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Original Research Article

The Role of Color Doppler Ultrasonography in Prediction of Perinatal Outcome in Pregnancies Associated with Decreased Amniotic Fluid

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Abstract:

Background: The need for studying the role of Color Doppler Ultrasonography (CDUS) in pregnancies complicated by oligohydramnios arises from the significant risks that decreased amniotic fluid poses to both maternal and fetal health. Oligohydramnios is associated with adverse outcomes, including intrauterine growth restriction (IUGR), preterm birth, and increased perinatal mortality. These outcomes necessitate early and accurate prediction to ensure timely intervention and management.

Methods: This study will be conducted at department of Radiodiagnosis, S.P. Medical College & A.G. of P.B.M Hospitals, Bikaner. It is a multi-disciplinary tertiary care referral hospital.

Results: There were highly significant differences in perinatal outcome between cases of normal and abnormal UA FVWs. Among patients with abnormal UA FVWs, the worst perinatal outcome was in cases of REDF, then AEDF and lastly high indices with reduced but present end-diastolic flow. The best perinatal outcome was detected in cases of normal UA FVWs. Good perinatal outcome was detected in patients with normal UA FVWs.

Conclusion: The present study concluded that No significant differences in adverse pregnancy outcome in pregnancy associated with borderline AFI and oligohydramnios

Keywords: Pregnancies, AFI and Oligohydramnios.

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Introduction

Antenatal fetal surveillance has been a major concern for the obstetricians for many centuries. Antenatal fetal health assessment incorporates all modalities utilized to determine fetal well-being in-utero prior to the onset of labor. The goal of such assessment is to minimize perinatal morbidity and mortality. Amniotic fluid index (AFI) is considered as a method of fetal surveillance. When AFI is decreased to less than 10 cm, it can be an indicator of problems for the mother and baby and it may be the cause or the result of the problem. [1]

When decreased AF is a result of maternal or fetal problem, this can be due to decreased fetal renal perfusion with subsequent chronic reduction in fetal urine production; this may be a consequence of hypoxemia-induced redistribution of fetal cardiac output and shunting of fetal blood away from the kidneys to more vital organs. [2]

Doppler study during pregnancy is a non-invasive clinical tool that allows evaluation of fetal and maternal circulations. The information obtained from such study has expanded the knowledge of the physiology of pregnancy and pathophysiology of a

variety of disorders. It is believed that if either or

$$n = \frac{Z^2 \times P \times (1-P)}{E^2}$$

both of fetal and maternal circulatory systems are impaired there is a risk of pregnancy complications and adverse perinatal outcome. [3-5]

The need for studying the role of Color Doppler Ultrasonography (CDUS) in pregnancies complicated by oligohydramnios arises from the significant risks that decreased amniotic fluid poses to both maternal and fetal health. Oligohydramnios is associated with adverse outcomes, including intrauterine growth restriction (IUGR), preterm birth, and increased perinatal mortality. These outcomes necessitate early and accurate prediction to ensure timely intervention and management.

Material and Method

Study Area: This study will be conducted at department of Radiodiagnosis, S.P. Medical College & A.G. of P.B.M Hospitals, Bikaner. It is a multi-disciplinary tertiary care referral hospital.

Study Population: The study population will include pregnant women referred or attending the teaching hospitals attached to Sardar Patel Medical College. These women will be categorized based on the presence or absence of oligohydramnios.

Study Design: This will be a cross-sectional, observational, non-interventional study including AFI group and normal AFI group for comparison.

The Sampling Technique:

1. **Purposive Sampling**: Participants are chosen because they meet the criteria necessary for studying the effects of Color Doppler ultrasonography (CDUS) in pregnancies complicated by oligohydramnios.
2. **Targeted Population**: The study specifically targets pregnant women with reduced AFI, excluding those with factors that could confound the results, such as fetal malformations, multiple pregnancies, premature rupture of membranes, or pre-eclampsia.
3. **Focus on Relevance**: This technique ensures that only relevant cases that will provide the most useful data for comparing Doppler flow velocity waveforms (FVWs) in normal pregnancies versus those with oligohydramnios are included.

