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Relationship of Maternal and Newborn (Cord) Serum Ferritin Concentrations Measured by Immunoradiometry

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Serum ferritin concentration was determined by immunoradiometry in venous blood samples of 45 pregnant women at term, in their babies' cord blood samples, and blood specimens obtained from 43 infants aged 3—12 months. The concentration of ferritin was higher in cord serum than in respective maternal samples and infant specimens. Low values were found in more than half of the maternal venous samples. Iron stores of newborns delivered by mothers with low serum ferritin concentration were lower than in newborns of mothers having normal ferritin levels. Serum ferritin measurement is a sensitive method to determine iron deficiency in pregnancy.

Storage iron is made up of two components: ferritin and haemosiderin [16]. Several studies have demonstrated a relationship between the serum ferritin concentration and the size of body iron stores in healthy adults, children and infants [3, 5, 8, 14, 15]. Parallel measurement of serum ferritin concentration in newborn and maternal blood samples may offer important information how maternal iron status influences fetal iron stores. To investigate this question we have attempted to determine the serum ferritin concentration in venous blood samples of pregnant women before delivery and their newborns' cord blood specimens.

Material and Methods

In the first series, serum ferritin was measured by immunoradiometry in cord blood samples of 14 newborns, and in venous blood samples of 43 infants. The newborns' gestational age was 38—41 weeks; the infants, aged between 3 and 12 months, were without hematological and infectious diseases and were grouped according to their age.

In the second part of the study cord and maternal blood samples were obtained from 45 patients having normal deliveries of live infants following uncomplicated pregnancies. All were between 38 and 41 completed weeks of gestation. No patient had had bleedings during pregnancy. A 3×250 mg supplement of elemental iron was provided daily from early pregnancy.

Serum ferritin was determined by immunoradiometry, utilising FER-ION kits (RAMCO Laboratories Inc., Houston, USA). Results below 10 ng/ml were considered low, as in our previous work [4]. In addition, serum iron (Fe), serum total iron-binding capacity (TIBC), and transferrin saturation (SI per cent = Fe/TIBC $\times$ 100) were also determined in 11 maternal blood samples having low ferritin concentration.

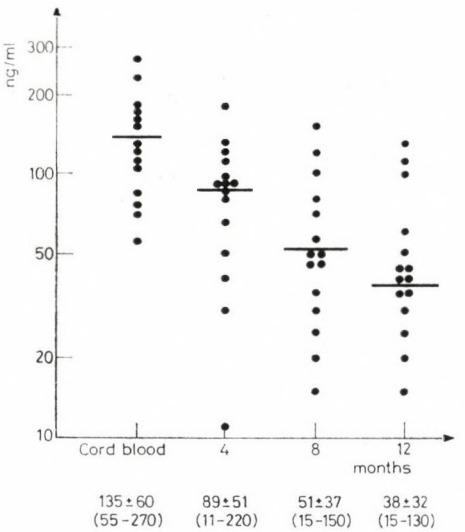

FIG. 1. Serum ferritin concentration during the first year of life

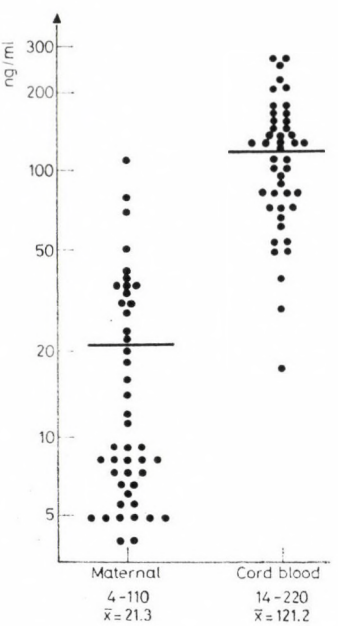

FIG. 2. Serum ferritin concentration in maternal and cord blood samples

Results

Figure 1 shows results obtained in the first series; individual values are indicated. Serum ferritin concentration was highest in cord blood samples, and it decreased during the first year of life.

In Figure 2 the serum ferritin in maternal and cord blood samples is demonstrated. Before delivery more than half of the mothers had a ferritin level lower than 10 ng/ml. Ferritin concentrations in cord blood samples were higher, above 10 ng/ml.

