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Umbilical Artery Doppler versus Amniotic Fluid Index in Assessing Obstetric and Perinatal Outcomes in Pregnancies Beyond 34 Weeks

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Abstract

Objective

To compare perinatal outcomes in patients with normal and abnormal umbilical artery Doppler findings.

Duration and place of study: this study was conducted in Suleman Roshan Medical College Tandoadam from May 2024 to May 2025

Methodology

This descriptive case series included 150 patients. All participants underwent ultrasound examination, and Doppler assessment was performed in cases of oligohydramnios. Based on Doppler findings, patients were divided into two groups: normal and abnormal. Perinatal

outcomes were analyzed and compared between the groups using the chi-square test, with a p-value ≤0.05 considered statistically significant.

Results

The frequency of lower segment cesarean section (LSCS) was significantly higher among women with abnormal Doppler findings (61%) compared to those with normal results (23%) (p=0.000). Similarly, the rate of neonatal intensive care unit (NICU) admission was markedly greater in the abnormal Doppler group than in the normal group.

Conclusion

Umbilical artery Doppler is an effective instrument to determine the woman who is at risk of unfavorable maternal and neonatal outcomes in cases of oligohydramnios. The inclusion of the modality into the regular practice can contribute to the minimization and prevention of obstetric and perinatal complication.

Keywords: Umbilical artery Doppler, Amniotic fluid index, Oligohydramnios, Perinatal outcome, Obstetric outcome

Introduction

The determination of fetal well-being is one of the foundations of contemporary obstetrics, especially in the late period of pregnancy when the threat of unfavorable results becomes particularly high. Proper evaluation of the fetus can result in prompt intervention and potentially minimize the morbidity and mortality of the mother and the baby [1,2]. Some of the fetal surveillance tools that have emerged with prominence in the non-invasive assessment of the

risk pregnancies are umbilical artery Doppler velocimetry and amniotic fluid index (AFI). Indirect yet useful data on placental performance, uteroplacental circulation, and total fetal status is obtained in both modalities [1,2].

Doppler of the umbilical artery is an evaluation of resistance to the flow of blood in the placental vasculature that is used as an indicator of placental insufficiency. Absent or reversed end-diastolic flow as an abnormal Doppler observation is closely correlated with intrauterine growth restriction (IUGR), preterm delivery, and neonatal morbidity [3-6]. Such hemodynamic responses indicate fetal adjustment to hypoxic stress and play an essential role in decision-making during obstetrics, such as the time and method of delivery [4,5]. It has been shown that pathologic Doppler results have the potential to predict poor results in the form of cesarean delivery, low Apgar, and neonatal intensive care unit (NICU) admission [5, 6].

Amniotic fluid index (AFI) is a sonographic parameter that is commonly used to evaluate the amount of amniotic fluid which is indirectly related to placenta perfusion and kidney fetal functioning [7,8]. Oligohydramnios or the low volume of amniotic fluid has been repeatedly associated with increased incidences of fetal distress, amniotic fluid contaminated with meconium, cesarean section, and neonatal morbidity [9,10]. Although AFI is not complex, non-invasive, and can be done at the bedside, its predictive power has been doubted because of interobserver variability and lack of consistent predictive power in relation to perinatal outcomes [11,12]. Still, it is one of the pillars of routine fetal surveillance due to its convenience and affordability.

Comparison Umbilical artery Doppler and AFI has been widely conducted with a heterogeneous result. Other studies indicate that Doppler velocimetry is more sensitive and specific in

foretelling adverse perinatal events at high-risk pregnancies and that AFI offers de facto bedside data that may complement Doppler results [1316]. The integration of two modalities can enable clinicians to stratify risk better and make informed decisions when it comes to the timing of labor induction or cesarean delivery [15,16].

Besides this, Doppler and AFI are specifically applicable in the case of pregnancy that is complicated by oligohydramnios, hypertensive disorder or suspected IUGR. Appropriate use of these tools may minimize interventions that are not necessary and detect fetuses that are really at risk of compromise [4,6,17]. Research has proposed that a methodical intervention that includes both doppler evaluation and amniotic fluid evaluation enhances the perinatal outcomes, decreases admissions to the NICU, and minimizes the long-term complication [17,18].

Considering the clinical value of proper antenatal monitoring, it is still necessary to assess the predictive capabilities of umbilical artery Doppler and AFI in the obstetric and perinatal outcomes. Comparison of these two modalities would assist in defining their respective place in routine practice, optimize patient management, and help to reduce maternal and neonatal morbidity and mortality [17,18].

