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THE VALUE OF PONDERAL INDEX AS A PROGNOSTIC FACTOR IN PREDICTING COMPLICATIONS IN TERM NEONATES

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ABSTRACT

Rohrer's ponderal index in newborns (birth weight $* 100/\text{height}^3$) has been used as an indicator of fetal growth status, especially to assess asymmetrical intrauterine growth retardation. Low ponderal index or disproportionate intrauterine growth retardation has higher neonatal morbidity and there are some specific guidelines in intrauterine growth retarded infants to control some of their prevalent complications like hypoglycemia.

As there are no specific guidelines to control and screen some possible morbidities in babies with more than 2500 gram weight, we decided to determine the association between different ponderal index values and neonatal complications such as hypoglycemia, meconium aspiration syndrome, hyperbilirubinemia, perinatal resuscitation and duration of hospital stay in first born term infants.

Three-hundred and sixty-one first born infants were studied during April 2000 to April 2001. Low, appropriate and high ponderal indexes were detected in 20.5%, 51% and 28.5% of infants respectively. Among these infants, there were 47 intrauterine growth retarded cases. The frequency of hypoglycemia, meconium aspiration syndrome, hyperbilirubinemia and age at hospital discharge with a stay of more than 7 days were higher in the low ponderal index group than the other two groups and the statistical differences were significant ($p < 0.05$). Comparing neonatal morbidities according to birth weight (more or less than 2500 g), we could not find significant differences except in hypoglycemia ($p < 0.05$).

This study showed that a low ponderal index could be used as a prognostic factor in predicting some morbidity in term neonates.

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INTRODUCTION

Infants with intrauterine growth retardation (IUGR) have a higher perinatal morbidity and mortality than their counterparts with normal birth weight.[1] Neonates below either the 3rd or 10th percentile for gestational age are generally considered growth restricted. The assignment of a birth weight percentile requires an accurate assessment of gestational age and the availability of tables appropriate for the population, which include adjustments for gender, race, and bith order. The slim but relatively tall neonates may have a birth weight percentile above that used to define growth restriction, despite being malnourished, chronically hypoxemic and at risk for perina-

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tal morbidity and mortality,[2] The ponderal index was arrived at by the following formula;

$$\text{Ponderal index (PI)} = \frac{\text{Birth weight} \times 100}{\text{Crown - heel length}^3}$$

PI can be used to identify infants whose soft tissue mass is below normal for stage of skeletal development.[3] This index is independent of gender, race, birth order and to a certain extent, gestational age.[2]

Low ponderal index or disproportionate IUGR has higher neonatal morbidity, particularly in hypoglycemia, perinatal asphyxia, hypothermia, and fetal distress and meconium aspiration syndrome than the proportionate IUGR group.[1]

Some complications like hypoglycemia can be predicted in IUGR infants but in others with a birth weight of more than 2500 g and gestational age of 38 - 40 weeks, a guideline does not exist.[3]

With this background we decided to determine the association between different ponderal index values (high, moderate, low) and neonatal complications like hypoglycemia, meconium aspiration syndrome, hyperbilirubinemia, perinatal resuscitation and duration of hospital stay in first - born term infants at our hospital. This relationship can be used for screening some possible neonatal complications.

MATERIAL AND METHODS

All first - born term infants were entered in this cross-sectional study during April 2000 to April 2001 at Tehran Vali-E-Asr hospital. Weight, height, hypoglycemia (<35 mg/dL within 24 hours after birth), meconium staining, meconium aspiration syndrome as diagnosed by the presence of meconium in the trachea while suctioning the airway after birth, clinical manifestations of aspiration, early hyperbilirubinemia (>15 mg / dL), perinatal rescuscitation and length of hospital stay were studied.

Term infants (37-42 weeks) with birth weight lower than 2500 grams were regarded as IUGR. Infants were classified in three groups by their PI values, according to the Lubchenco PI for gestational age[4] as low (PI < 10%), appropriate (10% < PI < 90%), and high (PI > 90%). The frequency of each complication was analyzed using SPSS software. For statistical analysis we used ANOVA and Chi-square tests.

RESULTS

Among 800 term infants, 361 first born neonates were entered into this study during April 2000 to April 2001. Low, appropriate and high PI were detected in 74 (20.5%), 184 (51%) and 103 (28.5%) infants respectively.

44 cases (12.2%) were IUGR, out of whom 27 (61.4%) were low, 11(25%) appropriate, and 6(13.6%) in high PI groups.

Non-IUGR infants were 317 cases out of whom 47 (14.8%) were in low, 173 (54.6%) in appropriate and 97 (30.6%) in high PI groups. The differences between mean birth weights and heights in LPI, API and HPI groups were significant (Table I).

Comparing weights between groups and comparing of height between LPI & API showed significant differences (Tukey HSD, $p< 0.001$). Although the mean height in the low PI group was higher than the other groups, their mean weight was lower.

The overall morbidity in the LPI group was higher than the other groups and the statistical differences between groups with hyoglycemia, meconium aspiration syndrome (MAS), hyperbilirubinemia and age at hospital discharge > 7 days were significant (Table II).

When classifying morbidities into two weight groups, and subclassifying them according to PI, the risk of morbidity in the LPI group was higher than the other groups (Table III).

There was a significant correlation between low ponderal index and incidence of hypoglycemia, hyperbilirubinemia and age at hospital discharge more than 7 days in infants with more than 2500 g weight (Table III).

Because of the low number of infants complicated with MAS we did not compare this complication in the two groups.

