CLINICAL ASSESSMENT OF NUTRITIONAL STATUS AT BIRTH

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Objective: *Clinical assessment of nutritional status of neonate using CAN score and comparison with other methods of determining intrauterine growth.* ***Design:*** *Cross sectional study.* ***Setting:*** *Tertiary care hospital.* ***Subjects:*** *637 consecutive, liveborn singleton neonates with known gestational age and no major congenital malformation.* ***Methods:*** *Birth weight, length, midterm circumference* ***and*** *head circumference recorded in newborns. Ponderal index and mid arm to head circumference ratio was calculated. Clinical assessment of nutritional status was done on the basis of CAN score and compared with other methods.* ***Results:*** *CAN score < 25 separated 60% of the babies as well nourished and 40% as malnourished. Weight for age and Ponderal Index classified 70-75% of babies as well nourished (AGA) and 25-30% as malnourished. Also MAC/HC classified nearly half the babies as well nourished and half as malnourished.* ***Conclusion:*** *CAN score may be a simple clinical index for identifying fetal malnutrition and for prediction of neonatal morbidity associated with it, without the aid of any sophisticated equipments.*

Key words: *CAN score, Fetal malnutrition.*

THE incidence of low birth weight (LBW) babies (< 2500 g) continues to be high in India at about 30% in contrast to 5-7% in developed countries(l). Preterm babies account for only 10% LBW babies, the rest being term intrauterine growth retardated (IUGR) infants(2). It is important to recognize IUGR babies because of the high incidence of neonatal morbidity and long term sequelae.

The reference criteria used for defining IUGR has been very variable. Weight for gestational age has been the most common criterion adopted by investigators. Here too, the cut off levels used have been -1 SD, -2 SD or the 10th percentile(3-5). These methods do not identify fetal malnutrition which indicates a clinical state that may be present at almost any birth weight(6). The concept of IUGR as defined by low birth weight for gestational age needs reappraisal since a proportion of malnourished infants will in fact have a birth weight >10th centile(7). The Ponderal index (PI) and mid arm/head circumference (MAC/HC) ratio are two other measurements of body proportionality used to identify at risk IUGR infants. But each has its own drawbacks(8,9).

Since neonatal morbidity and mortality is more closely related to nutritional status of newborn at birth than to the birth weight for gestational age, a clinical assessment of nutritional status (CAN score)(10) was

developed to differentiate malnourished from appropriately nourished babies. The present communication attempts to compare the utility of CAN score with other commonly used measures for defining nutritional status at birth.

Subjects and Methods

This study was carried out on 637 consecutive neonates delivered at Smt. Sucheta Kriplani Hospital, New Delhi.

Selection Criteria: Criteria for infants to be included in the study were as follows:

1. Live born, singleton infants with gestational age > 35 weeks.
2. Only infants whose hospital stay ex ceeded 24 hours of age.
3. Known gestational age (last menstrual period, Ballard score or obstetrical ultrasound if done).
4. No major congential malformation.

Neonatal Anthropometry: In all neonates weight was recorded on an electronic weighing scale at birth. Length, mid arm and head circumferences were recorded between 24-48 hours of birth.

The initial 50 assessments were done by two observers and the interobserver reliability was observed to be excellent.

All subsequent measurements were performed by a single observer.

Ponderal index (PI)(11) and mid arm/ head circumference (MAC/HC) ratios were calculated from these measurements. A PI of <2.2 and MAC/HC ratio <0.27 were considered as malnutrition. A weight for age below-1 SD by the grid for North Indian babies(3) was used for defining Intrauterine growth retardation.

Clinical Assessment of Nutrition (CAN): Clinical assessment of nutritional status was done within 48 hours on the basis of the superficial readily detectable signs of malnutrition in the newborn as described by Metcoff(10) *(Table I)*. *A* CAN score of < 25 was used to define malnutrition. This score offered the best breakpoint between growth retarded and normal infants as determined by weight for age.

Statistical Analysis

The observations were statistically analyzed on EPI INFO version 6 with test of significance calculated by X^2 test. Sensitivity, specificity, positive and negative predictive value and Odds ratio were also calculated, wherever required.

Results

Majority of the babies in the study comprised of full term infants (91.8%). Only 8.2% newborns were premature. Mean birth weight of study population was 2.60±0.48 kg, the mean length was 48.01±2.36 cm, the mean midarm circumference was 8.97±1.01 cm and the mean head circumference was 33.03 ± 1.47 cm.

Distribution of study population as well nourished (WN) and malnourished (MN) according to different methods is depicted in *Table II*. The MAC/HC ratio and CAN score classified 40% or more as malnourished, while both PI and weight for age classified only 25-29% as malnourished.

Comparison of CAN score with other methods for detection of fetal malnutrition is given in *Table III* The odds ratio (95% CI) for identifying malnutrition using CAN score compared to weight for age, PI and MAC/HC ratio were 8.5 (5.5-13.3), 4.6 (3.1-6.7) and 11.5 (7.7-17.4), respectively.

