ROLE OF COLOUR DOPPLER INDICES IN PREDICTION OF IUGR

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ABSTRACT

BACKGROUND
Objectives
- To evaluate the role of umbilical artery Doppler in growth restricted foetuses.
- To know the significance of Doppler flow velocity in perinatal outcome of the growth restricted foetuses.
- To decide the timing of delivery of the growth restricted foetuses.

MATERIALS AND METHODS
- Sixty two (62) patients with following inclusion criteria were studied and subjected to colour Doppler ultrasonography.
- Women with singleton pregnancies with Small for Gestational Age (SGA) foetuses.
- Foetal gestational age of 30 weeks and above with clinically suspected IUGR.

RESULTS
We have studied about 62 pregnancies with suspected IUGR, majority of the neonates were between 1.5 and 2 kgs birth weight. There were 7 intrauterine deaths and 53 live births. Of the 53 live births, 5 neonatal deaths, 32 neonates admitted to NICU, 15 neonates had 5 mins APGAR score less than 7 and 11 neonates had MAS. Of the IUDs, 2 had reversal of diastolic flow in umbilical artery. Of the 6 cases with the reversal of diastolic flow 2 were IUD, 3 were neonatal deaths and 1 with uneventful outcome; 2 IUDs had absent and 2 had decreased diastolic flow. In all the cases with reversal of flow, IUD of the foetus occurred within one week of diagnosis.

CONCLUSION
Doppler velocimetry is a primary tool for foetomaternal surveillance and indispensable for management of IUGR.

KEYWORDS
IUGR, Colour Doppler Ultrasonography.

BACKGROUND
Identification of the pregnancies at risk for preventing perinatal morbidity and mortality is a primary goal of obstetric care provider.[1]

Doppler velocimetry is a non-invasive sensitive tool for surveillance of foetal haemodynamics and foetomaternal circulation.[2] The testing modality is based on the premise that an insufficient uterine, placental or foetal circulation results in adverse pregnancy outcome.[2]

Umbilical Artery [UA] Doppler velocimetry is the most vigorously evaluated test among the non-invasive tests of foetal well-being.[3]

In response to prolonged foetal hypoxic stress, circulatory adaptation occurs resulting in redistribution of the cardiac output to provide a constant oxygen supply to the brain and other essential organs (i.e. heart and adrenal glands).[4,5]
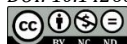
Recent studies indicate that the cerebroplacental ratio of PI of MCA and UA is the most sensitive Doppler index for predicting perinatal outcome in foetus, which has IUGR.[6,7]

Aims and Objectives of the Study
- To evaluate the role of umbilical artery Doppler in growth restricted foetuses.
- To know the significance of Doppler flow velocity in perinatal outcome of the growth restricted foetuses.
- To decide the timing of delivery of the growth restricted foetuses.

MATERIALS AND METHODS
Data for the study was collected from clinically suspected IUGR pregnancies from Basaveshwara Teaching and General Hospital and Sangameshwar Teaching and General Hospital. Study was done for a period of 1 year from November 2014 to October 2015.

Women were Included in the Study if the following Inclusion Criteria were met
- Women with singleton pregnancies with Small for Gestational Age (SGA) foetuses.
- Foetal gestational age of 30 weeks and above with clinically suspected IUGR.
- The gestational age was based on LMP, ultrasound biometry performed before 20th gestational week when

the LMP is uncertain or not known and early ultrasound before 13 weeks has not been performed.

Exclusion Criteria for the Study included any Pregnancy with

- Women with multiple pregnancy.
- Dysmorphic foetuses and karyotypically abnormal foetuses.
- Those who have not given consent.

Present study included a total number of 62 cases meeting an inclusion criteria. In all the cases, past and present obstetric and medical meticulous history was taken as per the case proforma after informed consent. A thorough general and obstetric examinations were done. Doppler ultrasound evaluation was performed along with ultrasound biometry and assessment of amniotic fluid. After ultrasound biometry assessment, all women were subjected to Doppler studies of the umbilical artery and middle cerebral artery serially between 30 and 40 weeks. These assessments were performed by using an ultrasound machine, THE PHILLIPS IU22 AND A PROBEC5 (2) OF 2 - 5 MHZ. The filter was set at 100 Hz. All measurements were plotted graphically in accordance with normograms provided by the Harrington et al for Doppler indices.

The waveforms were obtained during foetal inactivity and apnea. Umbilical artery Doppler flow velocity waveforms were obtained from a free loop of cord and measurements taken when a clear waveform was acquired in the absence of foetal breathing or body movement.

For MCA Doppler ultrasound, a transverse image of the foetal head was obtained at the level of sphenoid bones. Waveforms were taken. PI was measured, the presence, absence or reversal of end diastolic frequencies was noted. The PI was used as it continues to reflect changes in resistance with progressive absence of end diastolic frequencies or reversal of flow.

