

# Study of abnormal umbilical artery doppler and neonatal outcome



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Submitted: 04-08-2019

Revised: 12-08-2019

Published: 01-09-2019

## ABSTRACT

**Background:** Doppler provides assessment of uteroplacental and fetoplacental circulation during pregnancy. It is a sensitive tool in early detection of fetal compromise and allows needful intervention. **Aims and Objective:** To study the role of umbilical artery doppler in clinically suspected IUGR and its implication on neonatal outcome. **Materials and Methods:** A total of 104 singleton pregnancies with gestational age of more than 34 weeks who had clinical suspicion of IUGR were evaluated using obstetric ultrasound and doppler. Umbilical artery velocimetry with S/D >3 and RI >0.7 were considered abnormal. Newborns were classified as either small for gestational age (SGA) ie, IUGR or appropriate for gestational age (AGA). Neonatal outcome were classified as either normal or adverse events that included still birth, NICU admissions, perinatal asphyxia and/or neonatal death. **Results:** Out of 104 clinically suspected IUGR, 55 were born with small for gestational age. Among these SGA neonates, 45 subjects had abnormal umbilical artery S/D and 42 had abnormal RI. Abnormal umbilical artery S/D ratio had a sensitivity of 81.8 %, specificity of 59.2 %, the positive predictive value of 69.2 % and negative predictive value of 74.4 %. Abnormal Umbilical artery RI had a sensitivity of 76.4 %, specificity of 69.4 %, positive predictive value of 73.7 % and negative predictive value of 72.3 % in diagnosing IUGR. Abnormal umbilical artery velocimetry was associated with increased morbidity and mortality in IUGR neonates. **Conclusions:** Umbilical artery doppler plays an important role in diagnosing IUGR and predicting neonatal outcome.

**Key words:** Doppler; Umbilical artery velocimetry; Intrauterine growth restriction; Small for gestational age; Neonate

### Access this article online

**Website:**

<http://nepjol.info/index.php/AJMS>

**DOI:** 10.3126/ajms.v10i5.25135

**E-ISSN:** 2091-0576

**P-ISSN:** 2467-9100

## INTRODUCTION

Ultrasonography is safe in pregnancy and hence can be repeated as and when indicated. Doppler velocimetry is a noninvasive method of indirectly assessing the uteroplacental and fetal circulation.<sup>1</sup> It is a sensitive tool in early detection of fetal compromise. It can predict adverse perinatal outcome and can be utilized for timely intervention.<sup>2</sup> Vascular and hemodynamic changes appear in the severely compromised fetus which are predictors of poor perinatal outcome.<sup>3</sup> Several Doppler-derived indices of umbilical, uterine and middle cerebral arteries have been used to identify fetuses at risk of increased perinatal morbidity and mortality who may benefit from continuous surveillance or elective delivery. Umbilical artery Doppler waveform is one of the most frequently used noninvasive tests for fetal well-being. Umbilical artery velocimetry are beneficial in initial evaluation and follow up

of high risk pregnancy cases like maternal hypertension, IUGR and pregnancy induced hypertension.<sup>4</sup>

Among them umbilical artery systolic/diastolic (S/D) ratio, resistance index (RI) and pulsatility index (PI) are the most common parameters used in clinical practice.<sup>5,6</sup> Small for gestational age (SGA) fetuses are either constitutionally small fetuses or fetuses that have failed to achieve their growth potential (IUGR).<sup>7</sup> Intrauterine growth restriction (IUGR) is a condition in which a fetus fails to achieve its growth potential and is consequently at a risk of increased perinatal morbidity and mortality.<sup>8</sup> The timely clinical suspicion and diagnosis of IUGR via Doppler and abnormal umbilical velocimetry may help in preventing the possible perinatal complications, morbidity and mortality.<sup>9</sup> The aim of the study is to describe the role of umbilical artery Doppler in clinically suspected IUGR and to predict the neonatal outcome.

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## MATERIALS AND METHODS

This prospective, hospital based study was conducted in Department of Radiodiagnosis and Imaging in Manipal Teaching Hospital, Pokhara, Nepal. The study duration was of two years (January 2017 to December 2018). Patients with informed consent were selected with inclusion criteria of: 1. singleton pregnancy, 2. Gestational age of 34 weeks or more as confirmed with prior obstetric scan or as calculated from last menstrual period(LMP) and 3. clinically suspected IUGR. Whereas, subjects with uncertain gestational age & LMP, multiple pregnancies, documented pregnancy with major congenital or chromosomal abnormality or both and maternal or fetal conditions requiring immediate hospitalization and intervention were the major exclusion criteria.

