SERUM HEAT-STABLE ALKALINE PHOSPHATASE IN PREGNANCY
PART I—NORMAL PREGNANCY

by

JAMUNA RANA,* M.D.,
PARVATI K. MALKANI,** F.R.C.O.G., F.A.C.S., F.A.M.S.
and
KAMAL BUCKSHEE,*** M.D.

It is generally recognized that a dependable test of placental function is one of the most urgent needs in obstetrics. The advantages of using various placental enzymes as an index of placental function were found in the fact that their measurements are simple procedures. Coryn (1934) showed for the first time that serum alkaline phosphatase is elevated in late pregnancy. Serum alkaline phosphatase is composed of different iso-enzymes. Unless the placental fraction is well differentiated from non-placental iso-enzymes, estimates of alkaline phosphatase could not be a reliable test for assessing placental function. Various methods like taurocholate inhibition, electrophoresis, histochemistry, electron microscopy, E.D.T.A. inactivation and substrate specificity have been employed to study the behaviour of alkaline phosphatase in pregnancy. Neale et al (1965) first showed that the placental fraction of alkaline phosphatase is heat-stable at 56°C. Later, Hunter (1969) demonstrated that the critical temperature is 65°C, not 56°C.

Department of Obstetrics and Gynaecology,
All India Institute of Medical Sciences, New Delhi-16.

* Postgraduate Student
** Professor of Obstetrics & Gynaecology
*** Assistant Professor of Obstetrics & Gynaecology

Received for publication on 14-6-1973.

Material and Method

In the present study, serial serum HSAP estimations were performed on 40 normal pregnant women during pregnancy, labour and puerperium. Serum HSAP levels were also determined in 31 samples of cord blood.

Serum was inactivated with respect to all alkaline phosphatases except placental alkaline phosphatase by heating it at 65°C for 30 minutes (Hunter, 1969) and the enzyme level was estimated by using King's method (1959).

Results

A total of 196 estimations were made on 40 pregnant women. The number of serial estimations in a patient varied from 3 to 6. Of 40 pregnant women, 30 were seen from first trimester while the remaining 10 from the second trimester. Single serum HSAP estimation was also performed in 19 non-pregnant females and 10 males and the mean values were found to be 0.18 ± 0.21 and 0.17 ± 0.18 KAU/100 ml, respectively. Table I shows the serum HSAP levels in different trimesters of pregnancy.

The enzyme levels were estimated in 21 cases during labour and the mean value was found to be 11.43 ± 1.01 KAU/100 ml as compared to 11.64 ± 1.21 KAU/100 ml.
TABLE I

Serum HSAP Levels in Different Trimesters of Normal Pregnancy

<table>
<thead>
<tr>
<th>Duration pregnancy</th>
<th>HSAP in KAU/100 ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>(weeks)</td>
<td>Range</td>
</tr>
<tr>
<td>First trimester (29)</td>
<td>0 - 12</td>
</tr>
<tr>
<td>Second trimester (39)</td>
<td>13 - 28</td>
</tr>
<tr>
<td>Third trimester (40)</td>
<td>29 - 40</td>
</tr>
</tbody>
</table>

( ) — no. of cases.

ml found in 13 cases at term. The difference is not statistically significant.

In 31 samples of cord blood, the mean value of serum HSAP was found to be 0.36 KAU/100 ml.

A total of 56 estimations on 28 cases were performed for first 8 days after delivery. Table II illustrates the levels of serum HSAP at term, during labour, puerperium and in cord blood.