Table I: Mean birth weight & height of infants in the 3 groups.

	LPI	API	HPI	
Total Population	**74**	**184**	**103**	***p* values (ANOVA)**
Mean weight	2659 ± 525	3099 ± 412	3368 ± 536	< 0.001 f= 48.3
Mean height	50 ± 2.9	49.3 ± 2.2	47.6 ± 3.2	< 0.001 f= 20.1

To clarify the correlation between neonatal morbidity and weight of infants we compared these complications in the two groups irrespective of ponderal index.

Except for hypoglycemia, we found no correlation between neonatal morbidity and weight (Table IV).

DISCUSSION

IUGR has no accepted standard definition. The following definitions are the most often used: Birth weight less than the 10^{th}(or 5^{th}) percentile for gestational age (GA) or birth weight less than 2500 g and GA of 37 - 42 completed weeks of gestation.[5]

However, because there is no standard population from which to derive these percentiles, the birth weights that serve as the cutoff point in various published studies may differ by several hundred grams at any gestational age.[6]

In recent years several publications have shown that the cases of proportionate and disproportionate IUGR tend to have different epidemiologic characteristics. A series of recent reports also demonstrate a different neonatal morbidity of subgroups of growth-retarded newborns. These reports show that the disproportionate (low ponderal index) IUGR group has higher neonatal morbidity than the proportionate IUGR group.

In this study we showed that normal birth weight infants who were classified by ponderal index had higher neonatal morbidity than the groups with adequate ponderal index. These results are compatible with part of one study from Guatemala.[1] These data provided further evidence of the heterogeneity of the intrauterine growth retardation syndrome and of the independent effect of body disproportion on neonatal morbidity even

Table II: Incidence of neonatal morbidity with respect to PI.

Variable	LPI (74)	API (184)	HPI (103)	*p* (chi - square)
Hypoglycemia	20.2%	13.04%	2.9%	0.007
Resuscitation	2.7%	1.63%	0.9%	0.673
Meconium staining	10.8%	5.9%	5.1%	0.255
Meconium aspiration syndrome	4.05%	-	-	0.003
Hyperbilirubinemia	16.21%	13.58%	-	0.000
Age at hospital discharge > 7 d	23.18%	19.02%	1.9%	0.000

Table III: Correlation of variables in IUGR & non-IUGR infants between PI groups.

Variables		< 2500 gr N =44				> 2500gr N =317			
Age at hospital discharge >7	N= 57	LPI=27	API=11	HPI=6	*p*	LPI=47	API=173	HPI=97	*p*
		11	-	1	0.03	9	35	1	0.000
			N=12				N=45		
Hypoglycemia	N=44	7	4	2	0.796	8	20	3	0.009
			N=13				N= 31		
Need for resuscitation	N = 6	2	-	-	0.517	-	3	1	0. 0621
			N=2				N=4		
Meconium staining	N = 24	3	-	3	0.013	5	11	2	0.096
			N=6				N=18		
Hyperbilirubinemia	N = 42	5	-	-	0.25	7	25	0	0.000
			N=5				N=27		

Table IV: Correlation of neonatal morbidities classified by their weights.

Variable	W> 2500 N =317 Present	Absent	W< 2500 N = 44 Present	Absent	*p* (chi - square)
Hypoglycemia	31	286	13	31	0.001
Resuscitation	4	313	2	42	0.159
Meconium staining	18	299	6	38	0.097
MAS	3	314	0	44	0.676
Hyperbilirubinemia	27	290	5	39	0.569
Age at hospital discharge > 7 d	45	272	12	32	0.44

among infants with normal birth weights. We could find no correlation between age at hospital discharge, meconium staining and LPI in infants with lower than 2500 grams weight and in infants with more than 2500 grams weight there was a significant correlation between LPI and hypoglycemia, hyperbilirubinemia and age at hospital discharge.

The in utero PI also proved to be a valuable index in the prediction of fetal outcome in those cases of IUGR in whom the in utero PI was smaller than 1 SD from the average. Fetal and neonatal well being was clearly compromised when IUGR was associated with a low in utero PI.[7] Cesarean section delivery and fetal distress rates were significantly higher for infants with a low PI than for infants with a low birth weight. PI appears to be a better measure of infants with IUGR problems than birth - weight percentile.[8]

Because there are significant clinical implications attributed to the low PI group, this subgroup should be identified as early as possible preferably before birth.[1]

In our study, we showed that classification of infants by their ponderal index with respect or irrespective of weight has better values in anticipating complications.

In one study soft tissue wasting rather than low birth weight for gestational age was more important in the development and diagnosis of neonatal hypoglycemia[9] which is compatible with our study.

These infants with acute malnutrition or wasting, similar to children with an acute caloric restriction during childhood, have been shown to have insufficient glycogen liver stores and diminished subcutaneous fat reserves.[1]

International variations in intrauterine growth have consistently been judged in terms of average birth weight, low birth weight or birth weight for gestational age criteria. Neither of these provides an appropriate assessment of fetal growth. Variations in growth, both within and among populations relate predominantly to differences in the prevalence of factors that restrict growth rather than to inherent differences in growth potential.[10]

We have presented evidence that the level of disproportionality or low PI among term infants is an independent predictor of neonatal morbidity and this index can be used as a prognostic factor in some possible neonatal complications and may be a better index for screening programs in some morbidities of a term neonate. We suggest to determine the ponderal index in the postnatal or prenatal period by ultrasonography and if LPI is detected it is advisable to expect some morbidity in the perinatal period.

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