ORIGINAL ARTICLE

Comparison of Perinatal Outcomes in Growth Restricted Fetuses with Abnormal and Normal Umbilical Artery Doppler at a Tertiary Care Hospital

Rabia Channa[1], Faisal Nadeem[2], Sabiha Nasir[3], Muneeb Ullah[4]

ABSTRACT

Objectives: To compare perinatal outcomes in growth restricted Fetuses based on normal and abnormal umbilical artery doppler studies.

Study Design: Prospective Cohort Study.

Place and Duration of Study: This Study was conducted in Civil Hospital Karachi. Duration of the study was 6 months, from 24th November 2018 to 25th May 2019.

Materials and Methods: 232 growth restricted Fetuses were divided into two equal groups, 116 with normal umbilical artery doppler studies (Group A) and 116 with abnormal umbilical artery doppler studies (Group B). Inclusion criteria were pregnant patients with age 20-35 years and excluding malformations. Doppler assessment used 3-5 MHz probe (GE PRO-V, USA) for umbilical artery and vein, noting absent/reversed flow. Follow-up included delivery, neonatal assessment, and mortality recording.

Results: The mean age in our study was 28.92 ± 5.71 years, while gestational age was 33.97 ± 2.58 years. The normal umbilical artery doppler group experienced a 14.66% rate of premature deliveries compared to 52.59% in the abnormal group (p-value: 0.0001). NICU admissions were reported at 26.72% in the normal umbilical artery doppler group and notably higher at 76.72% in the abnormal group (p-value: 0.0001). A striking observation was the threefold increase in perinatal deaths within the abnormal umbilical artery doppler group (18.10%) as opposed to the normal group (7.76%) (p-value: 0.024).

Conclusion: Adverse perinatal outcomes were associated with abnormal umbilical artery Doppler in Fetuses with growth restriction. Timely preventive measures should be taken to reduce perinatal morbidity and mortality.

Key Words: Doppler, Umbilical artery, Growth Restriction, Perinatal, Outcomes.

Introduction

Fetal growth restriction (FGR) is characterized by weight at birth below 10th percentile for a specific age of gestation. Those infants whose weight falls below 10th centile for gestation age are considered as small for gestational age (SGA).[1] Another criterion for SGA involves fetal measurements of abdominal circumference that fall below an arbitrary percentile, often ranging from 2.5[th] to 10th percentiles as per charts derived from representative fetal samples.[2] Incorporating abnormal umbilical artery doppler waveforms into the FGR diagnosis is a practice followed by some, extending beyond size criteria alone. The aetiology of FGR is multifaceted.[3] FGR increases the risks of respiratory distress syndrome, necrotizing enterocolitis, intraventricular haemorrhage, clotting disorders, organ failure, premature birth, and perinatal mortality.[4,5] Although maternal circulation abnormalities contribute to FGR's pathophysiology, the feto-placental vasculature's role in normal development is equally significant. Studies underscore that FGR with absent or reversed end-diastolic umbilical artery velocities face poor fetal outcomes in comparison to FGR with preserved end-diastolic velocities.[6] Umbilical artery doppler assessment is recommended for FGR pregnancies with high risks.[7] The use of doppler techniques especially in obstetrics was initially explored by Fitzgerald and Drumm and has remained

[1]Department of Gynecology and Obstetrics
Civil Hospital, Karachi

[2]Department of General Surgery
Walsall Manor Hospital, United Kingdom

[3]Department of Gynecology and Obstetrics
Ali Medical Hospital, Islamabad

[4]Department of General Surgery
Maroof International Hospital, Islamabad

Correspondence:
Dr. Muneeb Ullah
Assistant Consultant
Department of General Surgery
Maroof International Hospital, Islamabad

a focal point of research.[8] Doppler velocimetry's potential to assess uterine, placental, and fetal circulations has been widely investigated.[8,9] Doppler assessment helps in FGR cases to examine potential small vessel disease in feto-placental and utero-placental blood circulation. Different criteria for doppler study regarding FGR have been proposed. Among these the systolic/diastolic ratio (S/D) is the crucial measure.[10] S/D ratio of more than 3 after 30 weeks of pregnancy is considered abnormal. Factors such as low fetal weight, reduced volume of amniotic fluid, and mother's hypertension are reliable predictors of FGR.[6,11]

Given the scarcity of data regarding the relationship between perinatal outcomes in FGR and the status of umbilical doppler in our region, this prospective study becomes paramount. It aims to emphasize the clinical relevance of umbilical artery doppler studies in fetal growth restriction management, particularly in guiding decisions about the timing and mode of delivery. This cohort study will furnish essential evidence for timely interventions, ultimately improving perinatal outcomes in pregnancies with FGR.

