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Research Article

Abnormal umbilical artery Doppler in third trimester and perinatal outcome: a retrospective study

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ABSTRACT

Background: Umbilical artery Doppler (UAD) has the greatest impact in modern obstetric assessment in high risk pregnancies. The objective of this study was to evaluate the maternal characteristics and perinatal outcome in pregnancies complicated by abnormal umbilical artery Doppler.

Methods: A retrospective study was designed to analyze the medical records of 50 singleton pregnant women who delivered in the labour ward of our institution from 1st July 2014 to 30th June 2015. The study population had abnormal umbilical artery Doppler velocimetry with varying degree of reduction in placental circulation. These patients were assessed for maternal complications and foetal outcome.

Results: Results of present study revealed that majority of women who had abnormal placental Doppler flow were under 37 weeks of gestation (82%). Absent end diastolic flow was seen more in pre-eclampsia/ eclampsia (38%), gestational diabetes (19%) and oligohydramnios (52%) as compared to high systolic/diastolic (S/D) ratio. Higher incidence of abruption (25%), operative deliveries (50%), intrauterine deaths (25%) and still births (25%) was seen with increase in the severity of placental insufficiency. High frequency of pre-maturity (76%) was noticed in this study as a result of abnormal Doppler. Neonatal complications like jaundice, RDS (Respiratory distress syndrome), IVH (Intra-ventricular haemorrhage) and NEC (Necrotizing enterocolitis) were recorded in increasing trends in present study.

Conclusions: Umbilical artery Doppler helps in the prediction of possible maternal and foetal complications in cases of compromised placental flow. Monitoring of antenatal parameters, availability of emergency facility for early surgical intervention and neonatal care pave a long way in curtailing perinatal morbidity and mortality.

Keywords: AEDF, REDF, Maternal complications, Perinatal outcome

INTRODUCTION

Umbilical artery Doppler (UAD) has the greatest impact in modern obstetric assessment in high risk pregnancies.¹ Abnormalities in umbilical artery waveforms are progressive with reduction, loss and ultimately reversal of diastolic flow.² Identification of foetus at risk of intrauterine fatality due to increased placental resistance is important in prevention and management of antenatal and postnatal complications.³ Foetuses with abnormal Doppler results are at a significantly higher risk for

oligohydramnios, early delivery, low birth weight (LBW), low Apgar score and neonatal ICU admissions.² Application of umbilical artery velocimetry in high risk pregnancies has been found to be associated with significant decrease in labour inductions, hospital admissions and fewer perinatal deaths. In particular, absent or reversed end diastolic flow of umbilical arteries, is associated with poor neonatal outcome ranging from premature delivery and stillbirth to postnatal neuro-developmental impairment.⁴

Given the higher rate of poor neonatal outcome in patients with abnormal Doppler, we aim to assess the usefulness of third trimester umbilical artery Doppler in identifying the high risk patients likely to have abnormal UAD and to evaluate the outcome of pregnancy in these patients.

METHODS

The medical records of all pregnant women with abnormal Doppler who delivered in labour ward of CMC hospital from 1st July 2014 to 30th June 2015 and their immediate neonatal outcomes were reviewed retrospectively. The study population included all pregnant women with abnormal UA Doppler identified by the ultrasound report on admission to labour ward. Gestational age was established by menstrual history and first trimester ultrasound. Foetal biometric parameters and amniotic fluid index (AFI) were calculated. Oligohydramnios was considered when AFI was five or less without premature rupture of membranes.

Inclusion criteria were singleton pregnancies in third trimester with abnormal umbilical artery Doppler. Exclusion criteria were post term pregnancies and those with prenatally diagnosed congenital malformations.

