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CORRELATION OF FOOT & HAND LENGTH MEASUREMENT WITH GESTATIONAL MATURITY IN NEONATES

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ABSTRACT

Anthropometric measurements serve as useful adjuncts of growth and maturity.Prospective study was conducted at tertiary care NICU to study the correlation between foot and hand length with gestational age in neonates. Foot length has significant correlation with gestational age in preterm SGA, preterm AGA and term AGA babies ($p<0.05$). Similarly, hand length has strong correlation with gestational age in preterm AGA and term AGA($p<0.05$).Hence foot length and hand length can be used as surrogate marker for gestational age especially in community settings .However larger studies are required and specific reference charts need to be created.

KEYWORDS:Foot length,Hand length,Gestational maturity

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INTRODUCTION

Parameters of growth are the most sensitive indicators of nutritional status of the community. Gestational age and birth weight are the two most useful parameters for assessing maturity of the newborn. Conventionally, gestational age of neonates is computed based on Naegele's formula or by ultrasonic evaluation during pregnancy, or after birth, using New Ballard assessment and scoring[1] . Gestational age estimates based on Naegele's formula have lower accuracy in settings with low literacy[2] and are likely to be affected by variation in ovulation and also by breastfeeding. Ultrasound, as a tool to assess gestational age, is a limiting factor, particularly in developing countries, like India where only 51% of women undergo the recommended number of atleast 3 antenatal visits; 59% of deliveries take place at home; and only 24% of pregnant women undergo ultrasonic evaluation during pregnancy[3]. Assessment of gestational age of newborns using New Ballard Score (NBS) may not be reliable as its accuracy depends on the skill of examiner[4] and the condition of the neonate. It cannot be used in asphyxiated neonates. In addition, it is a complex score, which requires the skills of a paediatric specialist. Thus, there is need to develop a simple, inexpensive and practical method to identify these highly vulnerable preterm newborns soon after birth[5,6]. Foot length and Hand length is one such parameter which can be measured easily in preterm and sick neonates without disturbing the baby. This can be used as a proxy measurement for gestational age and birth weight assessment.

MATERIALS AND METHODS

The study was conducted in tertiary neonatal unit of a teaching hospital.The unit provides intensive care to sick low birth weight neonates referred from community hospitals of Bangalore and surrounding states or brought directly from home by parents. Prospective study was conducted from November 2007 to December 2008. Anthropometric measurement was done on all babies admitted within three days of life. Babies with congenital deformities like congenital talipes equino varus, congenital vertical talus ,foot edema and other congenital anomalies were excluded.Gestational assessment was done using modified Ballard's scoring. Foot length was measured using sliding caliper which is having an accuracy of one tenth of a millimeter. Foot length was measured from posterior most prominence of foot to the tip of the longest toe of the right foot. Hand length was measured from the distal crease to the tip of middle finger using non-stretchable fiber tape and documented in millimeters**.**

Statistical Methods

Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean±SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5% level of significance. Analysis of variance (ANOVA) has been used to find the significance of study parameters between three or more groups of patients. Student "t" test (two-tailed, independent) has been used to find the significance of study parameters oncontinuous scale between two groups (Inter group analysis). Pearson correlation co-efficient has been computed between Birth weight with anthropometrical parameters, Foot length vs. anthropometrical parameters, Hand length vs. anthropometrical parameters. Regression analysis has been used to predict the Birth weight using the Foot length, Hand length vs. anthropometrical parameters.

RESULTS

This study group included a total of 312 neonates of which males were 68.3% and females were 31.7%.and 127 were preterms which constitutes to 40.7% and term babies were 185 which constitutes to 59.3%. The study group includes birth weight ranging from 800-4500 grams with mean 2333.02 and standard deviation of 785.87. The mean foot length of study group is 66.25±7.06 mm. The mean hand length of study group is 54.17±6.70 mm. The mean length of the baby in study group is 46.65±3.82 cm.The mean head circumference of the baby in study group is 31.78±2.54 cm. 312 babies studied

