Role of Foetal Biometry and Doppler Studies in the Evaluation of Intrauterine Growth Restriction

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Abstract: The term intrauterine growth restriction (IUGR) refers to a condition in which a fetus is unable to achieve its genetically determined potential size. IUGR is associated with four to eight fold increased risk of perinatal mortality and morbidity. 50% of the survived IUGR children have significant morbidity. Accurate and timely detection of IUGR can prevent adverse outcome of pregnancy to some extent. With the advent of ultrasonography (USG), it has become the most widely used, standard and simple way of detecting and confirming IUGR. Evaluation of IUGR fetuses by Doppler studies are done by studying uterine artery Doppler velocimetry waveforms, foetal arterial Doppler study and foetal envois Doppler studies. Methods: This is a descriptive study is for a period of 14 months from May 2014 to July 2015. The population consisted of 100 pregnant women referred from the inpatient ward as well as outpatient department of Obstetrics and Gynecology Department of Maharishi Markandeswar Hospital and Research Centre, 50 cases with clinically suspected intrauterine growth restriction (IUGR) and another 50 cases with clinically normal pregnancy are included. Results: Ultrasound biometry is the gold standard for assessment of foetal size. Foetal weight less than 10th percentile for gestational age is mostly used to diagnosis IUGR but other criteria like elevated HC/AC ratio, elevated FL/AC ratio, and presence of oligohydramnios without ruptured membranes, presence of advanced placental grade can also be used for improving the accuracy of diagnosis. Interpretation & Conclusion: The utero-placental insufficiency seen with IUGR is associated with a rise in vascular resistance in uterine & umbilical arteries which can be estimated by raised pulsatility index, resistance index, systolic/diastolic ratio in these arteries, and persistence of uterine artery diastolic notch, absent & reverse diastolic flow in umbilical artery. In the presence of foetal hypoxemia, central redistribution of blood flow occurs, known as the Brain – Sparing Reflex manifested by a fall in Pulsatility index, resistance indices, and systolic/diastolic ratio.

Keywords: intrauterine growth restriction (IUGR), pregnancy, ultrasonography (USG)

1. Introduction

The term intrauterine growth restriction (IUGR) is defined by the American college of Obstetricians and Gynaecologists as estimated foetal weight less than that expected for gestational age. Clinically this is applied when the expected foetal weight is less than 10th percentile for gestational age because perinatal mortality and morbidity is significantly increased in this group.

The failure of a foetus to attain its expected growth may result from different complications; the final common pathway most often encountered is via uteroplacental insufficiency. IUGR is associated with four to eight fold increased risk of perinatal mortality and morbidity. 50% of the survived IUGR children have significant morbidity. Accurate and timely detection of IUGR can prevent adverse outcome of pregnancy to some extent. The methods most often used for antenatal diagnosis of IUGR are clinical palpation and measurement of fundal height. With the advent of ultrasonography (USG), it has become the most widely used, standard and simple way of detecting and confirming IUGR.

Once diagnosis of IUGR is made Doppler imaging is valuable for monitoring the pregnancy. The utero-placental insufficiency seen with IUGR is associated with a rise in vascular resistance which can be estimated by pulsatility index, resistance index, systolic/diastolic ratio and persistence of uterine diastolic notch. Umbilical artery Doppler waveforms reflect the status of the feto-placental circulation and increased placental vascular resistance is strongly correlated with IUGR.

This study was conducted to evaluate IUGR fetuses by ultrasonography using foetal biometry Doppler flow velocimetry waveform analysis in Maharishi Markandeswar institute of medical sciences Ambala, India. We intended to study early detection of IUGR fetuses using real-time sonography and Doppler velocimetry and see how they vary in ultrasound morphometric measurements and Doppler vascular studies in normal and IUGR fetuses with efficacy in detection of the same.

2. Material and Methods

This study was a longitudinal study done in Obstetrics and gynaecology department of Maharishi Markandeswar Institute Of Medical Sciences Ambala, India in collaboration with the radio-diagnosis Department of the same Institute. The duration of the study was 14 months from May 2014 to July 2015. The population consisted of 100 pregnant women referred from the inpatient ward as well as outpatient department. 50 cases with clinically suspected intrauterine growth restriction (IUGR) and another 50 cases with clinically normal pregnancy were included. Patients excluded from the study were ones with multiple pregnancy, Intrauterine death (IUD), fetus with congenital anomalies, period of gestation less than 28 weeks, macrosomic babies.

