 ± 0.82 (n = 16)	9.2 ± 0.75 (n = 19)	> 0.05
35–37	7.5 ± 0.82 (n = 17)	9.2 ± 0.82 (n = 20)	> 0.05
38–40	8.6 ± 0.91 (n = 14)	9.9 ± 0.61 (n = 22)	> 0.05

In Figure 1 the levels of vitamin A, β-carotene and vitamin E in the two populations are compared irrespective of the gestation length at which the plasma samples were obtained. It is interesting that significant differences between the two populations are found with regard to β-carotene and vitamin E values. These were not observed when the values were compared on the basis of gestational lengths. Table IV shows percent distributions of values for vitamin A, β-carotene and vitamin E in the two populations.

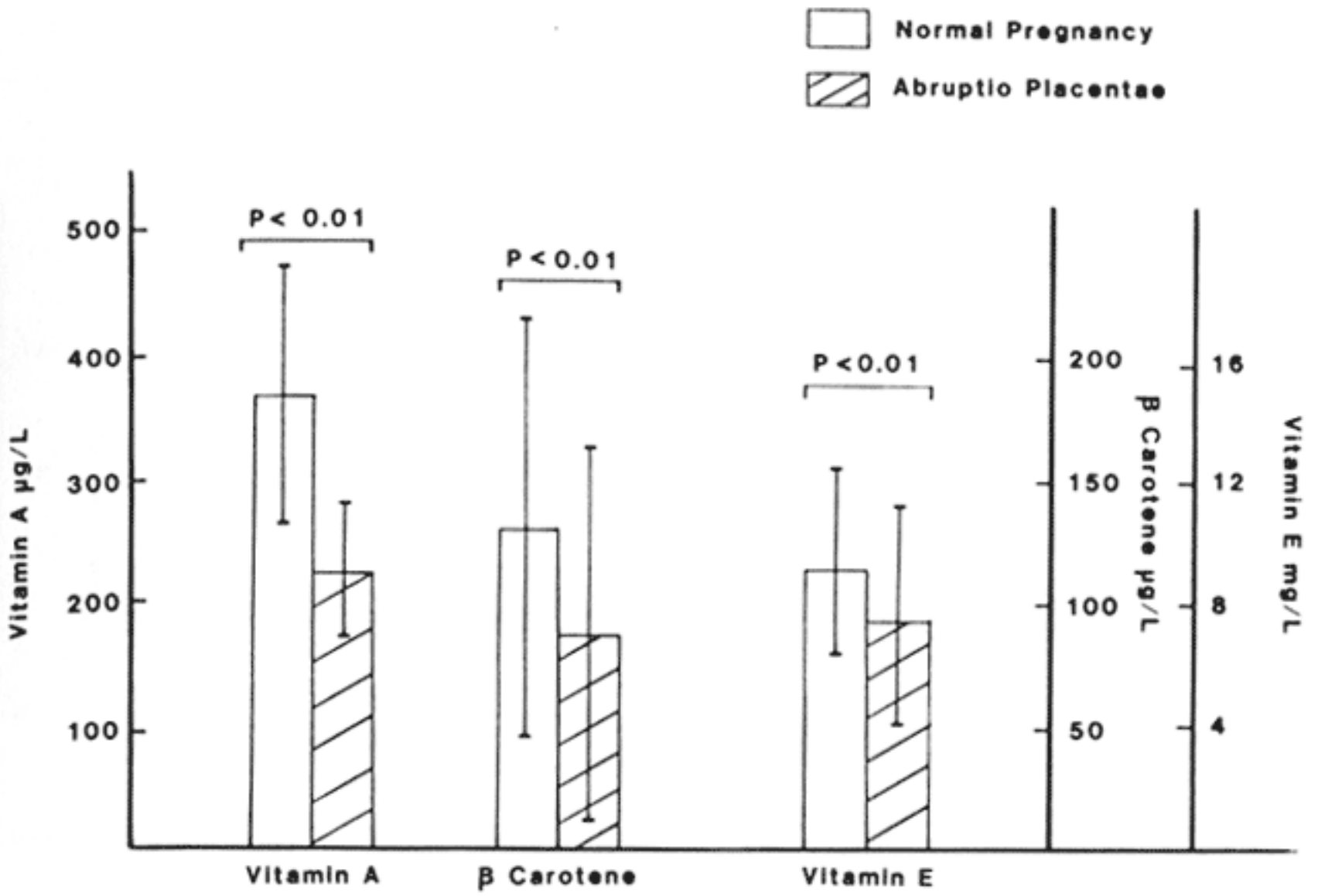

Fig. 1: Comparison of vitamin A, β-Carotene and vitamin E values in abruptio placentae with normal pregnancy. Mean values represent total number of samples in each group irrespective of gestational lengths.