Discussion

Low birth weight is a major public health problem in India in contrast to what is observed in most developed and many

TABLE I- *The Nine Signs for Clinical Assessment of Nutritional (CAN) Status in the Newborn (Fig. l)(10).*

1. *Hair*

   Large amount, smooth, silky, easily groomed(4).

   Thinner, some straight, "staring" hair(3).

   Still thinner, more straight, "staring" hair which does not respond to brushing(2).

   Straight "staring" hair with depigmented stripe (flag sign)(l).

2. *Cheeks*

   Progression from full buccal pads and round face(4), to significantly reduced bucal fat with narrow, flat face(l).

3. *Neck and Chin*

   Double or triple chin fat fold, neck not evident (4); to thin chin. No fat fold, neck with loose, wrinkled skin, very evident (1).

4. *Arms* - Full, round, cannot elicit "accordion" folds or lift folds of skin from elbow or tricep area (4); to a striking "accordion" folding of lower arm, elicited when examiner's thumb and fingers of the left hand grasp the arm just below the elbow of the baby and thumb and fingers of the ex aminers right hand circling the wrist of the baby are moved towards each other; skin is loose and easily grapsed and pulled away from the elbow.

5. *Legs*

   Like arms.

6. *Back*

   Difficult to grasp and lift skin in the interscapular area(4); to skin loose, easily lifted in a thin fold from the interscapular area(l).

7. *Buttocks*

   Full round gluteal fat pads (4); to virtually no evident gluteal fat and skin of the buttocks and upper posterior high loose and deeply wrinkled(l).

8. *Chest*

   Full, round, ribs not seen(4); to progressively prominence of the ribs with obvious loss of inter-costal tissues(l).

9. *Abdomen*

   Full, round, no loose skin(4); to distended or scaphoid, but with very loose skin, easily lifted, wrinkled and "accordion" folds demonstrable.

developing countries of the world. Two third of these low birth weight babies are growth retarded(9). It has been shown that growth retarded babies differ in etiology, neonatal morbidity, mortality and later development from term appropriately grown infants(12).

Most of the classification systems for intrauterine growth retarded babies are based on observed birth weight below the 3rd or 10th percentile for gestational age estimated by use of various growth curves(3,13-15). However, none of the above classification system identifies fetal malnutrition, a term coined by Scott and Usher(16), which indicates a clinical state that may be present at almost any birth

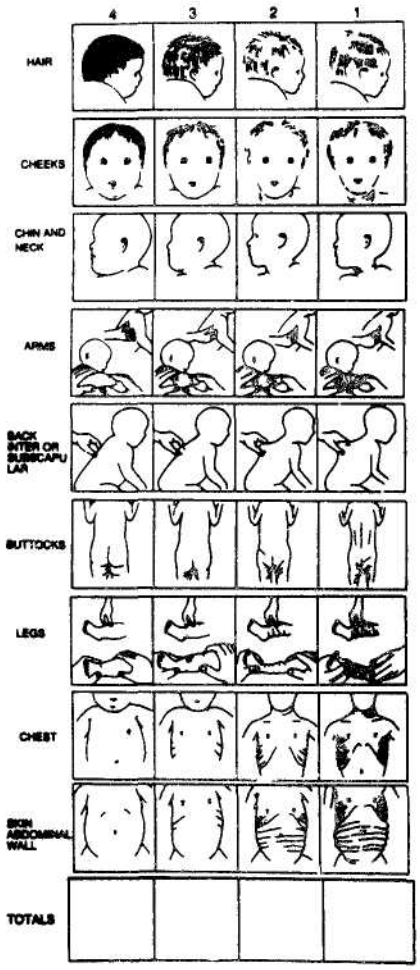

Fig 1 Physical signs for clinical assessment of nutritional status in newborn Reproduced from Metcaff(10) with permission

weight irrespective of classification of infants into appropriate for gestational age (AGA), intrauterine growth retardation (IUGR) or small for gestational age (SGA) categories.

The clinical manifestation of fetal malnutrition depends in part on the timing it began during gestation. It is characterized by obvious intrauterine loss of, or failure to acquire normal amount of subcutaneous fat and muscle. Weight, length and head circumference may or may not be affected.

Ponderal index has also been used by various authors to classify intrauterine growth retarded infants. Miller and Hassanein(11) proposed that a full term infant is growth retarded if his PI is < 2.2. Man Mohan *et al.(17)* defined SGA as those with PI falling short of 10th percentile for their gestational age so in a term infant PI < 2.25 should be an indicator of intrauterine undernutrition. Ponderal index relies on the principle that length is spared at the expense of weight during period of acute malnutrition; weight and length velocities may be proportionately impaired so infants with chronic insult *in utero* may be misclassified by PI. When CAN score was compared with ponderal index it gave a sensitivity of 65.6% and a specificity of 75.5% in the present study.

Meadow and colleagues(18) concluded that the MAC/HC ratio, independent of birth weight, readily discriminated the late gestation growth retarded baby. Their study showed that this ratio can be used as a reliable test to identify neonates whose growth is retarded, even when their weight does not fall below 10th percentile. But those babies whose head circumference is reduced because of proportionate growth retardation might not be identified. The low value in this study might indicate the chronic stress these infants face *in utero.* CAN score gave a high specificity (85.6%) but a low sensitivity value (65.9%) with MAC/HC ratio.

