

Umbilical Artery Doppler Study in Perinatal Outcome of Fetuses with FGR: A Prospective Cohort Study

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Abstract

Introduction: The incidence of intrauterine growth restriction is approximately 10%. The management depends upon diagnosis, follow up and timely delivery of the fetus.

Material & Methods: Prospective cohort study was conducted at a zonal hospital from Oct 2014 to Aug 2016 on 60 women with clinical suspicion of FGR. After confirming FGR with ultrasound, these patients were followed with umbilical artery velocimetry. The neonatal outcomes - gestational age at delivery, birth weight, APGAR score, NICU admissions were noted.

Results: Low end diastolic velocity was present in 23 patients and 05 fetuses had absent end diastolic velocimetry. The mean age of delivery was 37.3 Weeks in normal velocimetry, 36 Weeks in high S/D ratio and 33.5 Wks (31-37.3 Wks) in absent diastolic flow group. Mean birth weight was 1.67 kg in the low end diastolic velocity, 1.002 kg in the absent diastolic velocity group and 2.03 kg in the normal umbilical artery velocimetry group. APGAR of < 7 was seen in 6 (26%) of low end diastolic velocity, 3 (60%) of absent doppler velocimetry as compared to 3 (9.2%) in the normal doppler velocimetry group.

Conclusion: The data indicates that the umbilical artery doppler study could distinguish the group of small for date fetuses in risk for complications. Growth restricted fetuses with normal umbilical flow velocimetry are at lower risk than those with abnormal velocimetry in terms of poor APGAR scores and neonatal intensive care admissions

Keywords: Fetal growth restriction (FGR), Umbilical artery doppler

Introduction

Fetal growth restriction (FGR) is most commonly defined as weight of fetus less than tenth centile for that gestational age. Fetal growth restriction is a common clinical sign for chronic fetal hypoxemia. It is difficult to differentiate between suboptimal fetal growth due to intra uterine starvation and adequate growth of a constitutionally small infant. Umbilical artery velocimetry is a good predictor in these growth-restricted fetuses at risk of antenatal compromise. FGR has a significant impact on perinatal morbidity and mortality. Because of these adverse neonatal outcomes, it is imperative that these fetuses are monitored carefully during pregnancy detecting the fetus with pathological growth restriction that is at risk for perinatal complications has been an ongoing challenge in obstetrics. This differentiation is very important to minimize unnecessary admissions and interventions on constitutionally small ones who are less likely to suffer from an adverse neonatal outcome. Doppler came to our rescue due to its ability to evaluate the uteroplacental and fetoplacental circulation in a non invasive manner. John Christian Doppler, first described the effect in 1842. Doppler velocimetries of fetal vessels became the important non-invasive tool to differentiate between FGR and constitutionally small babies that are unlikely to have serious perinatal morbidity. In FGR, maternal as well as fetal circulations are studied. Several authors have reported a low end diastolic velocities and high S/D ratio in umbilical arteries due to increased resistance to blood flow in growth restricted foetuses

The present study was conducted to study the role of umbilical artery velocimetry in perinatal outcome of FGR pregnancies.

Material and Methods

This prospective cohort study was conducted at a zonal hospital from Oct 2014 to Aug 2016. The study population consisted of 60 women with clinical suspicion of FGR. Singleton pregnancies with FGR / oligohydramnios were included and pregnancies with fetal congenital anomalies, multifetal gestation, PROM were excluded from the study. These 60 women underwent antenatal Doppler study examinations of umbilical artery between 28 to 38 weeks of gestation. The diagnosis of growth restriction in these fetuses depended on ultrasonographic assessment of fetal growth. Gestational age was established with menstrual history and ultrasonographic assessment before 22 weeks gestation for biometry. The ultrasonography evaluation excluded

fetal congenital anomalies and the fetal biometry included assessment of biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femoral length (FL).

Pulsed wave doppler ultrasound examination of the umbilical artery was performed using color doppler machine GE Logic 5 with 3.5 MHz curvilinear transducer. The umbilical artery was identified and flow velocity waveforms were obtained from free-floating loop of cord. Recordings were accepted for analysis only after a clear steady state was obtained for at least three consecutive pulsatile waveforms. No waveforms were recorded during periods of fetal breathing and body movements. The systolic/diastolic (S/D) ratio of the umbilical artery and absent or reversal of end diastolic velocity was noted.