Discussion

In the present study, the level of serum HSAP was found to rise gradually with the advance in pregnancy, being maxi-

TABLE II

Serum HSAP Levels at Term, During Labour, Puerperium and in Cord Blood (Normal)

<table>
<thead>
<tr>
<th>No. of estimations</th>
<th>Mean HSAP ± S.D. (KAU/100 ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>At term</td>
<td>13</td>
</tr>
<tr>
<td>In labour</td>
<td>21</td>
</tr>
<tr>
<td>Postpartum Day 1</td>
<td>11</td>
</tr>
<tr>
<td>Day 2</td>
<td>7</td>
</tr>
<tr>
<td>Day 3</td>
<td>1</td>
</tr>
<tr>
<td>Day 4</td>
<td>14</td>
</tr>
<tr>
<td>Day 6</td>
<td>9</td>
</tr>
<tr>
<td>Day 8</td>
<td>14</td>
</tr>
<tr>
<td>Cord blood</td>
<td>31</td>
</tr>
</tbody>
</table>

TABLE III

Serum HSAP Levels in Labour, Birth Weight and Placental Weight

<table>
<thead>
<tr>
<th>Birth weight (G)</th>
<th>Placental weight (G)</th>
<th>Mean HSAP (KAU/100 ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000-2500</td>
<td>500-550</td>
<td>11.95</td>
</tr>
<tr>
<td>2500-3000</td>
<td>551-600</td>
<td>11.54</td>
</tr>
<tr>
<td>Above 3000</td>
<td>551-700</td>
<td>11.23</td>
</tr>
</tbody>
</table>

Birth weight and placental weight were recorded in 21 cases, but no correlation could be found between serum HSAP level and either of these two parameters as shown in table III.
trend of the enzyme activity is comparable to those found by other workers, Hunter et al. (1970), Quigley et al. (1970), Pirani et al. (1972) and Aleem (1972). Curzen et al. (1966, 1968) showed the level of serum HSAP to rise gradually in the third trimester, reaching the maximum level at 38-39 weeks and then a slight fall at 40 weeks. The gradual rise in the enzyme level can be explained by the fact that the syncytiotrophoblast which contains the enzyme in large quantity, proliferates with the advance in pregnancy. There was a slight fall in the enzyme level during labour as shown in Table II, but this fall was not statistically significant when compared to the enzyme activity at term. This observation is similar to that of Aoba et al. (1967), Peters et al. (1968) and Hunter (1969). Kitchener et al., (1965) could not show any difference in serum HSAP levels during labour from those at term in a series of 24 pregnant women. Shaper et al., (1969), Quigley et al. (1970) and Pirani et al. (1972) show a transient rise in HSAP level during labour.

The level of HSAP in cord blood, as found in the present study, was excessively low as compared to that at term in mother's blood. This can be explained by the fact that the microvilli of syncytiotrophoblast containing alkaline phosphatase lie in close contact with the mother's blood, but are separated from the foetal circulation by the mesenchyme. Besides this, a second possibility of increased metabolism of the enzyme by the foetus, thereby lowering its level has been thought of. But the excessively low level is more in favour of an anatomical barrier rather than the increased metabolism.

Birth weight and placental weight were recorded in 21 cases, but no significant correlation could be found between serum HSAP and either of these two parameters as shown in Table III.

For first 8 days postpartum, serum HSAP was estimated which showed a gradual fall in the enzyme activity, thereby proving indirectly that placenta is the main source of heat-stable fraction of the enzyme. The same pattern was found by other workers as shown in Fig. 1. By the eighth day after delivery, the levels had not yet reached the non-pregnant state.

Summary

Serial serum HSAP levels were estimated during pregnancy, labour and puerperium by King's method (1959). The serum was heated at 65°C for 30 minutes as suggested by Hunter (1969). A total of 273 estimations were performed on blood samples from 40 normal pregnant women. HSAP levels in 31 samples of cord blood were estimated.

Serial serum HSAP estimations showed a gradual rise with the advance in pregnancy, reaching the maximum level at term, followed by a slight fall in the
enzyme activity during labour. The values of serum HSAP were found to decline gradually during the first 8 days post-partum, not reaching the non-pregnant level by eighth day. No significant correlation could be found between serum HSAP and either birth weight or placental weight.

References