DOPPLER STUDY OF THE UTERINE AND UMBILICAL ARTERY TO PREDICT INTRAUTERINE GROWTH RETARDATION

Radiodiagnosis

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ABSTRACT

The primary objective of this study is to transvalue the role of colour doppler sonography in the evaluation of pregnancy with intrauterine growth restriction. The study included 50 antenatal women with singleton pregnancy diagnosed as having a fetus with intrauterine growth restriction based on greyscale ultrasound findings. Further, an obstetric Doppler Ultrasound was done, and diagnostic statistics were applied to determine the Umbilical artery PI, RI, and Uterine artery PI, RI and correlating with perinatal outcomes. The specificity, sensitivity, positive predictive value, negative predictive value, and diagnostic accuracy were determined for all Doppler measurements. Among women with an identifiable cause, 42% had pregnancy-induced hypertension (PIH), 40% had moderate to severe anaemia complicating pregnancy. At the same time, 20% of the study group had no detectable cause for IUGR. The persistence of early diastolic notch beyond 26 weeks showed 60% sensitivity as a predictor for the perinatal outcome. The sensitivity of RI, PI of the uterine artery in predicting perinatal outcomes was 73 % and 76.7 %, respectively. Whereas, the sensitivity of RI, PI of the Umbilical artery in predicting perinatal outcomes was 63% and 70%, respectively. Doppler imaging provides indirect evidence of fetal compromise and is known to improve outcomes of high-risk pregnancies with intrauterine growth restriction. Hence, it is of eminent value for monitoring during the pregnancy.

KEYWORDS

INTRODUCTION

The term Intrauterine growth restriction (IUGR) is used to describe the condition of a fetus whose size or growth is subnormal. The most common definition of intrauterine growth restriction is : a fetus is growth restricted if its weight is less than the tenth percentile for its gestational age¹.

IUGR has many causes; maternal causes are hypertension, renal disease, collagen vascular disease, drug or alcohol abuse and poor nutrition. In utero fetal infections such as cytomegalovirus, toxoplasmosis and chromosomal anomalies such as triploidy and trisomies 13 and 18 also result in IUGR.2 Placental insufficiency in the absence of any cause is called primary placental insufficiency and is a common cause of IUGR.

Correct antenatal diagnosis of IUGR by real-time ultrasound can reduce the complications and improve the perinatal outcome. With the introduction of ultrasound, the small fetuses could be identified. However, it could not be possible to identify which of these fetuses were at increased risk due to uteroplacental insufficiency. Therefore, the non-stress test and the biophysical profile are used to monitor small fetuses.

Doppler ultrasound evaluation of fetal circulation non-invasively assessed the fetal response to hypoxia by evaluating the uteroplacental and fetoplacental blood flow. Thus it became possible to identify those small fetuses that were at increased risk of perinatal morbidity and mortality due to hampered uteroplacental and fetoplacental circulations.

The present study focusses on establishing the role of Umbilical artery and Uterine artery Doppler ultrasonography in predicting poor perinatal outcomes in clinically suspected IUGR pregnancies and on determining the role of Doppler velocimetry in the clinical management of such pregnancies.

OBJECTIVES

- To evaluate the role of colour Doppler sonography in pregnancies with intrauterine growth restriction by assessing the uteroplacental and fetoplacental circulations.

- To evaluate the usefulness of Uterine artery and Umbilical artery Doppler indices as predictors of adverse perinatal outcome in clinically suspected IUGR pregnancies.
- To determine the role of Doppler ultrasound in the management of IUGR pregnancy.

RESULTS

A prospective study on 50 antenatal women diagnosed as having a fetus with intrauterine growth restriction based on greyscale ultrasound findings. Flow velocity waveforms of the Uterine and Umbilical arteries were obtained from all the 50 cases and were analyzed.

DOPPLER STUDIES:

In the present study, R.I and P.I Doppler indices of both the Uterine and Umbilical arteries were taken according to the 50th percentile.

UTERINE ARTERY DOPPLER STUDIES

1.CHANGES IN UTERINE ARTERY RESISTANCE INDEX (RI)

Thirty mothers (60%) had an elevated Uterine artery RI, and 20 patients (40%) had normal Uterine artery RI.

2.CHANGES IN UTERINE ARTERY PULSATILITY INDEX (PI)

Thirty-three mothers (66%) had an elevated Uterine artery PI, and 17 patients (34%) had normal Uterine artery PI.

3. PERSISTENT EARLY DIASTOLIC NOTCH OF UTERINE ARTERY

In the present study, the diastolic notch was present in 18 patients(36%), out of which 28 per cent had notches in bilateral arteries, and 8 per cent had notch involving single artery. Thirty-two patients (64%) had normal Uterine artery flow waveform.

CHANGES IN UTERINE ARTERY USING THREE PARAMETERS(RI,PI& DIASTOLIC NOTCH)

66% of antenatal mothers with IUGR showed an abnormal Uterine artery flow velocity profile when all three parameters (RI, PI and presence of persistent early diastolic notch) were considered. The rest

of the 34% showed normal uterine artery velocity profiles.

UMBILICAL ARTERY DOPPLER STUDIES

1. UMBILICAL ARTERY PULSATILITY INDEX

27 mothers (54%) had an elevated umbilical artery PI, and 23 patients (46%) had standard Umbilical artery PI.

2. UMBILICAL ARTERY RESISTANCE INDEX

Twenty-five mothers (50%) had an elevated Umbilical artery RI, and 25 patients (50%) had normal Umbilical artery RI.