Serum ferritin in cord blood of newborns whose mothers had low and normal serum ferritin levels, can be seen in Table I. Newborns of mothers with normal ferritin level had a significantly higher serum ferritin concentration than babies of mothers with low iron stores.

Table I

Serum ferritin concentration in cord samples grouped according to maternal iron stores

Maternal iron stores	(n)	Maternal	Cord
		serum ferritin concentration (ng/ml)	
Low	(24)	6.5± 1.6	98.5±50.6
Normal	(21)	38.3±23.1	147.2±66.0
t-test			p<0.01

The parameters of iron metabolism in 11 mothers having low serum ferritin level are summarized in Table II, and their individual serum ferritin and Fe concentrations are demonstrated in Figure 3. The average

Table II

Parameters of iron metabolism in pregnant women having low ferritin concentrations (n = 11)

Parameters		X ± S.D.	range
Serum ferritin	(ng/ml)	7.5± 1.6	4.0—9.0
Serum Fe	(μmol/l)	13.8± 3.2	8.5—18
TIBC	(μmol/l)	99.3±23.1	59—132
SI	(%)	13.9± 5.4	8.8—23

TIBC = total iron binding capacity; SI = transferrin saturation

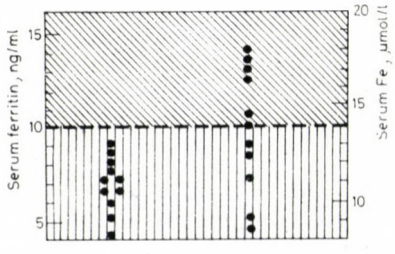

Fig. 3. Serum ferritin and serum Fe concentration of pregnant women having low iron stores (n = 11); individual values; ▨ = normal concentration, ▥ = low level

serum Fe concentration was at the lower border of the normal range. Some individual Fe levels were in the normal range despite the low serum ferritin concentrations.

Discussion

Introduction of the immunoradiometric method has made serum ferritin measurement accessible to practice [1, 9]. Using this method Addison et al [1] have described that ferritin is present in the serum of healthy persons. Further studies have elucidated that the serum ferritin level was closely related to iron stores or the iron content of tissues [3, 5, 8 15]. In childhood serum ferritin is a good discriminant between iron deficiency anaemia and infectious anaemia [4].

There are contradictory reports on the influence of maternal iron stores on the fetal ones [6, 7, 11]. It has been generally accepted that iron supply is increased during pregnancy and a considerable part of pregnant women shows iron deficiency before delivery [2]. On the other hand, it is also well-known that the fetus accumulates his iron stores in the last period of pregnancy [13]. Thus the maternal deficiency may be very important for the newborns' iron stores, and for iron deficiency anaemia in infancy.

The biochemical indices of iron metabolism are elevated in cord serum [6, 13]. Its ferritin concentration is higher than the maternal level. The range of serum ferritin concentration in cord and maternal blood samples were in our study in accordance with data in the literature [6, 11, 14]. It is in agreement also with other studies that the serum ferritin level is decreased during the first year of life [12].

We have pointed out that, despite of prophylactic iron therapy, the maternal ferritin is low at term in more than half of the cases. In our study the incidence of low serum ferritin concentration at term was higher than the findings of Kelly et al [6] and similar to those of Pácsa et al [10].

There was no direct correlation between individual maternal and cord ferritin concentrations which is in agreement with other findings [6, 11]. However, when the newborns were grouped according to whether their mothers had a low or normal ferritin level, there was a significant difference between the respective cord ferritin concentrations. Similar results were reported by Kelly et al [6] and it is therefore suggested that the fetal iron stores are reduced when the maternal stores are low.

Our results showed that the serum ferritin concentration is a more sensitive marker of the maternal iron stores than is the serum Fe level, since low serum ferritin levels can be registered despite of normal serum Fe concentrations. This means that the haemostatus of pregnant women may appear normal on the basis of their serum Fe concentration, when the low serum ferritin predicts an iron deficiency.

Serum ferritin measurement, in this manner, is a useful method to determine the iron deficiency in pregnancy. A low maternal serum ferritin level means a risk factor for the development of infantile iron deficiency anaemia.

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