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Original Research Article

A study of Doppler Prediction of Adverse Perinatal Outcome in Growth Restricted Fetuses

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Abstract: Fetal growth restriction is associated with substantial perinatal mortality and morbidity. Incidence of fetal demise, birth asphyxia, meconium aspiration, neonatal hypoglycemia and hypothermia are all increased, as is the prevalence of abnormal neurological development. Postnatal growth and development of growth - restricted fetuses depends on the cause of restriction, nutrition in infancy and social environment. Infants with growth restriction due to congenital, viral infection, chromosomal or maternal constitutional factors remain small throughout life. Those infants with in utero growth restriction due to placental insufficiency will often have catch up growth after birth and approach their inherited growth potential when provided with an optimal environment. Aim of the study is to detect any abnormalities in feto placental unit and fetal circulation in IUGR. To identify the hypoxemic fetus & timing delivery so as to precede acidemia. To correlate the occurrence of adverse perinatal outcome with degree of abnormality in Doppler indices. A note was made of the maternal weight, blood pressure and obstetric examination findings of fundal height and various laboratory investigation results. Those with uterine fundal height less than 3cms from the expected height were clinically diagnosed as IUGR and ultra sound examination was done with special emphasis on morphometric measurements. Abdominal circumference less than 5th percentile and estimated fetal weight less than 10th percentile for that gestational age were selected for study. In cases with risk factors, serial sonography was done to identify fetal growth restriction. Initial dating scan followed by second ultra-sound examination was done at around 34 to 36 weeks. Gray scale fetometry is a reliable method to distinguish IUGR & normal fetuses. However it does not detect adverse outcome. Predictive capability of Doppler in confirmed IUGR cases were analyzed. By analyzing abnormal Doppler indices, the fetal hemodynamic& compromise secondary to hypoxemia can be accurately pinpointed. Timely intervention before the onset of academia (altered ducts venous hemodynamic) can effectively reduce perinatal mortality.
Keywords: Fetal growth, Gray scale fetometry, hypoxemic fetus

INTRODUCTION:

To avoid undue alarm in patients, to who the term “Retardation” implies abnormal mental function, the term “Fetal growth restriction” is now preferred. About 3-10% of infants are growth restricted [1]. In 1961, Warkany and co-workers reported normal values for infant weight, lengths and head circumferences which sewed to define fetal growth restriction. In 1963, Gruenwald[3] reported that approximately one third of low birth weight infants were mature and that their small size could be explained by “chronic placental insufficiency” [2]. In 1963, Lubchenco and coworkers from Denver published detailed comparisons of gestational ages to birth weights in an effort to derive norms for expected fetal size and therefore growth at a given gestational week [3]. Battagalia and Lubchenc classified small for gestational age infants as those whose weights were below the 10th percentile for their gestational age [4]. The neonatal mortality rate of a small for gestational age infant born at 38 weeks was 1 percent compared with 0.2% in those with appropriate birth weights. Seeds and Peng concluded that the threshold for impaired growth based upon the risk of fetal death should be set even higher at the 15th birth weight percentile. Manning and Hohler and Gardosi concluded that 25- 60% of infants conventionally diagnosed to be small for gestational age were in fact appropriately grown when determinants of birth weight such as maternal ethnic group, parity & weight are considered [5]. A definition based upon birth weight below the fifth percentile was also proposed by Seeds [6]. Usher and McLean proposed that fetal growth standards should be based on mean values with normal limits defined by ± 2 standard deviations because this

definition would limit small for gestational age infants to 3% of births instead of 10% with use of the 10th percentile. From a clinical standpoint this definition appears to be most meaningful [7]. This is because most poor outcomes are in those infants with birth weights below the third percentile. In a study of 122,754 pregnancies delivered at Parkland Hospital, Mclntire and Colleagues (1999) found that mortality and morbidity were significantly increased among infants born at term only when their birth weights were at or below the third percentile for their gestational age. Relationship between birth weight percentile and perinatal mortality & morbidity is observed on 1560 SGA fetuses [8]. A progressive increase in both mortality and morbidity is observed as birth weight percentile falls. (Manning1995).Owen and Colleagues in 1997 and Owen and Khan in 1998 reported that reduction in the rate of velocity of fetal growth detected by serial ultrasonic fetal anthropometry is related to caesarean delivery for fetal distress and significant fetal growth restriction [9].

