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Predicting Perinatal Outcome Using Doppler in IUGR and PIH - Evaluating Cerebro Umbilical Ratio

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I. Introduction

IUGR is said to be present in those babies whose birth weight is below the tenth percentile of the average for the gestational age. Incidence among term babies is 5%.Incidence in preterm babies is 15%. Lubchenaco and co-workers published norms for expected fetal weight at a given gestational week, Battalgia and Lubchenaco then classified small for gestational age infants as those whose Birth weight were below the 10th percentile for their gestetional age. These infants were shown to be at increased risk for Neonatal death. Neonatal mortality rate of SGA infant born at 38 wks was 1% compared with that of 0.2% in those with appropriate birth weight. There are several nomogroms to determine percentile distribution of birth weights at different gestational ages. Nomograms by Brenner et. al., (1976), Alexandar et. al., (1996), Arbuckle et. al., (1993), and finally Meintire et. al., (1999) are in use. Many SGA fetuses are not pathologically growth restricted but are small, normal biological fetuses. Maning and Holder 1991, Gordosi and Colleques (1992) proposed 25 percent to 60 percent of SGA infants were appropriately grown when maternal ethnic group, parity, weight and height were considered. Because of these disparities seeds, in 1984 suggested definition based on birth weight below the fifth percentile. Usher and Mclean (1969) proposed that Fetal growth standards should be based on mean weight for Age with normal limits defined by 2 standard deviation. As per this, SGA infants limits to 3 percent instead of 10 percent.

II. Aim Of The Study

To evaluate the screening efficiency of

1. Ratio of Pulsatility indicies of umblical and the middle cerebral arteries.
2. The pulsatility index of the umblical artery.
3. The pulsatility index of the middle cerebral artery in predicting the adverse perinatal outcome in pregnancies complicated by intrauterine growth restriction.

III. Materials And Methods

This study was conducted in the Obstetrics and Gynaecology department, Theni Medical College and Hospital, between March 2013- October 2014. A total of 90 singleton pregnancies constituted the study population.

Inclusion criteria:

1. Women who had regular menstrual cycles prior to conception and sure of their last menstrual period (LMP) or whose gestational age had been established by first trimester ultrasonogram.
2. Women with singleton pregnancy.
3. Women of gestational age between 30 and 40 weeks of pregnancy.
4. Women identified to have IUGR and women with high-risk pregnancies like pregnancy induced hypertension, hypertension complicating pregnancy and other conditions with associated fetal growth restriction.
5. Pregnancies beyond 30 weeks of gestation complicated by severe pre eclampsia and intra uterine growth restriction (or) both were selected.

Gestational age determination was based on a best estimate from menstrual historal, clinical gestational age and fetal biometry. Severe preecclampsia defined according to the standard criteria of uncontrolled blood pressure, proteinuria and ultrasound parameters of IUGR. Other pregnancy complications like gestational diabetes are also included if associated with severe PIH.

Exclusion criteria:
1. Women with fetuses with major congenital malformation diagnosed by a prenatal ultrasonogram.

Method:

Doppler examinations were performed with a LOGIQ 500 duplex doppler scanner (GE medical systems) using a 2.5 MHz tranducer. Studies were done with the patient in semi-recumbent position and the fetus in a quiet resting and apnoeic state. This was determined both by direct observation using real-time ultrasound and by the absence of doppler waveform patterns typical of gross fetal movements and breathing, i.e., irregularity of arterial waveforms and swaying of the venous waveforms. The Doppler determinations were done by one consultants in the unit for all the study patients.

IV. Results

Age Distribution

Age group	cases	
	No.	%
Less than 20 yrs	5	5.6
20-24	29	32.2
25-29	40	44.4
30 & above	16	17.8
Total	90	100
Range Mean S.D	18-40 yrs 26 4.4 yrs	

Obstetric Code

OBS.CODE	CASES	
	NO.	%
PRIMI	59	65.6
MULTI		
G2	24	26.7
G3	4	4.4
G4	1	1.1
G5& ABOVE	2	2.2
MULTI TOTAL	31 90	34.4 100

Gestational Age

GESTATIONAL AGE	CASES	
	NO.	%
PRETERM	41	45.6
TERM	49	54.4
TOTAL	90	100

Weight Of Mother/Baby (Kgs)

WEIGHT	RANGE	MEAN	S.D
MOTHER	42-68	52.3	6
BABY	1-4.5	2.13	0.69

Antenatal Risk Factor

ANTENATAL RISK FACTOR	CASES	
	NO.	%
PIH	68	74.4
SEVERE PIH	6	6.7
PRE.H/O SGA	1	1.1
IUGR	10	11.1
CHRONIC HT	2	2.2
BOH	1	1.1
NIL	2	2.2
TOTAL	90	100

