SERUM PROTEINS AND PROTEIN-BOUND IODINE IN PREGNANT MOTHER AND NEW-BORN INFANT

By

Y. BERNARD1 AND C.M. FRANCIS2

From the Department of Physiology, Medical College, Trivandrum.

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Serum protein-bound iodine values were above normal in the pregnant mother and in the newborn. The range of values was, however, different from what previous workers had noted. Thirty-four pairs of pregnant mothers at term and new born babies (cord blood) were investigated for any influence of serum proteins on the protein-bound iodine values. There was no correspondence between the two. No significant difference was seen between the concentrations of protein-bound iodine in arterial (aorta) and venous (inferior vena cava) blood.

A number of investigators have observed that the protein-bound iodine (PBI) values of the blood are regularly elevated during normal pregnancies. While certain workers like Man et al., (1952) have found about the same concentration in the maternal blood as in the umbilical cord blood during birth, others like Russel et al., (1960) have reported that the PBI values of mother at term are above those for the new-born (cord blood). One of the reasons given for the elevated PBI level of pregnancy is an increase in the binding capacity of serum carrier proteins for thyroxine. Macy (1953) and Mack (1955) have shown by electrophoretic studies, that the concentration of the alpha globulins increased in the maternal serum throughout pregnancy, reaching maximum values near the time of delivery. Mack also observed that alpha globulins in cord blood were appreciably lower than that of maternal blood, approaching normal non-pregnant values. Early in certain investigations into the permeability of the placenta, it was observed that our results did not quite agree with those reported previously. Since it was thought that this discrepancy might be due to a difference in the nutritional status of the mother affecting the serum proteins, especially the \( \alpha \)-globulins and also the protein-bound iodine, it was decided to determine simultaneously the serum proteins and PBI in the pregnant mother and the new born, to find out the relationship, if any, between the serum proteins and PBI values.

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1) Department of Zoology, Scott Christian College, Nager Coil.

Present Address 2) Department of Physiology, Medical College, Kottayam.
IODINE IN INFANT

The estimation of protein-bound iodine was carried out by the method of Barker (1951) incorporating some of the modifications suggested by Morton and Ware (quoted from Starr 1954). The precipitation, washing of serum proteins and incineration were carried out by Morton's modification while dissolving the iodine from ash and the colorimetric determination of iodine content were done according to Ware's modification.

The separation of serum proteins was carried out by micro-electrophoresis using Kern LK 30 Micro electrophoresis apparatus. Michaelis buffer having a pH of 8.5 was used for the fractionation. The serum sample to be investigated electrophoretically was diluted 3-4 times with the buffer to give a protein concentration of 1.5-2.0 per cent in order to have an easily interpreted interference picture (40-60 fringes). It was then dialysed against the buffer, using at least 20 times as much buffer solution and with 4 changes. The apparatus was then charged, filling both channels completely and fractionation carried out with a current such that the product of voltage and the current intensity came to about 200 milliwatts. When the foremost fractions have almost run through the channels, photograph is taken. Each fraction is represented by a more or less narrow fringe group, which is separated from the group on either side by a broader fringe. For accurate interpretation of the diagram, the fringes are marked along the abscissa on a graph paper, after projecting through a photographic enlarging apparatus to produce an enlargement of about 5 times and with the albumin to the right. Points are then marked above the marks on the abscissa, at distances which increase every time by a constant, this constant being such that with the foot of the albumin fraction on the axis of the abscissa, the last point is 120 m.m high. A curve is drawn joining these points and the inflection points found. Lines are drawn from the inflection points, parallel to the abscissa. A 200 millimetre scale is placed with its zero on the parallel through the highest point of the curve and with the 200 m.m. mark on the axis of abscissa. The different points where the parallels cut the scale are then read off, the differences obtained and divided by 2. This gives the percentage values of the different protein fractions.