Cases included subjects referred to department of Radiodiagnosis and imaging suspected of IUGR. Detailed antenatal history along with previous obstetric ultrasound was collected from patients.

Obstetric scan along with doppler was done using LOGIQ P3 by Wipro GE System using 3 MHz curvilinear transducer. A free loop of umbilical cord located between the abdominal wall and placental insertion was selected for umbilical artery doppler study. The indices used for measurement were umbilical artery waveform, RI and S/D ratio. Umbilical artery velocimetry with RI  $>0.7$  and S/D  $> 3$  and in were considered abnormal.

Neonatal data were obtained within 24 hours of birth and based on Lubchenco chart, the newborns were classified as either small for gestational age (SGA) ie, IUGR or appropriate for gestational age (AGA). Neonatal outcome were classified as either normal or adverse events that included still birth, NICU admission, perinatal asphyxia and/or neonatal death.

A total of 116 patients with study eligibility were collected over a period of 2 years. However, 4 were lost to follow up, 5 were excluded because of uncertain LMP and gestational age and 3 were excluded because of inadequate data. Finally, a total of 104 patients were enrolled for study.

Data collected were entered in the Microsoft excel sheet. SPSS version 18 was used for statistical analysis. Ethical clearance was obtained from the institutional ethical clearance committee.

## RESULTS

A total of 104 pregnant subjects with clinical suspicion of IUGR enrolled for the study. Forty six were primigravida and 58 were multigravida. Patients were aged between

18 and 38 years (average of 25 years). Sixteen out of 104 (15.4%) subjects gave bad obstetric history. Twenty five percent subjects (26 out of 104) had history of pregnancy induced hypertension (PIH).

Average gestation age according to LMP was 36 weeks 6 days (range of 33 weeks 4 days to 40 weeks 2 days). Average gestation age of fetus derived by ultrasound measurement was 35 weeks 1 day (range of 31 weeks 1 day to 38 weeks 6 days).

Out of those 104 subjects with clinical suspicion of IUGR, 49 were born with appropriate for gestation age, whereas, 55 were born with small for gestation age and hence IUGR. AFI measurement ranged from 1.8 cm to 24.48 cm with average of 8.7 cm. Twelve subjects had AFI less than 5 cm (Table 1).

The average expected fetal weight calculated by USG was 2345 grams (with a minimum weight of 1690 grams and maximum weight of 3420 grams). Doppler velocimetry included calculation of S/D ratio and RI of the umbilical artery. The various Doppler velocimetry findings of the umbilical artery are shown in Table 2 and 3.

Out of 104 foetuses, 55 were born with small for gestation age and 49 were appropriate for gestation age. Both S/D ratio and RI of umbilical artery were abnormal in foetuses with adverse outcome.

Umbilical artery S/D ratio  $> 3$  had a sensitivity of 81.8 %, specificity of 59.2 %, the positive predictive value of 69.2

**Table 1: Amniotic fluid index of the pregnant ladies**

AFI	Frequency	Percentage
$>10$ cms	36	34.6
5-10cms	56	53.8
$<5$ cms	12	11.6

**Table 2: Findings of umbilical artery S/D ratio amongst SGA/AGA neonates**

Umbilical Artery S/D ratio	SGA %	AGA %	Total %
Abnormal ( $>3$ )	45 (81.8)	20 (40.8)	65 (62.5)
Normal	10 (18.2)	29 (59.2)	39 (37.5)
Total	55 (100)	49 (100)	104 (100)

**Table 3. Findings of umbilical artery RI amongst SGA/AGA neonates**

Umbilical Artery RI	SGA %	AGA %	Total %
Abnormal ( $>0.7$ )	42 (76.4)	15 (30.6)	57 (54.8)
Normal	13 (23.6)	34 (69.4)	47(45.2)
Total	55 (100)	49 (100)	104 (100)

% and negative predictive value of 74.4 % in diagnosing IUGR. Abnormal Umbilical artery S/D ratio of more than 3 was observed in 65 out of 104 subjects. Six subjects had absent end diastolic flow (AEDF) and all these were found in SGA subjects. None of the subjects had reverse end diastolic flow (REDF).