Women were divided into two groups depending on Doppler findings. Group 1 comprised of women with IUGR foetus with absent or reversed diastolic flow in umbilical artery and abnormal cerebroplacental ratio (MCA PI/UA PI). Group 2 included women with IUGR foetus with normal Doppler flow waveforms. Each woman was given a course of steroids between 30 and 34 weeks of gestation to enhance the foetal lung maturity.

Outcome Criteria

Doppler US results were analysed for prediction of perinatal outcome. Decision to deliver was taken in situations as:

- Gestational age of 37 weeks.
- AEDF/REDF.
- Abnormal Doppler flow measures.
- Abnormal FHR pattern.
- Poor biophysical profile.
- Worsening of maternal condition.
- IUD.

UA pulsatility index ratios were considered abnormal if the value was above the 95th percentile of previously published values for gestational age. The MCA pulsatility index was considered abnormal if the value was below the 5th percentile of previously published values for gestational age. The MCA/UA PI ratio (Cerebroplacental ratio) is considered abnormal when it is less than 1.08 as given by the Gramellini D et al.[8]

RESULTS

Study was done for a period of 1 year from November 2014 to October 2015; 62 pregnancies with clinically suspected IUGR were evaluated with Doppler US. Acceptable waveforms were obtained in all cases.

Age (Years)	No. of Patients	%
1 8 - 2 5	46	74.2%
26 - 30	9	14.5%
31 - 35	6	9.7%
> 36	1	2%
Grand Total	**62**	**100%**

Table 1. Age Distribution of Study Cases

Gravidity	Total	%
Primigravida	3 1	50%
2nd Gravida	1 8	29%
3rd or > Gravida	1 3	21%
Grand Total	**62**	**100%**

Table 2. Gravidity Distribution of Study Cases

Gestational Age in Weeks	No. of Cases	%
30 - 34	14	22.6%
35 - 37	12	19.4%
> 3 7	36	58%
Grand Total	**62**	**100%**

Table 3. Gestational Age Distribution in Study Group

Associated Conditions	Total	%
Only IUGR	29	46.8%
Preeclampsia	22	35.5%
BOH	5	8%
Anaemia	2	3.2%
DM	1	1.6%
HELLP	1	1.6%
RHD	2	3.3%
Grand Total	**62**	**100%**

Table 4. Maternal Complications of Study Group

Vaginal Delivery	Abnormal	Normal	Grand Total
Induced	6	10	16
Spontaneous	5	11	16
Grand Total	**11**	**21**	**32**
LSCS	**Abnormal**	**Normal**	**Grand Total**
EL	-	8	8
EM	20	2	22
Grand Total	**20**	**10**	**30**

Table 5. Mode of Delivery

Vaginal delivery was more in normal group, 72.4%. LSCS was more in abnormal Doppler group, 65.51%. There was significant association between abnormal Doppler and LSCS.

	No. of Cases	Percentage
Adverse	28	45.2%
Uneventful	34	54.8%
Total	**62**	**100%**

Table 6. Pregnancy Outcome in Study Group

Duration	Abnormal	Normal	Grand Total
< 24 hours	5	-	5
< 1 week	25	23	48
> 2 weeks	1	3	4
1 - 2 weeks	-	5	5
Grand Total	**31**	**31**	**62**

Table 7. Duration between Doppler and Delivery

Adverse Outcome	Abnormal	Normal	Grand Total
Death	3	2	5
EOS	2	1	3
IUD	5	2	7
MAS	10	1	11
RDS	1	-	1
Low APGAR score	8	3	11
Admission to NICU	20	4	24
Grand Total	**49**	**13**	**62**

Table 8. Adverse Outcome in Study Group

UA	Abnormal	Normal	Grand Total
Complication/Death	21	9	30
Live and Healthy	14	18	32
Grand Total	**35**	**27**	**62**

Table 9. Umbilical Artery Doppler and Perinatal Outcome

MCA	Abnormal	Normal	Grand Total
Complication/ Death	13	17	30
Live and Healthy	5	27	32
Grand Total	**18**	**44**	**62**

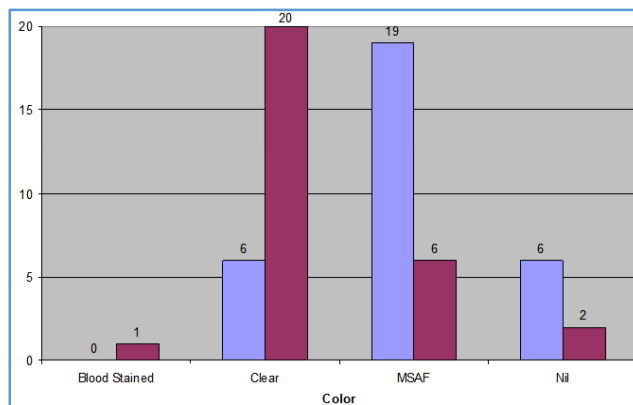*Table 10. Middle Cerebral Artery Doppler and Perinatal Outcome*