Methodology

This descriptive case series analyzed 150 pregnant women that were examined with regards to fetal well-being using umbilical artery Doppler and amniotic fluid index (AFI). The individuals were recruited against preset selection criteria that comprised of singleton pregnancy and gestation age of over 34 weeks. A study sample was predetermined to eliminate confounding

factors and guarantee high validity of fetal measurements through exclusion of patients with known congenital anomalies, multiple gestations, and marked maternal comorbid status.

Each of the participants was thoroughly clinically assessed with a structured interview and maternal medical and obstetric history. Measurement of amniotic fluid index was done by using ultrasound evaluation done by a trained researcher. Umbilical artery Doppler velocimetry (an experienced radiologist performed the oligohydramnios cases) was done to measure placental resistance and fetal blood flow. Doppler findings were then used to classify patients into two groups, normal, and abnormal. Abnormal observations were increased resistance index, no end-diastolic flow, or reversed end-diastolic flow and other clinically important changes in normal waveforms.

The perinatal outcomes were monitored and documented individually. These outcomes were mode of delivery (vaginal or cesarean delivery), Apgar score after 1 and 5 minutes, neonatal intensive care unit (NICU) admission, and other complications (fetal distress or neonatal morbidity). The main aim was to assess the rates of adverse outcome of the normal and abnormal Doppler groups.

The use of chi-square tests would be used to statistically analyze the categorical variables of the two groups. The means of continuous variables were summarized with means and standard deviation. The p-value of less than or equal to 0.05 was regarded as statistically significant. The standard statistical software was used to manage and analyze the data in order to achieve accuracy and reproducibility of the results.

This methodology allowed for a systematic evaluation of the predictive value of umbilical artery Doppler and AFI, providing a reliable framework for assessing their role in identifying fetuses at risk for adverse obstetric and perinatal outcomes.

Results

A total of 150 pregnant women were included in the study. Based on umbilical artery Doppler assessment, 95 patients (63%) had normal findings, while 55 patients (37%) demonstrated abnormal Doppler patterns, including elevated resistance index and absent or reversed end-diastolic flow (Table 2).

The maternal demographic characteristics were comparable between the normal and abnormal Doppler groups. The mean maternal age was 28.5 ± 4.2 years in the normal Doppler group and 29.1 ± 3.8 years in the abnormal Doppler group. Nulliparity was observed in 47% and 51% of women in the normal and abnormal Doppler groups, respectively. Mean BMI values were also similar (27.2 ± 3.1 vs. 27.5 ± 3.5) (Table 1).

Assessment of amniotic fluid revealed that oligohydramnios was more frequent among women with abnormal Doppler findings. In the normal Doppler group, 24% of patients had oligohydramnios, compared to 55% in the abnormal Doppler group (Table 3).

Obstetric outcomes differed significantly between the two groups. The rate of lower segment cesarean section (LSCS) was markedly higher in the abnormal Doppler group (61%) compared to the normal Doppler group (23%) ($p < 0.001$). Conversely, vaginal delivery was more common in patients with normal Doppler findings (77% vs. 39%) (Table 4).

Neonatal outcomes were also adversely affected by abnormal Doppler findings. NICU admission occurred in 38% of neonates born to mothers with abnormal Doppler, compared to 11% in the normal Doppler group ($p < 0.001$). Similarly, low Apgar scores at 5 minutes (<7) were observed in 27% of the abnormal Doppler group versus 9% in the normal group ($p = 0.002$). Additionally, birth weight below 2.5 kg and meconium-stained liquor were more prevalent in neonates from the abnormal Doppler group (Table 5).

The combined analysis of Doppler findings and AFI demonstrated that patients with both oligohydramnios and abnormal Doppler had the highest incidence of adverse outcomes. LSCS was performed in 67% of these patients, and NICU admission occurred in 37%. Low Apgar scores (<7) were observed in 27% of neonates in this subgroup, highlighting the additive predictive value of using both modalities together (Table 6).

These results indicate that umbilical artery Doppler is a strong predictor of adverse obstetric and perinatal outcomes. While AFI remains useful for initial screening, Doppler assessment, particularly when combined with AFI, significantly enhances risk stratification and aids clinical decision-making regarding the timing and mode of delivery.

