

COMPARATIVE STUDY OF SERUM PROTEINS IN MOTHERS AND IN CORD BLOOD

by

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The importance of changes in the serum protein pattern in pregnancy cannot be overemphasized. Many workers have observed a gradual decline in total serum protein level in mothers with normal pregnancy, which is chiefly due to a significant decrease in the albumin fraction while the globulins, on the other hand show a rise (Kulkarni *et al* 1960; Kishore and Gupta 1963; Basu and Arulalanthan 1973). During pregnancy there is appreciable transfer of alpha-aminonitrogen from the mother to the foetus which is totally dependent upon the mother for the supply of gamma globulins, while the albumin and other globulin fractions are synthesized by the foetus to supplement the maternal source.

The significance of the role of placenta in regulating the serum protein level of the foetus can only be assessed when the cord blood serum proteins are also

studied along with the maternal serum proteins. This work has therefore been undertaken to study the serum protein pattern of the mother and the cord blood in normal and abnormal pregnancies.

Material and Methods

The patients admitted to the Obstetric ward of the Darbhanga Medical College Hospital provided the clinical material for this study. Cases were divided into the following groups:

1. Group I: 25 normal healthy females of child bearing age forming the control.
2. Group II: 50 healthy pregnant women with normal pregnancy.
3. Group III: 25 cases delivering premature babies. Prematurity was assessed on the basis of birth weight; 2500 gms. or below being considered as premature.
4. Group IV: 25 cases with pre-eclamptic toxæmia.

Mother's blood was collected during second stage of labour and that from cord by clamping it and collecting the blood from the placental end of the umbilical vein after the cord was severed. Total serum proteins from both the samples was estimated by Microkjeldahl method (King and Wootton 1956) and fractionation was done by horizontal paper electrophoresis

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and scanning the electrophoretogram with the help of a densitometer (Varley 1967).

Discussion

The mean total serum protein level among the mothers of this study shows a fall from 7.23 gm.% among the control (Range 6.20 to 7.94 gm.%) to 6.036 gm.% in normal pregnancy (Range 5.20 to 6.78 gm.%); to 5.74 gm.% in the premature delivery group (Range 5.15 to 6.43 gm.%) and to 5.37 gm.% in the pre-eclampsia group which ranged from 4.88 to 5.72 gm.% (Table I). Albumin level also

and 3.26 gm.% respectively. On the other hand shows an opposite trend in the pre-eclampsia group where there is a significant fall to 2.93 gm.%. An interesting fact that emerges on further scrutiny of Table I is that the gamma globulin fraction shows practically no change in any of the groups, the change in the globulin level being accounted for by other globulin fractions. Various authors have attributed this change in the serum protein pattern in pre-eclampsia to concurrent albuminuria as well as probable impairment of function of the liver which is

TABLE I
Mean Levels of Serum Proteins in Mothers of Different Groups

S.N. Protein	Mean levels in gm.%			
	Control	Normal	Premature	Pre-eclamptic
1. Total protein	7.23	6.036	5.74	5.37
2. Albumin	4.11	2.65	2.57	2.42
3. Total globulin	3.06	3.39	3.26	2.43(-)
alpha ₁ globulin	0.24	0.48	0.39	0.37
alpha ₂ globulin	0.58	0.49	0.51	0.45
beta globulin	0.83	1.00	0.98	0.70
gamma globulin	1.41	1.42	1.40	1.40

shows a similar trend but the total globulin level, on one hand shows statistically significant increase in normal pregnancy and prematurity groups from the mean control level of 3.06 gm.% to 3.39 gm.%

responsible for the synthesis of all protein fractions except the gamma globulins (Kulkarni *et al* 1960; Basu 1973; and Yunus *et al* 1978).