Sample Size:

Sample Size Calculation:

Where:

- n = required sample size
- Z = Z-value (e.g., 1.96 for a 95% confidence level)
- P = 50% (prevalence)
- E = margin of error (e.g., 0.05 for a 5% margin of error) Example Calculation:

Prevalence P = 0.05 (50%) Confidence level = 95% (Z=1.96)

Margin of error E = 0.05

n = {(1.96)2x0.05x(1-0.05)}/(0.05)2

=72

Thus, a sample size of approximately 72 participants would be required for this study under these assumptions. Adjustments may be needed based on specific study conditions and more precise prevalence estimates.

Study Duration: November 2024 to October 2025.

Inclusion Criteria:

1. Singleton pregnancy.
2. In the third trimester.
3. AFI < 10.
4. All deliveries will be in the labor ward of S.P. Medical College, Associate group of Hospitals, P.B.M., Bikaner

Exclusion Criteria:

1. Fetal malformation.
2. Multiple pregnancy.
3. Those with premature rupture of membranes.
4. AFI > 10.
5. Patients with signs of preeclampsia

Statistical Analysis: Results of Doppler velocimetry will be record, tabulated and statistically analyzed. Descriptive statistics will be done for all data (study and control group). Data will be represent as means ± standard deviations (SD) or numbers and percent [N (%)].

Comparison between different groups will be done using student's t-test, chi-square test, Z test and Analysis of Variance (ANOVA) where appropriate.

P value <0.05 will be considered significant and that <0.001 will be considered highly significant.

Results

Table 1: General characterstics of subjects in decrease AFI group and Comparison groups

Variable	Decrease AFI group (N=60)	Comparison group (N=30)	P value
Age	27.33±4.7	26.44±5.5	> P=0.42 (NS)
Parity (Primi :Multi)	25:35	12:18	P=0.939 (NS)

Table 2: Perinatal outcome in reduced AF according to Doppler FVWs of the umbilical artery

Perinatal outcome	UA S/D ratio		Test of significance	P
	Normal N (32)	Abnormal N (28)		
GA at delivery (Mean ± SD)	37±0.83	34.2±1.03	t=11.65	<0.001
Intrapartum fetal distress [N	2(6.2%)	16(57.14%)	Z=4.29	<0.001
C/S for fetal distress [N (%)]	1(3.1%)	13(46.42%)	Z=3.96	<0.001
1 min Apgar score (Mean ± SD)	7.25±1.12	3.80±1.45	t=10.38	<0.001
5 minute Apgar score (Mean ± SD)	9.75±1.11	6.22±1.22	t=11.73	<0.001
Birth weight (Mean ± SD)	2850±332	2155±123	t=10.45	<0.001
Admission to NICU [N (%)]	2(6.2%)	15(53.57%)	Z=4.06	<0.001
Perinatal mortality [N (%)]	0(0%)	5(17.85%)	Z=2.49	0.006

GA: gestational age, UA S/D ratio: umbilical artery systolic/diastolic ratio, C/S: Cesarean section, NICU: neonatal intensive care unit, SD: Standard deviation, P: Probability, N: Number

Table (2) shows that the adverse perinatal outcomes occur more frequently with abnormal UA Doppler FVWs than with normal UA Doppler FVWs; the table show decrease in GA at delivery (mean =34.2 weeks), birth weight (mean =2155 gram), Apgar score at one & five minutes (mean =3.8 & 6.22 respectively) when UA Doppler indices were abnormal, also there were high incidence of intrapartum fetal distress (57.14%), CS for fetal distress (46.42%), admission to NICU (53.57%) & perinatal mortality (17.85%) when compared with normal UA Doppler FVWs, statistically the differences in perinatal outcome between cases of normal and abnormal UA Doppler FVWs were significant P<0.05.

