

RELATIONSHIP OF CORD BLOOD FOETAL HAEMOGLOBIN TO LENGTH OF GESTATION AND BIRTH WEIGHT

by

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The precise method of estimating the duration of pregnancy is still an unsolved problem and it is generally agreed that the present conventional methods are generally unsatisfactory. In clinical work the assessment of gestational age is based either on the menstrual history of the mother or on certain morphological characteristics in the new born infants. The first mentioned approach is subjective and is often based on unreliable data. Morphological characteristics, which form basis of our present objective age determination methods are subject to great individual variations. A rational attack on the problem was originally induced in medicolegal demands for an objective appraisal of the duration of pregnancy—(Brody, 1960). Many neonatal characters other than physical growth have been studied to determine the maturity status of new born and to differentiate a full term from a pre-term baby. Post-conceptual age of foetus cannot be determined from its growth alone as intrauterine growth depends on several factors. In the early period of gestation foetal haemoglobin is predominant type of hemoglobin which gradually decreases and is replaced by

adult type of hemoglobin as the period of gestation advances.

It is generally believed that this replacement of foetal hemoglobin by adult hemoglobin is essentially a maturation process which is affected more by length of gestation than physical growth. Many workers have studied its utility in determining post conceptional age (Garbie *et al.*, 1969; Fraser and Raper, 1962; and Andrews and Willet, 1965). These studies have shown significant differences in foetal hemoglobin levels between pre-term and term infants but there is a wide scatter in the data.

Material and Methods

One hundred and fifty new borns between 22 and 43 weeks of gestation were studied. All the infants were healthy at the time of birth and did not have any disease or congenital malformations. In all these cases gestational age was known. All these mothers were healthy and free from disease.

Cord blood foetal hemoglobin levels were determined by Alkali-denaturation method (Singer *et al.*, 1951).

The new borns were divided into 3 groups on the basis of their gestational age.

Group I: Pre-term (22-37 weeks) 64 cases.

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Received for publication on 9-5-74.

Group II: Full-term (38-41 weeks) 84 cases. blood foetal hemoglobin ranged between 36-86 (Mean 62). In group II full-term

Group III: Post-term (42 weeks on-wards) 2 cases. infants its range was between 38-68 (mean 59). In group III (Post-term infants the range was 42-65 (mean 56).

Results

Results are summarised in Tables I, II, III and IV. Although there is a significant fall in the levels of foetal hemoglobin with increase in gestational period, a wide scatter in the data at all periods of gestation was

In Group I (Pre-term infants) cord found.

TABLE I
Birth Weight and Foetal Haemoglobin

	Birth weight (Kg.)		Foetal hemoglobin (%)	
	Range	Mean	Range	Mean
22	0.4-0.5	(0.425)	70-88	(75)
28	0.8-1.2	(0.96)	62-86	(68)
30	1.1-1.5	(1.35)	59-71	(64.6)
32	1.6-1.8	(1.71)	56-61	(58.2)
34	1.8-2.6	(2.3)	44-68	(58.0)
36	2.2-3.0	(2.5)	40-70	(52.7)
38	2.3-3.2	(2.55)	36-68	(46.2)
40	2.4-3.3	(2.65)	38-66	(42)
42	2.6-3.3	(2.7)	45-68	(53.6)
44	2.6-2.6	(2.6)	42-65	(53.5)

TABLE II
Comparison of Three Groups, i.e. Term, Pre-term and Post-term with Respect to Foetal Hemoglobin levels.

Foetal haemoglobin (%)	Pre-term (22-37 weeks)	Term (38-41 weeks)	Post-term (42-45 weeks)
Range	36-86	38-68	42-65
Mean	62	59	56
Number of cases	64	84	2

TABLE III
Comparison of Foetal Hemoglobin Levels of Low Birth Weight Infants (less than 2.5 Kg) of Pre-term and Term infants

Foetal haemoglobin (%)	Pre-term (gestation period less than 37 weeks)	Term and post-term (gestation period more than 38 weeks)
Range	36-86	24-68
Mean	56	44
Number of cases	64	86

Infants with low birth rate weight i.e. less than 2.5 kg. were divided into two groups. I pre-term and II term and post-term. Comparison of foetal hemoglobin levels in the two groups is recorded in Table III. In pre-term group foetal hemoglobin levels are ranged between 36-86% (mean 56) as compared to 24-68% in term and post-term group. Mean of post-term group is 44. This shows definite difference in hemoglobin levels in two groups. It also demonstrates that in infants weighing less than 2.5 kg. and which are truly premature, foetal hemoglobin levels are higher, while in low birth weight infants beyond 38 weeks (term and post-term infants) foetal hemoglobin levels tend to become low.

