VITAMIN E AND LIPOPROTEIN LEVELS IN THE SERA OF PREGNANT WOMEN

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Summary The serum levels of vitamin E, cholesterol and lipoproteins, \(\alpha_1\)-lipoproteins and \(\beta\)-lipoproteins in pregnant women were investigated. It was found that serum vitamin E, cholesterol and the lipoproteins had a tendency to increase throughout gestation. The mean serum \(\alpha_1\)-lipoprotein concentration was higher in pregnant women than in healthy control women. The ratios of the vitamin E concentration to the sum of \(\alpha_1\)-lipoproteins and \(\beta\)-lipoproteins concentration in sera was constant. Furthermore, it was found that serum vitamin E was correlated closely to the lipoprotein content \((r = 0.814, p < 0.001)\), except in a few subjects with abnormally high vitamin E levels.

It has been shown that the majority of vitamin E in serum was bound to \(\alpha_1\)-lipoproteins and \(\beta\)-lipoproteins in human serum (1). FERGUSON et al. (2), and STRAUMFJORD and QUAIFE (3) reported that serum vitamin E increased throughout gestation. In this study, an attempt was made to determine the serum vitamin E and lipoprotein levels in women at various stages of pregnancy by means of fluorometric methods, and to clarify whether the increase is accompanied by an increase in the binding proteins, \(\alpha_1\)-lipoproteins and \(\beta\)-lipoproteins.

MATERIALS AND METHODS

Serum samples from 52 pregnant women (2–9 months of gestation) and from 39 healthy control group women (rural women group) were collected in Yamagata Prefecture and the serum lipoproteins were determined immediately. The specimens were then frozen and stored until analyzed for vitamin E and cholesterol. Serum vitamin E was determined by Thompson’s fluorometric method modified by Abe and Katsui (4). The lipoproteins were determined by Mancini’s single radial
immunodiffusion method (5). Total serum cholesterol was determined with a cholesterol test kit using a modified Zak-Henly method.

RESULT AND DISCUSSION

The correlation between the concentration of serum vitamin E and month of gestation was examined (Fig. 1). An increase in the mean serum level of vitamin E throughout gestation was observed, except in a few subjects with abnormally high vitamin E levels. Namely, the mean vitamin E contents of sera increased from 0.82 ± 0.06 (S.E.) mg/100 ml for measurements during two months of gestation to 1.53 ± 0.07 (S.E.) mg/100 ml at eight months of gestation. This result agreed well with that of FERGUSON et al. (2).

Fig. 1. Correlation between serum vitamin E and month of gestation. ○, Serum vitamin E values of each subject; ○, mean vitamin E values of same month of gestation; —, linear regression of mean vitamin E values except the values of 7 and 9 months of gestation.

In a previous paper the authors reported that serum vitamin E was mainly bound to \( \alpha_1 \)-lipoproteins and/or \( \beta \)-lipoproteins (1). Therefore, Figs. 2 and 3 show the relation of gestational age to the concentration of \( \alpha_1 \) - and \( \beta \)-lipoproteins, respectively. The concentration of the main vitamin E-binding proteins rose throughout gestation. Table 1 showed the mean level of serum vitamin E, cholesterol, \( \alpha_1 \)-lipoproteins and \( \beta \)-lipoproteins in the pregnant women and non-pregnant controls. The ratios of the vitamin E concentration to the sum of \( \alpha_1 \)-lipoproteins plus \( \beta \)-lipoproteins concentration (the main vitamin E-binding protein)
Fig. 2. Correlation between the concentration of \( \alpha_1 \)-lipoproteins and month of gestation. ●, \( \alpha_1 \)-Lipoproteins concentration of each subject; ○, mean values of \( \alpha_1 \)-lipoproteins of same month of gestation; —, linear regression of mean values of \( \alpha_1 \)-lipoproteins.

Fig. 3. Correlation between the concentration of \( \beta \)-lipoproteins and month of gestation. ●, \( \beta \)-Lipoproteins concentration of each subject; ○, mean values of \( \beta \)-lipoproteins of same month of gestation; —, linear regression of mean values of \( \beta \)-lipoproteins.
Table 1. Vitamin E, cholesterol, $\alpha_1$-lipoproteins and $\beta$-lipoproteins levels in sera of pregnant women and control group.