Abnormal Umbilical artery RI was observed in 57 out of 104 subjects. Umbilical artery RI had a sensitivity of 76.4%, specificity of 69.4%, positive predictive value of 73.7 % and negative predictive value of 72.3 % in diagnosing IUGR.

Post Delivery/Neonatal Outcome: The average weight of the neonate at birth was 1.9 kg (range of 1.45 kg to 3.75 kg). A total of 55 neonates (52.8 %) were born with small for gestation age (SGA). NICU admissions comprised of a total of twenty eight neonates.

Neonatal Outcome in SGA with Abnormal Umbilical Artery Doppler Studies: Out of 104 clinically suspected IUGR, 55 (52.9 %) were born with small for gestational age. Forty five had abnormal umbilical artery S/D ratio and abnormal RI amongst 42. Forty out of 55 (72.7%) neonate with SGA were delivered by LSCS. Twenty four out of 28 (85.7%) had NICU admission. Nine developed perinatal asphyxia. Two had neonatal death within 1 week. There were 4 still born deaths among those with SGA.

## DISCUSSION

In a study conducted in Thailand by Chanprapaph et al<sup>10</sup> there were 212 clinically suspected IUGR, with gestational age between 30-42 weeks. The prevalence of IUGR was 50.9% which is comparable to our study percentage of 52.9 %. In another study conducted in 118 cases of high risk singleton pregnant women in China, the prevalence of IUGR in the study population was 16.9%.<sup>11</sup> In a study by Ghosh GS et al.<sup>12</sup> abnormal flow pattern in umbilical artery was detected in 102 out of 353 (28.4%) cases. Borowski D et al.<sup>13</sup> detected 77.8% of abnormal S/D ratio in umbilical artery in fetuses with clinical signs of IUGR which is comparable to our findings of 81.8 %. Umbilical artery S/D ratio of more than three had sensitivity of 66.7%, specificity of 78.85%, positive predictive value 74.42% and negative predictive value of 65.08% respectively in a study by Chanprapaph et al.<sup>10</sup> Whereas, Fleischer et al<sup>14</sup> reported that S/D ratio greater than 3 had a sensitivity of 78 percent in predicting IUGR. Abnormal flow pattern in umbilical artery was seen in 102 (28.4%) patients in a study by Ghosh GS et al.<sup>12</sup> Forty-four of the 134 (32.8%) pregnancies with low birth weight had abnormal doppler velocimetry in the umbilical arteries in an Indian study by Arora et al.<sup>15</sup> In a study conducted by Wang et al<sup>11</sup> in high risk singleton pregnant women in China, the sensitivity,

specificity and positive predictive value of umbilical arterial S/D ratio to predict IUGR were 80.0%, 83.7% and 50.0%. Whereas, our study showed abnormal Umbilical artery S/D ratio had a sensitivity, specificity, positive predictive value and negative predictive value of 81.8 %, 59.2 %, 69.2 % and 74.4 % respectively in diagnosing IUGR. A study was conducted by Soregaroli et al<sup>16</sup> in 578 singleton pregnancies with diagnosis of IUGR in Italy. The mean age at delivery was 35 weeks 5 days with mean birth weight of 1.85 kg with 28 (4.8%) intrauterine deaths, 3 elective terminations of pregnancy and 26 neonatal deaths. In our study there were 2 neonatal death and 4 still birth. Mean age of delivery was 36 weeks and 2 days with mean birth weight of 1.9 kg which is comparable to the study by Soregaroli et al.<sup>16</sup>

## CONCLUSIONS

Doppler provides assessment of uteroplacental and fetoplacental circulation during pregnancy. It is a sensitive tool in early detection of fetal compromise and allows needful intervention. Umbilical artery doppler plays an important role in diagnosing IUGR and predicting neonatal outcome. A larger sample size with proper randomization would generate even robust findings. Routine use of doppler is highly recommended in high risk pregnancies including IUGR.

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**Authors Contribution:**

**GM**-Concept and design of the study, literature search and review, manuscript preparation ,data collection, statistical analysis, critical revision of literature;  
**PR**-Data collection, statistical analysis, manuscript editing.

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**Source of Support:** Nil, **Conflict of Interest:** None declared.