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## Amniotic Fluid Index versus Umbilical Artery Doppler Velocimetry in Prediction of Perinatal Outcome

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### **Abstract:**

*Aim and Objectives:* To assess the sensitivity, specificity, positive and negative predictive values of Amniotic Fluid Index and Umbilical Artery S/D Ratio in the third trimester for the prediction of perinatal outcome and to compare the performance of both the tests.

*Materials and Methods:* It is a prospective study conducted at a tertiary care centre. AFI and Umbilical Artery S/D Ratio was measured every 4 weeks for high risk pregnancy cases beyond 30 weeks period of gestation and perinatal outcome noted. Results were analyzed by diagnostic tests sensitivity, specificity, positive and negative predictive values.

*Result:* Amniotic Fluid Index has sensitivity, specificity and positive and negative predictive values of 55 % – 87.5%, 65 % - 75%, 35% - 60%, 70% - 97% in predicting poor perinatal outcome. Whereas Umbilical artery S/D ratio has sensitivity, specificity and positive and negative predictive values of 60 % – 80% , 70 % - 80%, 20% - 80%, 80% - 100% in predicting poor perinatal outcome.

*Conclusion:* Antepartum foetal surveillance is the cornerstone of management which has been revolutionized by use of Ultrasound. There is a significant association between AFI, Umbilical artery Doppler on perinatal outcome. Both the tests should form an integral part of antepartum fetal surveillance In the present study Umbilical Artery S/D ratio has better performance value than Amniotic Fluid Index in predicting perinatal outcome. Umbilical Artery S/D Ratio is better predictor of perinatal outcome in high risk pregnancies.

**Keywords:** AFI, Umbilical Artery S/D Ratio, perinatal outcome

### **1. Introduction**

The aim of Third trimester care is to determine the foetuses which are at increased risk of poor perinatal outcome. Antepartum fetal surveillance is the cornerstone of management which has been revolutionised by use of Ultrasound.

In 1980 Manning et al introduced foetal biophysical profile. The biophysical profiles variables used were the NST, Foetal Breathing Movements, Foetal tone and Amniotic Fluid Volume. BPP provides a valuable method in management of high risk pregnancies. It is highly accurate and reliable test of diagnosing foetal hypoxia.<sup>1</sup>

Amniotic Fluid serves several roles during pregnancy. Oligohydramnios has been correlated with increased risk of intrauterine growth retardation, meconium aspiration syndrome, severe birth asphyxia, low APGAR scores and congenital abnormalities.<sup>2</sup> Early detection of oligohydramnios and its management may help in reduction of perinatal morbidity and mortality.<sup>3</sup> Amniotic Fluid Index is an indirect measure of foetoplacental function.<sup>4</sup>

Doppler velocimetric study is a valuable tool for evaluation of high risk pregnancies. It is recommended that umbilical artery Doppler should be the standard of practice in managing high-risk pregnancies complicated with fetal growth restriction and preeclampsia.<sup>5</sup> Doppler is found to detect changes in foetoplacental and uteroplacental circulation which correlate strongly with the fetal growth and therefore associated with pregnancy outcome. Doppler velocimetry is helpful in predicting high risk pregnancies with intrauterine

growth retardation.<sup>6</sup> Using Doppler techniques timely recognition of fetal compromise is possible to enable appropriate intervention and to prevent complications.<sup>7</sup>

There is a significant association between AFI, Umbilical artery Doppler on perinatal outcome.

## 2. Aims and Objectives

This study aims at assessing the specificity, sensitivity, positive and negative predictive values of Amniotic Fluid Index and Umbilical Artery S/D Ratio in the third trimester at or after 30 weeks period of gestation in the high risk cases for the prediction of perinatal outcome. To compare the predictive value of both the tests in high risk pregnancy outcome.

## 3. Materials and Methods

This was a prospective study conducted at Lady Goshen Hospital, Managlore, which is a tertiary care hospital providing services to the district of Dakshina Kannada and seven other neighbouring districts in the state of Karnataka and Kerala. The study population consisted of Pregnant women with gestational age 30 weeks or beyond with high risk factors. AFI and Umbilical Artery S/D Ratio of high risk pregnancy cases were measured every 4 weeks and perinatal outcome was noted.