After obtaining consent from the patients a detailed history were obtained with special reference to maternal age, parity, last menstrual and other obstetric history including previous pregnancy outcomes. Medical history including hypertension, diabetes, asthma, renal disease, heart disease was also noted. Gestational age was calculated from the last
menstrual period and/or early ultrasound examination. History taking was followed by physical examination.

All the patients were subjected to ultrasound examination with ultrasonography machine PHILIPS X 30 with the facility of colour Doppler imaging. Carrier frequency of 3.5 MHz and 7.5 MHz were used. The foetal biometry included assessment of biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femoral length (FL). Head Circumference/Abdominal Circumference ratio, Femur Length/Abdominal Circumference Ratio, foetal heart rate, placental maturity and amount of liquor were noted. Amniotic fluid index was calculated by adding the vertical depths of the largest pocket in each of the four uterine quadrants.

Foetal weight was estimated according to the Hadlock formulae that uses Femur Length, Abdominal Circumference and Bi-parietal Diameter. Foetal weight less than 10th percentile based on the chart given by Doubilet et al in 1997 were taken as small for gestational age (SGA) babies and foetal weight between 10th percentile to 90th percentile were taken as appropriate for gestational age (AGA) babies. 3

Pulse wave Doppler ultrasound examination were then performed. Uterine artery was studied by first identifying the placental site. If the placenta was central, bilateral uterine arteries were studied and the mean were taken.

Sampling point for the uterine artery was the point where it crossed the external iliac artery near the cervico-uterine junction. For the umbilical artery flow velocity waveforms were obtained from a free floating loop of cord. The sampling point for the middle cerebral artery (MCA) was taken near its origin from the internal carotid artery. Flow velocity waveforms obtained from the arteries were computed automatically. The programme identified individual cardiac cycles and computed peak systolic velocity (S), end diastolic velocity (D), mean velocity and the indices pulsatility index (PI), resistance index (RI) and systolic/diastolic (S/D) ratios.

S/D=S/D ratio.  
S – D/S= RI ratio.  
S – D/mean = PI ratio

Parameters observed were pulsatility Index (PI), resistance index (RI), systolic/diastolic (S/D) ratio, uterine notch, absent or reversed end diastolic flow in Umbilical Artery, Cerebro-placental index (CPI) and cerebro-umbilical indexes (CU). Umbilical & Uterine Artery Pulsatility Index & Resistance Index values were based on chart given by Merz E in 2005. 4 95th percentile was taken as the cutoff point. Umbilical Artery S/D >3, Uterine artery S/D >2.6 and Middle Cerebral Artery S/D >4 were considered abnormal (Bhatt et al 2003). Middle Cerebral Artery Resistance Index values were based on chart given by Bahiman and colleagues in 2002. 5

Middle Cerebral Artery Pulsatility Index >1.45 in pre term & 1 for term were considered normal (Fawaz et al 2005). 6

Data regarding pregnancy outcome in terms of period of gestation at birth, mode of delivery, indication of caesarean section, birth weight, Apgar score and NICU admissions were retrieved from the delivery records of the Obstetrics and Gynaecology Department of Maharishi Markandeshwar Institute of Medical Sciences And Research, Ambala, India.

3. Results and Observations

A total of 100 cases were included in the study, 50 clinically suspected IUGR cases and another 50 with normal uncomplicated singleton pregnancies were included in this study. Of 50 IUGR suspected cases, 35 cases (about 2/3rd) were actually small for gestational age (SGA) and 15 cases had foetuses appropriate for gestational age (AGA) and were included in the control group as shown in the pie chart (figure 1).

Figure 1:

Table 1: t-test showing Mean Difference in Age of Pregnant Women by Outcomes

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Age of pregnant women (Yr) Mean (SD)</th>
<th>Mean difference</th>
<th>T</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SGA</td>
<td>29.60(3.6)</td>
<td></td>
<td>2.09</td>
<td>2.025</td>
</tr>
<tr>
<td>AGA</td>
<td>27.54(4.5)</td>
<td></td>
<td>2.09</td>
<td>2.025</td>
</tr>
</tbody>
</table>

The mean age of the pregnant women with SGA babies were significantly higher as compared to those who had AGA babies (P<0.000).

