Research Article

To study correlation of foot length and gestational age of new born by new Ballard score

Anshuman Srivastava*, Utkarsh Sharma, Sumit Kumar

TMMC&RC, Department of Pediatrics, TMU, Moradabad, Uttar Pradesh, India

*Correspondence:
Dr. Anshuman Srivastava,
E-mail: dranshumansrivastava@yahoo.co.in

ABSTRACT

Background: It is important to know an infant's gestational age because its behaviour and anticipated problems can be predicted on this basis. It is also important for prediction of morbidity, mortality and further management.
Methods: Study was done for two years.254 newborns delivered at MYH hospital and admitted in MYH and CNBC nursery were studied. Their gestational age ranged from 27 to 42 weeks.
Results: Gestational age and foot length also showed a positive correlation with a correlation coefficient of 0.99. Both AGA and SGA babies showed positive correlation of gestational age with foot length with correlation coefficient of 0.99 and 0.99 respectively.
Conclusions: Foot length of 73.7 mm can be used as a cut- off point for differentiating between term and preterm babies. Foot length measurements can be easily used by peripheral health workers to differentiate between term and preterm babies. They can be used at remote places by peripheral health workers.

Keywords: Gestational age, Foot length, New Ballard score

INTRODUCTION

Birth weight is single most important criterion for determining neonatal and infant survival. LBW is a sensitive indicator of socio-economic conditions and indirectly measures the health of the mother and child. Babies with a birth weight of less than 2500 g irrespective of period of their gestation are termed as LBW babies.[1] In India 30-35 % babies are LBW and more than half of these LBW newborns are full term babies.[2] LBW includes preterm babies born before 37 weeks of gestation as well as infants of any gestation who are small for dates due to intrauterine growth retardation

To determine gestational age in newborn, clinicians in industrialized countries rely on various prenatal and postnatal indicators such as first trimester ultrasound and last menstrual period[3] and neonatal data such as Dubowitz or Ballard scoring systems.[4,5] Date of last

menstrual period is not very reliable because many patients have irregular cycles. USG is out of reach of many poor patients. Different scoring systems use a number of neurological and physical criteria which are suitable for doctors but are cumbersome to use at remote places by paramedical staff. Foot length is simple to measure and do not require much expertise.

It will be worthwhile to determine if foot length correlate with gestational age assessment by New Ballard scoring.

METHODS

Subject selection-In our study we enrolled 254 newborns delivered at MYH hospital and admitted in MYH and CNBC nursery over a period of two years. Their gestational age ranged from 27 to 42 weeks. Gestational age of babies was determined by NEW BALLARD SCORE taken from Ballard JL et al: New Ballard score

expanded to include extremely premature infants.[5] Six neurological and six physical signs were used to assess gestational age.

Birth weight (BW): Babies were weighed naked on weighing machine (BRAUN Company) nearest to 50 gm. at Labor room, MYH Hospital within 24 hrs. of birth.

Foot length (FL): The foot length of right foot was measured by a steel ruler (SHARP company) to the nearest of 0.05cm thrice by the author and the average was recorded. The measurement was taken by fixing the tip of heel to the zero mark of the ruler and after straightening the foot and toes, the foot length measurement was recorded, the other end being the tip of the great or second toe (whichever was the longer length).

All the measurements were taken within 24 hrs. of birth. Standard statistical methods used for data analysis included correlation coefficient, simple regression equation, mean and standard deviation.[6,7]

RESULTS

A total of 254 newborns delivered at MYH and kept in MYH and CNBC nursery were studied. Their gestational age ranged from 27 to 42 weeks.
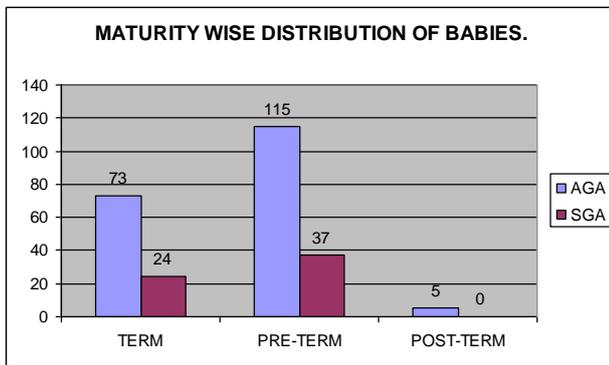
Figure 1: Maturity wise distribution of babies.
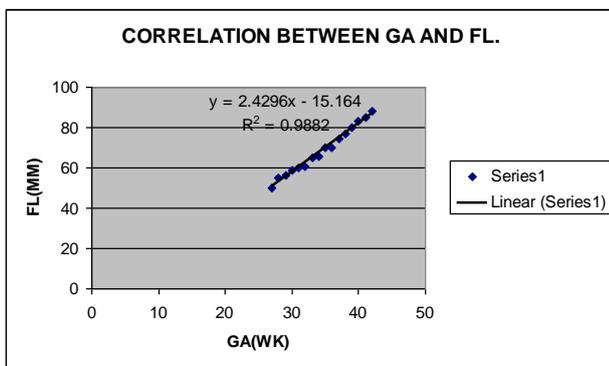
Figure 2: Correlation between GA and FL.

Out of 254 newborn, 130 babies were male and 124 were female. When babies were classified as average for gestational age (AGA) and small for gestational age (SGA), 193(76%) were AGA and 61(24%) were SGA.

