The Relationship of the Fetal Crown-Rump Length to the Yolk Sac Diameter in Normal Pregnancy

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Introduction

A wanted pregnancy is typically viewed as a time filled with excitement, but the uncertainty about its outcome can be quite worrisome to the patient. Parental concern often begins from the first trimester. Currently, significant data exist regarding normal and abnormal ultrasonographic measurements of the gestational sac (GS), yolk sac (YS), crown-rump length (CRL) in early gestations [1,2]. These parameters have been studied for the dual purpose of establishing standardized parameters for each gestational age and predicting early pregnancy failure [3-5]. The yolk sac is the primary source of nutrition, metabolic, immunologic, excretory, and hematopoietic functions prior to placental development, and the CRL is known to accurately correlate with gestational age during the first trimester of pregnancy [6-10]. While these measurements have typically been looked at individually, the current understanding of the relationships between them is limited. The primary purpose of this study is to establish normal values for the ratio of the fetal Crown-Rump Length (CRL) to the yolk sac (YS) diameter during the first trimester of normal pregnancy and determine whether it correlates with gestational age.

Materials and Methods

This study was conducted at Wyckoff Heights Medical Center in Brooklyn, New York, after obtaining approval from the Institutional Review Board. A retrospective review of 1453 patient charts from May 1, 2012 to June 30, 2016 was completed. The records were selected chronologically from a list of routine first trimester sonograms performed in the Maternal Fetal Medicine Unit during this time period. After review, a total of 637 records were found to have complete data available, including pregnancy outcomes, for completion of this study. After exclusion of those pregnancies complicated by vaginal bleeding, hypertension, diabetes, severe anemia, fetal growth restriction, fetal macrosomia, preterm labor and delivery, intrapartum cesarean delivery for non-reassuring fetal heart rate tracing, low Apgar scores (<6), fetal anatomic malformation or aneuploidies, missed abortions, threatened abortions, elective pregnancy terminations, multiple gestations, 341 pregnancies with normal pregnancy outcomes were deemed eligible. Data for the normal pregnancy outcomes were stratified by gestational age to establish average values for the YS diameter, the CRL, and the ratio of the CRL to the YS diameter at each gestational week 5 through 11. The mean CRL/YS ratio was established for each gestational age interval and a Pearson coefficient of correlation (r) was calculated, with p<0.05 considered significant.

Results

The patients were distributed based on their gestational age intervals: N1 for 5-5 6/7 weeks, N2 for 6- 6 6/7 weeks, N3 for
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7-7 6/7 weeks, N4 for 8-8 6/7 weeks, N5 for 9-9 6/7 weeks, N6 for 10-10 6/7 weeks and N7 for 11-11 6/7 weeks. The fetal CRL measurements, the yolk sac diameters and the ratio of CRL/YS significantly correlate with gestational age (Table 1); (Figure 1-3).

**Figure 1:** Crown-rump length vs. gestational age.

**Figure 2:** Yolk sac diameter vs. gestational age.

**Figure 3:** Crown-rump length/yolk sac diameter ratio vs. gestational age.

**Discussion**

Our sonographic values for CRL and yolk sac diameters are consistent with accepted standards for the stated gestational ages [3-5]. Our sample comes from a diverse multi-ethnic population with standard measurements potentially applicable to a large variety of communities. Establishing the normal relationship between the fetal crown-rump length and the yolk sac diameter aims at providing an additional tool to those caring for pregnant women, so they may offer valuable information to them about their pregnancies. This study may serve as a precursor to additional research involving complicated pregnancies and the determination of whether any complication may be predictable on the basis of abnormal CRL/YS ratios. Should this be established in the future, it would allow for earlier identification of abnormal pregnancies and the potential for early interventions aimed at improving pregnancy outcomes.
Table 1: The evolution of CRL measurement, the Yolk Sac Diameter and the CRL/YS ratio as gestational age increases.

<table>
<thead>
<tr>
<th>Gestational Age Interval</th>
<th>N1</th>
<th>N2</th>
<th>N3</th>
<th>N4</th>
<th>N5</th>
<th>N6</th>
<th>N7</th>
<th>Correlation</th>
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</thead>
<tbody>
<tr>
<td>CRL (mm)</td>
<td>2.95</td>
<td>6.84</td>
<td>11.96</td>
<td>19.65</td>
<td>26.26</td>
<td>35.41</td>
<td>41.44</td>
<td>(r=0.994, p&lt;0.00001 significant)</td>
</tr>
<tr>
<td>YS (mm)</td>
<td>2.17</td>
<td>2.36</td>
<td>2.73</td>
<td>2.96</td>
<td>3.61</td>
<td>3.9</td>
<td>4.41</td>
<td>(r=0.990, p&lt;0.00001 significant)</td>
</tr>
<tr>
<td>CRL/YS</td>
<td>1.4</td>
<td>2.9</td>
<td>4.4</td>
<td>6.6</td>
<td>7.3</td>
<td>9.1</td>
<td>9.4</td>
<td>(r=0.9886, p&lt;0.000026 significant)</td>
</tr>
</tbody>
</table>

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References