Table 3: Perinatal outcome in Decrease AFI group according to the degree of abnormality of UA FVWs

Group and Outcome	REDF (N=3)	AEDF (N=12)	Reduced flow (N=13)	Normal flow (N=32)	Test of significance	P
GA at delivery (Mean ± SD)	32±2.8	33.4±1.2	36.4±2.2	37±0.83	F=27.355	<0.001
Intrapartum fetal	3(100%)	9(75%)	4(30.7%)	2(6.2%)	X^2=27.17	<0.001
C/S for fetal	2(66.6%)	7(58.3%)	4(30.7%)	1(3.1%)	X^2=19.07	<0.001
1 minute Apgar score (Mean ± SD)	2.76±0.35	3.62±0.68	5.16±1.61	7.25±1.12	F =38.96	<0.001
5 minute Apgar score (Mean ± SD)	4.36±0.48	5.16±0.51	8.15±1.30	9.75±1.11	F =70.09	<0.001
Birth weight (Mean ± SD)	2050±231	2255±410	2565±311	2850±332	F =12.28	<0.001
Admission to NICU [N (%)]	3(100%)	9(75%)	3(23.0%)	2(6.2%)	X^2=28.32	<0.001
Perinatal mortality [N (%)]	2(66.6%)	2(16.6%)	1(7.69%)	0(0%)	X^2=17.37	<0.001

GA: gestational age, AEDF: absent end-diastolic flow, REDF: reversed end-diastolic flow, C/S: Cesarean section, NICU: neonatal intensive care unit, SD: Standard deviation, P: Probability, N: Number

Table (3) shows the perinatal outcome in Decrease AFI group according to the degree of abnormality of the UA FVWs. It is apparent that the worst perinatal outcome was with REDF, then AEDF, and lastly reduced but present end-diastolic flow, (all cases with REDF (N=3) develop intrapartum fetal distress and are admitted to NICU, with 66.6% perinatal mortality, while with AEDF (N=12) 75 % of cases develop intrapartum fetal distress and admitted to NICU, with 16.6% perinatal mortality). Good perinatal outcome was detected in patients with normal UA FVWs. Statistically; the differences between the different types of UA FVWs abnormalities were highly significant P<0.001. Regarding the AFI in the study group, thirty-one patients had oligohydramnios, while twenty-nine patients had borderline AFI.

Table (4) perinatal outcome in oligohydramnios and borderline AFI.

GA: gestational age, C/S: Cesarean section, NICU: neonatal intensive care unit, SD: Standard deviation, P: Probability, N: Number, NS: Non

Table 4: Perinatal outcome in oligohydramnios and borderline AFI.

Perinatal outcome	Study Group		Test of significance	P
	Oligohydramnios N (31)	Borderline AFI N (29)		
GA at delivery (Mean ± SD)	35.8±1.11	36±1.03	t=0.47	0.72
Intrapartum fetal distress [N (%)]	9(29.03%)	9(31.03%)	Z=0.17	0.43
C/S for fetal	7(22.58%)	7(24.13%)	Z=0.14	0.44
1 minute Apgar score (Mean ± SD)	3.9±1.55	3.80±1.45	t=0.25	0.79
5 minute Apgar score (Mean ± SD)	6.22±1.22	6.45±1.25	t=0.72	0.47
Birth weight (Mean ± SD)	2155±123	2175±150	t=0.56	0.57
Admission to NICU [N (%)]	9(29.03%)	8(27.58%)	Z=0.125	0.45
Perinatal mortality [N (%)]	3(9.67%)	2(6.89%)	Z=0.39	0.34

significant

Table (4) shows the perinatal outcome in oligohydramnios and borderline AFI. All perinatal outcome variables; GA at delivery, birth weight, Apgar score at one & five minutes, intrapartum fetal distress, CS for fetal distress, admission to NICU and perinatal mortality were closely related in either oligohydramnios or borderline AFI. Statistically; the differences in perinatal outcome between cases of two groups were insignificant P>0.05.