Table 1: Maturity wise distribution of babies.

	AGA	SGA
Term	73	24
Pre-Term	115	37
Post-Term	5	0

Table 2: Correlation between GA (wk.) and FL (mm).

GA(WK)	No of babies	FL (MM)	SD	Correlation
27	4	50	0	
28	2	55	0	
29	4	56.5	1.7	
30	26	58.8	2.9	
31	16	60	0	
32	25	60.6	2.0	
33	39	64.7	1.1	
34	19	65.4	2.4	0.99
35	15	70	0	
36	2	70	0	
37	42	74.5	1.3	
38	19	77.0	2.2	
39	12	80.0	0.6	
40	14	82.9	0.8	
41	10	85.2	0.6	
42	5	87.9	0.9	

GA =gestational age.
SD = standard deviation.
r = correlation coefficient

In this study, 97(38.2%) babies were term, 152(59.8%) were pre-term and 5(2%) were post-term (Table 1).

Birth weight and foot length showed a positive correlation with a correlation coefficient of 0.94. Both AGA and SGA babies showed positive correlation of birth weight with foot length with correlation coefficient of 0.96 and 0.97 respectively.

Gestational age and foot length also showed a positive correlation with a correlation coefficient of 0.99. Both AGA and SGA babies showed positive correlation of gestational age with foot length with correlation coefficient of 0.99 and 0.99 respectively.

DISCUSSION

About 10-12% of Indian babies are born preterm (less than 37 completed weeks) as compared to 5-7% incidence in west. These infants are anatomically and functionally immature and therefore their neonatal mortality is high.

This study was undertaken to devise a simple method of estimating gestational age so that Para medical workers at remote places could easily identify preterm babies and refer them to higher centers for further management. In this study gestational age estimation by NEW BALLARD SCORE was correlated with physical criteria of gestational age estimation that is foot length.

Of the 254 babies 5 were post-term, 152 were pre-term and 97 were term. Preterm, term and post-term babies were subdivided into average for gestational age (AGA) and small for gestational age (SGA) groups according to a form developed by Kay J. L., Seton Medical center, Austin, TX, with Mead Johnson and Co., Evansville, IN. Manual of neonatal care.[8] First, foot length was correlated with birth weight of babies. Correlation coefficient of birth weight with foot length was found to be 0.94 by linear regression analysis. The findings are in conformity with studies of James D K et al [2], Gohil J R et al.[9] Amato MHuppi P, Claus R, 1991,[10] showed obstetrical dates, physical Ballard score and anterior vascular capsule of lens correlated significantly with foot length. When AGA and SGA babies were separated correlation of birth weight versus foot length came out to be 0.96 in AGA babies and 0.97 in SGA babies.

Gestational age determination was done by New Ballard score taken from Ballard JL et al: New Ballard score expanded to include extremely premature infants. J Pediatric 1991; 119:417.[5] The foot length of right foot was measured by a steel ruler (SHARP company) to the nearest of 0.05 cm thrice by the author and the average was recorded. The measurement was taken by fixing the tip of heel to the zero mark of the ruler and after straightening the foot and toes, the foot length measurement was recorded, the other end being the tip of the great or second toe (whichever was the longer length).

Correlation coefficient of gestational age with foot length came to be 0.99. Streeter, 1920, showed that the fetal foot has a characteristic pattern of normal growth. He proposed that the fetal foot could be used to estimate gestational age.[11] In 1987; Mercer et al described the ultra sonographic measurement of fetal foot to estimate gestational age. They concluded that fetal foot length was a reliable parameter for estimating gestational age.[12] Kim HJ, Moon HR, 1980, showed that a positive correlation (r=0.79) between foot length and gestational age exists.[13]

When babies were divided into AGA and SGA correlation coefficient of gestational age and foot length was 0.99 in AGA and 0.99 in SGA babies. So foot length had a strong correlation with gestational age in both AGA and SGA babies. So, it is possible to predict the gestational age of babies with help of foot length measurement. The relationship between foot length and gestational age was found out to be by linear regression analysis:

$$FL= 2.4*GA-15.10.$$

Where, GA=Gestational age in weeks
And FL=Foot length in mm

Determination of cut off points for identifying preterm and term babies

Foot length of 73.70mm was identified from linear regression analysis as the cutoff point corresponding to a gestational age of 37 weeks. This finding is similar to that obtained by. Kim HJ, Moon HR, 1980.[13] He showed that foot length of 7.0 cm serves as a reliable index of prematurity. S R Daga, A S Daga, S Patole, S Kadam and Y Mukadam, 1988,[14] suggested foot length corresponding to 34 weeks of gestational age, viz 6.5 cm as a cut off point for identifying a newborn at risk. Kumar GP; Kumar UK, 1993,[15] showed that period of gestation in weeks from foot length can be obtained by multiplying 3.4863 and adding 8.8649.

CONCLUSION

Gestational age has a strong correlation with foot length. Foot length of 73.7mm can be used as a cut- off point for differentiating between term and preterm babies. Foot length measurements can be easily used by peripheral health workers to differentiate between term and preterm babies. They can be used at remote places by peripheral health workers. They can differentiate pre-term and term babies by measuring foot length distance with the help of a simple measuring tape. High risk pre-term babies can be quickly referred to higher centers. This will also help to strengthen our referral system.

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