Pulsed wave Doppler ultrasound examination of the umbilical artery was performed using colour Doppler Philips HD 11XE with 3.5 MHz curvilinear transducer. The umbilical artery was identified and flow velocity waveforms were obtained from free floating loop of cord. All Doppler recordings were performed by an expert sonologist. Depending upon the reduction of end diastolic Doppler flow velocity, placental insufficiency was quantified into three categories;

- High systolic/diastolic flow ratio for gestational age
- absent end diastolic flow/diastolic cut off in umbilical artery
- reverse end diastolic flow as per the criteria adapted by Gagnon R et al³

Conservative treatment that was offered to the patients in the hospital with UAD consisted of bed rest, daily foetal movement count and non-stress test. Steroids were administered as two doses 24 hours apart to all women between 28 and 34 weeks to enhance foetal lung maturity. Induction of labour was performed with prostaglandin E2 gel or oxytocin if spontaneous labour did not start in those women planned for vaginal delivery. Caesarean section was done for obstetrical indications. The maternal characteristics and perinatal outcomes were compared between these groups. The antenatal variables identified for inclusion in the present study were maternal age, parity and gestational age at delivery. Antenatal complications and birth outcomes were assessed. The neonatal outcomes were also reviewed.

RESULTS

The study population was divided into three groups: high S/D ratio, AEDF and REDF. Umbilical artery Doppler (UAD) waveforms were considered abnormal if S/D ratio was equal to or more than three or diastolic flow is absent/ reversed in foetus of more than 28 weeks of gestational age.⁴ Majority of patients in the present study were in the group of high S/D ratio (50%) followed by AEDF (42%). REDF was observed only in 8% cases (Table 1).

Table 1: Distribution of patients according to UAD.

Uad	No. of patients (n=50)	Percentage
High S/D	25	50%
AEDF	21	42%
REDF	4	8%

There was no significant difference between pregnancies complicated by varying degrees of compromised umbilical artery flow with respect to maternal age. High S/D ratio was more common among primipara (84%) as compared to REDF where all patients were multipara (100%). Majority of patients with UAD abnormalities in all the three groups were less than 37 weeks of gestational age (75-85%). 96% of pregnant women with high S/D ratio had reactive non-stress test (NST) when compared to AEDF/REDF in which only 48% women had reactive NST. Non-reactive NST showed increasing trends with increasing placental in-sufficiency (Table 2).

Table 2: Clinical characteristics of patients with abnormal UAD.

Characteristics	High S/D (n=25)	AEDF (n=21)	REDF (n=4)
Maternal age (mean years)	27	29	27
Parity			
P0	21 (84%)	13 (62%)	0
P1	2 (8%)	3 (14%)	4 (100%)
>P2	2 (8%)	5 (24%)	0
Gestational age (weeks)			
<37	20 (80%)	18 (86%)	3 (75%)
37-39	3 (12%)	2 (10%)	1 (25%)
>40	2 (8%)	1 (5%)	0
Non-stress test			
Reactive	24 (96%)	10 (48%)	0
Non-reactive	1 (4%)	11 (52%)	4 (100%)

Occurrence of pre-eclampsia/eclampsia and oligohydramnios was higher in patients with AEDF/REDF. Gestational diabetes was observed in less than 20% cases with high S/D ratio and in AEDF. More than half pregnant women with abnormal UAD had intrauterine growth restriction (IUGR) (Table 3).

Abruption rate was higher in REDF as compared to high S/D ratio and AEDF. Frequency of delivery by caesarean section was higher in foetuses with abnormal Doppler. Incidence of meconium stained liquor and intra-partum death was higher (50%) in REDF. Occurrence of still births was highest in foetuses with REDF whereas no foetal mortality was seen in those with high S/D ratio. Higher percentage of neonates (50%) had Apgar score <7 in 5 minutes in reverse diastolic flow cases but in other two groups, <7 score was seen in less than 20% neonates. Resuscitation was required in less than 25% neonates. New-borns with REDF were at higher risk of RDS, IVH and NEC than those with high S/D ratio and AEDF (Table 4).

Table 3: Obstetric risk factors in relation to UAD.

Characteristics	High S/D (n=25)	AEDF (n=21)	REDF (n=4)
Pre-eclampsia/eclampsia	5 (20%)	8 (38%)	1 (25%)
Gestational DM	4 (16%)	4 (19%)	0
Oligohydramnios	12 (48%)	11 (52%)	0
IUGR	13 (52%)	12 (57%)	2 (50%)

Table 4: Labour complications and birth outcomes in different groups.