had a gestational age range of 28-41 weeks with a mean of 36.11 weeks.For the 312 neonates studied the mean foot length is 66.25 mm with a range of 49-80 mm and standard deviation of 7.07. The preterm SGA, AGA had a mean foot length of 55.43, 60.04 mms respectively. The mean foot length for term SGA, AGA, LGA is 63.80, 72.06 and 77.30 mms respectively.Preterm babies maximum crown heel length of 47cm and minimum of 36cm. The term babies had a maximum crown heel length of 52cm and minimum 46cm.The mean hand length is 54.18mm with a range of 38-66 mm and standard deviation of 6.70. The preterm SGA, AGA had a mean hand length of 42.75, 48.66 mms respectively. The mean hand length for term SGA, AGA, LGA is 52.77, 59.44 and 63.90 mms respectively(table-1).

Table 1

Mean and standard deviation of study parameters according categories

Parameters	Preterm SGA	Preterm AGA	Term SGA	Term AGA	Term LGA
gestational age in weeks	33.85±1.31	32.78±1.59	37.10±0.31	38.43±1.07	39.80±0.63
foot length(mms)	55.43±3.68	60.04±3.78	63.80±2.42	72.06±2.32	77.30±2.06
hand length (mms)	42.75±2.88	48.66±3.49	52.76±1.52	59.44±3.24	63.90±1.79
length (cm)	39.45±1.56	43.78±1.65	46.72±0.75	49.47±2.54	50.85±0.67
head circumference	27.58±0.97	29.36±1.27	31.87±0.69	33.91±0.68	35.05±0.16
Birthweight (grams)	1303.50±225.23	1558.83±229.28	2151.67±203.62	2960.96±248.5	4115.00±145.3

Table 2

Pearson correlation of foot length and other anthropometric measurements

Pair	Preterm SGA	Preterm AGA	Term SGA	Term AGA	Term LGA
FL vs. Length	0.723 (<0.001**)	0.654 (<0.001**)	-0.117 (0.537)	0.223 (0.007**)	0.036 (0.921)
FL vs. HC	0.521 (0.019*)	0.713 (<0.001**)	0.249 (0.185)	0.308 (<0.001**)	0.461 (0.180)
FL vs. BW	0.583 (0.007**)	0.714 (<0.001**)	0.122 (0.554)	0.226 (0.006**)	0.522 (0.122)

Table 3

Pearson correlation of hand length and other anthropometric measurements

Pair	Preterm SGA	PretermAGA	Term SGA	Term AGA	Term LGA
HL vs. Length	0.508 (0.022**)	0.647 (<0.001**)	-0.060 (0.754)	0.186 (0.025*)	-0.153 (0.673)
HL vs. HC	0.549 (0.012*)	0.722 (<0.001**)	0.222 (0.239)	0.348 (<0.001**)	0.412 (0.237)
HL vs. BW	0.634 (0.003**)	0.676 (<0.001**)	0.029 (0.879)	0.290 (<0.001**)	0.433 (0.211)

Table 4

Pearson correlation of gestational age with and other anthropometric measurements

Pair	Preterm SGA	Preterm AGA	Term SGA	Term AGA	Term LGA	Overall
FL vs. GA	0.598 (0.005**)	0.860 (<0.001**)	-0.158 (0.403)	0.371 (<0.001**)	0.137 (0.707)	0.883 (<0.001**)
HL vs. GA	0.492 (0.028*)	0.839 (<0.001**)	-0.245 (0.193)	0.288 (<0.001**)	0.471 (0.170)	0.853 (<0.001**)

It was observed from table-4 that foot length correlates strongly with gestational age in case of preterm AGA and term AGA, but has weak correlation with preterm SGA, term SGA and term LGA. Similarly, hand length has strong correlation with preterm AGA and term AGA and poor correlation with preterm SGA, term SGA and term LGA. Foot length correlates strongly with length of the baby in preterm SGA/AGA but poor correlation with term SGA/AGA/LGA. Foot length has strong correlation with head circumference in case of preterm AGA and term AGA, poor correlation with preterm SGA, term SGA and term LGA. Foot length has strong correlation with body weight in case of preterm AGA and correlates poorly with other gestational ages. Hand length correlates strongly with foot length in all gestational ages except in case of term LGA.