Umblical Artery- P.I

UMBLICAL ARTERY P.I	CASES	
	NO.	%
NORMAL (<1.12)	48	53.3
ABNORMAL(>/=1.12)	42	46.7
TOTAL	90	100
RANGE MEAN	0.82-1.8 1.13	

S.D	0.18

Middle Cerebral Artery –P.I

MIDDLE CEREBRAL ARTERY P.I	CASES	
	NO.	%
NORMAL(>1.12)	51	56.7
ABNORMAL(</= 1.12)	39	43.3
TOTAL	90	100
MCA/UA RATIO		
NORMAL(>1.08)	16	17.8
ABNORMAL(<1.08)	74	82.2
TOTAL	90	100

Range 0.6-1.38
Mean 1.03
Sd .13

Types Of Labour

Type Of Labour	No.	%
Spontaneous	4	4.4
Induction Of Labour	31	34.4
Induced Labour-Pih	8	8.9
Operative	47	52.2
Total	90	100

Mode Of Delivery

Mode Of Delivery	Cases	
	No.	%
Ln	11	12.2
Ln With Epi	26	28.9
Assisted Breech	1	1.1
Outlet Forceps	1	1.1
Lscs		
Elective	1	1.1
Emergency	40	44.4
Rpt	10	11.1
Total Lscs	51	56.7
Total	90	100

Liquor

Liquor	No.	%
Clear	71	78.9
Oligo	6	6.7
Msaf	13	14.4
Total	90	100

Apgar Score At 5 Min

Apgar Score At 5 Min	Cases	
	No.	%
<7	32	35.6
>7	58	64.4
Total	90	100

Neonatal Complications

Neonatal Complications	Cases	
	No.	%
Increased Br	23	5.6
Hypoglycemia	6	6.7
Hie	6	6.7
Hypothermia	2	2.2
Mas	1	1.1
Rds	1	1.1
Sepsis	1	1.1
Iud	1	1.1
Neonatal Death	10	11.1
Still Birth	3	3.3
Nicu Admissions	49	54.4

Apgar <7 At 5 Min	**32**	**35.6**
No Complication	**19**	**21.1**

Perinatal Outcome

Perinatal Outcome	**Cases**	
	No.	**%**
Good(Alive & No Complication)	**19**	**21.1**
Adverse(Death,Nicu Admission)	**71**	**78.9**
Total	**90**	**100**

Relationship Between Cerebral Umbilical Ratio And Other Variables

Variable	**Cerebral Umblical Ratio**						**P**
	Normal(1.08)		**Abnormal(<1.08)**		**Mean**	**S.D**	
	No.	**%**	**No.**	**%**			
Age<30(74)	**13**	**17.6**	**61**	**82.4**	**1**	**0.14**	**0.837 N0t S**
>30(16)	**3**	**18.8**	**13**	**81.3**	**3**	**0.11**	**Significant**
Weight							
< 45kg(17)	**4**	**23.5**	**13**	**76.5**	**1**	**0.11**	**0-5603**
>45 Kg(73)	**12**	**16.4**	**61**	**83.6**	**4**	**0.14**	**O.6598**
Primi(59)	**11**	**18.6**	**48**	**81.4**	**1**	**0.15**	**Notsignifica**
Multi(31)	**5**	**16.1**	**26**	**83.9**	**3**	**0.1**	**nt**

Antenatal Risk Factor	**Cerebral Umbilical Ratio)**			
	Normal 16 Cases (>1.08)		**Abnormal 74 Cases(<1.08)**	
	No	**%**	**No**	**%**
Pih(67)	**12**	**17.9**	**55**	**82.1**
Severe Pih(6)	**-**	**-**	**6**	**100**
Iugr(10)	**2**	**20**	**8**	**80**
Chronic Ht(2)	**-**	**-**	**2**	**100**
Other Medical Disorders(3)	**1**	**33.3**	**2**	**66.7**

Onset Of Labour	**Cerebral Umbilical Ratio**			
	Normal 16 Cases		**Abnormal 74 Cases**	
	No.	**%**	**No**	**%**
Spontaneous Labour -4	**4**	**100**	**-**	**-**
Induction Of Labour-36	**5**	**17.9**	**31**	**82.1**
Emergency Lscs-40	**4**	**10**	**36**	**90**
Elective Lscs -1	**-**	**-**	**1**	**100**
Repeat Lscs-10	**3**	**30**	**7**	**70**

V. Discussion

The development of a good utero - placental circulation is essential for achievement of a normal pregnancy. IUGR is associated with an increased risk of perinatal mortality, morbidity and impaired neuro-development. The correct detection of the compromised IUGR fetus to allow for timely intervention is a main objective of antenatal care.

