

Lipoids in Maternal, Cord and Newborn Blood Serum

By

Ildikó BOBOK, G. CSÁKÓ, Hedvig CSERNYÁNSZKY and K. LUDMÁNY

Department of Paediatrics, and Institute of Pathophysiology, University Medical School, Debrecen

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The total lipid and cholesterol contents have been determined in the serum of healthy parturients and in that of the corresponding cord blood and the blood of their newborn infants. The serum total lipid level of each parturient was higher than the upper physiological limit in adults. The mean was 1316 ± 267 mg per 100 ml. One quarter of this value has been found in the cord blood and one third of it in the serum of the newborns. The distribution by height of these two values was independent of the mother's value.

During labour the cholesterol level was high and did not change parallel with the value for total lipid. The cord blood and newborn serum levels were practically identical and amounted to only slightly more than one third of the maternal value.

• The esterified fraction of total cholesterol amounted to 70–79% in the three samples.

It is concluded that the placenta does not let through the lipoids, the amount of which is increased at the end of pregnancy, and that lipid synthesis and concentration is controlled by the foetus itself.

INTRODUCTION

The main function of lipoproteins is to transport the lipoids to the site of utilization and to mobilize them from their stores. The purpose may be the energy supply, provision for the structural components of tissues and for the precursors of other components, and, finally storage itself. Still, in spite of their important functions in metabolism, the serum concentration of circulating lipoproteins or their fractions does not truly reflect the actual state of fat metabolism in the organism. The present study had the aim of obtaining data

concerning the serum lipid level of the mother and her newborn, and the interrelations of these levels.

MATERIAL

Blood samples were obtained immediately before delivery from 12 healthy primiparae or secundiparae after 6–8 hours fasting. They were 18 to 34 years of age, their body weight was between 61–70 kg. Subsequently blood samples were taken from the placental stump of the umbilical cord and from the newborns of the same mothers at 7–20 hours of extrauterine life. Gestational age of the newborns was 38–41 weeks, their birth weight varied between 2800–4100 g, and their Apgar

score was 10 at 5 minutes. Eight newborns did not suck before sampling while 4 had been put on the breast one or two times. These 4 infants were sampled at least 6 hours after the last feed.

METHODS

Total lipid content was estimated after digestion with sulphuric acid and the intensity of colour produced with phosphoric acid-vanillin was measured spectrophotometrically. Determination of the total protein content was done by the biuret method, and of total and esterified cholesterol by the Schönheimer-Sperry method.

RESULTS

1. The total serum protein value was in the parturients 5.84–8.00 g; in cord blood, 5.26–8.00 g; in the newborns, 5.06–7.59 g per 100 ml.

2. The value for total serum lipid was in each parturient higher than the upper normal limit characteristic of adults where the scatter is between 450 and 900 mg per 100 ml. The mean of the twelve examined samples was 1316 ± 267 mg per 100 ml. As shown in Fig. 1, the difference between the lowest and highest values amounted to about 100%, similarly as with normal values.

In Fig. 1, the total lipid values for the parturients are shown in increasing order. Under each value the corresponding total lipid concentration in cord blood and newborn serum is shown in the same order. The total lipid level in cord blood showed an even wider scatter than

in maternal blood, from 128 to 487 mg per 100 ml and the individual values were under the lower limit of normal adults. The serum total lipid value

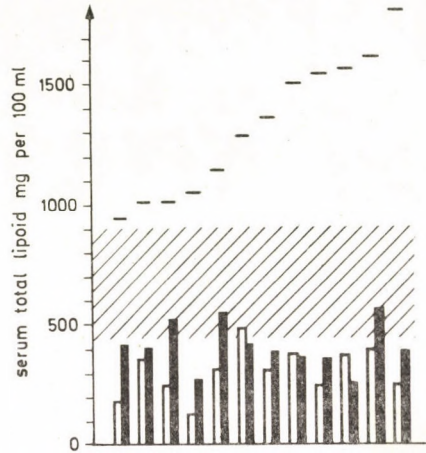


FIG. 1. Total lipid in the serum of parturients, in increasing order (short lines), and in the corresponding cord (empty columns) and newborn sera (full columns). Lined zone = scattering of values for healthy non-pregnant adults

for newborns was also low on the first day of the life; the mean was 408 ± 108 mg, with 250 and 560 mg per 100 ml as extreme values, thus the mean was not significantly higher than the corresponding value for cord blood. The lipid level in both cord blood and newborn serum was entirely independent of the corresponding maternal value.

3. Fig. 2 shows the values for total serum cholesterol. In the upper part of the figure the maternal total lipid levels are seen in an increasing order, and below them the total cholesterol, the esterified and free cholesterol levels.

The cholesterol level of the par-

turients was remarkably high, 304 ± 46 mg per 100 ml, with an esterified fraction amounting to 79.6%. The individual high serum cholesterol levels showed no parallelism with the

serum total lipid levels. Fig. 3 shows the total cholesterol in the three kinds of blood sample as a function of the maternal total lipid level. The total cholesterol level in

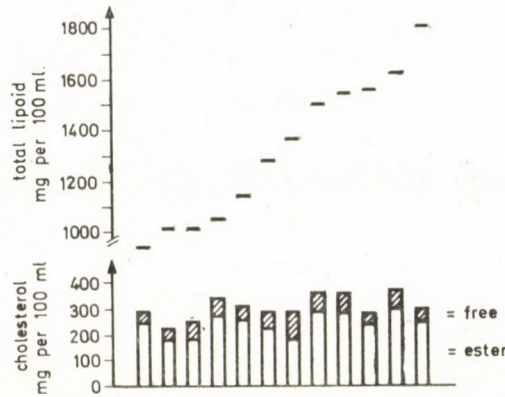


FIG. 2. Total serum cholesterol and cholesterol fraction in parturients. Above, total lipid values