Table 2: Comparison of outcome by Gravida (N=100)

<table>
<thead>
<tr>
<th>Gravida</th>
<th>Outcome, N(%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SGA</td>
<td>Prim =19(30.6%)</td>
<td>43(69.4%)</td>
</tr>
<tr>
<td>AGA</td>
<td>Multi =16(42.1%)</td>
<td>22(67.9%)</td>
</tr>
</tbody>
</table>

Of these 100 cases, 62 were primigravidae and 38 were multigravidae. There was no significant statistical difference in the pregnancy outcome by Gravida of the patients.

Table 3: Comparison of Gestational outcome by presence of risk factors (N=44)
Among the risk factors, those patients with hypertension were more more likely to have SGA babies as compared with other risk factors like urinary tract infection, respiratory tract infection, asthma etc. And the difference was found to be statistically significant as shown in this table.

<table>
<thead>
<tr>
<th>Risk factors</th>
<th>Outcome, N(%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SGA</td>
<td>AGA</td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>19(79.2)</td>
<td>5(20.8)</td>
</tr>
<tr>
<td>Others</td>
<td>6(30.0)</td>
<td>14(70.0)</td>
</tr>
</tbody>
</table>

The proportion of abnormal HC/AC ratio (>1) is higher among the SGA babies as compared to AGA babies and the difference was clinically significant (P<0.000).

Table 5: Sensitivity, Specificity, PPV & NPV of HC/AC ratio in detecting SGA foetus

<table>
<thead>
<tr>
<th>HC/AC Ratio</th>
<th>SGA</th>
<th>AGA</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;1</td>
<td>28</td>
<td>5</td>
<td>33</td>
</tr>
<tr>
<td>≤1</td>
<td>7</td>
<td>60</td>
<td>67</td>
</tr>
<tr>
<td>Total</td>
<td>35</td>
<td>65</td>
<td>100</td>
</tr>
</tbody>
</table>

SENSITIVITY 84.8%
SPECIFICITY 92.3%
Positive Predictive Value 84.8%
Negative Predictive Value 89.5%

Abnormal FL/AC ratio (>23.5) was significantly higher among SGA babies as compared to AGA babies (p <0.000) as seen in table.

Table 6: Comparison of Gestational outcome by FL/AC Ratio (N=100)

<table>
<thead>
<tr>
<th>FL/AC Ratio</th>
<th>Outcome, N(%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤2.6</td>
<td>15(20.4)</td>
<td>60(80.0)</td>
</tr>
<tr>
<td>&gt;2.6</td>
<td>20(80.8)</td>
<td>5(20.0)</td>
</tr>
</tbody>
</table>

Abnormal S/D ratio of >2.6 in uterine artery were significantly more in SGA foetuses’ as seen in this table.

Table 7: Comparison of Gestational outcome by Placental Grade (N=100)

<table>
<thead>
<tr>
<th>Placental Grade</th>
<th>Outcome, N(%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SGA</td>
<td>AGA</td>
<td></td>
</tr>
<tr>
<td>Grade II</td>
<td>5(19.2)</td>
<td>21(80.0)</td>
</tr>
<tr>
<td>Grade III</td>
<td>30(40.5)</td>
<td>44(59.5)</td>
</tr>
</tbody>
</table>

Abnormal S/D ratio of >2.6 in uterine artery were significantly more in SGA foetuses’ as seen in this table.

Table 8: Comparison of Gestational outcome by Doppler study outcome (N=100)

<table>
<thead>
<tr>
<th>Doppler study</th>
<th>Outcome, N(%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>12(16.9%)</td>
<td>59(83.1%)</td>
</tr>
<tr>
<td>Abnormal</td>
<td>23(79.3%)</td>
<td>6(20.7%)</td>
</tr>
</tbody>
</table>

Table 9: ‘t-test’ showing mean difference in Uterine artery PI among the two groups

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Uterine artery PI Mean (SD)</th>
<th>Mean difference</th>
<th>T</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SGA</td>
<td>1.536(0.57)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AGA</td>
<td>1.006(0.35)</td>
<td>0.5306</td>
<td>5.699</td>
<td>0.000</td>
</tr>
</tbody>
</table>

The mean (SD) of Uterine Artery PI were higher in SGA babies than AGA babies and the difference was statistically significant.