Study Duration 2 yrs from October 2012 to September 2014

### Inclusion criteria

1. Well documented period of gestation
2. Singleton pregnancy
3. High Risk Pregnancy include
  - Pregnancy induced hypertension
  - Bad obstetric history
  - Intrauterine growth retardation
  - Post-dated pregnancy
  - Diabetes complicating pregnancy
  - Rh negative women
  - Anaemia complicating pregnancy
  - Heart disease complicating pregnancy
  - Elderly primigravida

### Exclusion criteria

- Multiple gestation
- Ultrasound proved congenital abnormalities

### Perinatal outcome

The perinatal outcome was considered abnormal when any one or a combination of the following parameters was present.

- APGAR scores less than 7 at 5 minutes
- Respiratory complications within 72 hours of delivery
- Meconium
- Perinatal Mortality

Ultrasound evaluation of amniotic fluid index and umbilical artery S/D ratio was done .

### 3.1. Determination of Amniotic Fluid Index (Phelan et al)

Amniotic Fluid Index was measured by placing the women in supine position. A Linear Transducer (5 mega Hertz) head was placed along longitudinal axis of the body and held perpendicular to the floor. Uterine cavity was divided into 4 quadrants. In each quadrant the deepest, unobstructed, clear pocket of amniotic fluid was measured. The four measurements are added together and the sum represents the AFI.

Values of Amniotic Fluid (cm)

<5 -- Oligohydramnios

5-8 -- Decreased Amniotic Fluid

8.1-24 -- Normal

> 24 -- Polyhydramnios

### 3.2. Measurement of Umbilical Artery S/D Ratio

Umbilical artery sampling was made at three planes, mid portion and two other places in the umbilical cord. The patient was made to lie down in the semi recumbent position with a lateral tilt. Doppler transducer placed on the abdominal wall over the uterus and carefully manipulated till Doppler signals appropriate for the umbilical circulation were identified. The examination was performed only during foetal apnoea as foetal breathing alters Doppler waveform. Philips HD7XC with 5 MHZ was used for measuring the wave form in the umbilical artery.

When there are three to four waves of equal height on the Angioscan screen the image is frozen and measurements are taken. S/D ratio of 3 was chosen as the upper limit because of the best sensitivity and specificity achieved high risk pregnancy.<sup>8</sup>

Statistical Formula With 95% confidence level and 80% power statistical formula is:

$$n = X = \frac{Z^2 p(1-p)}{e^2}$$

Z=95% (confidence level=1.96), P=80% power

Sample size = 54

The results were analyzed by diagnostic tests i.e sensitivity, specificity, positive and negative predictive value.