TABLE IV

Comparison of Foetal Hemoglobin Levels of Infant Under 2.5 Kg. and Over 2.5 Kg. Irrespective of Age of Gestation

	Under 2.5 Kg. Number (69)	Over 2.5 Kg. Number (82)
Range	36-86	24-70
Mean	53	51

Table IV records comparison of foetal hemoglobin levels of infants under 2.5 kg. and over 2.5 kg., irrespective of age of gestation. Recorded findings suggest that there is some difference in hemoglobin levels in infants weighing less than 2.5 kg. and those weighing more than 2.5 kg. and this also indicates that on an average low birth weight infant has higher foetal hemoglobin content. However, difference in hemoglobin levels is too small to be of any significance. These findings differ from observations made by Andrews and Willet (1965).

Discussion

In early stages of foetal life most of

the hemoglobin is present in foetal form. This study has confirmed the work of others in that foetal hemoglobin gradually decreases as the period of gestation increases. (Schulman *et al.*, 1954; Cook *et al.*, 1957; Garbie *et al.*, 1959; Fraser & Raper, 1962; Andrews and Willet, 1965; and Gupta *et al.*, 1973). It may be that as intrauterine age of the foetus advances the bone marrow takes up the function of formation of hemoglobin of adult variety, while with increase in gestational age liver and spleen cease to form the foetal hemoglobin. In this study it has been found that foetal hemoglobin is about 75% of total hemoglobin at 22 weeks gestation. Foetal hemoglobin is relatively high till 34 weeks of gestation, while after that there is significant fall of about 2.5% per week.

Although most of the workers have reported significant differences in foetal hemoglobin levels between premature and mature infants, the wide range precludes accurate prediction of gestational age from foetal hemoglobin levels alone (Schulman *et al.*, 1954; Cook *et al.*, 1957; Garbie *et al.*, 1959; Fraser and Raper, 1962; Andrews and Willet 1965; Gupta *et al.*, 1973). Observations made in the present study support the conclusion arrived at by earlier workers that foetal hemoglobin alone cannot be used as an index of post-conceptual age.

Replacement of foetal hemoglobin by adult variety is related to the duration of pregnancy as is demonstrated by the finding of identical foetal hemoglobin concentration in dizygotic twins of different birth weights (Salzberger 1956). Our findings in Table III and those of Weippl (1963) have demonstrated higher foetal hemoglobin concentration in truly premature infants in contrast to term infants of the same birth weight due to

intrauterine growth retardation. Findings in the present study also suggest that foetal hemoglobin has no correlation to birth weight.

Summary

One hundred and fifty normal infants born to healthy mothers between 22 and 43 weeks of gestation were studied for their foetal hemoglobin levels. The object of the study was to assess the value of foetal hemoglobin in the assessment of maturity of new borns. It has been observed that although the foetal hemoglobin decreases as age of gestation increases and there are significant differences in pre-term and term infants, wide scatter in data at all periods of gestation prevents it being used as an index of maturity. Foetal hemoglobin levels at birth have no relation to the birth weight of new born. In low birth weight infants i.e. weighing less than 2.5 kg., in pre-term infants foetal hemoglobin was found to be significantly higher (mean 56) than in term infants (mean 44).

Acknowledgement

We thank Dr. V. G. Ganla, Dean,

Medical College & Hospital, Aurangabad for giving permission to publish this paper. We are also thankful to Dr. (Mrs.) C. H. Sathe, Professor of Obstetrics & Gynaecology and Dr. M. S. Deshpande, Professor of Pathology, Medical College, Aurangabad for providing facilities to carry out this work.

References

1. Andrews, B. F. and Willet, G. P.: *Am. J. Obst. & Gynec.* 91: 85, 1965.
2. Brody.: *J. Obst. & Gynec. Brit. Emp* 17: 819, 1960.
3. Cook, C., Brode, H. R. and Allen, D. W.: *Paediatrics*, 20: 272, 1957.
4. Fraser L. D. and Raper A. B.: *Arch. Dis. Children*, 37: 289, 1962.
5. Garbie, A. B., Decosta, E. J. and Reis, R. A., *Am. J. Obst. & Gynec.* 78: 57, 1959.
6. Gupta, H. L., Harjit Singh, Dhatt, P. S., Mehta H. C. and Verma K. C.: *Ind. J. Med. Res.* 61: 903, 1973.
7. Salzberger, M.: *Expt. Med. Surg.* 14: 130, 1956.
8. Schulman I., Smith C. H., and Stern G. *S. Am. J. Dis. Child* 88: 567, 1954.
9. Singer K, Chernoff A. I. and Singer L.: *Blood*, 6: 413, 1951.
10. Weippl, G. H.: quoted by Gupta et al., 1973.