Cerebral - umbilical ratio is the ratio between the pulsatility indices of the middle cerebral artery and the ubilical artery. Previous studies done by Gramellini et. al., Arias et. al., and Singh el. al., had concluded that the cerebral umbilical was superior than the individual doppler indices of umbilical artery and middle cerebral arteries in predicting adverse perinatal outcome in IUGR fetuses. This study was done to evaluate the efficacy of the cerebral-umbilical ratio and pulsatility indices of the middle cerebral and umbilical arteries to predict adverse perinatal outcome in IUGR fetuses. From March 2013to October 2014, doppler indices namely the pulsatility indices of the umbilical artery and the middle cerebral artery and the cerebro umbilical ratio was studied in 90 (Ninety) women. Clinically suspected to have IUGR and in women with P1H. Doppler determination was performed with the patient in semi-recumbent position and the fetus in a quiet resting and apnoeic state. This was done between 30 - 40 weeks of pregnancy. The pulsatality indices of the umbilical artery, middle cerebral artery and the raio were calculated. The last value obtained before delivery was taken for the study. The doppler studies were done by one consultant for all the study patients. After a technically sstisfactory doppler waveform was obtained on the screen, the image was frozen. Pulsatility indices of the best three cardiac cycles were calculated and the average of them was obtained. The results of the doppler values were not revealed the consultant managing the patient. The patients were followed at the time of delivery and the perinatal outcome data obtained. Wladimiroff et. al., had shown that there was no significant variation in the cerebro umbilical ratio between 30 - 40 weeks of pregnancy. Gramellini et. al., studied twenty five women with normal pregnancies and obtained cutoff value of 1.08 for cerebro umbilical ratio. This was -2 standard

deviations of the mean of the value obtained between 30 - 41 weeks of gestations. A value ≤ 1.08 was considered abnormal and value >1.08 was considered normal.. The same cerebral-umbilical ratio cutoff value of 1.08 was used in this study. The women were divided into 2 groups based on this cutoff value. The adverse perinatal outcome like low birth weight, low apgar scores, rate of cesarean section for fetal distress, meconium staining of the amniotic fluid, number of days of nursery care and the neonatal complications were analysed in both the groups. In this study the demographic variables like Age, height, weight of the women were similar in both the groups. In the abnormal ratio groups the percentage of women belonging to lower socio-economic status was found to be significally higher than in the normal ratio group (92.5% vs 29%) with the 'p' value of 0.023. This indicates the incidence of SGA babies with abnormal cerebral-umbilical ratio is likely to be high in the women of lower socio-economic status category.

As similar finding had not been reported by others. The Antenatal risk factors that are associated with IUGR are studied in both groups. The percentages of women with an risk factors like pregnancy induced hypertension, hypertension complicating pregnancy, vascular disorders, maternal infection, and delivery of small for gestational age babies in the previous pregnancy were found to be higher in the abnormal ratio group compared to that in the normal ratio group through it was not statistically significant. Arias et. al., studied the resistance index in 61 antenatal women with similar risk factors and found that 22 women had abnormal cerebro-umbilical ratio. In women with clinically detected IUGR when ratio was > 1.08 significant no. Of women were found to have no antenatal risk factor compared to women with ratio ≤ 1.08 and the 'p' value was 0.002, C.I. - 0.03 - 0.51. This indicates that when there is IUGR associated with antenatal risk factors. There is increased chance of having abnormal cerebro-umbilical ratio. The gestational age at delivery in the abnormal ratio group was significantly lower, than normal ratio group. The babies with IUGR and abnormal ratio were delivered much earlier, because of evidence of fetal distress.