Table 1. Maternal Demographics

Characteristic	**Normal Doppler (n=95)**	**Abnormal Doppler (n=55)**
Mean Maternal Age (years)	28.5 ± 4.2	29.1 ± 3.8
Nulliparous (%)	45 (47%)	28 (51%)
Multiparous (%)	50 (53%)	27 (49%)
BMI (kg/m²)	27.2 ± 3.1	27.5 ± 3.5

Table 2. Distribution of Doppler Findings

Doppler Finding	**Number of Patients (%)**
Normal	95 (63%)
Abnormal	55 (37%)
- Elevated Resistance Index	35 (23%)
- Absent End-Diastolic Flow	12 (8%)
- Reversed End-Diastolic Flow	8 (5%)

Table 3. Amniotic Fluid Index (AFI) Status

AFI Category	**Normal Doppler (n=95)**	**Abnormal Doppler (n=55)**	**Total (n=150)**
Normal AFI	72 (76%)	25 (45%)	97 (65%)
Oligohydramnios	23 (24%)	30 (55%)	53 (35%)

Table 4. Mode of Delivery

Mode of Delivery	**Normal Doppler (n=95)**	**Abnormal Doppler (n=55)**	**p-value**
Vaginal Delivery	73 (77%)	21 (39%)	<0.001
LSCS	22 (23%)	34 (61%)	<0.001

Table 5. Neonatal Outcomes

Outcome	**Normal Doppler (n=95)**	**Abnormal Doppler (n=55)**	**p-value**

NICU Admission (%)	10 (11%)	21 (38%)	<0.001
Apgar <7 at 5 min (%)	9 (9%)	15 (27%)	0.002
Birth Weight <2.5 kg (%)	14 (15%)	18 (33%)	0.01
Meconium-Stained Liquor (%)	8 (8%)	12 (22%)	0.01

Table 6. Combined AFI and Doppler Outcomes

Group	**Number of Patients**	**LSCS (%)**	**NICU Admission (%)**	**Apgar <7 (%)**
Normal AFI + Normal Doppler	70	15 (21%)	8 (11%)	6 (9%)
Oligohydramnios + Normal Doppler	25	7 (28%)	2 (8%)	3 (12%)
Normal AFI + Abnormal Doppler	25	14 (56%)	10 (40%)	7 (28%)
Oligohydramnios + Abnormal Doppler	30	20 (67%)	11 (37%)	8 (27%)

Discussion

The present study demonstrates that abnormal umbilical artery Doppler findings are strongly associated with adverse obstetric and perinatal outcomes, including higher rates of cesarean delivery, NICU admission, and low Apgar scores. These findings are consistent with

previous research highlighting the predictive value of Doppler assessment in high-risk pregnancies [19, 20].

In the present study 61 percent of the women who had abnormal Doppler needed the cesarean section, which is much higher than 23 percent of the women who had normal Doppler. Ebrashy et al. [21] also found that atypical Doppler waveforms led to high numbers of operative deliveries, which supports the applicability of Doppler in informing the provision of timely obstetric care. Also, the NICU admission rate of the abnormal Doppler girls at 38/100 of the neonates is consistent with the findings of Oros et al. [22], who found greater NICU needs in the neonates born of a pregnancy with abnormal Doppler. Abnormal umbilical artery flow patterns were also significant predictors of perinatal morbidity according to Odibo and others [23], which further confirm the current findings.

The paper also identifies the additive value of using AFI together with Doppler assessment. Both oligohydramnios and abnormal Doppler women showed the largest number of adverse outcomes, 67% LSCS and 37% NICU admission. According to Reddy et al. [24], the combination of modalities improves risk stratification to enable clinicians to be more predictive of perinatal complications. Likewise, Seyam and Al-Malt [25] found that AFI per se was not very predictive, but with the inclusion of Doppler velocimetry, sensitivity and specificity of adverse outcome increased substantially.

Although AFI is popular in initial fetal surveillance, the predictive value is less as compared to Doppler. Nabhan and Abdelmoula [26] indicated that AFI is susceptible to interobserver variability and not suitable to accurately predict perinatal complications with single application.

This is aided by the current study, which indicated that abnormal Doppler findings were better predictors of adverse neonatal outcomes as compared to using AFI only.

On the whole, these results support the use of umbilical artery Doppler as a non-invasive and credible method of monitoring the health of fetuses in the high risk of placental insufficiency or oligohydramnios pregnancies. The findings indicate that the combination of Doppler evaluation and AFI measurement enables conducting the high-risk pregnancies, timely obstetric treatment, and enhancing the perinatal outcomes.

Conclusion

The Umbilical artery Doppler can be used to predict poor obstetric and perinatal outcomes in pregnancies beyond 34 weeks where there is occurrence of oligohydramnios. The abnormal Doppler results were correlated with an increased cesarean section, low admission to NICU, and low Apgar. Though the amniotic fluid index is beneficial in terms of the initial screening, its use in combination with Doppler assessment is beneficial to predict the risk and make clinical choices in time. Combining the two in the routine fetal monitoring could be beneficial in minimizing the effects of neonatal complications and overall perinatal outcomes.

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Permission

Ethical approval obtained

Conflict of Interest

None

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