MATERIALS AND METHODS:

This study was conducted jointly at the Institute of Obstetrics and Gynecology and Barnard Institute of Radiology, Chennai both coming under the Madras Medical College, Chennai. Two hundred documented IUGR cases confirmed by clinical evaluation and serial ultrasound biometry were selected for the study and it was done on singleton pregnant women with well documented period of gestation beyond 34 weeks. Known congenital anomalies were excluded from the study. The machine used for Doppler was an Aloka 3500 color Doppler machine with a 3.5 to 5 MHz curvilinear probe. Name, Age, Unit, Registration number and Address of the patients were noted. Detailed obstetric history including the history of pregnancy induced hypertension; gestational diabetes and chronic hypertension were obtained [10]. History of previous pregnancies including birth weight of previous babies, perinatal deaths, and mode of delivery were elicited. Details of present pregnancy were asked, including the date of last menstrual period, details of scan in the first trimester and clinical examination noting, if available, were scrutinized. A note was made of the maternal weight, blood pressure and obstetric examination findings of fundal height and various laboratory investigation results. Those with uterine fundal height less than 3cms from the expected height were clinically diagnosed as IUGR and ultra sound examination was done with special emphasis on morphometric measurements [11].

Abdominal circumference less than 5th percentile and estimated foetal weight less than 10th percentile for that gestational age were selected for study. In cases with risk factors, serial sonography was done to identify fetal growth restriction. Initial dating scan followed by second ultra-sound examination was done at around 34 to 36 weeks. Patients with irregular cycles, unknown dates, those with restricted growth from the 1st trimester onwards by ultrasound and pelvic examination were excluded from the study group as were those with history of viral exanthematous fever, intake of drugs like antiepileptic, antipsychotics &anticoagulants. All these cases were kept under surveillance till confinement. A careful search for causes of IUGR like Smoking, Alcoholism and Hypertension were made. Anemia, if present, was corrected and PIH, if detected, was managed appropriately. The cases were monitored by Fetal Kick Count, Cardiotocography, Serial measurements of fetometry AFT and Doppler studies. Doppler studies were done on Umbilical artery, Middle Cerebral Artery and Ducts venosus with a real time color Doppler ultra sound machine. Umbilical cord was located in the pool of amniotic fluid and values were taken at mid cord or placental insertion. Middle cerebral artery was localized in transverse section of fetal skull, at the level of thalamus in the Sylvian fissure. The ductus venosus was sampled in the abdominal circumference section, where it joins the umbilical vein to IVC. The Doppler transducer was placed on the abdominal wall over the uterus and carefully manipulated till Doppler signals appropriate for those particular vessels were identified. The signals were recorded for a minimum of 5 to 8 cycles with blood flow velocity waveforms of equal shape and amplitude and of satisfactory quality were obtained. The image was frozen and measurements taken. Doppler was considered as abnormal when there was absent or reverse diastolic flow in umbilical artery or PI values were above the 95th percentile for that gestational age. Cerebro placental ratio less than one was also taken as abnormal. Those cases where fetal assessment was normal were monitored fortnightly till delivery [12]. Those with absent and reverse flow were taken up for termination of pregnancy [13]. In those cases with low diastolic flow in umbilical artery, where fetal maturity adequate for survival was present, the pregnancy was terminated. In cases where fetal maturity was not reached monitoring was done with NST and BPP daily or twice weekly depending upon the severity of abnormality and associated complications. Pregnancy was terminated when there were abnormal readings from CTG or a low score on the bio-physical profile. In those cases where differential shunting of blood flow to fetal brain was present, termination was done even before NST or BPP were found to be abnormal. Mode of delivery was planned depending on the weight and gestational age and amount of liquor present. Outcome of pregnancy was recorded in detail including intrauterine demise, neonatal death, birth weight, Apgar score, development of neonatal complications and presence of congenital anomalies, placental weight and pathology. These details were entered in a proforma and the data was statistically analyzed and evaluated.

Procedure of Obstetric ultrasound examination and Doppler evaluation performed.

FETOMETRY

Biparietal Diameter:

Measurement was performed from the outer edge of skull on the proximal surface, to the inner edge of skull on the distal surface in a section that included the midline echo with the cavum septum pellucidum in the anterior third and the thalami on either side. During the study, care was taken to apply minimal pressure to the maternal abdomen with the transducer as the fetal head compression is associated with alterations of intra-cranial arterial flow velocity waveforms.

Head Circumference: It was measured at the same level as the BPD using the method of expanding ellipse.

Femur Length: A section showing both ends of the femur clearly was obtained and measurement of diaphysis was performed.

Abdominal circumference: A cross sectional view of the fetal abdomen showing the intrahepatic portion of umbilical vein in the anterior third of the abdominal circumference was used for measurement of abdominal circumference by the expanding ellipse method [14-16].