Table 10: Comparison of Gestational outcome by Uterine artery S/D (N=100)

<table>
<thead>
<tr>
<th>Uterine artery S/D</th>
<th>Outcome, N (%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤2.6</td>
<td>14(19.7%)</td>
<td>57(80.3%)</td>
</tr>
<tr>
<td>&gt;2.6</td>
<td>21(72.4%)</td>
<td>8(27.6%)</td>
</tr>
</tbody>
</table>

Abnormal S/D ratio of >2.6 in uterine artery were significantly more in SGA foetus’ as seen in this table.

Table11: Sensitivity, Specificity, PPV & NPV of Uterine artery SD Ratio indetecting SGA.

<table>
<thead>
<tr>
<th>Ut A S/D</th>
<th>SGA</th>
<th>AGA</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;2.6</td>
<td>21</td>
<td>8</td>
<td>29</td>
</tr>
<tr>
<td>≤2.6</td>
<td>14</td>
<td>57</td>
<td>71</td>
</tr>
<tr>
<td>TOTAL</td>
<td>35</td>
<td>65</td>
<td>100</td>
</tr>
</tbody>
</table>

SENsitivity 60%, SPECIFICITY 87.6%, PPV 72.4%, NPV 80.2%. Uterine artery diastolic notching was seen in 11 SGA foetuses, 8 of them hadunilateral notching and 3 bilateral notching,And 8 of them had hypertension.

Table 12: ‘t-test’ Showing mean difference in Umbilical artery RI among the two groups
The mean (SD) of UA RI were higher in SGA babies than AGA babies and the difference was statistically significant.

**Table 13:** Comparison of Gestational outcome by Umbilical artery S/D (N=100)

<table>
<thead>
<tr>
<th>Umbilical artery S/D</th>
<th>Outcome, N (%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SGA</td>
<td>AGA</td>
</tr>
<tr>
<td>≤ 3</td>
<td>18(22.8%)</td>
<td>61(77.2%)</td>
</tr>
<tr>
<td>&gt; 3</td>
<td>17(81.0%)</td>
<td>4(19.0%)</td>
</tr>
</tbody>
</table>

The proportion of CPI ≤ 1 indicative of brain sparing effect were significantly higher in the SGA foetus group as shown in table.

**Table 15:** Sensitivity, specificity, positive predictive value and negative predictive value of CPI in detecting brain sparing

Sensitivity 48.5%, Specificity 93.8%, PPV 80.9%, NPV 77.2

**Table 16:** Comparison of Gestational outcome by Cerebro-umbilical index(CUI=MCA PI/UA PI) (N=100)

<table>
<thead>
<tr>
<th>CUI MCA PI/UA PI</th>
<th>Outcome, N (%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SGA</td>
<td>AGA</td>
</tr>
<tr>
<td>&gt;1.08</td>
<td>19(22.6%)</td>
<td>65(77.4%)</td>
</tr>
<tr>
<td>≤ 1.08</td>
<td>16(100%)</td>
<td>0(0)</td>
</tr>
</tbody>
</table>

The proportion CU index ≤ 1.08 indicative of brain sparing effect were significantly higher in the SGA foetus group as shown in table.

**Table 17:** Comparison of Gestational outcome by foetal maturity (N=100)

<table>
<thead>
<tr>
<th>Maturity</th>
<th>Outcome, N (%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SGA</td>
<td>AGA</td>
</tr>
<tr>
<td>Preterm</td>
<td>3(75.0)</td>
<td>1(25.0)</td>
</tr>
<tr>
<td>Term</td>
<td>32(33.3)</td>
<td>64(66.7)</td>
</tr>
</tbody>
</table>

*Fisher’s exact test

Overall there were only 4 preterm cases of which 3 were in the SGA group. Most of the SGA foetuses were of term size. There was no significant difference in the gestational outcome by maturity of the babies as shown in the table.

**Figure 2:** Bar chart showing mode of delivery

Out of 100 cases, 61 cases delivered vaginally of whom 3 cases required instrumental delivery. Cases arean sections were performed in 39 cases.
In case of SGA babies’ acute foetal distress (AFD) was the indication for CS in majority of cases.