Materials and Methods

Prospective cohort study was carried out in the Obstetrics and Gynaecology department of Civil Hospital Karachi from 24th November 2018 to 25th May 2019. Ethical approval letter numbered OBG-2016-183-7258 is attached. The sample size determination was guided by considering the proportion of perinatal death in both normal and abnormal umbilical artery doppler groups, statistical power (80%), significance level (5%), and an estimated error of estimation (5%). Consequently, the final sample size was established as 232; 116 participants in each Group A and Group B. Group A had normal umbilical artery doppler studies while Group B had abnormal umbilical artery doppler studies. Nonprobability consecutive sampling technique was used. Inclusion criteria included pregnant women, age between 20 to 35 years, primigravida and multigravida with single fetus between gestational age 28 to 38 weeks and lastly those who were at risk of having FGR. Those who had already been detected with congenital malformations during antenatal check-up were excluded. Patients were enrolled after obtaining informed consent. Ultrasound doppler was carried out by colour pulsed wave doppler electronic probe of machine GE PRO-V (USA). The abnormal flow findings included absent or reversed umbilical artery end diastolic flow in umbilical artery and pulsatile flow in ductus venosus or umbilical venous system. Follow-up extended to delivery, with neonatal assessment encompassing 1-minute Apgar scores and birth weight. Cases of neonatal death, stillbirths, and admissions/shifting to neonatal intensive care unit (NICU) were documented using pre-approved forms. All the data and all the follow up were documented under the supervision of same doctor (researcher). Analysis of data was done using SPSS version 20.0. Quantitative variables such as age, parity, gestational age, and birth weight were presented as means ± standard deviation (SD). Qualitative variables including low birth weight, gestational diabetes mellitus, pre-eclampsia, and outcomes like preterm birth, perinatal death, and NICU admission were expressed as numbers and percentages (%). A Chi-square test was employed to compare outcome variables between the two groups and a p-value of < 0.05 was deemed statistically significant. Relative risk calculations were utilized to identify significant effect modifiers and confounders, such as gestational age, parity, gestational hypertension, diabetes mellitus, pre-eclampsia, and low birth weight, with control achieved through stratification. Subsequently, post-stratification Chi-square tests were applied, and relative risk was computed.

Results

Study participants had a mean age of 28.92 ± 5.71 years while gestational age was 33.97 ± 2.58. Mean of parity was 2.80 ± 1.01. Gestational hypertension was seen in 25% (n=58) patients, pre-eclampsia was seen in 8.19% (n=19) patients while gestational diabetes was seen in 31.03% (n=72) patients. The detail distribution of age, gestational age, parity, gestational hypertension, pre-eclampsia, gestational diabetes, low birth weight, between Group A and Group B is in Table I.

The average weight of babies born to Group A and Group B was 3.26 ± 1.03 kg and 3.01 ± 0.79 kg respectively. Significant distinctions in perinatal outcomes emerged between the normal and abnormal umbilical artery doppler groups.