Discussion

As regarding the umbilical artery in the study group, the present study shows that UA FVWs are similar to those reported for uterine artery. It considers an umbilical S/D ratio of 3 is the upper limit of normal umbilical S/D ratio in cases of reduced AFI above 30 weeks gestation. Accordingly, cases of reduced AFI with umbilical S/D ratio < 3 were considered to have normal UA FVWs, and cases of reduced AFI with umbilical S/D ratio > 3 after 30 weeks gestation, were considered to have abnormal UA FVWs. The present study also considers that cases of reduced AFI with AEDF or REDF of UA FVWs are also included in the group of abnormal UA FVWs, they represent the extreme abnormalities of the UA FVWs.

The results of UA FVWs reported in this study can be explained depending upon the pathophysiological basis of abnormal UA FVWs. Under normal physiological conditions, the placenta presents an area of low vascular impedance, allowing continuous forward blood flow throughout the cardiac cycle. Because blood flow in diastole is mostly passive, as placental impedance increase, the UA end-diastolic flow decreases. Therefore, elevated placental impedance is associated with either low, absent or even reversed end-diastolic flow Fairline and walker (1991) supported the concept of an inverse relationship between end-diastolic velocities and downstream impedance. [6]

The results of UA FVWs reported in this study are in agreement with that reported by Kwon et al (2006) who demonstrated that the incidences of abnormal umbilical artery Doppler velocimetry in borderline AFI were higher than in normal AFI group. Lombardi et al, (1989), Carroll et al, (2000) also reported that the umbilical artery Doppler indices in oligohydramnios were higher than in normal pregnancy. [7,8]

As regarding the MCA in the study group, the present study shows that MCA Doppler indices are within the normal value as in normal pregnancy, but sometimes, they are lower as a result of increased end-diastolic flow, it can be explained by the redistribution of fetal cardiac output and “brain sparing effect” with preferential flow to the fetal brain and cerebral vasodilatation, it is a mechanism to prevent fetal brain hypoxia rather than a sign of impedance brain damage. [9,10]

The findings reported in this study are in agreement with Strigini et al, (1997); they reported that the routine use of cerebral velocimetry in high-risk pregnancies adds little information beyond that obtained from UA FVWs; however, it is useful in predicting SGA infants with adverse perinatal outcome when UA FVWs is abnormal. [11]

Lastly, the present study evaluates the relationship between abnormal Doppler velocimetry in the Decrease AFI group and adverse perinatal outcomes.

It compares the perinatal outcome in reduced AFI according to UA FVWs whether normal or abnormal. There are statistically significant differences in different perinatal outcome measures between cases of normal and abnormal UA FVWs (P<0.001).

The current study also compares the perinatal outcome in Decrease AFI group according to the degree of abnormality of UA FVWs. It is apparent that the worst perinatal outcome was in cases of REDF, then AEDF and lastly high indices with reduced but present end-diastolic flow. The best perinatal outcome was detected in cases of normal UA FVWs.

These findings show a strong association between abnormal UA DV and adverse perinatal outcome. Abnormal reduced UA FVWs patterns (Reduced

end-diastolic flow, AEDF, REDF), in the present study, can identify patients with reduced AFI at greater risk of developing fetal distress or perinatal death when compared to cases of reduced AFI with normal UA FVWs.

Finally, the study compared between oligohydramnios and borderline AFI groups in their adverse perinatal outcomes. There are insignificant differences in perinatal outcome between cases oligohydramnios and borderline AFI.

Conclusion

The present study concluded that no significant differences in adverse pregnancy outcome in pregnancy associated with borderline AFI and oligohydramnios.

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