In abnormal group out of 18, 13 (72%) had adverse outcome; and in normal group out of 44, 27 (64.2%) had favourable outcome.
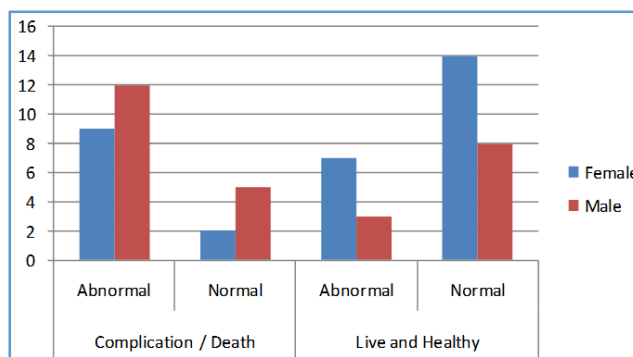
P < 0.0001.

There is a significant association between Doppler study of MCA and perinatal outcome.
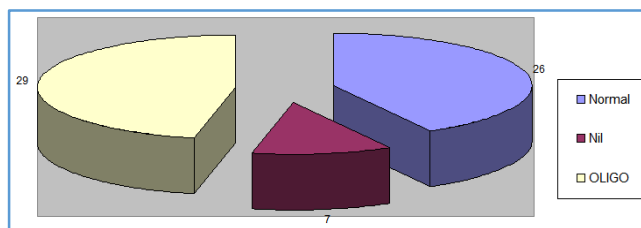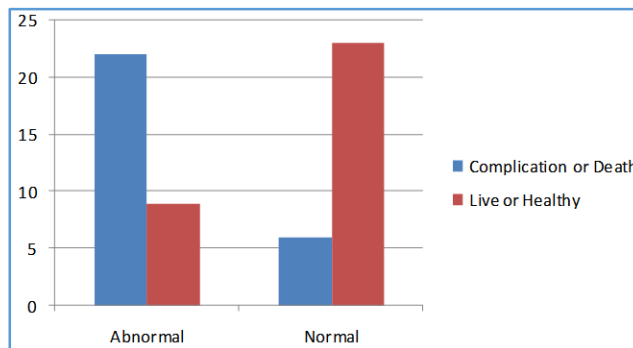

Graph 1. Amniotic Fluid Distribution in Study Group

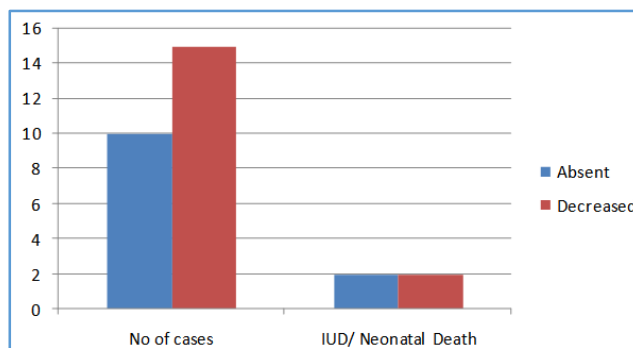*Graph 2. Colour of Amniotic Fluid*

Graph 3. Sex of the Baby

Graph 4. Doppler Velocimetry and Perinatal Outcome
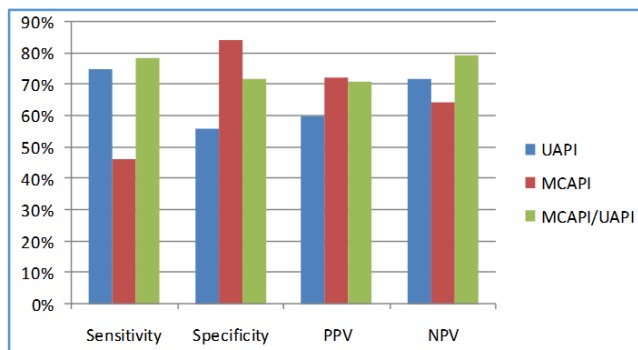

Graph 5. Spectral Characteristics of Umbilical Artery

Out of 6 cases of reversed flow, 2 were IUD's and 3 were neonatal deaths.

2 in each absent and decreased flow were RJD/neonatal death.

In all the cases with reversal of flow, IUD of foetus occurred within 1 week of diagnosis.

Graph 6: Showing Performance Characteristics of Doppler Indices

DISCUSSION

Intrauterine growth restriction is associated with increased risk of perinatal morbidity, mortality and impaired neurological development.

