CORRELATIVE STUDIES ON FOETAL IMMUNOGLOBULIN LEVELS AND MATERNAL NUTRITION

by

M. Madhavan
K. Baba Krishnan
T. K. Mohanalakshmi
C. R. Kanthamani
and
S. Jaya

SUMMARY

The study was conducted in 100 random cases of uncomplicated pregnancies with the vaginal deliveries. Nutritional assessment of the mothers was done by estimating their height, weight, Haemoglobin, Total proteins, serum albumin and serum iron, and they were grouped as I (nutritionally sound), II (Satisfactory) and III (Nutritionally poor). Immunoglobulins G, A and M were estimated in the maternal and cord sera by the single radial immunodiffusion technique. Our study showed that maternal nutrition affects the synthesis of serum IgG in the mother, as it was lowered in the nutritionally poor group, though its transfer across the placenta was not affected. There was no significant difference in the serum IgA and IgM levels in the nutritionally different groups either in the mothers or in their babies.

Introduction

It was Dr. R. K. Chandra who established the concept of foetal malnutrition as a factor in intrauterine growth retardation (Chandra and Newborne, 1977). Anderson (1972) suggested the brain/liver weight ratio as an index of prenatal nutrition. Though there are well defined indicators to assess intrauterine growth retardation based on serum chemistry, hormones and maternal leukocytic enzymes, none of them appear to be entirely satisfactory. In a developing country like India with high perinatal mortality, foetal malnutrition as a cause of the foetal loss cannot be over-ruled. In this study we have attempted to assess some of the well recognised parameters of malnutrition in mothers and their newborn babies and to correlate the effect of maternal malnutrition on the foetus, especially on the foetal immunoglobulin levels.

Material and Methods

The study was conducted in 100 random

From: Department of Pathology, Postgraduate Institute of Basic Medical Sciences, University of Madras, Taramani, Madras-600 113, and Kasturba Gandhi Hospital for Women and Chidren, Madras-600 005.

Accepted for publication on 10-2-83.

cases of uncomplicated pregnant women who had vaginal delivery. Nutritional assessment of the mothers was done by the following parameters: Height (in cms), Weight (in Kg), Haemoglobin levels (gms/dl), Serum proteins (gms%), Serum albumin (gms%) and Serum iron (mgm%). The mothers were grouped as Group I (nutritionally sound), Group 2 (satisfactory and Group 3 (nutritionally poor), based on these criteria as shown in Table I. The biochemical estimations were done in the cord blood also. Using the single radial immunodiffusion method modified by Fahey and Mc Kelvey (1965), assay of immunoglobulins G, A and M was done in both the maternal and cord blood samples. The antisera and standards were obtained from the Immunodiagnostics, Pvt. Ltd., Delhi, which compared favourably with the antisera and standards marketed by Wellcome Research Laboratories, Beckenham, England.

levels in all the cases. It was noted that there was a statistically significant difference between Groups I and II and Groups I and III in the maternal levels ($p < 0.01$ and $p < 0.001$ respectively) but not in the foetal levels. When the mean values of serum IgG were considered (Table III) there was again a statistically significant difference between Groups I and II and Groups I and III in the maternal levels ($p < 0.01$ in both) but not in the foetal data. In each nutritional group, a comparative study was done between maternal and foetal IgG levels (Table IV) and it was noted that in Groups II and III, 66.6% and 74.4% respectively had lowered serum IgG values in both the mother and the newborn, in contrast to 31.8% in Group I. There was no correlation between the birth weights of the babies or their biochemical parameters with the maternal nutrition (Table V and VI) in our series.

TABLE I

Parameters for Classification of the Mothers inti Groups Based on Their Nutritional Status

Nutr. group	Height in CM.	Weight in Kg.	Hb. in BM/IL	S. Pro. Gm%	S. Alb. Gm%	S. Iron MGM %
I	150 (156.5**) *(42)	50 (54.9) (25)	12.5 (14.7) (50)	7 (7.1) (5)	4 (4.3) (15)	90 (128.5) (45)
II	145-150 (53)	45-50 (27)	10.5-12.5 (30)	6-7 (58)	3-4 (63)	70-90 (36)
III	145 (136) (5)	45 (41) (18)	10.5 (8.7) (20)	6 (5.49) (27)	3 (2.6) (22)	70 (56.2) (19)

** Mean values. * Number of cases.

Results

While assessing the various criteria for the nutritional status, the subjects were taken as Group I if 3 out of the 6 parameters were positive. We had 22 mothers of Group I, 39 of Group II and III each, and all belonged to the low socio-economic strata (below Rs. 500 p.m.). Table II shows the maternal and foetal serum IgG

80% of the newborns did not have any IgA in their sera while the remaining 20% showed a range of 6-20 mgm, which could not be correlated with the maternal nutritional status. The serum IgM levels, either in the mothers or in the newborns (Table VII) could not be correlated with the nutritional parameters.