Table II shows the levels of total and

TABLE II
Mean Levels and Statistical Comparison of Total and Differential Proteins in Normal Mothers and Cord Blood (Total No. 50)

S.N. Protein	Mean levels in gm.%			
	Mother	Cord	t	p
1. Total protein	6.036	5.09(-)	18.98	<.001
2. Albumin	2.65	2.89(+)	5.77	<.001
3. Total globulin	3.39	2.23(-)	27.34	<.001
alpha ₁ globulin	0.48	0.31(-)	4.48	<.001
alpha ₂ globulin	0.49	0.39(-)	6.02	<.001
beta globulin	1.00	0.61(-)	27.65	<.001
gamma globulin	1.42	0.91(-)	22.76	<.001

differential serum protein in mothers and cords of the normal pregnancy group. Total protein and all its fractions except albumin show significantly lower levels in the cord blood as compared to the mother ($P < 0.001$ in all the cases). Albumin shows a significant rise from a mean level of 2.65 gm.% (range 2.15-3.23 gm.%) in mother to 2.89 gm.% in cord (range 2.31-3.43 gm.%). This is also statistically significant at $P < 0.001$ level. This is in agreement with the findings of Sita Devi (1969), Studd *et al* (1972) and Pushpa Sharma *et al* (1973). Of the different globulins, the most significant fall was observed in beta and gamma fractions which fell from mean levels of 1 gm.% and 1.4 gm.% in mothers to 0.61 gm.% and 0.91 gm.% respectively in cord ($t = 27.65$ and 22.76). It may be recalled that the foetus is totally dependent upon the mother for its supply of gamma globulins, whereas the foetal liver is capable of synthesizing the other components among which the beta globulins are the most complex. Oncley *et al* (1947) have described at least 4 fractions of beta globulins ranging in molecular weight from 90,000 to 1,000,000. It is probable that the foetal liver is not yet capable of synthesizing the more complex proteins in adequate amounts thus decreasing their level in the new born. On the other hand,

the rise in albumin may be compensatory phenomenon as it is much simpler and smaller in structure (Mol. wt. 69,000).

In the premature group a slightly different picture was obtained (Table III). Mean level of total protein in cord blood serum was 5.05 gm.% (range 4.33-5.59 gm.%) which was significantly reduced from the mothers' mean level of 5.74 gm.% (range 5.15-6.45 gm.%). Although the fall is significant at 0.001 level in this case also, yet it is much smaller in quantum ($t = 6.54$) as compared to the fall in normal pregnancy ($t = 18.08$). The mean albumin level in cord was 2.67 gm.% (range 2.22-3.18 gm.%) as against 2.57 gm.% in mothers (range 2.08-2.96 gm.%) which is statistically insignificant. All the globulin fractions showed statistically significant lower mean levels in the cord in relation to mother. But in this group the quantum of fall in gamma globulins was not as marked as in the normal pregnancy group ($t = 3.5$ vs 22.76 in normal). The most marked fall from mean levels 0.51 gm.% to 0.34 gm.% ($t = 16.31$) and from 0.98 gm.% to 0.62 gm.% ($t = 11.57$) was registered in the α_2 and beta globulin fractions respectively. The α_2 globulins also are quite complex having mol. wt. in the range of 300,000. This marked fall in the higher mol. wt. α_2 and beta globulin fractions may again

TABLE III

Mean Levels and Statistical Comparison of Total and Differential Proteins in Cord Blood of Premature Babies and Their Mothers (No. 25)

S.N. Protein	Mean levels in gm.%			
	Mother	Cord	t	p
1. Total protein	5.74	5.05	6.54	<0.001
2. Albumin	2.57	2.67(+)	1.31	*
3. Total globulin	3.26	2.38	11.19	<0.001
α_1 globulin	0.39	0.23	3.80	<0.001
α_2 globulin	0.51	0.34	16.31	<0.001
beta globulin	0.98	0.62	11.57	<0.001
gamma globulin	1.40	1.23	3.50	<0.001

* Not significant.

point towards the anabolic insufficiency of the premature liver. The absence of the rise in the albumin level in cord blood of this group as opposed to the significant rise in normal pregnancy group lends support to this view as the premature liver may not be efficient enough to effect a compensatory rise in the synthesis of albumin. However, more elaborate experimental evidence is required to prove this conclusively.