Doppler velocimetry is a non-invasive technique that evaluates abnormal haemodynamics that takes place in response to changes in placental resistance. A Doppler index that reflects both of these areas can be useful for identifying foetuses with increased placental and decreased cerebral resistance.

Umbilical artery and middle cerebral artery Doppler ultrasound clearly depicts the information about placental resistance and the changes in foetal haemodynamics in response to it. Umbilical artery Doppler reflects the mal-development of placental tertiary stem villi, which increases the placental resistance leading to growth restricted foetus. Middle cerebral artery Doppler has enabled the confirmation of brain sparing effect in IUGR. Hence, we choose the UAPI, MCAPI and MCAPI AJAPI, i.e. Cerebroplacental ratio as the tool for predicting the perinatal outcome in IUGR.

We studied the Doppler index of umbilical artery only after 30th week because in agreement with Schulman, Gramellni.[8] We believe that it is difficult to define the normal or abnormal umbilical flow velocity before 30th week with the exception of absent end diastolic flow velocity after 20th week.

We studied the Doppler index of MCA, because it is the most accessible artery to see the cerebral redistribution as it is the main branch of circle of Willis and carries 80% of the blood flow to the ipsilateral cerebral hemisphere, constant 3 to 7% of cardiac output throughout gestation.

The MCAPI and UAPI values for corresponding gestational age were compared with the reference values given by Harrington et al normograms. MCAPI was considered abnormal when it is less than 5th percentile for that gestational age and UAPI was considered abnormal when it is more than 95th percentile for the corresponding gestational age.

It is possible to use a single cut-off value for cerebroplacental ratio after 30th week, because cerebral umbilical Doppler ratio does not vary significantly between 30th and 40th week as reported by Waldy Miroff et al who observed significant differences in cerebroplacental ratio only between 26 - 38 weeks. After 26th week, the statistical comparison showed no significant difference between the intervals considered. Arbeille et al also found the cerebral placental ratio constant during the pregnancy and suggested

1 as the cut-off value; all values below 1 were considered abnormal. We considered the study of Gramellini et al[8] that cerebroplacental ratio less than 1.08 as abnormal.

We have studied about 62 pregnancies with suspected IUGR majority of the neonates were between 1.5 to 2 kgs birth weight. There were 7 intrauterine deaths and 53 live births. Of the 53 live births 5 neonatal deaths, 32 neonates admitted to NICU, 15 neonates had 5 mins APGAR score less than 7 and 11 neonates had MAS. Of the IUDs, 2 had reversal of diastolic flow in umbilical artery. Of the 6 cases with the reversal of diastolic flow 2 were IUD, 3 were neonatal deaths and 1 with uneventful outcome; 2 IUDs had absent and 2 had decreased diastolic flow. In all the cases with reversal of flow IUD of the foetus occurred within one week of diagnosis.

The current study has shown that AEDF and REDF in umbilical artery is strongly associated with major perinatal morbidity and mortality. This has been well recognised in the literature that there was a strict correlation between abnormal UAPI and poor perinatal outcome in IUGR. The studies have shown that the AEDF and REDF in umbilical artery were associated with increased perinatal mortality and morbidity.

In our study when we compared the overall diagnostic accuracy in prediction of adverse outcome in IUGR, CP ratio had the diagnostic accuracy of 75% which was more than UA PI (65%) and MCA PI (66.66%). The values obtained in our study are comparable with that of Gramellini et al.

Our study results in evaluating the usefulness of umbilical artery and middle cerebral artery Doppler in predicting adverse perinatal outcome in IUGR indicate that both abnormal umbilical Doppler indices and CP ratio are strong predictors of adverse outcome in IUGR. MCA PI is more specific, but not a reliable indicator when used alone. The combination of UA and MCA Doppler indices may increase the utility of Doppler ultrasound in clinically suspected IUGR.

CONCLUSION

- Doppler US is the best non-invasive investigation to assess changes in foetal haemodynamics in clinically suspected IUGR.
- Foetal Doppler indices provide information, i.e. not readily obtained from more conventional tests of foetal wellbeing.
- Foetal vessels such as umbilical artery and middle cerebral artery Doppler helps to differentiate the foetus with pathological growth restriction from that of other Small for Gestational Age (SGA) foetus.
- Both abnormal umbilical Doppler indices and cerebroplacental ratio are strong predictors of adverse outcome in IUGR.
- AFDF and REDF in umbilical in IUGR is an ominous finding associated with increased perinatal morbidity and mortality.
- Foetal Doppler study plays a significant role in management of IUGR foetus by identifying compromised foetus from that of non-compromised foetus. Also helps in timely intervention and improves perinatal outcome.
- Foetal Doppler showed to be an integral part while evaluating in-utero health of growth restricted foetus.

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