Serum Protein Pattern in African Neonates

GABRIEL C. EZEILO

With technical assistance of Gabriel Ekeke

From Department of Physiology, School of Medicine, University of Zambia, Lusaka, Zambia

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Serum protein pattern in African neonates. Serum protein concentrations were determined in the cord blood of 75 African and 10 European babies born in Zambia, and in the venous blood of 5 pregnant African women at term.

When the high γ -globulin fraction was excluded, there was no significant difference between the pattern of serum proteins of the Africans and the Europeans at birth.

Present evidence favours the view that the high serum γ -globulin and low albumin of the adult Negro have an environmental rather than a genetic background.

It is well established that adults of Negro origin (Africans, American Negroes, and West Indians) have a higher concentration of serum γ -globulin, and, generally, a lower one of albumin than adults of Caucasian origin. The evidence suggests that this difference is due to environmental factors, but the possibility of a genetic factor has never been ruled out.

Comparative studies on the serum protein patterns of neonates of both races are few and conflicting. Stanier and Thompson (1954), using paper electrophoresis, compared the serum protein pattern in 14 African neonates in Uganda with that found in 10 white American neonates by Longsworth, Curtis, and Pembroke (1945) using chemical fractionation: the African neonate had lower albumin and β -globulin levels than the whites in America, but the γ -globulin levels were the same. Carr and Gelfand (1960) analysed cord blood samples from 54 African and 11 European babies born in Rhodesia, and reported that the proportions of the serum protein fractions in the two races were identical. Edozien (1961) studied African and European neonates in Nigeria, and found that at birth the African had a higher concentration of serum γ -globulin than the European.

In addition to the lack of agreement in the findings of these workers, there is a question whether the comparison between the serum proteins of the two races at birth should include the γ -globulin, since the human fetus does not synthesize this

fraction, but acquires it from the mother (Sandor, 1966).

The present work was designed to help to define whether the serum protein pattern of Negro adults differs from that of Europeans because of heredity or environment. It was conducted on a larger sample of African neonates than that used by previous workers, and on a small collection of European neonates in Zambia. It was hoped also to provide information about the relative concentrations of serum proteins in African mothers at term, and their infants. In Europeans, there is general agreement that the serum of the mother at term has less albumin and γ -globulin, but much more α - and β -globulins than her infant; but in Africans, the reports are contradictory. Stanier and Thompson (1954) reported that the African mother at term had a lower percentage of albumin, but a higher one of globulin, including γ -globulin, than the neonate. On the other hand, Edozien (1961) reported that the maternal serum γ -globulin level was lower than that of the neonate in both Africans and Europeans.

Material and Methods

Samples of cord blood, both African and European, from term babies born by normal delivery, and venous blood from some African mothers, were obtained from the obstetric department of the University Teaching Hospital, Lusaka. 2.5 ml blood was collected in a clean dry bottle, allowed to clot, and centrifuged. The serum proteins were analysed on the same day; if not, the serum was frozen and analysed on the following day. Total protein was estimated by the biuret

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TABLE I

Serum Proteins (g/100 ml) of African Neonates, their Mothers at Term, and Normal Adults; and of European Neonates in Zambia

	Total Protein ± SEM	Albumin	Globulins			
			α ₁	α ₂	β	γ
<i>African</i>						
Cord blood (75)	5.30 ± 0.07	2.88 (54.2%)	0.105 (2.0%)	0.42 (7.9%)	0.67 (12.6%)	1.192 (23.4%)
Mothers (5)	5.95 ± 0.189	2.38 (40%)	0.56 (9.4%)	0.97 (16.3%)	1.94 (19.5%)	0.913 (15.3%)
Normal adults (77)	7.20 ± 0.087	3.78 (52.5%)	0.215 (3.0%)	0.69 (9.6%)	0.876 (12.2%)	1.635 (22.7%)
<i>European</i>						
Cord blood (10)	5.80 ± 0.25	3.30 (57.3%)	0.17 (2.9%)	0.486 (8.4%)	0.736 (12.7%)	1.07 (18.5%)

method (Weichselbaum, 1946), and protein fractionation by cellulose acetate microelectrophoretic technique using Teknolabo-Milano apparatus. Veronal buffer with pH 8.6 was used, and at a constant voltage of 190V, clear separation was obtained within 18 to 20 minutes. The strips were stained with Ponceau S stain, washed with dilute acetic acid (10%), dried with 95% ethanol, and cleared with a mixture of 7 parts dioxane to 3 parts of isobutyl alcohol. Each strip was heat-dried in the oven, and scanned with an electronic electrophoresis strip analyser (Automazione Industriale, Milano). Albumin correction was set on the scanner on the basis of a comparison with the value of albumin determined by biuret method.

Results and Comments

A total of 90 samples was analysed, 75 cord bloods from Africans, 10 from Europeans, and 5 from African mothers.

Table I shows the results of the serum protein analysis in the three groups. Values for adult Zambians have been included in this Table, obtained from 77 blood donors in a previous study (Ezeilo, 1970).

Total protein. The total serum protein concentration of the African neonate was 73.5% that of the African adult. Sandor (1966) gave a figure of 75% for Europeans.

Our mean total protein value of 5.3 g/100 ml agrees precisely with the value reported by Stanier and Thompson (1954) which was 5.31 g/100 ml for African neonates.