For the purpose of analysis, the study population was divided in three groups: a normal doppler group, a diminished end-diastolic flow group and an absent diastole or reversed diastolic flow group. All doppler recordings were performed by radiologist. Doppler examinations were repeated weekly or biweekly according to the severity of the reduction of the end diastolic flow in the umbilical artery. Patients with S/D ratio equal to or more than three, absent diastole or reversed diastolic flow were admitted for further evaluation and delivery. Conservative treatment that was offered to the patients in the hospital with low end diastolic velocimetry consisted of bed rest, daily fetal movement count, non stress test and biweekly amniotic fluid estimation. Criteria considered to decide for delivery were absent diastole or reversal of diastolic flow, abnormal fetal heart tracing and deterioration of maternal condition.

Steroids were administered as a single dose only once to all patients between 28 and 34 weeks to enhance fetal lung maturity. Induction of labor was performed with prostaglandin E2 gel or oxytocin if spontaneous labor did not start in those patients for vaginal delivery. A group of patients were decided for elective caesarean section for associated obstetrical indications. The mothers in whom labor was induced or those mothers who spontaneously went in into labor and fetuses developed distress during the course of labor were delivered by emergency caesarean section.

Outcome data included diagnosis to delivery interval, elective caesarean section rate, emergency caesarean section rate for fetal distress, gestational age at delivery, birth weight, apgar scores and admission to neonatal intensive care unit.

Results

Twenty eight of 60 (46.6%) pregnancies with LBW had abnormal Doppler waveforms in the umbilical arteries. The mean S/D ratio for the normal umbilical artery velocimetry group (n=32) was 2.64. The abnormal Doppler velocimetry was present in 28 patients in which low end diastolic velocity group of 23 patients the average S/D ratio in umbilical artery was 4.16 and 05 fetuses had absent end diastolic velocimetry.

Neonatal Outcome (Table 1)

	Normal Doppler velocimetry (32)	Abnormal Doppler velocimetry (28)	
		Low end diastolic velocity (23)	Absent Diastole diastolic velocity (05)
Delivery at < 36 Weeks	-	9/23 (39%)	4/5 (80%)
Period of Gestation at delivery (Wks)	37.3 (33.6-39.6)	36 (31.1-39.2)	33.5 (31-37.3)
Diagnosis from abnormal doppler to delivery	-	1 day	14 hrs (4 hrs -24 hrs)
Avg Birth weight (kg)	2.03 (1.79- 2.4)	1.67 (0.94- 2.4)	1.002 (0.88- 1.12)
NICU Admission	6 (18.75%)	13 (56.4%)	5 (100%)
APGAR < 7 at birth	3 (9.3%)	6 (26%)	3 (60%)
Perinatal death	-	2 (8.6%)	1 (20%)

Labour Outcome (Table 2)

	Normal Doppler velocimetry (32)	Abnormal Doppler velocimetry (28)	
		Low end diastolic velocity	Absent Diastole velocity
Spontaneous labour	04 (12.5%)	01 (3.5%)	-
Induction	24 (75%)	08 (28.5%)	-
Emergency Caesarean	02 (6.25%)	08 (28.5%)	02 (7%)
Elective Caesarean	02 (6.25%)	06 (21.5%)	03 (10.7%)

The average diagnosis to delivery interval was of 01 day in low end diastolic velocity group and an average of 14 hrs in absent end diastolic velocimetry group.

These fetuses with abnormal umbilical artery doppler waveforms are at an increased risk for delivery at a lower gestational age. The total fetuses delivered at less than 36 weeks gestation are nil in normal doppler group, 09 (39.1%) in low-end diastolic velocity group and 04 (80%) in-group with absent diastole. The mean period of gestation of delivery was 37.3 weeks in normal velocimetry group and 36 weeks in group with high S/D ratio, at 37 Wks. It was 33.5 Wks (31-37.3 Wks) in the group with absent diastolic flow.

Frequently the fetuses in the abnormal doppler group are delivered by caesarean section due to non-reassuring fetal heart pattern than the fetuses with normal umbilical flow findings. 10 (35.7%) babies in the abnormal velocimetry group were delivered by emergency caesarean for fetal distress, another nine (32%) were delivered by elective Caesarean section for other obstetric causes.

The fetuses in the abnormal doppler group had lower birth weight , average of 1.67 kg in the low end diastolic velocity group, 1.002 kg in the absent diastolic velocity group as compared to 2.03 kg in the normal umbilical artery velocimetry group.