Table IV: Percent distributions of Vitamin A, β-carotene and Vitamin E values in abruptio placentae and in normal pregnancy

	Vitamin A (µg/l)				β-carotene (µg/l)			Vitamin E (mg/l)			
	< 200	200–300	300–400	> 400	< 70	70–140	140–210	> 210	< 7.5	7.5–10	> 10
Abruptio placentae:	28.2	66.2	4.2	1.4	50.7	32.4	12.7	4.2	56.3	16.9	26.8
Normal pregnancy	4.7	20.9	37.2	37.2	19.8	48.8	19.8	11.6	25.5	32.2	41.9

In abruptio placentae 94.4% of the subjects have vitamin A values below 300 µg/l, 83.1% have β-carotene values below 140 µg/l and 56.3% have vitamin E values below 7.5 mg/l plasma. In the group with normal pregnancies only 25.6% subjects have vitamin A value below 300 µg/l, 68.6% have β-carotene values below 140 µg/l and 25.5% have vitamin E values below 7.5 mg/l plasma.

Discussion

The results of the present investigation have shown that levels of vitamin A, β-carotene and vitamin E in abruptio placentae are lower than those found in the normal pregnancy. Whether this is the result of inadequate intake, impaired gastrointestinal absorption or enhanced metabolism of these compounds is not known but earlier studies have indicated that levels of folic acid [10, 11] and of ascorbic acid [3, 26] in abruptio placentae are also low.

The presence of bile and pancreatic secretions is essential for an efficient absorption of vitamin A, β-carotene [27] and vitamin E [6, 18] from the gastrointestinal tract. As far as we know, this is not the case with water soluble vitamins and both folic acid [25] and ascorbic acid [13, 28] are absorbed by specilized carrier, mediated processes. Although several factors can independently affect the absorption of fat [7] and water [8, 13, 25] soluble vitamins, factors (other than pathological conditions) capable of affecting both types of absorptive processes are generally unknown. The mucosal cell plays an essential role in the transport of nutrients from the gastrointestinal lumen to the blood circulation and it is possible that some abnormality of these cells could impair absorption of both fat and water soluble vitamins giving low levels in abruptio placentae. Mucosal cell abnormality is associated with poor absorption of vitamin E [18] but very little information is available on its effects on other vitamin absorptions. There is also no evidence that such an abnormality does exist in abruptio placentae and at present we have no knowledge if low levels of both fat and water soluble vitamins in these subjects were indeed due to poor absorption from the gastrointestinal tract.

Low plasma levels of these compounds in abruptio placentae could even have been due to their inadequate supply and/or enhanced degradation and elimination from the body. However there is no evidence that metabolism of these compounds in abruptio placentae is in any way different from the normal pregnancy. The possibility that low levels of these compounds in abruptio placentae were the result of inadequate supply, therefore, remains. In this context it is noteworthy that abruptio placentae has a common occurrence in populations with poor socio-economic conditions [11, 22] and foods rich in carotenoids and vitamin A also contain considerable amounts of vitamin C and other vitamins.

From our present and earlier published work it however seems that abruptio placentae is a condition associated with multiple vitamin deficiency and not with the deficiency of folic acid alone as was earlier suggested [10, 11]. Whether the multiple vitamin deficiency leads to abruptio placentae or is itself the result of some other metabolic problem in these subjects is not yet known. Haematological changes characteristic of folic acid deficiency are a commmon feature in women suffering from abruptio placentae [4, 9]. In addition placental lesions such as necrosis of the marginal decidual basalis and infarction of placentae are commonly observed in abruptio placentae [21]. Vitamin C is required for the synthesis of collagen [2] and for the maintenance of various vascular structures [30]. Thus folic acid and vitamin C deficiencies could result in the development of haematological and placental tissue abnormalities regularly seen in abruptio placentae.

The deficiency of fat soluble vitamins could also lead to some of the problems observed in this condition. Vitamin A deficiency causes infertility or impaired reproduction in several animal species [20]. In the pregnant rat this also leads to necrosis of the junctional zone of placenta [14] and also in a decline in steroid synthesizing (Δ^5, 3β-hydroxy-steroid dehydrogenase and 11β-steroid hydroxylase) and mucopolysaccharide synthesizing (ATP sulfurylase and sulfotransferase) enzymes [23]. β-carotene is a precursor of vitamin A and it is possible that low levels of β-carotene in abruptio placentae were due to its enhanced conversion to vitamin A. However they could also have been due to reduced absorption and/or enhanced degradation and excretion. In this regard it is noteworthy that oestrogen levels are high in pregnancies ending prematurely [29] and oestrogen has a stimulant effect on β-carotenase enzyme which degrades β-carotene [17].

Considerable evidence from animal studies is now available to suggest that vitamin E is involved in the cyclo-oxygenase catalyzed oxidation of arachidonic acid in the body [12, 15]. This pathway which leads to the formation of several prostaglandins including PGE_2, PGF_2^{α} and PGI_2 is also involved in the synthesis of thromboxane A_2 (TXA_2). Both PGE_2 and $PGF_2\,\alpha$ are potent stimulants of the uterine tissue [16], PGI_2 is a potent vasodilator/antithrombic substance while TXA_2 is a powerful prothrombotic agent [19]. Thus it is possible that vitamin E deficiency in these subjects could also have contributed towards the development of certain problems like the bleeding and the premature birth so commonly seen in abruptio placentae.

Acknowledgement: The authors are grateful to F. Hoffmann-La Roche & Company for bearing the cost of analyses of blood samples for vitamins and to Dr. Mike WALZMAN for obtaining blood samples.

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