Table I: Distribution of Variables between Group A and Group B

Group	Mean Age	Gestational Age	Parity	Gestational Hypertension	Pre-eclampsia	Gestational Diabetes	Low Birth weight
	Mean ± SD	Mean ± SD	Mean ± SD	N (%)	N (%)	N (%)	N (%)
Group A (n=116)	28.90 ± 5.71	34.08 ± 2.60	2.82 ± 1.07	30 (25.86%)	10 (8.62%)	37 (31.9%)	46 (39.66%)
Group B (n=116)	28.95 ± 5.71	33.85 ± 2.57	2.79 ± 1.03	28 (24.14%)	9 (7.76%)	35 (30.17%)	45 (38.79%)
Total	28.92 ± 5.71	33.97 ± 2.58	2.80 ± 1.04	58 (25%)	19 (8.19%)	72 (31.03%)	91 (39.22%)

Particularly, the normal umbilical artery doppler group A experienced a 14.66% (n=17) rate of premature deliveries compared to 52.59% (n=61) in the abnormal umbilical artery doppler group B. NICU admissions were reported at 26.72% (n=31) in the normal umbilical artery doppler group and notably higher at 76.72% (n=89) in the abnormal group. A striking observation was the threefold increase in perinatal deaths within the abnormal umbilical artery doppler group (18.10%) as opposed to the normal group (7.76%). Their *p*-values and details are shown in Table II.

Table II: Perinatal Outcomes between the Group A and Group B

Outcome Variable		Group A	Group B	*p*-value	RR
Preterm Delivery	Yes	17 (14.66%)	61 (52.59%)	0.0001	3.59
	No	99 (85.34%)	55 (47.41%)		
NICU Admission	Yes	31 (26.72%)	89 (76.72%)	0.0001	2.87
	No	85 (73.28%)	27 (23.28%)		
Perinatal Mortality	Yes	9 (7.76%)	21 (18.10%)	0.024	2.33
	No	107 (92.24%)	95 (81.90%)		

Discussion

Utero-placental blood flow alterations, observed in conditions like hypertension and FGR, have prompted doppler ultrasonography for early analysis and surveillance of fetal growth, in addition to being non-invasive, economical, and simple method.[12] In this context, we carried out a study to determine the relationship between perinatal outcomes in FGR with normal and abnormal umbilical artery doppler study. Our findings revealed significant differences in perinatal outcomes between the normal and abnormal umbilical artery doppler groups (*p*-value

0.0001). Some authors advocated use of umbilical artery doppler screening in second and third trimesters for risk assessment of premature delivery while some recommend its use in all three trimesters.[13,14,15] Meanwhile our study was based on third trimester screening and notably, the abnormal group showed a markedly higher proportion of premature deliveries compared to the normal group. Admission to NICU was significantly elevated in abnormal umbilical artery doppler group compared to the normal group. This was also noted in an International Research.[16] Importantly, perinatal mortality was higher in abnormal umbilical artery doppler group than in the normal group consistent with international data.[17] This aligns with similar comparative studies that underscored the adverse impact of abnormal umbilical artery doppler on perinatal outcomes.[18] Previous research by Rochelson, Berkowitz, Alfirevic, and others emphasized the link between abnormal umbilical artery doppler and increased perinatal morbidity and mortality.[4,19] The role of doppler in estimating poor outcomes and the potential benefits of its integration into high-risk pregnancy surveillance protocols have also been established.[11,12,20] However, Doppler's use in low-risk populations has shown no advantage over standard fetal surveillance.[10,21] Abnormal venous Doppler waveforms and umbilical artery reversed flow have been associated with increased neonatal deaths, perinatal morbidity, and adverse fetal outcomes.[22,23] Abnormal Doppler findings, like those in the umbilical artery, can independently predict NICU admissions beyond low-birth-weight considerations.

Limitations of our study included being a single tertiary care study. Doppler analysis was performed during the third trimester of pregnancy. The expertise of doctor performing doppler study was

variable and depended upon available doctor at the time of study. Long-term outcomes such is completion of milestones, neurological and physiological development were not followed in current study.

This study however forms the basis for future research regionally that will ultimately lead to local recommendations of screening doppler velocimetry studies in fetal growth restriction cases as a diagnostic tool along-with serial fundal height estimation and fetal biometry. Doppler studies may also be used as a diagnostic tool in addition to screening for prediction of pre-eclpamsia in high-risk cases.

Conclusion

This study confirmed the adverse perinatal outcomes associated with abnormal umbilical artery doppler in FGR. This calls for timely preventive measures and mitigate perinatal mortality and morbidity for both mothers and fetuses.

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DATA SHARING STATMENT
The data that support the findings of this study are available from the corresponding author upon request.

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