The mean concentration of total serum protein was lower in the African cord blood than in the European. This supports the findings of Stanier and Thompson, Bersohn *et al.* quoted by Carr and Gelfand (1960), and Carr and Gelfand themselves, though the differences in their figures were not significant.

Serum protein fractions. These were examined in European and African neonates, in adults, and in mothers at term.

Neonates. The absolute values of albumin and γ-globulin suggest that the African neonate had a significantly lower percentage of albumin than the European (t for the difference of means is 3.97, and $P < 0.001$); but there was no significant difference between the γ-globulins ($t = 1.26$; $0.2 < P < 0.3$). This agrees with the findings of Stanier and Thompson, who also found that the β-globulin was lower in the Africans. We did not find this, nor did Carr and Gelfand (1960), or Symul (quoted by Stanier and Thompson) who reported that all protein fractions were equal in the two races.

This kind of straight comparison is considered questionable, however, on two grounds: firstly, the blood of the African infant seems to be more hydrated than that of the European. This is suggested by the fact that if the constituents of cord blood of African babies and of white babies born in Lusaka are compared, not only is the total protein in the African babies lower, but so also are the red cell count, and packed cell volume, and by the same proportion (unpublished study). Thus the ratio of the total protein (African/European neonates) is $5.3/5.8 = 0.92$, while the ratio of the mean red cell counts (African/European neonates) is $4.26/4.6 = 0.93$. This suggests that the sera of the African neonates contain more water which could invalidate a comparison based on absolute concentrations. Secondly, in a search for inherited ethnic differences in neonatal serum proteins, it is wise only to compare those proteins which are known to be synthesized by the fetus. Hence γ-globulin, which is acquired from the mother, was removed from the total, and the

relative proportions of the remaining protein fractions determined. The result of this exercise is shown in Table II.

TABLE II

Percentages of Serum Proteins (excluding γ -globulin) at Birth in Present Study; and in Study of Carr and Gelfand in Rhodesia, 1960

	Albumin	Globulins		
		α_1	α_2	β
African neonates (Zambia, 1970)	71.5	2.59	10.3	16.4
European neonates (Zambia, 1970)	70.4	3.68	10.35	15.7
African neonates (Rhodesia, 1960)	73.0	5.8	9.6	11.8
European neonates (Rhodesia, 1960)	70.5	6.7	10.1	12.4

There was no significant difference between the ratio of albumin to the globulins, nor between the various globulin fractions in the two races. The slight discrepancy in the α_1 -globulins is within the limits of experimental error. If the figures of Carr and Gelfand (1960) are treated in the same way (see also Table II), a similar result is obtained. The low β -globulin in the African neonate reported by Stanier and Thompson is not seen in our figures, whether or not the γ -globulin fraction is removed from the total, in calculating proportions.

African neonates and adults. The percentages of total serum proteins in the neonate were strikingly similar to those of the adult, with the exception of the α -globulins which were significantly lower in the neonate.

African neonates and mothers at term. Both in terms of absolute values, and in terms of proportions, the albumin and γ -globulin were higher in the neonate than in the mothers (for albumin, $t = 3.21$, and $P < 0.001$; for γ -globulin, $t = 2.06$; $0.2 > P > 0.05$). On the other hand, the mothers had much higher α - and β -globulin fractions than the infants, the differences being large enough to make statistical evaluation unnecessary. Similar findings were reported by Sandor (1966) for Europeans, and the raised maternal α - and β -globulins were explained by the increase in serum lipids during pregnancy. This study supports Edozien's report of higher γ -globulin in the neonate than in the mother, but not that of Stanier and Thompson (1954) who reported the reverse.

Discussion

Since the human neonate acquires its γ -globulin ready made from the mother (Sandor, 1966), its

concentration in cord blood does not reflect the characteristics of the fetus. Hence the comparison between the two races (Negro and White) was made after elimination of the γ -globulin. Since African adults usually have a higher concentration of γ -globulin in their sera than Caucasians, it is not surprising that the African also has a higher one. Edozien (1961) found that there was a linear relation between the maternal and neonatal γ -globulin concentrations both in Africans and in Europeans, with the fetus in each case having a higher level of γ -globulin than the mother. It is difficult to explain Stanier and Thompson's finding that the maternal γ -globulin in the African was higher than that of the neonate.

The only reason for invoking a genetic background for the high γ -globulin and low albumin in peoples of Negro origin would be if this pattern was present irrespective of the environment. However, there is now evidence that this is not the case. Schofield (1957) reported that 30 West Africans, who resided in Britain for 6 years, had a fall in the γ -globulin and a rise in serum albumin to bring their values close to those of British levels. Edozien (1961) observed that the level of serum γ -globulin in Africans was highest in the coastal and highly malarial zones of West Africa, and diminished as one passed inland to the north, east, or south of this zone. Furthermore, Africans placed on regular antimalarial therapy did not develop the hyper- γ -globulinaemia of the unprotected control group. He quoted similar studies in Gambia by Gilles and McGregor (quoted by Edozien, 1961).

The present study, which shows that the African fetus synthesizes serum proteins (excluding the γ -globulin fraction) in the same proportions as the European, adds weight to the suggestion that the low serum albumin found in adult life is environmental rather than genetic in origin.

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Correspondence to be addressed to Dr. Gabriel C. Ezeilo, Head of Physiology Department, School of Medicine, University of Zambia, Box 2379, Lusaka, Zambia.

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