#### 4. Results and Observations

41% of high risk population had Hypertensive disorders complicating pregnancy, 20.1% were IUGR, 15% GDM, 5.5% each anaemic, pastdated, bad obstetric history patients and 3.7% each were elderly or had previous LSCS. Of the total no. of cases 37% had Oligohydramnios, 17% decreased amniotic fluid, 44% had normal liquor and 2% were having polyhydramnios. 50% cases with oligohydramnios had low Apgar i.e less than 7/10 at 5 minutes whereas only 12.5% cases with Normal AFI had low Apgar. 60% Cases with oligohydramnios had meconium whereas 40% with oligohydramnios had clear liquor. 25% cases with normal AFI had meconium. 45% cases with oligohydramnios and 55.5% with decreased amniotic fluid babies had respiratory complications within 72 hrs of delivery. Whereas 16.6% cases with normal AFI had respiratory complications. 87.5% of mortality was in oligohydramnios cases whereas 12.5% in normal Amniotic fluid cases. 65% of study population had normal Umbilical Artery S/D Ratio. 22% had Umbilical Artery S/D Ratio of >3. 9% cases had absent end diastolic velocity and 4% had Reversal of diastolic Flow. Only 17.14% cases with normal Umbilical Artery S/D Ratio had low Apgar at 5 minutes whereas 41.67% cases with Umbilical Artery S/D Ratio >3 had low Apgar. 60% of cases with Absent end diastolic velocity and 50% cases with Reversal of diastolic Flow had low Apgar. 50% patients with Umbilical Artery S/D Ratio >3 passed meconium whereas 60% of cases with Absent end diastolic velocity and 50% cases with Reversal of diastolic Flow had meconium in utero. 58.33% cases with Umbilical Artery S/D Ratio >3 had respiratory complications within 72 hrs of delivery whereas 60% of cases with absent end diastolic velocity and 50% cases with Reversal of diastolic Flow had respiratory complications. 50% of perinatal mortality cases had Umbilical Artery S/D Ratio >3 whereas 25% mortality cases had Absent end diastolic velocity and 12.5% had Reversal of diastolic Flow. The specificity, sensitivity, Positive and Negative Predictive value of Umbilical Artery S/D ratio were higher as compared to Amniotic fluid index in prediction of Low Apgar Score. The sensitivity, specificity and Positive and Negative Predictive value of Umbilical Artery S/D ratio was higher as compared to Amniotic fluid index in prediction of meconium. The test performance of Umbilical Artery S/D ratio was higher as compared to Amniotic fluid index in prediction of Respiratory complications within 72 hrs of delivery. The test performance of Umbilical Artery S/D ratio was higher as compared to Amniotic fluid index in prediction of perinatal mortality.

Test performance	Amniotic Fluid Index(cm)	S/D Ratio
Sensitivity	66.6%	72.2%
Specificity	74.3%	83.3%
Positive Predictive value	50.0%	68.4%
Negative Predictive value	85.3%	85.7%

Table 1: Test performance of Amniotic Fluid Index and S/D Ratio for Apgar at 5'

Test performance	Amniotic Fluid Index(cm)	S/D Ratio
Sensitivity	57.1%	66.7%
Specificity	75.8%	80.6%
Positive Predictive value	60.0%	63.1%
Negative Predictive value	73.5%	82.9%

Table 2: Test performance of Amniotic Fluid Index and S/D Ratio for Meconium

Test performance	Amniotic Fluid Index(cm)	S/D Ratio
Sensitivity	50.0%	61.1%
Specificity	69.4%	77.9%
Positive Predictive value	45.0%	57.9%
Negative Predictive value	73.5%	80%

Table 3: Test performance of Amniotic Fluid Index and S/D Ratio for Respiratory complications within 72 hrs of delivery

Test performance	Amniotic Fluid Index(cm)	S/D Ratio
Sensitivity	87.5%	87.5%
Specificity	71.7%	78.2%
Positive Predictive value	35.0%	58.8%
Negative Predictive value	97%	97.2%

Table 4: Test performance of Amniotic Fluid Index and S/D Ratio for Perinatal mortality

## 5. Discussion

Amniotic Fluid Index and Umbilical Artery Velocimetry both forms an important part of antepartum fetal surveillance. Estimation of Amniotic fluid volume is an integral part of antenatal surveillance. Reduce amniotic fluid and altered Umbilical Artery velocimetry carries an increased risk of an intrapartum complication in high-risk pregnancies<sup>9</sup>. Relationship between Oligohydramnios and altered Umbilical Artery velocimetry and perinatal morbidity, and mortality has been well established. The present study was undertaken to find out which test is better predictor of perinatal outcome in high risk pregnancy.

Sultana S et al<sup>10</sup> studied low AFI with poor APGAR score. In their study they found sensitivity, specificity, PPV and NPV for the detection of low APGAR is 57.1%, 57.3%, 16%, 88% whereas in present study is 66.6%, 74.3%, 50%, 85.3%. The performance of test in present study is better than in Sultana S et al study. In a study done by Morris et al<sup>11</sup> the sensitivity of AFI in prolonged pregnancy for major adverse outcome, low Apgar, Meconium Stained Amniotic Fluid and admission to NICU was low 28.6%, 15%, 9.4% and 11.5% respectively. The performance of tests was quite low which may be due to following reasons.