3. UMBILICAL ARTERY END DIASTOLIC FLOW PATTERN

Eleven fetuses (22%) showed absence end-diastolic flow and no fetus had a reversal of end-diastolic Umbilical artery flow. Rest of the thirty-nine fetuses had a positive diastolic flow.

CHANGES IN UMBILICAL ARTERY USING THREE PARAMETERS (RI, PI & END DIASTOLIC FLOW PATTERN)

Twenty-seven patients (54%) had an abnormal Umbilical artery flow velocity profile when all three parameters (RI, PI and end-diastolic flow pattern) were considered. The rest of the 23 cases (46%) showed standard umbilical artery velocity profiles.

ANALYSIS OF BOTH UTERINE AND UMBILICAL ARTERIES

82% of the study group (41 mothers) showed abnormalities in either the Uterine or Umbilical arteries when both were assessed together. When individual arteries were considered, Uterine arteries showed better pick up rates (66%) than the Umbilical arteries (54%).

ANALYSIS OF PERINATAL OUTCOME

There were five intrauterine deaths and 45 live births. Of the 45 live births, ten neonates were admitted to NICU, 22 neonates had 5 min APGAR score of less than 7, and 23 babies were born by emergency caesarian section. There were 30 neonates with birth weight less than 2.5kg. Thirty fetuses (60%) had at least one adverse perinatal outcome. The remaining 20 fetuses (40%) had a favourable outcome.

PERINATAL MORTALITY V/S ABSENT END-DIASTOLIC FLOW

Absent end-diastolic flow velocity was seen in 11 fetuses (22%) in our study, of which 5 were Intra Uterine deaths. The mortality in cases of absent end-diastolic flow was 45%.

REPRESENTATIVE CASE

CASE: A 32-year-old gravid mother with 31 weeks of gestation showed the following Doppler indices

Figure 1: arrow pointing to absent end diastolic flow

Figure 2: arrow pointing to persistent early diastolic notch

DISCUSSION

Intrauterine growth restriction is merely a result of a series of events occurring along several possible pathways. Hence, an accurate antenatal diagnosis must decide whether the fetus is constitutionally

small for gestational age or small as a consequence of impaired placental perfusion. Analysis of Doppler flow velocities can solve this problem by examining Uterine arteries (uteroplacental circulation) and Umbilical arteries (fetoplacental circulation).

Etiology of IUGR

Among women where a cause for IUGR was identified, 42% had pregnancy-induced hypertension (PIH), 40% had moderate to severe anaemia complicating pregnancy. This can be attributed to asymmetrical IUGR, which accounts for 80%. 20% of the study group had no detectable cause for IUGR.

Uterine artery

In the present study, the persistent early diastolic notch beyond 26 weeks of gestation showed a sensitivity of 60%.

The sensitivity of RI was 73 % in our study in comparison with that of Benson and Doubilet3 (67%) and Coleman et al4(83%). This discrepancy may be attributed to different cut off levels of the resistive index, varying between 0.5 to 0.62.

The sensitivity of PI was 76.7 % in our study in comparison with that of Lavanya Rai et al5(86%) and BN Lakhkar et al6(83%). This discrepancy may be attributed to different cut off levels of pulsatility index, varying between 0.6- 0.8.

The specificity of Uterine artery Doppler study to detect adverse perinatal outcome was 60% with Uterine artery RI and 50% with Uterine artery PI.

When these Doppler parameters were taken into account, the sensitivity of Uterine artery Doppler for predicting perinatal outcome was high. This is in agreement with the study by Zimmermann et al7, who found a combination of several Doppler parameters to be superior to a single parameter.

Umbilical artery

The umbilical artery was the primary vessel used for the monitoring of high-risk pregnancies as the umbilical artery represents fetoplacental circulation and reflects placental resistance. In the present study, the Umbilical artery PI had a sensitivity of 70%, and Umbilical artery RI had a sensitivity of 63% in predicting perinatal outcome. The specificity of Doppler examination of the Umbilical artery using PI in predicting perinatal outcome was 70% and with RI was 70%.

Absent or reversal of the end-diastolic flow velocity was seen in 22% fetuses in our study compared with that of 37% in the study by Benson and Doubilet³.

Doppler studies of the Umbilical artery and Uterine artery together had better sensitivity than that of the individual vessels. However, among these, Uterine artery Doppler indices showed more sensitivity, and Umbilical artery Doppler indices showed more specificity.

Prediction of perinatal outcome

Thirty fetuses had at least one adverse outcome. Remaining 20 fetuses had a favorable outcome. There were 5 intrauterine deaths and 45 live births. Of the 5 IUD's, all had absent diastolic flow. The mortality in cases of absent end diastolic flow was 45%, indicating grave prognosis. Of the 45 live births, 10 neonates were admitted to NICU, 22 neonates had 5 min APGAR score less than 7, and 23 babies were born by emergency caesarian section. These results are slightly higher than Gramellini et al64. This can be contributed to the difference in perinatal mortality and morbidity rates from western standards to Indian standards.

CONCLUSION

The Umbilical-placental and Uterine vascular beds are directly involved in the hemodynamic adjustments of fetal growth restriction. A Doppler index that reflects both of these areas can be useful for identifying fetuses with increased uteroplacental and fetoplacental circulations.

Assessment of uteroplacental and fetoplacental circulations together is more sensitive in the prediction of perinatal outcomes.

Doppler imaging is of value for monitoring the pregnancy because it can provide indirect evidence of fetal compromise and is known to

improve outcomes of high-risk pregnancies with intrauterine growth restriction. Hence Doppler evaluation is complementary to all other surveillance modalities.

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