Characteristics	High S/D (n=25)	AEDF (n=21)	REDF (n=4)
Maternal complications			
Abruption	2 (8%)	0	1 (25%)
Labour induction	2 (8%)	5 (24%)	2 (50%)
Vaginal delivery	4 (16%)	6 (29%)	2 (50%)
CS delivery	21 (84%)	15 (71%)	2 (50%)
Meconium stained liquor	0	1 (5%)	1 (25%)
Intra-partum foetal death	0	2 (10%)	1 (25%)
Foetal outcome			
Still birth	0	2 (10%)	1 (25%)
Prematurity	20 (80%)	16 (76%)	2 (50%)
Apgar at 1 minute <7	1 (4%)	9 (43%)	2 (50%)
Apgar at 5 minute <7	0	4 (19%)	2 (50%)
Need of resuscitation	5 (20%)	2 (10%)	1 (25%)
Neonatal complications			
Jaundice	5 (20%)	5 (24%)	2 (50%)
RDS	3 (12%)	1 (5%)	3 (75%)
IVH	2 (8%)	0	1 (25%)
NEC	2 (8%)	1 (5%)	1 (25%)

DISCUSSION

Umbilical artery Doppler is an important tool to predict perinatal mortality and trend of complications in high risk pregnancies. It is a non-invasive procedure which enables us to assess the efficiency of placental circulation, foetal response and adaptation to changing situations in the uterus.⁵ With increased placental vessel resistance, there is decreased end diastolic flow in umbilical cord while the systolic flow is not significantly affected.³ Quantitatively, reduction in end diastolic flow velocity varies from reduced to absent and sometimes reversed end diastolic flow.⁴ Satisfactory development of trans-placental circulation is necessary for normal pregnancy outcome. Placental insufficiency leads to primary adaptive responses in foetus in the form of restricted growth. To compensate resultant hypoxia in such cases, hemodynamic redistribution takes place to favour oxygenation of vital organs like brain, heart and kidney. Progressive decompensation leads to decreased amniotic fluid.⁶

In the present study, reduced UAD velocity waveforms were correlated to decreased gestational age at delivery (<37 weeks). This signifies the importance of evaluation of high risk patients for placental efficiency in early third trimester so as to keep a watch on the expected complications.⁷ Trend for more underlying medical problems was seen in mothers having abnormal UAD. They had high incidence of pre-eclampsia/ eclampsia and gestational diabetes mellitus. More than 50% of women abnormal UAD had IUGR with higher prevalence among AEDF and REDF. As emergency delivery becomes inevitable in severely compromised foetuses, the incidence of caesarean section always remains higher as seen in the present study.

The time to deliver foetus in abnormal UAD is always a challenge. The aim is always to get a mature baby as far as possible but time of delivery is to be balanced with neonatal outcome caused by hypoxia.⁶ It is better to prolong gestation to 34 weeks to reduce morbidity in preterm delivery.⁸ After 34 weeks, indication of delivery depends upon the severity of placental insufficiency. Abnormal UAD of short duration prior to term, points to acute and severe underlying process which gives less time for foetal adaptability and need for surgical intervention for delivery.

In the present study, incidence of intrauterine death and still births was higher in AEDF/ REDF whereas no such fatality was seen in high S/D ratio. Prematurity was highest in high S/D ratio (80%) followed by AEDF (76%). In REDF, it was only 50% due to higher percentage of IUD and still births in this group. Apgar score <7 at 1 and 5 minutes was observed in 50% cases with REDF when compared to only 4% in high S/D ratio. Need for resuscitation was required only in 25% cases of REDF. Neonatal complications like jaundice, RDS, IVH

and NEC were found to be higher in REDF cases when compared to other two groups.

CONCLUSION

Abnormal umbilical artery Doppler provides an estimation of downstream placental vessel resistance and placental blood flow. Reduced, absent and reversed end diastolic flow guides the obstetrician to keep enhanced foetal surveillance and provides an opportunity to wait till a reasonable degree of foetal maturity occurs. This will reduce perinatal complications associated with prematurity. Hence umbilical artery Doppler can be a useful tool in the management of high risk pregnancies and can help in deciding the time of delivery so that foetal outcome can be improved.

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