INTRODUCTION
The Royal College of Obstetricians and Gynaecologists (RCOG) defines small for gestational age (SGA) foetus as foetal abdominal circumference (AC) or estimated foetal weight (EFW) less than 10th centile [1]. The RCOG further classifies SGA fetuses into constitutionally small and foetal growth restriction (FGR).

Constitutionally small refers to a foetus that fulfills the criteria of SGA but is found normal when its growth characteristics are plotted on a maternal customized centile graph implies that the fetus is normal for maternal ethnicity and size. On the other hand FGR refers to a pathological restriction of the genetic growth potential. This implies that the fetus is compromised hence FGR is associated with poor perinatal and infant outcomes [1].

FGR has conventionally been classified as symmetric and asymmetric depending on the gestational age (GA) of onset, as variable aetiologies operate at different GA.

FGR predisposes a fetus to adverse outcomes in fetal, neonatal and infantile periods whose sequelae continue well into childhood and adulthood. Perinatal mortality is increased in the FGR foetus and newborn [2]. If the baby survives, the chances of suffering with respiratory distress, necrotizing enterocolitis, perinatal asphyxia and hypoxic ischemic encephalopathy are high. Such infants are at higher risk of sepsis because of a compromised immune system. In long-term these babies are shorter and lighter, more likely to be diagnosed with cerebral palsy and have a lower IQ [3].

Intrauterine diagnosis of FGR is essential to plan and implement appropriate management protocols in fetal interest. Such diagnosis is dependent upon assessment of fetal growth by sonographic measurements. Abdominal circumference (AC), head circumference (HC), biparietal diameter (BPD) and femur length (FL) have specific biometry values. These were considered for supporting or refuting the diagnosing of asymmetric FGR.

Though HC, BPD and FL are relatively unaffected in asymmetric FGR, they could be affected in early onset FGR. Hence transverse cerebellar diameter (TCD) emerges as a better indicator of gestational age. It is relatively resistant to hypoaxia due to the brain sparing effect which ensures blood supply to the brain is maintained at the cost of systemic hypoperfusion [5]. Thus the morphometric relation of TCD/AC appears a better indicator of detecting FGR [6].

The study aims at assessing and evaluating various age independent indices used in the diagnosis of FGR. Four indices namely, HC/AC, FL/AC, BPD/AC and TCD/AC, which are commonly used in clinical practice, were evaluated for their diagnostic performance. All these ratios show insignificant correlation to GA when analysed by regression and hence are GA independent [7,8,9].

MATERIALS AND METHODS:
The study was conducted at ESIC Medical College Hospital, which is a tertiary care teaching hospital with referrals from 35 ESIC hospitals and dispensaries, in addition to its own patients. The study was conducted over a year from 2015 to 2016, on 125 consenting patients as a prospective observational study. The study was taken up after approval from Institutional Ethics Committee.

Expectant mothers in third trimester of pregnancy were included in the study with previous normal scan findings thus ruling out symmetric FGR. Those with EFW less than 10th centile, at eligibility were then included after obtaining consent for collecting, processing and publishing their data. A 3.5MHz transducer was used for all morphometric analysis.

GA was calculated from early first trimester scan, calculated by crown rump length (CRL). For calculating expected ratios, foetal biometric data for AC, HC, BPD and FL proposed by Sabagh et al was used [10]. Biometric values for TCD proposed by Sniders et al were used [11]. Ratios were calculated considering 50th centile biometry values. These were considered for supporting or refuting the diagnosing of asymmetric FGR.

AC was measured in the transaxial view of the fetal abdomen at the level of the fetal liver, using the umbilical portion of the left portal vein and stomach bubble as landmarks. The measurement was taken from the outermost aspects of the fetal soft tissues by tracing the trackball.

HC was measured in the transaxial plane traversing the thalamus and equidistant from the temporoparietal bones with cuxum septum pellucidum appearing anteriorly. When both cerebral hemispheres and calvaria appeared symmetric an ellipse was drawn with the
calipers till the outer perimeter of the calvaria. At the same point the BPD was calculated from one outer end to the other inner end. Similarly in the same plane when the transducer was rotated by 30° the cerebellum and cistern magna became visible. The cerebellum appeared as a homogenously echogenic and triangular structure and TCD was measured by placing the calipers end to end.

The pregnancy was monitored with antepartum surveillance and delivery was planned in accordance with Greentop Guideline – 31 [1]. Weekly sonographic biometry was performed. After birth ponderal index (PI) was calculated by using the formula, $PI = \frac{weight}{age\times height^2} \times 10^4$ (where weight is in kilograms and height is in meters). A value below 2 was considered confirmatory for FGR or foetal wasting [12]. Birth weight is in kilograms and height is in meters). A value below 2 was considered confirmatory for FGR or foetal wasting [12]. Birth weight is in kilograms and height is in meters). A value below 2 was considered confirmatory for FGR or foetal wasting [12].