First Doppler ultrasound was not used in their study because of which amniotic fluid was overestimated as quadrants which contain umbilical cord loop were included.

Second reason is that about 33% patients delivered after one week of estimation Of Amniotic Fluid Index. Amniotic Fluid index drops drastically with increased gestation. In the present study care was taken to avoid these mistakes which may have resulted in better performance of AFI in present study.

Golan et al.<sup>12</sup> reported a low apgar score at 5minute, high incidence of meconium and high perinatal mortality. Meconium staining is an indicator of fetal distress and has its own complication in the newborn. Because of the high performance of AFI in present and various studies we believe that AFI would help to identify women who need increase ante partum surveillance for pregnancy complication.

In a study done by BN Lakhkar et al<sup>13</sup> the sensitivity, specificity, positive predictive value, negative predictive value for major adverse outcomes was 66.6 %, 45.4%, 66.6%, 45.4% like fetal mortality and minor adverse outcome like APGAR less than 7 for 5' and admission to NICU whereas in present study is performance of test for predicting perinatal mortality is 83.3%, 70.8%, 26.3%, 97.4% and Apgar at 5 minutes is 72.2%, 83.3%, 68.4%, 85.7%. Both the studies showed that Umbilical Artery S/D Ratio is good predictor of perinatal outcome in high risk pregnancy cases.

Whereas the sensitivity, specificity, positive predictive value, negative predictive value of Umbilical Artery Doppler S/D ratio done by Ogunyimi et al<sup>14</sup> was 65 - 100% 83 - 92%, 20 - 81 % and 91 - 100% and the present study is 60-80%, 70 - 80 %, 20-80 %, 80 - 100 % which is quite comparable. Yildirim G<sup>15</sup> found that pregnancies with absent or reversed end diastolic flow in the umbilical artery have high perinatal mortality and morbidity. They found increased rate of admission to NICU, RDS, septicemia and necrotising enterocolitis in IUGR Patients

In a study done by Jang DG<sup>16</sup> about the perinatal outcomes and maternal clinical characteristics in IUGR with absent or reversed end diastolic flow velocity in umbilical artery found that perinatal outcomes such as Apgar score, admission to NICU, RDS, neonatal sepsis and neonatal mortality were statistically less favorable in abnormal Umbilical Artery S/D Ratio group. In another study by Ozeren M et al<sup>17</sup> the Umbilical Artery S/D Ratio has high sensitivity of 88% and diagnostic accuracy of 94% in predicting perinatal outcome. Qahtani mentioned in her review article that Doppler ultrasonography of the umbilical artery in high-risk pregnancies reduced significantly the number of antenatal admissions, induction of labor and Caesarean section for fetal distress. Additionally, the clinical action guided by Doppler ultrasonography reduced the probability of perinatal deaths by 38%.

Dubinsky et al<sup>18</sup> studied a cohort of 108 small for gestational age fetuses. The study found that sensitivity, specificity, positive predictive value, negative predictive value of Amniotic Fluid Index in predicting poor perinatal outcome was 32%, 94%, 70%, 77% and for Umbilical Artery Doppler S/D ratio 64%, 96%, 88%, 87%.

So there is ample evidence that Doppler indices from the fetal circulation can reliably predict adverse perinatal outcome in a high risk obstetric patients.

Compared to other methods of fetal monitoring like Amniotic fluid index, Umbilical Artery Doppler S/D Ratio has better performance in detecting fetal compromises early and aids in the appropriate timing of delivery. Doppler studies in high-risk pregnancies are more beneficial in the perinatal management.

## 6. Conclusion

Both the tests AFI and Umbilical Artery S/D Ratio are important for predicting low Apgar, meconium, respiratory complications and perinatal mortality in high risk pregnancy cases. Both the tests should form an integral part of antepartum fetal surveillance. In the

present study we conclude Umbilical Artery S/D ratio has better performance value than Amniotic Fluid Index in predicting perinatal outcome. Umbilical Artery S/D Ratio is better predictor of perinatal outcome in high risk pregnancies.

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