TABLE II

Correlation of IgG Levels in Mothers of Different Nutritional Groups to Those of Their Babies

Nutritional group	Serum IgG levels (MGM%)	
	Maternal	Foetal
I	1175 ± 89.56 (500 — 2300)	1042.91 ± 81.96 (260 — 1520)
II	874.18 ± 50.45 (360 — 1580)	923.03 ± 62.42 (200 — 1720)
III	825.00 ± 47.66 (380 — 1370)	827.56 % 53.55 (310 — 1680)

TABLE III

Maternal and Faetal IgG Levels as Per Mean

Nutritional groups	Material		Cord	
	1150	1150	1150	1150
I	54.5	45.5	40.9	59.1
II	84.6	15.4	74.4	25.6
III	82.1	17.9	82.1	17.9

*mgm% (Numbers indicate percentages).

TABLE IV

Comparison of Maternal and Foetal IgG Levels

Nutritional groups	Both Normal	Both Low	MNCL*	MLCN**
I	36.4	31.8	9.1	22.7
II	2.6	66.6	10.3	20.5
III	10.2	74.4	7.7	7.7

(The figures show percentages).
* Maternal—Normal, Cord-low.
** Maternal—low, Cord-normal.

TABLE V

Correlation Between the Nutritional Grouping of the Mothers and the Weight of the New Borns

Nutr. Group	Mean Wt. in Each Gr.	Above 3 Kg.	2.5-3 Kg.	Below 2.5 Kg.
I	2.7	7	11	4
II	2.9	12	26	1
III	2.8	8	24	7

TABLE VI

Mean Values of of Nutritional Parameters in the Foetal Samples

Nutri-group	Hb. in gms%	Protein gms%	Albumin gms%	Iron mgm%
I	15.6	6.3	3.3	129.4
II	15.5	6.7	3.2	125.4
III	14.9	5.9	3.0	127.9

TABLE VII

Serum IgM Levels in Maternal and Foetal Samples

Nutritional group	Serom IgM levels (mgm%)	
	Maternal	Foetal
I	73.20 ± 5.97* (20-160)**	57.23 ± 39.83 (0 — 90.5)
II	102.26 ± 26.68 (20-1062)	8.76 ± 2.32 (0 — 50)
III	111.74 ± 28.32 (32—1172)	5.97 ± 1.66 (0 — 32)

*Mean with standard error.
**Range

Discussion

While comparing the relative value of the different parameters used, it was noted that only maternal height, weight and serum albumin levels had correlation with the maternal and foetal IgG values. Gitlin and Biasucci (1969) found that IgG is synthesised in foetal liver and lymphnodes by the 12th week and in the spleen and thymus in the 18th week of intrauterine life. Though the foetus can thus synthesise IgG, a high proportion of the IgG found in the foetus is of maternal origin by selective placental transfer (Van Furth *et al*, 1965). The foetal serum IgG increases with gestational age and constitutes almost the whole of its immunoglobulin. Placental insufficiency is known to interfere with the transfer of IgG_1 (Chandra, 1975a) and we have therefore avoided including cases of this nature in our series. Earlier workers (Gholmy *et al,* 1970; Chandra, 1975b) have observed that nutritional deficiency reduces the synthesis of IgG and this coincides with our view. Also it has to be kept in mind that racial variations in the foeto-maternal IgG ratio with higher foetal levels in Caueasians and lower ones in Africans and Chinese have been observed (Zak and Good, 1959; West *et al,* 1962; Michaux *et al,* 1966; Jones and Payne, 1967; Cochran, 1972).

It has been the observation of the earlier workers that foetal production of IgA is doubtful (Van Furth *et al,* loc cit, 1965; West *et al,* loc cit, 1962; Momma, 1965) though traces of IgA were found in cord sera in African studies (Mc Farlane, 1966). Our findings agree with the latter, as 20 of our cord sera showed traces of IgA. 34% of the neonates had presence of serum IgM in our series. Our findings corroborates with those of Chandra *et al* (1970), Naeye *et al,* (1973) and indicate that maternal IgG production is lower in nutritionally poor mothers though the foetal IgG levels are protected.

Acknowledgements

We place on record our appreciation to the Tamil Nadu State Research Committee for having given financial assistance to conduct this work.

References

1. Anderson, J. M.: J. Clin. Path. 25: 867, 1972.
2. Chandra, R. K.: Materno-foetal transmission of Immunoglobulins, Cambridge University Press, p. 77, 1975a.
3. Chandra, R. K.: Brit. Med. J. 2: 583, 1975b.
4. Chandra, R. K., Guha, D. K. and Ghai, O. P.: Ind. J. Paed. 37: 361, 1970.
5. Chandra, R. K. and New berne, P. M.: Nutrition, Immunity and Infection Mechanism of interactions. Plenum press, New York and London, p. 50, 1977.
6. Cochran, T. E.: J. Obstet. Gynec. Brit. C'Wealth. 79: 238, 1972.
7. El Gholmy, A.: Hashish, S., Helmy, O., Aly, R. H. and Gomal, Y. E.: J. Trop. Med. Hyg. 73: 192, 1970.
8. Fahey, J. L. and Mc Kelvey, E. M.: J Immunol. 94: 84, 1965.
9. Gitlin, D. and Biasucci, A.: J. Clin. Invest. 48: 1433, 1969.
10. Jones, W. R. and Payne, R. B.: Am. J. Obstet Gynec. 99: 1160, 1967.