<table>
<thead>
<tr>
<th>Subjects</th>
<th>No. of sera</th>
<th>$\alpha_1$-Lipo u/dl$^a$</th>
<th>$\beta$-Lipo u/dl$^a$</th>
<th>Vitamin E mg/dl</th>
<th>Cholesterol mg/dl</th>
<th>Vitamin E/ MVEBP$^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pregnant women</td>
<td>47</td>
<td>$123 \pm 23$</td>
<td>$100 \pm 24$</td>
<td>$1.07 \pm 0.31$</td>
<td>$245 \pm 72$</td>
<td>$0.0048 \pm 0.0009$</td>
</tr>
<tr>
<td>Control women</td>
<td>39</td>
<td>$94 \pm 12$</td>
<td>$96 \pm 19$</td>
<td>$0.91 \pm 0.20$</td>
<td>$181 \pm 24$</td>
<td>$0.0047 \pm 0.0007$</td>
</tr>
</tbody>
</table>

$^a$ Pooled sera from 80 healthy persons averaged at 100 u/dl.
$^b$ MVEBP (main vitamin E-binding proteins): Sum of $\alpha_1$-lipoproteins and $\beta$-lipoproteins.

in sera was constant. There was a significant difference between the $\alpha_1$-lipoproteins levels of pregnant women and those of the non-pregnant controls ($p < 0.001$). Namely, high $\alpha_1$-lipoproteins levels were obtained in our investigation of pregnant women.

The level of vitamin E in comparison with $\alpha_1$-lipoproteins and $\beta$-lipoproteins in the sera of pregnant women was determined (Figs. 4 and 5), and showed a positive close correlation in cases where the vitamin E values were below 2 mg/100 ml: $r = 0.814$, $p < 0.001$. This is in agreement with Rubinstein's observation that the best correlation of vitamin E is with the total serum lipid: $r = 0.85$ (6). The majority of the subjects whose vitamin E values were above 2 mg/100 ml failed to show an elevation of serum lipoproteins. The ratios of vitamin E concentration to the main vitamin E-binding protein concentration was elevated 2–3-fold in pregnant women with a high vitamin E content, as compared with normal pregnant women and the control group (Tables 1 and 2). The pregnant women with a high vitamin E content also had
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Fig. 5. The relation of vitamin E to $\alpha_1$-lipoproteins in the sera of pregnant women.

elevated cholesterol levels (Table 2). RUBINSTEIN et al. (6) reported that a patient with fat-induced hyperlipidemia had an enormous elevation of serum vitamin E (up to 27.8 mg/100 ml) which was mostly found in the chylomicron fraction. Hence, we suspect that the pregnant women with high vitamin E content in this case also have different vitamin E-binding proteins from the other groups.

Our result indicates that the ratio of vitamin E concentration to the main vitamin E-binding protein concentration in sera is constant in pregnant women and the control group with the exception of a few subjects with abnormally high vitamin E levels. The mean serum $\alpha_1$-lipoprotein concentration was higher in pregnant women than in the non-pregnant control group.

Table 2. Vitamin E, cholesterol, $\alpha_1$-lipoproteins and $\beta$-lipoproteins concentrations of sera of pregnant women with high vitamin E levels.

<table>
<thead>
<tr>
<th>No.</th>
<th>Mon. gest.</th>
<th>$\alpha_1$-Lipo u/dl</th>
<th>$\beta$-Lipo u/dl</th>
<th>Vitamin E mg/dl</th>
<th>Cholesterol mg/dl</th>
<th>$\text{Vitamin E/MVEBP}^c$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>122</td>
<td>87</td>
<td>2.98</td>
<td>560</td>
<td>0.0143</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>85</td>
<td>132</td>
<td>2.66</td>
<td>473</td>
<td>0.0123</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>144</td>
<td>100</td>
<td>3.20</td>
<td>375</td>
<td>0.0131</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>114</td>
<td>75</td>
<td>2.32</td>
<td>371</td>
<td>0.0123</td>
</tr>
</tbody>
</table>

* Mon. gest.: month of gestation.

$^b$ Pooled sera from 80 healthy persons averaged at 100 u/dl.

$^c$ MVEBP (main vitamin E-binding proteins): Sum of $\alpha_1$-lipoproteins plus $\beta$-lipoproteins.
REFERENCES