Blood samples were drawn simultaneously from the maternal vein and from the cord of the new born, from the mothers attending the S.A.T. Hospital, Trivandrum. These patients were economically poor. Only such of those persons who were clinically euthyroid and did not manifest any endocrine or other abnormalities were chosen. They were in apparent good health and their age ranged from sixteen to thirty nine years. The serum was collected...
after allowing the blood to clot and centrifuging at 3000 r.p.m. (RCF 1120 g) for fifteen minutes. The serum was then transferred to another clean tube and again centrifuged to remove all red cells. Wherever possible two estimations were carried out on the same sample of blood.

The cord blood was taken without consideration whether it was arterial or venous. In order to find out whether there is any difference between the arterial and venous protein-bound iodine values which will affect the results, experiments were performed in rabbits drawing blood simultaneously from the aorta and the inferior vena cava. The protein-bound iodine values of the serum were determined separately for arterial and venous samples.

RESULTS

The PBI values in 34 normal pregnant women at term ranged from 6.4 to 15.0 micrograms per cent. In most of the individuals the PBI level was either above the upper level or could be classified as high normal. In the corresponding new borns also, the PBI level was found to be somewhat elevated above those of the normal non pregnant levels; the mean PBI values being 9.7 micrograms per cent for the mother and 7.5 micrograms per cent for the new born (Figs. 1 and 2). Of the 34 cases, except for a single exception, the maternal PBI values were higher than the corresponding cord blood PBI values when these were determined simultaneously. In Fig. 3, the protein-
179 r.p.m. (RCF 1120 g) to another clean tube whenever possible two esti-

mate whether it was arterioph or venous. Any difference between the

blood simultaneously from bound iodine values of the

stem samples.

term ranged from 6.4 to 9.1 in individuals the PBI level was high normal. In the

found to be somewhat elevated; the mean PBI values

5 micrograms per cent except for a single exception,

bound iodine values for both mothers at term and their corresponding cord

cord blood PBI in Fig. 3, the protein-
except one, the points fall below the bisecting line indicating a lower concentration in the cord blood.

There was practically no difference in the PBI values between arterial and venous blood in the rabbit. The values of PBI show a range which was similar to that in man, varying from 2.5 to 8.4 micrograms per cent with a mean of 5.2 micrograms per cent.

Among the various fractions of serum proteins, the albumin fraction is a good deal higher in the newborn than in the corresponding maternal blood while all the globulins except the gamma globulin is less in the newborn. The percentage values (mean and range) of the various serum proteins of 34 mothers and their corresponding newborn are given in Table I. The total protein content of the cord blood is less than that of the maternal blood, the average values being 6.44 grams per cent in the maternal blood and 5.92 grams per cent in the cord blood. Table II shows the actual concentrations of the serum proteins in the maternal and cord blood, in grams per cent.

**TABLE I**

<table>
<thead>
<tr>
<th>GROUP</th>
<th>ALBUMIN</th>
<th>Y1 GLOBULIN</th>
<th>Y2 GLOBULIN</th>
<th>Y3 GLOBULIN</th>
<th>Y4 GLOBULIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOTHER AT TERM</td>
<td>40.7</td>
<td>8.0</td>
<td>16.0</td>
<td>10.0</td>
<td>15.8</td>
</tr>
<tr>
<td>(32.5 - 51.8)</td>
<td>(5.4 - 11.7)</td>
<td>(10.5 - 21.9)</td>
<td>(10.6 - 28.9)</td>
<td>(6.7 - 24.4)</td>
<td></td>
</tr>
<tr>
<td>NEW BORN</td>
<td>57.6</td>
<td>4.3</td>
<td>7.8</td>
<td>9.5</td>
<td>20.4</td>
</tr>
<tr>
<td>(48.9 - 65.9)</td>
<td>(3.0 - 6.8)</td>
<td>(6.1 - 11.8)</td>
<td>(6.9 - 14.7)</td>
<td>(12.3 - 23.4)</td>
<td></td>
</tr>
</tbody>
</table>