The neonates in the abnormal doppler group had lower birth weight percentiles with higher perinatal asphyxia in terms of lower Apgar score which was below 7 at birth. 6 (26%) babies of low end diastolic velocity group, 3 (60%) of absent Doppler velocimetry group were born with APGAR of <7 at birth as compared to 3 (9.2%) in the normal Doppler velocimetry group.

Babies with abnormal umbilical artery doppler studies were about four times likely to be admitted to the neonatal intensive care unit. Overall 18.75% (06/32) of small for gestational age babies with normal umbilical artery doppler studies were admitted to neonatal intensive care unit in contrast to 56.5% (13/23) small for gestational age babies with low-end diastolic velocity on umbilical artery doppler. However, all the fetuses with absent diastolic umbilical artery flow were admitted to the neonatal intensive care unit.

Discussion

Doppler velocimetry identifies normal and altered blood flow velocity in the umbilical artery and is responsive to changes in placental resistance. It is a noninvasive and relatively inexpensive method of detecting changes in blood flow velocities and thus aids in evaluating abnormal fetal hemodynamics that results in abnormal pregnancy outcome.

It has been shown by various workers [1, 9, 10, 14, 15] that perinatal morbidity and mortality were significantly greater in small for gestational age babies with abnormal umbilical artery doppler studies than in those with normal studies. Various studies [2, 3, 4, 13, 17] have reported on the association of abnormal umbilical artery velocity waveforms with fetal growth restriction and its prediction. All infants whose birth weight is below the 10th percentile are not exposed to a pathologic process in utero but some are constitutionally small and healthy. It is a challenge to differentiate the fetus with pathologic growth restriction that is at risk for perinatal complication from constitutionally small but healthy fetus. The pregnancies most likely to be benefit from the use of umbilical artery velocimetry are those with the diagnosis of FGR. Meta-analysis [11] of the use of doppler ultrasonography in high-risk pregnancies with FGR has revealed a statistically significant improved perinatal outcome. Table 1 reveals that fetuses with abnormal umbilical artery velocimetry have a shorter diagnosis of abnormal doppler to delivery interval than those with normal doppler, preterm delivery, decreased birth weight, increased NICU admissions as seen in studies by Baschat [12] and Sofia [18]. Various workers [6,11] have noticed in fetuses with abnormal umbilical artery doppler velocimetry a similar poor perinatal outcome.

There are old reports [19,20] suggesting that doppler studies of velocity waveforms of the umbilical artery are useful in identifying fetuses prone for FGR than sonographic estimation of fetal weight. Vergani's study [7] found that abnormal umbilical velocimetry independently predicts the likelihood of admission to NICU for reasons other than low birth weight alone.

In present study the following maternal and neonatal parameters were studied, incidence of pre-eclampsia, delivery by LSCS due to fetal distress, gestational age at birth, low Apgar (< 7 at 5 min), birth weight, NICU admission and perinatal mortality which included stillbirth and neonatal death.

The difference between mean age of mothers in both abnormal and normal Doppler group was not significant which is similar to as reported by Arora et al [8]. The difference between mean gravidity in abnormal and normal group was not significant. They had high incidence of delivering small for gestational age babies, gestational hypertension and history of perinatal death in the previous pregnancy. These mothers of small for gestational age babies with abnormal umbilical artery doppler velocimetry frequently delivered by caesarean section for fetal distress and were less likely to undergo induction of labor than those with normal doppler. Same has been seen in studies by Siddiqui [15] and Islam [16]

There was a still higher incidence of caesarean section for fetal distress in the group with absent diastolic flow (Table 2) with subsequent low Apgar scores which is also noticed by Seyam et al [5] and Gandhi [6] In birth weight at delivery there was a significant difference in normal and abnormal umbilical artery velocimetry group, which is consistent with the studies by Arora et al [8] and Vergani et al [4].

NICU admissions in present study were more in abnormal umbilical artery velocimetry group than normal group (64.6% Vs 18.75%). This difference was significant and is consistent with studies by Arora et al [8] (70% Vs 30%) and others [5,6,7,12]

Perinatal mortality was found more in abnormal umbilical S/D ratio group than normal (10.7% Vs 0%).

Conclusion

Umbilical artery Doppler study is an important diagnostic and prognostication tool in the management of FGR. The data from our study indicates that the umbilical artery Doppler study could distinguish the group of small for date fetuses in risk for complications. Growth restricted fetuses with normal umbilical flow velocimetry are at lower risk than those with abnormal velocimetry in terms of poor APGAR scores and neonatal intensive care admissions.

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