DISCUSSION

There are various measurements in neonates to assess growth. Some of the routine measurements done at birth are head circumference, chest circumference, crown heel length, birth weight etc. Many times equipment required to measure them will not be available or the babies will be sick and minimum handling is needed to get maximum information about the growth of the baby. Flexed posture of the term baby may also lead to difficulty in measurement of length. In such cases, foot and hand length is an easy tool which can be measured even in sick neonates without handling them much. As foot and hand length can be easily measured, requiring less handling, less disturbing to the neonate we decided to study foot length measurement in the neonates and correlate it with other body parameters mainly gestational age and other parameters like birth weight, crown heel length, head circumference so that foot and hand length can be used proxy measurement for estimation of gestational age and birth weight. Assessment of the gestational age by Ballard's scoring is time consuming and again requires handling of the sick neonates.The present study was done to assess the correlation of foot length and hand length with gestational age, birth weight, head circumference, and length of the baby for different gestational age groups. Present study showed following correlation: Foot length has significant correlation with gestational age in preterm SGA, preterm AGA and term AGA but no correlation with term SGA and term LGA.Foot length correlates significantly with birth weight in preterm AGA, preterm SGA,term AGA and poor correlation with term SGA and term LGA.Foot length correlates significantly with head circumference in preterm AGA and term AGA moderate correlation with preterm SGA and poor correlation with term SGA and term LGA.Foot length correlates significantly with crown heel length in preterm SGA, preterm AGA and term AGA and poor correlation with term SGA and term LGA. Foot length correlates significantly with hand length in preterm SGA, preterm AGA, term SGA, term AGA and trivial correlation with term LGA(table-2).Mean measurements were comparable to studies by Kulkarni[7] et al and Jayandra[8] et al.Though the mean foot length in other studies[7,8,9] showed there is a positive linear relationship between foot length and gestational age, the correlation coefficient of foot length and gestational age was different in different studies. The foot length correlated well with one or more body measurement, though extent of correlation was different for different gestational age groups. The study also showed positive correlation between foot length and other body measurements like weight, head circumference and gestational age, but correlation varied between term and preterm and correlation was better for preterm babies. This is similar to study by James[9] et al where the correlation between foot length and other parameters were more pronounced in preterm. All these studies show that there is no single parameter with which foot length correlated uniformly and to the same extent at all gestational ages. Similarly, hand length had significant correlation with gestational age in preterm SGA, Preterm AGA and term AGA but poor correlation with term SGA and term LGA. Hand length also has significant correlation with other measurements like birth weight, length, head circumference in preterm SGA, preterm AGA and term AGA, poor correlation with term SGA, term LGA(table-3).There was no significant correlation between foot and hand length with other parameters in term SGA and term LGA

The difference in the study results could be influenced by the following factors

Foot length is measured by using different methods by different observers. There is no uniformity in the measuring technique and the device used. Some authors have devised their own self adjusting sophisticated equipment. Some studies have used foot prints on plaster sheets and measured the foot length using a scale. The technique we used for measurement of foot length is to measure the distance between the posterior most prominences of heel to the tip of longest toe, the greatest foot length as suggested in Current Diagnosis &Treatment textbook. The instrument we used is a sliding caliper which offers an accuracy of one tenth of a millimeter. There are chances of intra and interobserver variations which can also contribute to errors of measurement.Timing of measurement of foot length can also contribute to the difference in measured values. The time of measurement of foot length, varied differently . There is a need to develop charts for foot length with corresponding gestational age and birth weight .

CONCLUSION

The foot length and hand length correlated with gestational age, birth weight, head circumference and crown heel length significantly in preterm SGA, preterm AGA and term AGA.Foot length and Hand length is a simple anthropometric measurement which can be used as a proxy measurement to birth weight at different gestational age groups especially in sick neonates. It can be recommended at community level for health workers for early reference of preterm SGA/AGA babies to higher centers.

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