### Table 18: Comparison of Gestational outcome by NICU admission (N=100)

<table>
<thead>
<tr>
<th>NICU admission</th>
<th>Outcome</th>
<th>N(%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>SGA</td>
<td>14(87.5)</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>AGA</td>
<td>2(12.5)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>SGA</td>
<td>21(25.0)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AGA</td>
<td>63(75.0)</td>
<td></td>
</tr>
</tbody>
</table>

SGA babies were more likely to be admitted in the NICU as compared to the AGA babies and the difference was found to be statistically significant (P<0.000).

### 4. Discussion

In this study no significant statistical differences were observed in the pregnancy outcome by Gravida of the patients but the mean age of the mothers of SGA babies were higher. The failure of a foetus to attain its expected growth may result from different complications but the final common pathway most often encountered is uteroplacental insufficiency. In this series among the various risk factors hypertension was a very significant risk factor for IUGR which was in agreement with other workers (Thaler et al 1992, K Harrington e al 1999 and Coleman et al 2000).
Benson and Dobuilet (2005) noted that detection of IUGR with only weight estimation has some limitations because in 95% of cases the predicted weight falls up to 18% of the actual weight. Therefore, additional sonographic criteria like elevated HC/AC ratio, elevated FL/AC ratio, and presence of oligohydramnios without ruptured membranes, presence of advanced placental grade are also used for improving the accuracy of diagnosis as mentioned in Dutt DC (2004).  

In this study the number of raised HC/AC ratio (>1) were significantly more in SGA babies as compared to AGA babies and the difference was clinically significant (P<0.000). In this study 80% of SGA fetuses had abnormal HC/AC ratio. Benson et al in 1986 reported that elevated HC/AC ratio has a sensitivity of 82%, specificity of 94%, positive predictive value 62% and negative predictive value 98% for detecting IUGR, and in this study sensitivity 84.8%, specificity 92.3%, PPV 84.8% and NPV 89.5% were noted.

In this study the proportion of advanced placental grade was also significantly more among SGA babies as compared to AGA babies in this study.

Uterine artery mean PI (1.5 vs.1), RI (0.7 vs 0.5) and S/D (2.9 vs 2.4) ratio were all significantly raised in SGA foetuses in comparison to AGA foetuses in this study indicating raised impedance to blood flow.

In this series abnormal S/D ratio of > 2.6 in uterine artery were significantly more in SGA foetuses. Fleicher et al (1986) noted that if the S/D ratio of uterine artery exceeds 2.6 the situation in predictive of adverse perinatal outcome. Here S/D ratio of >2.6 had a sensitivity of 60%, specificity 87.6%, PPV 72.4% and NPV 80.2%. Bhushan and Shefeek (1999) reported that sensitivity, specificity and NPV of uterine artery S/D ratio for detecting SGA babies are 67%, 90.3%, 80% and 82.6%.

In this study uterine artery notching were found in 11 cases and all of them had SGA babies. 8 of them were associated with hypertension. Thaler et al (1992), Bower et al (1993), Park et al (1996) and AxFlixedner R (2004) also noted higher association of uterine notching with hypertension.

MCA is suggestive of brain sparing effect. The proportion of CPI (MCA RI/UA RI) ≤ 1 indicative of brain sparing effect was significantly higher in the SGA foetus group. Its sensitivity was 48.5%, specificity 93.8%, PPV 80.9% and NPV 77.2%. Alaa et al (2005) considered MCARI/UA RI < 1.0 abnormal. It had a sensitivity of 64.1%, specificity 72.7%, PPV 89.2% and NPV 36.3% respectively. There was a strong correlation between the MCA RI/UA RI and neonatal outcome. They concluded that MCA RI/UA RI < 1.0 may be helpful in the identification of newborns at risk of morbidity, irrespective of whether they are small or appropriate for the gestational age.

Malhotra et al (2001) remarked that the PI ratio of MCA/UA (CU index) is valuable for monitoring growth retardation and small for gestational age fetuses, particularly those, whose umbilical artery PI is high. In this study the proportion CU index (MCA PI/UA PI) ≤ 1.08 indicative of brain sparing effect was significantly higher in the SGA foetuses group. It was associated with a sensitivity of 45.7%, specificity 100%, PPV 100% and NPV 77.3%. Odibo AO et al (2005) reported that with a MCA PI/UA PI threshold of less than 1.08, the sensitivity, specificity, positive and negative predictive values were 72%, 62%, 68% and 67%. They concluded that the accuracy of using gestational age-specific reference levels was similar to that of using a categorical threshold.