The study re-emphasizes the observations of Metcoff that SGA and IUGR are not synonymous with fetal malnutrition and it is a clinical diagnosis, independent of birth weight for gestational age, and ethnic groups. The advantage of CAN score is that

TABLE II–*Distribution of Well Nourished (WN) and Malnourished (MN) By Different Methods*

Category	Birthweight to gestation	Number (%)	CAN	Number (%)	PI	Number (%)	MAC/HC	Number (%)
WN*	AGA	478 (75)	> 25	382 (60)	> 2 2	451 (71 0)	> 0 270	320 (50 23)
MN**	IUGR/ SGA	159 (24 9)	< 25	255 (40)	< 2 2	186 (29 0)	< 0 270	317 (49 76)

* Well nourished
** Malnourished

TABLE III–*Comparison of Can Score with Other Methods for Detection of Fetal Malnutrition*

Value	Birthweight & gestation	PI	MAC/HC
Sensitivity (%)	72 2	65 6	65 9
Specificity (%)	76 7	70 5	85 6
Positive predictive value (%)	90 3	47 8	82 0
Negative predictive value (%)	47 8	83 2	71 7

it is a simple, clinical index for identifying fetal malnutrition and may have the potential to predict neonatal morbidity associated with it without the aid of any sophisticated equipments. A larger subject population would be required to establish the utility of CAN score as a good clinical index for predicting neurodevelopment outcome in infants with fetal malnutrition.

REFERENCES

1. Bhargava SK. Perspectives in Child Health in India. Indian Pediatr 1991; 28: 1403-1410.
2. Villar J, Alobelli L, Kestler E, Belizan J. Health priority for developing countries. The prevention of chronic fetal malnutri tion. Bull World Health Organ 1986; 64: 847-851.
3. Ghosh S, Bhargava SK, Madhavan S, Taskar AD, Bhargava V, Nigam SK. Intrauterine growth of north Indian babies. Pediatrics 1971; 47: 826-830.
4. Lubchenco LO, Hansman C, Dressier M. Intrauterine growth as estimated from live birth weight data at 24 to 42 weeks of gestation. Pediatrics 1963; 32: 793-800.
5. Hamell PV. NCHS Growth Charts, Monthly Vital Statistics Report. National Center for Health Statistics, Health Re sources Administration 1976; 25:1.
6. Metcoff J. Association of fetal growth with maternal nutrition. *In:* Human Growth, Vol. 3, 2nd edn.. Eds. Falkner F, Tanner JM, New York, Plenum Publishing Corporation 1986; pp 333-388.
7. Altman DZ, Hyten F. Intrauterine growth retardation, let's clear about it. Br J Obstet Gynecol 1989; 96:1127-1128.
8. Georgieff MK, Sasanow SR, Chockalingam UM, Pereira GR. A comparison of mid arm/head circumference ratio and Ponderal index for evaluation of mentally retarded infants after abnormal intrauterine growth. Acta Pediatr Scand 1988; *77:* 214-219.

9. Kumari S, Jain S, Sethi GR, Yadav M, Saili A, Lai UB. A simple method of screening for Intrauterine growth retardation. Indian] Pediatr 1988; 55: 283-286.

10. Metcoff J. Clinical assessment of nutritional status at birth: Fetal malnutrition and SGA are not synonymous. Pediatr Clin North Am 1994; 41: 875-891.

11. Miller HC, Hassanein K. Diagnosis of impaired fetal growth in newborn infants. Pediatrics 1971; 48: 511-522.

12. Bhargava SK, Ghosh S, Lall UB, Kumar A, Kumari S. Morbidity pattern in newborns by gestation and intrauterine growth. Indian Pediatr 1974; 11: 481-485.

13. Battaglia FC, Lubchenco LO. A practical classification of newborn infants by weight and gestational age. J Pediatr 1967; 71:159-163.

14. Gruenwald P. Growth of the human fetus: Normal growth and its variation. Am J Obstet Gynecol 1966; 94:1112-1116.

15. Deter RL, Hadlock FP, Harrist RB. Evaluation of fetal growth and the detection of Intrauterine growth retardation. *In:* Ultrasonography in Obstetrics and Gynecology. Ed. Callen PW. Philadelphia, W.B. Saunders Co, 1983; pp 113-140.

16. Scott KE, Usher R. Fetal malnutrition: Its incidence, causes and effects. Am J Obstet Gynecol 1966; 94: 951-963.

17. Man Mohan, Shiv Prasad SR, Chellani HK, Kapani V. Intrauterine growth curves in North Indian babies: Weight, length, head circumference, Ponderal in dex. Indian Pediatr 1990; 27: 43-51.

18. Meadow NJ, Till J, Leaf A. Screening for intrauterine growth retardation using ratio of midarm circumference to occipitofrontal circumference. Br Med J 1986; 292:1039-1040.