**TABLE II**

<table>
<thead>
<tr>
<th>GROUP</th>
<th>TOTAL PROTEIN</th>
<th>ALBUMIN</th>
<th>Y1 GLOBULIN</th>
<th>Y2 GLOBULIN</th>
<th>Y3 GLOBULIN</th>
<th>Y4 GLOBULIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOTHER AT TERM</td>
<td>5.44</td>
<td>2.78</td>
<td>0.30</td>
<td>0.64</td>
<td>1.31</td>
<td>1.01</td>
</tr>
<tr>
<td>(2.550 - 3.187)</td>
<td>(0.355 - 0.324)</td>
<td>(0.649 - 1.390)</td>
<td>(0.004 - 0.711)</td>
<td>(0.102 - 1.007)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEW BORN</td>
<td>5.92</td>
<td>3.32</td>
<td>0.30</td>
<td>0.48</td>
<td>0.64</td>
<td>1.18</td>
</tr>
<tr>
<td>(3.904 - 3.908)</td>
<td>(0.017 - 0.375)</td>
<td>(0.370 - 0.360)</td>
<td>(0.304 - 0.705)</td>
<td>(0.127 - 1.462)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
indicating a lower concentration. Values between arterial and venous blood show a range which was 0.16 grams per cent with a mean of 0.18 grams per cent. The albumin fraction is a ponding maternal blood is less in the new born. Serum proteins of 34 S GLOBULIN | Y. BERNARD AND C.M. FRANCIS DISCUSSION

The results regarding the concentration of iodine in the mother and new born agree qualitatively with the report of Russel et al., (1960). In all cases except one, the maternal PBI was higher than that of the corresponding cord blood. The increase was however not so marked as reported by Russel and co-workers. Previous observers have noted increase of PBI in pregnancy, but the rise in concentration differed from group to group. Heineman, Johnson, and Man (1948) studied 29 cases of normal uncomplicated pregnancies and found that the protein-bound iodine of these individuals ranged from 6.2 to 11.2 micrograms per cent. The normal non-pregnant level in their control was 5.6 ± 1.3 micrograms. DE Mowbray and Tickner (1952) have studied 41 healthy women with normal pregnancies. They found that the range of protein-bound iodine in the group was from 4.0 to 20.0 micrograms per cent with a mean value of 8.8 micrograms per cent. Hallman, Bondy and Hage-wood (1951) determined PBI in 14 normal pregnant women of five to eight months duration of gestation. The PBI values ranged from 6.8 to 13.6 micrograms per cent with a mean value of 10.2 micrograms per cent.

Since none of the cases showed evidence of hyperthyroidism, the increased iodine values may be reflecting an increased concentration of binding protein and the different values obtained by the different groups of workers might depend on varying concentrations of the serum proteins. Compared to the normal non-pregnant levels, the albumin was less in the mother at term and more in the new born. The α1, α2, and β-globulins were more in the mother at term and less in the new born. The globulin was more in the mother at term than in the normal adult and very much increased in the new born. Since the carrier protein has an electrophoretic mobility between α1 and α2 globulins, we might expect an increase in α1 or α2 or both fractions, if there was an increase during pregnancy. While the pregnant mother shows increase in these fractions, the cord blood actually contains less of them. This difference becomes more apparent when the actual concentrations are taken into consideration instead of the percentage values. Longsworth et al., (1945) have found a higher concentration of α1 and α2 globulins in the maternal blood, while they were almost equal to the normal in the foetal blood. If the increase in PBI value was due to increase in the protein fractions, we should have expected an increase in both maternal and foetal α1 and α2 fractions, whereas we find an increase only in the maternal blood and a decrease in the new born. Since there is no increase in the protein fractions in which will be the carrier protein, it is unlikely that the increase in protein-bound iodine concentration is due to a rise in the concentration of carrier protein in the blood. If at all the proteins are
the ones responsible for the increased concentration of protein-bound iodine, it is more likely that the proteins show a greater binding capacity than an actual increase in the protein content.

No significant difference was seen between the concentrations of protein-bound iodine in the arterial and venous blood of rabbits, though a difference might have been expected. During certain preliminary investigations, we have observed that exercising the muscles also does not produce a significant arteriovenous difference. This problem is being further investigated.

REFERENCES

Starr, P. (1954). Hypothyroidism, an essay on Modern Medicine, pp. 22-30; 32-34. Springfield, Ill., Charles C. Thomas,