DOPPLER EVALUATION

Umbilical Artery:

A loop of umbilical cord close to the placenta was located. The segment of umbilical cord was elongated so that the two umbilical arteries and one umbilical vein could be distinguished. Angle of insonation was adjusted to less than 60 degrees. An optimum Doppler signal was obtained and the pulsatility index was measured [17].

Foetal Middle Cerebral Artery:

Section of foetal head used for BPD measurement was obtained and then the transducer was angled caudally till the middle cerebral artery was seen coursing along the sphenoid wings. Sample volume size and angle of insonation were adjusted after placing the cursor in the artery and appropriate signals obtained. The pulsatility index was measured. In FGR, the expected abnormal findings would be an increased diastolic flow due to the cephalization of blood flow and brain sparing effect. This would reflect as a decrease in PI values [18].

Foetal ductus venosus:

A transverse section of the fetal abdomen was obtained with the transducer angled slightly cephalad, color flow switched on and the aliasing signal in the ductus venosus identified where it connects the umbilical vein to the IVC. The sample volume and the angle of waveform obtained. The PI was then measured [19].

RESULTS:

The study was conducted on 200 third trimester women with ultrasonologically confirmed IUGR cases and the following observations were made.

Among the 200 cases that were confirmed to be IUGR by B-Mode Ultrasound, 179 cases showed abnormalities in the Doppler wave forms. 21 cases revealed normal Doppler wave forms.

Table 1: IUGR Cases

Total No of IUGR Cases	**200**	**%**
Normal Doppler	21	10.5
Abnormal Doppler	179	89.5

GRADING OF DOPPLER ABNORMALITIES:

According to the increasing severity of altered Doppler indices inthe 200 IUGR cases, we categorized the cases into six from grade 0 (normal Doppler) to grade 5.

Table 2: Showing Details of Doppler Abnormalities

GRADES		**No**	**%**
0	Normal Doppler	21	10.5
1	Increased UA PI alone	38	19
2	CPR reversal	93	46.5
3	Absent/reversed EDF in UA with decreased MCA PI	19	9.5
4	Absent/reversed EDF in UA with increased MCA PI	23	11.5
5	Ducts venosus alteration	6	3

Out of the 179 cases, 48 cases showed absent/reversed diastolic flow in umbilical artery, out of which 19 had compensated MCA flow while 23 had gone in for decompensate MCA flow (hypoxic and decompensated fetus), 38 cases showed only low diastolic flow in umbilical artery, 93 cases showed low diastolic flow in umbilical artery and increased diastolic flow in middle cerebral artery (hypoxic and compensated fetus). 6 cases showed increased PI in the ductus (acidotic fetus).

Table 3: The age distribution of the patients in our study

Age Group	No of patients	Percentage (%)
18-22	61	30.5
23-27	93	46.5
28-31	40	20
32-36	5	2.5
> 36	1	0.5

Most of the patients were in the age group of 23-27 yrs. There was only 1 patient more than 36 years of age.

This table-4 the birth order of the patients in our study group.

Table 4: Gravidity

Gravidity	No of patients	Percentage (%)
PRIMI	108	54
SECOND	51	21.5
THIRD	34	17
FOURTH AND MORE	7	3.5
> 36	1	0.5

Majority of our patients were primi gravidae (54%). Only 7 patients were of the birth order 4 or more.

The distribution of gestational at which Doppler analysis was done in the study group is show in the table-5.

Table 5: Gestational Age

GESTATIONAL AGE (WEEKS)	NUMBER OF PATIENTS GRADE						
34-36	0	0	0	0	0	5	5 [2%]
36-37	2	5	17	11	13	1	49 [24%]
37-38	1	3	26	6	6	0	42 [21%]
38-39	7	16	25	2	3	0	53 [26%]
39-40	10	12	24	0	0	0	46 [23%]
> 40	1	2	2	0	0	0	5 [2%]

Most of our patients with mild Doppler abnormalities were adequately monitored till term or even beyond. Patients with higher grades of Doppler abnormalities were induced earlier based on their biophysical profile, non-stress test and liquor status for best fetal outcome.

CONCLUSION:

Fetometry by B-Mode Ultrasound is a reliable method of investigation to distinguish between IUGR and normal fetuses. This is probably because in IUGR fetuses, the earliest feature is reduced growth that is readily assessed by a measurement of abdominal circumference that will show consistently lower values than those expected for the particular gestational age. However the B-Mode ultrasound did not reliably detect the adverse perinatal outcome. But on grading the abnormalities from 0 to 5 based on increasing severity of altered Doppler indices, we got the above statistics. We also found that the patients who had mild abnormalities on Doppler (Grade 0, 1 and 2), did not have any mortality related to severity of IUGR, nor did they have any significant morbidity [20].

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