Inclusion Criteria:
1. Age 18 – 40 years.
2. USG criteria for FGR (EFW < 10th centile).
3. LMP known from first trimester (CRL).
4. Week gestation.
5. Late onset FGR.
6. Maternal stature less than 145cm.
7. Preexisting or coexisting obstetric/placental pathology.

Exclusion Criteria:
1. Early onset FGR.
2. Unbooked / referred cases.
3. Twin gestation.
4. Foetal anomalies and / or chromosomal anomalies.
5. Absent or reduced end diastolic velocity (AREDV) at eligibility.
6. Maternal stature less than 145cm.
7. Preexisting or coexisting obstetric/placental pathology.

Research Involving Human Participants:
- All procedures performed on the patient were in accordance with the ethical standards of the institutional and national research committee and with the 1975 Helsinki declaration and its latest amendment in 2000 and other comparable ethical standards.
- All treatment protocols followed are in accordance with the latest accepted Evidence Based Medicine Norms of the RCOG standards.
- Foetal sex was neither detected nor informed, in accordance with the latest accepted Evidence Based Medicine Norms of the RCOG standards.
- All treatment protocols followed are in accordance with the latest accepted Evidence Based Medicine Norms of the RCOG standards.

RESULTS:
We had 4163 deliveries in the past one year; out of these 732 were SGA babies, which bring the incidence to 17.58%. Of these, 125 consenting patients fulfilling our criteria were considered for study. Table-1, shows the demographic details of the study group, when evaluated against the latest accepted Evidence Based Medicine Norms of the RCOG standards.

Table – 2 shows the biometric values and calculated ratios from GA at viability (Indian standards), the data is collected from Sabbaghia et al [10] for AC, HC, BPD and FL, TCD are adopted from Snijders et al [11]. As these are age independent ratios, the mean of ratios is calculated and considered as the cutoff point for classifying fetuses as FGR.

**TABLE – 2 GESTATIONAL AGE INDEPENDENT RATIOS**

<table>
<thead>
<tr>
<th>Gestational age (weeks)</th>
<th>AC [10 mm]</th>
<th>BPD [10 mm]</th>
<th>FL [10 mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21–25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26–30</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>31–35</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>&gt;35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>ULN§</td>
<td>0.03</td>
<td>-</td>
<td>0.06</td>
</tr>
</tbody>
</table>

ULN – Upper limit of normal
§ - approximated to nearest value

Table – 3 illustrates the false positive and false negative rates with different age independent ratios used. TCD/AC had the least false positive rate (9.5%) whereas FL/AC had highest false positive rate (26.19%). Maximum number of cases were missed using FL/AC (32.53%) compared to 16.8% missed using TCD/AC. A difference of 7.14% and 4.82% in false positive and false negative rates was observed between HC/AC and BPD/AC, with a better outcome associated with HC/AC.

**TABLE – 3 FALSE POSITIVE AND FALSE NEGATIVE RATES WITH VARIOUS INDICES**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>TCD/AC</th>
<th>HC/AC</th>
<th>BPD/AC</th>
<th>FL/AC</th>
</tr>
</thead>
<tbody>
<tr>
<td>True Positive (n)</td>
<td>69</td>
<td>66</td>
<td>62</td>
<td>56</td>
</tr>
<tr>
<td>False Negative (n)</td>
<td>14</td>
<td>17</td>
<td>21</td>
<td>27</td>
</tr>
<tr>
<td>False Positive (n)</td>
<td>4</td>
<td>6</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>True Negative (n)</td>
<td>38</td>
<td>36</td>
<td>33</td>
<td>31</td>
</tr>
</tbody>
</table>
Meyer et al reported a higher diagnostic sensitivity with TCD/AC unique in that it starts late and ends sooner than that in other parts of other cerebral structures [14]. The growth spurt of cerebellum is also documented that cerebellar growth is more preserved compared to FL/AC which tends to resemble the findings in our study.

A study done on Indian patients comparing TCD/AC to HC/AC also concluded a higher diagnostic validity with the use of TCD. Considering the evidence TCD/AC appears to be a reliable index for diagnosing and assessing asymmetrical FGR foetuses. This is reinforced by the fact that TCD/AC is a stable, GA independent index which doesn’t appear to change after 20 weeks of gestation [6, 19]. There is availability of strong evidence that TCD is also an accurate measure of calculating the GA [20,21] but this was not considered as it was not included in our operational definition.

CONCLUSION:
Though FGR remains a frustrating obstetric diagnosis due to lack of specific evidence based interventions, to prevent or revert the effects of FGR on the foetus. Still the diagnosis remains an important step to plan surveillance and determine the time and mode of delivery. An antenatal diagnosis of FGR would thus help us plan appropriate measures to prevent further irreversible hypoxic damage to the foetus.

DECLARATIONS:
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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee of ESIC Medical College.

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[13] Hill, Lyndon M. MD; Guzick, David MD, PhD; Rivello, Dawn RDMS; Hixson, Joyce RDMS; Peterson, Carol RDMS. (1990) "The Transverse Cerebellar Diameter Cannot be Used to Assess Gestational Age in the Small for Gestational Age Fetus." Obstet and Gynecol, 75(1), 329-333.