There was more proportion of spontaneous labour when compared to induced labour in normal ratiogroup. Labour was induced in 82.1% abnormal ratio group. About 44 operative deliveries were performed in abnormal ratio group. The indication's for operative delivery was fetal distress and oligohydramnior in about 22 cases. In the rest of the cases it was due to severe PIH, induction failure (or) CPD. There was more number of labour natural and labour natural with episiotomy in the abnormal ratio group. This is due to more number of cases in abnormal ratio group than normal ratio group. More over about 78.4% of operative delivery occurred in abnormal ratio group. In the study by Grammelini et al., the rate of C.S was 88.8%. In abnormal ratio group and 12.5% in the other group. In another study by arias et al. The rate of C.S. was 86.3% in the abnormal ratio group and 51.2% in normal ratio group. In this study the incidence of LSCS was 78.4% compared to 21.6% in normal ratio group. About 80% of neonatal deaths occurred in the abnormal ratio group. All the neonatal deaths in the abnormal group were due to IUGR complications. Among 2 neonatal death in normal ratio group, 1 case was extreme prematurity and the other was deeply asphyxiated baby. Meconium staining of the amniotic fluid was noted in the abnormal ratio group. In study by Singh et. al., did not find an increase in the incidence of meconium staining of amniotic fluid. The mean birth weight in abnormal ratio group was 2.15kg where as it was 2.11kg in the normal ratio group. The mean birth weight was higher in the abnormal ratio groups then the normal group in this study. This is because of more number of cases in the abnormal ratio group. But in the study by Grammelini et al, there was significant difference in birth weight (1659+639gm and 3031+584) in the normal ratio groups. Other perinatal outcomes like APGAR score, NICU admission, no of neonatal death and IUD were significantly higher in abnormal ratio group. About 83.9% of babies who had prolonged nursery stay had abnormal ratio. Most of the babies stayed there because of Hyperbilirubenemia, Hypoglycaemia, Hypoxic isclamic enceplacopathy and hypothermia.

In the study by singh et al, 75% babies stayed at NICU for more than 10 days. One baby in the abnormal group had multiple anomalies like microcephaly and Rocker bottom foot. In the study by arias et al, 3 babies with abnormal ratio had anomalies. The birth weight of the babies at delivery were plotted in the standard birth chart and small for gestational age babies identified. In this study. 44 babies out of 90 had birth weight less than 10th percentile, 91.3% of SGA babies contributed by abnormal ratio group and only 8.3% of SGA babies contributed by normal ratio group. In study by singh et al, 94.4% of babies with abnormal ratio have less than 10th percentile babies as against 57.5% in the normal ratio group. The sensitivity, specificity, the positive predictive value and the negative predictive value of the doppler indices in predicting the adverse perinatal outcome at the cutoff values used in this study were calculated. The sensitivity of cerebroumbilical ratio to predict adverse outcome was 86% where as that for P.I of umbilical artery (≥ 1.12) was 45% and for P.I. for middle cerebral artery ≤ 1.2 was 39%. The pulsatility indices of the umbilical artery and the middle cerebral artery values are useful to predict the adverse perinatal outcome. The abnormal cerebral umbilical ratio is better to predict the adverse perinatal outcome such as fetal distress, small for gestational age babies and neonatal compliations like hyperbilirubenemia in cases of IUGR along with the other antenatal surviellance.

VI. Summary

The doppler study indices- pulsatality indices of the umbilical artery and the middle cerebral artery and the cerebral umbilical ratio were determined in ninety antenatal women with IUGR diagnosed by clinical method, from March to October 2009. The aim of this study was to evaluate the efficacy of the cerebral-umbilical ratio and the pulsatality indices of the middle cerebral and the umbilical arteries in predicting the adverse perinatal outcome in women with IUGR. The cutoff values of '1.08' for the cerebral-umbilical ratio; pulsatility indices of '1.12' for the umbilical artery and '1.2' for the middle cerebral artery were taken for this study. Women with IUGR and antenatal risk factor were found to have abnormal cerebral-umbilical ratio (≤ 1.08; 'p' value = 0.002). The mean gestational age at delivery was significantly lower in women with the abnormal cerebral-umbilical ratio. More that fifty percent of women with abnormal cerebral-umbilical ratio of ≤ 1.08 were delivered by cesarean section.

The proportion of low birth weight of the babies were higher in women with abnormal cerebral-umbilical ratio. The incidence of hyperbilirubinemia and prolonged nursery stay was found to be higher in newborns who had abnormal cerebral-umbilical ratio. 50.5% of the women diagnosed clinically to have IUGR, delivered small for gestational age babies (birth weight < 10th percentile).

The sensitivity for the cerebral-umbilical ratio of ≤ 1.08, to predict the adverse perinatal outcome in IUGR was 79.3% for pulsatility index of umbilical artery of ≥ 1.12, it was 42.3% and for the pulsatility index of middle cerebral artery of ≤ 1.2 was 66.6%. When the cerebral-umbilical ratio is abnormal in women with IUGR, they are likely to have significant increase in perinatal risks like fetal distress, incidence of cesarean section, small for gestaitonal age babies, prolonged nursery stay and hyperbilirubinemia in the new born.

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