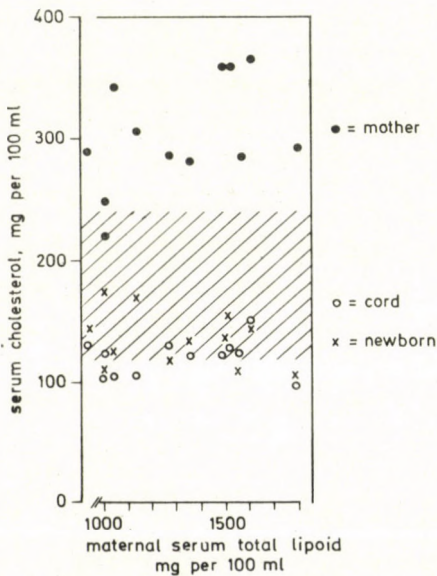


FIG. 3. Total cholesterol in maternal, cord and newborn serum, and physiological values for adults (lined zone), as a function of the serum total lipid concentration

the parturients was considerably higher than the physiological value for normal adults, while those in cord blood and newborn serum were near or below the lower limit. Thus, it is not only the mother's cholesterol level which is independent of the broad variations of the total lipid concentration; the cholesterol level in cord blood and newborn blood behaves in the same way. The esterified fraction amounted to 73.7% of total cholesterol in cord blood and to 69.6% in the newborn's serum.

DISCUSSION

The serum lipoids (lipoproteins) of the mother are increasing moderately from the midpoint of pregnancy [17]

and in the third trimester the serum value for each component (triglycerides, cholesterol, phospholipoid, NEFA) reaches and even exceeds the upper physiological limit of healthy non-pregnant adults [7, 15]. The present patients also exhibited a high total lipid value of more than 1000 mg per 100 ml. The scatter was similar as in normal persons in that the highest value was roughly double of the lowest one. Although the role of several factors have been assumed, the function of the high lipid level is not clear. There is an increased oestrogen production in this period [18] which, under experimental conditions, is accompanied by an increase in circulating lipoproteins. BURT [5] approached the question from the aspect of glucose utilization. The relation between the latter and the serum lipid level is well-known. In addition, other neurohormonal factors such as the anterior pituitary lobe hormones, glucocorticoids and thyroxine, etc., may have to be taken into consideration. The assumption of the pregnant's serum lipoids being influenced by the fat demand, synthesis and regulation of the placenta and foetus, requires thorough clarification [10].

Although the results for cord blood supply limited information concerning the foetus, it is remarkable that in agreement with other observations [3, 4, 14] the mean total lipid content of cord blood should amount to one quarter of the maternal serum level. This raises the question of the active or passive role of the placenta,

and of its filtering and metabolic function in foetal lipid metabolism and in the formation of serum lipoids. It has been shown in animal experiments [2] that certain fatty acids pass across the placenta rapidly, while other fatty acids and cholesterol only slowly or not at all. A mechanism similar to the digestive processes has been assumed to be responsible for the passage of triglycerides through the placenta, where processes synthesizing fatty acid from acetate and pyruvate precursors are active, using the energy of the glycogen deposits in the villi [20]. The placenta seems to let through intact lipid molecules, while destroying others and transporting them as smaller components. In addition, the placenta synthesizes lipid molecules from the basic compounds and stores them. Further investigations will only clarify the pertaining details.

According to the present results, on the first day of life the serum total lipid level of the newborn is considerably lower than that of his mother and of the normal adult. After 4—5 days this low value is gradually increasing but the mean adult value is reached only at the end of the first year [14].

It has been known for close to hundred years [1] that the serum lipid concentration is different in mother and foetus and that these values do not change in parallel. Recent investigations have shown that the foetal blood lipoids are synthesized by the foetus rather than obtained from the mother. The fat deposits

of the foetus accumulate in the last trimenon and especially in the last month of pregnancy, and they mainly originate from carbohydrate precursors [9]. During the first hours of life the serum total lipid concentration increases to reach a significant level even before the first meal. The increase mostly affects the triglycerides.

In the case of a high total lipid concentration, the serum total cholesterol level is usually also high [7, 8, 13, 18, 19]. The increased serum cholesterol levels observed by us should not be considered to represent a true hypercholesterolaemia and, as its change is a function of hyperlipaemia, its origin, like that of the increased serum total lipoids is not clear. In connection with this, two remarkable observations are worth mentioning. GREEN [8] has shown that a diet containing small amounts of saturated fatty acids and large amounts of unsaturated fatty ones does not influence the increase and high level of serum cholesterol in pregnant, while in the same women the same diet had always reduced the amount of serum cholesterol in the prepregnancy period. The other observation is that by DANNEBURG and BURT [6]. They found that glucose or insulin, or both, given intravenously, do not lower the concentration of serum cholesterol in non-pregnant women, but in pregnant cause a further increase of the cholesterol level.

As already mentioned, very little cholesterol is let through the placenta

to the foetus. Still, the baby of a hypercholesterolaemic mother is also hypercholesterolaemic [16]. There is no evidence of an active cholesterol synthesis in the placenta and both the present results and those of MULDRY et al. [11] show that the cholesterol found in the foetal organism is the result of own synthesis and only a small fraction of it originates from the mother.

Thus, it remains an open question, how the concentration of serum lipoids in the pregnant woman is influenced by the placenta and by the demands and activity of the foetus.

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Dr. I. BOBOK
Gyermekklinika
H-4012 Debrecen