Padmargirison and Rai (2006) noted that when brain sparing effect occurs (CU index < 1.08) and if the prospects for neonatal survival are good, it is better to deliver the foetus.

Amniotic fluid index and umbilical artery pulsatility index were the first variable to become abnormal, followed by the middle cerebral artery, aorta, and variation of foetal heart rate, ductus venosus and inferior vena cava.

Mean gestational age at delivery (38w) and birth weight of SGA babies (2.1 kg) in this study were lower than AGA babies (gestational age 39w & birth weight 3.1 Kg). Patrizia et al (2002) also observed lower gestational age at delivery (37.7 ± 20 vs. 38.8 ± 1.6) and lower birth weight (2193 ± 446 vs. 2524 ± 379) in growth restricted foetuses near term.

Caesarean section rate noted in this study were significantly higher in SGA foetus group. In SGA group CS rate was 51% and in AGA group 32%.

Low APGAR score of < 7 and NICU admissions in this study were significantly more in SGA babies in comparison to AGA babies.

In this study SGA foetuses with abnormal Doppler study had a poor outcome in comparison to those with normal Doppler study. SGA babies with abnormal Doppler had lower fetal weight, poor Apgar score, NICU admissions and higher CS rate.

5. Conclusion

The most common definition accepted for diagnosing IUGR is when the expected foetal weight is less than 10th percentile for gestational age.

The failure of a foetus to attain its expected growth may result from different complications; the final common pathway most often encountered is via uteroplacental insufficiency. Riza Madazli et al (2001) noted that in growth restriction the main and primary pathology is inadequate uteroplacental perfusion which is reflected as increased umbilical artery impedance, changes in the MCA are a secondary phenomenon.

With the advent of ultrasonography (USG), it has become the most widely used, standard and simple way of detecting and confirming IUGR. Ultrasound biometry is the gold standard for assessment of foetal size. Foetal weight less than 10th percentile for gestational age is mostly used to diagnose IUGR but other criteria like elevated HC/AC ratio,
elevated FL/AC ratio, and presence of oligohydramnios without ruptured membranes, presence of advanced placental grade can also be used for improving the accuracy of diagnosis. In this series among the various risk factors hypertension were more frequent is SGA babies.

Once diagnosis of IUGR is made Doppler imaging is valuable for monitoring the pregnancy, it provides valuable information about the hemodynamic status of the foetus.

Flow pattern of uterine artery reflects the evidence of uteroplacental vascular ischemia. Umbilical artery Doppler waveforms reflect the status of the fetoplacental circulation. Doppler study of MCA provides information regarding hemodynamic rearrangements that occur in response to foetal hypoxia.

The uteroplacental insufficiency seen with IUGR is associated with a rise in vascular resistance in uterine & umbilical arteries which can be estimated by raised pulsatility index, resistance index, systolic/diastolic ratio in these arteries, and persistence of umbilical artery diastolic notch, absent & reverse diastolic flow in umbilical artery. In the presence of foetal hypoxemia, central redistribution of blood flow occurs, known as the Brain – Sparing Reflex manifested by a fall in Pulsatility index, resistance index, systolic/diastolic ratio of MCA, CPI (MCA RI/UA RI) and CUI (MCA PI/UA PI).

Previously foetal arterial Doppler studies were mostly done in umbilical artery and middle cerebral artery. In this series uterine artery, foetal Umbilical & MCA arterial Doppler velocimetry waveforms were studied.

In this series SGA babies were significantly associated with raised PI, RI and S/D ratio in uterine and umbilical arteries, persistence of notch in uterine artery, absent diastolic flow in umbilical artery, lowered PI, RI, S/D ratio in middle cerebral artery and decreased Cerebroplacental indices.

In SGA foetuses mean gestational age and birth weight were lower. CS rates were high, low apgar score and NICU admissions were also higher. SGA foetuses with normal Doppler studies most likely represent constitutionally small, not pathologically growth restricted foetuses.

Because the changes in umbilical, uterine & MCA strongly correlate with pregnancy outcome in growth restricted fetuses the use of fetal biometry & Doppler examination is recommended in all cases of suspected IUGR cases.

References

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