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

FIROUZEH NILI, M.D., MARJAN MAKIPOUR, M.D., AND JAMILEH MOBINI, M.D.

From the Department of Pediatrics, Vali-E-Asr Hospital, Tehran University of Medical Sciences, Tehran, I.R. Iran.

ABSTRACT

Rohrer’s ponderal index in newborns (birth weight * 100/height³) 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.


Keywords: Intrauterine growth retardation, Ponderal index, Neonatal morbidity.

INTRODUCTION

Infants with intrauterine growth retardation (IUGR) have a higher perinatal morbidity and mortality than their counterparts with normal birth weight. 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 birth order. The slim but relatively tall neonates may have a birth weight percentile above that used to define growth restriction, despite being malnourished, chronically hypoxic and at risk for perina-
Value of Ponderal Index in Term Neonates

tal morbidity and mortality,2 The ponderal index was ar­
rived at by the following formula;

\[
Ponderal \ index \ (PI) = \frac{Birth \ weight \times 100}{Crown - heel \ length}\]

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 pre­
pdicted 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, hyper­
bilirubinemia, perinatal resuscitation and duration of
hospital stay in first - born term infants at our hospital.
This relationship can be used for screening some pos­
sible 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 pres­
ence of meconium in the trachea while suctioning the
airway after birth, clinical manifestations of aspiration,
early hyperbilirubinemia (>15 mg / dL), perinatal
resuscitation 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 age4 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 de­
tected in 74 (20.5%), 184 (51%) and 103 (28.5%) in­
fants 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 differ­
ences (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 be­
tween groups with hyoglycemia, meconium aspiration
syndrome (MAS), hyperbilirubinemia and age at hospi­
tal discharge > 7 days were significant (Table II).

When classifying morbidities into two weight groups,
and subclassifying them according to PI, the risk of mor­
bidity 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, hyper­
bilirubinemia 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.

<table>
<thead>
<tr>
<th></th>
<th>LPI</th>
<th>API</th>
<th>HPI</th>
<th>p values (ANOVA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>74</td>
<td>184</td>
<td>103</td>
<td></td>
</tr>
<tr>
<td>Mean weight</td>
<td>2659 ± 525</td>
<td>3099 ± 412</td>
<td>3368 ± 536</td>
<td>&lt; 0.001, f= 48.3</td>
</tr>
<tr>
<td>Mean height</td>
<td>50 ± 2.9</td>
<td>49.3 ± 2.2</td>
<td>47.6 ± 3.2</td>
<td>&lt; 0.001, f= 20.1</td>
</tr>
</tbody>
</table>
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 10th (or 5th) percentile for gestational age (GA) or birth weight less than 2500 g and GA of 37-42 completed weeks of gestation.

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.

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. 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>
<thead>
<tr>
<th>Variable</th>
<th>LPI (74)</th>
<th>API (184)</th>
<th>HPI (103)</th>
<th>p (chi-square)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypoglycemia</td>
<td>20.2%</td>
<td>13.04%</td>
<td>2.9%</td>
<td>0.007</td>
</tr>
<tr>
<td>Resuscitation</td>
<td>2.7%</td>
<td>1.63%</td>
<td>0.9%</td>
<td>0.673</td>
</tr>
<tr>
<td>Meconium staining</td>
<td>10.8%</td>
<td>5.9%</td>
<td>5.1%</td>
<td>0.255</td>
</tr>
<tr>
<td>Meconium aspiration syndrome</td>
<td>4.05%</td>
<td>-</td>
<td>-</td>
<td>0.003</td>
</tr>
<tr>
<td>Hyperbilirubinemia</td>
<td>16.21%</td>
<td>13.58%</td>
<td>-</td>
<td>0.000</td>
</tr>
<tr>
<td>Age at hospital discharge &gt; 7</td>
<td>23.18%</td>
<td>19.02%</td>
<td>1.9%</td>
<td>0.000</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Variables</th>
<th>&lt; 2500 gr</th>
<th>&gt; 2500gr</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at hospital discharge &gt;7</td>
<td>LPI=27</td>
<td>API=11</td>
<td>HPI=6</td>
</tr>
<tr>
<td>N=57</td>
<td>11</td>
<td>1</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>N=12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypoglycemia</td>
<td>N=44</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>N=13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Need for resuscitation</td>
<td>N = 6</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>N=2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meconium staining</td>
<td>N = 24</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>N=6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hyperbilirubinemia</td>
<td>N = 42</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>N=5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table IV: Correlation of neonatal morbidities classified by their weights.

<table>
<thead>
<tr>
<th>Variable</th>
<th>W &gt; 2500 N = 317</th>
<th>W &lt; 2500 N = 44</th>
<th>p (chi-square)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypoglycemia</td>
<td>Present 31</td>
<td>Absent 286</td>
<td>Present 13</td>
</tr>
<tr>
<td>Resuscitation</td>
<td>Present 4</td>
<td>Absent 313</td>
<td>Present 2</td>
</tr>
<tr>
<td>Meconium staining</td>
<td>Present 18</td>
<td>Absent 299</td>
<td>Present 6</td>
</tr>
<tr>
<td>MAS</td>
<td>Present 3</td>
<td>Absent 314</td>
<td>Present 0</td>
</tr>
<tr>
<td>Hyperbilirubinemia</td>
<td>Present 27</td>
<td>Absent 290</td>
<td>Present 5</td>
</tr>
<tr>
<td>Age at hospital discharge &gt; 7 d</td>
<td>Present 45</td>
<td>Absent 272</td>
<td>Present 12</td>
</tr>
</tbody>
</table>

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. 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 hypoglycemia9 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.

REFERENCES

7. Yagel S, Zacut D, Igelstein S, Palti Z, Hurwitz A, Rosenn...