Table IV shows the mean serum protein values in mothers and cord blood of the pre-eclampsia group. Among the mothers it was 5.37 gm.% (range 4.88-5.72 gm.%) and in the cord 5.04 gm.%

(range 4.23-5.66 gm.%). The difference is significant but only at $P = 0.01$ level against $P = 0.001$ in other groups. This is probably because the mothers of this group have the lowest serum protein values as discussed earlier. The cord blood shows mean albumin level of 3.1 gm.% (range 2.46-3.93 gm.%) which is significantly higher than the mother's mean level of 2.42 gm.%. The fall in every globulin fraction is significant statistically.

The serum protein patterns of the cord blood of the normal, premature and pre-eclampsia group were also compared. (Table V). Total protein level was found to be almost equal in all the groups. But there were significant differences in the

TABLE IV
Mean Levels and Statistical Comparison of Total and Differential Serum Proteins in Mothers With Pre-eclampsia and Corresponding Cord (No. 25)

S.N. Protein	Mean levels in gm.%			t	p
	Mother	Cord			
1. Total protein	5.37	5.04		3.26	<0.01
2. Albumin	2.42	3.10(+)		6.04	<0.001
3. Total globulin	2.93	1.90		10.04	<0.001
alpha ₁ globulin	0.37	0.24		9.71	<0.001
alpha ₂ globulin	0.45	0.37		3.29	<0.001
beta globulin	0.70	0.52		6.89	<0.001
gamma globulin	1.40	0.80		14.04	<0.001

TABLE V
Statistical Comparison Between the Mean Serum Protein Levels in the Cord Blood of Different Groups

S. N.	Protein	Mean level in gm.%			Group 1/vs2		Group 1/vs3	
		Normal	Prema- ture	Pre- eclampsia	t	p	t	p
		50	25	25				
1.	Total protein	5.09	5.05	5.04	0.47	0.6*	0.58	0.5
2.	Albumin	2.89	2.67(-)	3.10(+)	3.36	<.001	3.72	<.001
3.	Total globulin	2.23	2.38(+)	1.90(-)	3.19	.01-.001	5.9	<.001
4.	alpha ₁ "	0.31	0.23	0.24	7.42	<.001	6.49	<.001
	alpha ₂ "	0.39	0.34	0.37	2.24	.02-.01	0.97	0.4*
	beta "	0.61	0.62	0.52(-)	0.47	0.4*	4.24	<.001
	gamma "	0.91	1.23(+)	0.80(+)	7.49	<.001	4.40	<.001

* = Insignificant.

differential protein pattern in the prematurity and pre-eclampsia groups between each and in relation to normal pregnancy. Albumin level in the premature group was significantly lower than the normal, whereas it was higher in the pre-eclampsia group (Normal 2.89 gm.%, premature 2.67 gm.%, pre-eclampsia 3.10 gm.%). Total globulins, on the other hand showed an opposite trend by registering a higher mean value in premature group (2.38 gm.%) and lower in the pre-eclampsia group (1.90 gm.%) in relation to the normal value of 2.23 gm.%. Alpha₁ globulins were lowered in both but alpha₂ was lowered in the premature group only, whereas it showed no change in the pre-eclampsia group. Beta globulins showed an opposite trend as its increase in the premature group was statistically insignificant, whereas in pre-eclampsia it was significantly lowered. Gamma globulins also showed strikingly opposite pattern in these groups. The mean level in the normal was 0.91 gm.%, 1.23 gm.% in the premature and 0.80 gm.% in pre-eclampsia. Both the rise in prematurity and fall in pre-eclampsia were statistically significant ($P < .001$). The significance of this difference in the pattern of gamma globulin becomes clear in face of the fact that its level among the mothers of the three groups is almost equal. The foetus depends solely upon the mother for its supply of gamma globulins. It is probable that the placental barrier is weaker in prematurity and becomes progressively stronger with the attainment of foetal maturity, thus allow-

ing more gamma globulins to pass through in this group. On the other hand, toxæmia may impair the placental function partly obstructing the passage of gamma globulin.

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