Amniotic Fluid Index in Term Pregnancy: A Poor Predictor of Perinatal Outcome

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Objective: To determine the predictive value of Antepartum Amniotic Fluid Index in term pregnancy for perinatal outcome including fetal distress, mode of delivery, and infant Apgar score.

Study Design: Observational as well as comparative study.

Place and Duration of Study: This study was carried out in Unit-III at Sir Ganga Ram Hospital, Lahore from 14-05-2002 to 15-06-2003.

Patients and Methods: During this study 500 patients with singleton pregnancy were selected and Amniotic Fluid Index (AFI) was evaluated within 4 days of delivery in these patients with technique of Phelan et al. All outcome variables of these pregnancies were recorded on printed proformas. On the bases of AFI measurements patients were divided in two groups. Those who have AFI > 50mm and $\leq$ 50 mm. The significance of difference or comparison of means was measured by Chais-quare test (by Yats corrections) and Probability values were calculated. Perinatal outcomes in pregnancies with amniotic fluid index of $\leq$ 50mm were compared with those with an amniotic fluid index of > 50 mm. Finally AFI was evaluated as a predictor of neonatal outcome by calculating % positive and negative predictive values of AFI for the selected outcomes.

Results: According to results AFI showed significant positive predictive values for poor infants Apgar scores. For the chances of operative delivery it showed NPV 73.118% but only 36.72% PPV. There were more likely poor predictive values of AFI for the other selected outcomes.

Conclusion: Instead of the AFI, alternative technique of ultrasonographically assessing amniotic fluid may be used in clinical practice.

Key Words: Amniotic fluid index, AFI.

Ultrasonographic assessment of amniotic fluid is used frequently to identify fetuses at risk of having adverse outcomes as suggested by the finding of abnormal fluid volumes. Hydramnios is associated with anomalies or aneuploidy[1] whereas oligohydramnios is linked with pulmonary hypoplasia, postural deformity, fetal distress, and perinatal morbidity and death[2]. In 1987 Phelan et al[3] described the amniotic fluid index (AFI) as the summation of the largest vertical pocket in 4 quadrants. And since then this technique of assessing amniotic fluid volume has become increasingly popular in obstetric practice. A MEDLINE search for reports published from 1987 to 1997 includes 125 publications with AFI as the subject. A recent Technical Bulletin on obstetric ultrasonography from The American College of Obstetricians and Gynecologists[4] states that AFI is a more accurate and reproducible method of determining abnormalities in amniotic fluid volume than are other techniques. An AFI $\leq$ 50mm, consistent with most ultrasonographic criteria for oligohydramnios, has been used as an indication for delivery of infants at or near term. This practice has been suggested by Rutherford et al[5] and by Sarno et al,[6] who noted a significantly higher risk of cesarean delivery for fetal distress and low infant Apgar scores for those parturients with an AFI $\leq$ 50 mm than for those with an AFI > 50 mm. Since these initial publications, other investigators[7-10] have not consistently confirmed the association of adverse peripartum outcomes with an AFI $\leq$ 50 mm. This prompted us to determine the significance of AFI for pregnancy outcome.

Aims and Objectives

To determine the predictive value of antepartum Amniotic Fluid Index in term pregnancy for perinatal outcome including fetal distress, mode of delivery, and infant Apgar score.

Patients & Methods

This study was carried-out in the Department of Obstetrics and Gynecology Unit III, Sir Ganga Ram Hospital Lahore during one year period from 14.05.2002 to 15.06.2003. During this study 500 patients were selected, booked or unbooked attending antenatal clinic or labor room of Unit III in Sir Ganga Ram Hospital Lahore. Inclusion criteria for the study population was: women with singleton pregnancy with well established dates, at 40.0-42.0 weeks gestational age (GA), fetus with no anomalies, amniotic fluid index evaluated within 4 days of delivery in these patients, and determination of amniotic fluid volume with technique of Phelan et al. Following patients were excluded from the study: Patients with less than 40 weeks and unsure gestational age, patients with multiple pregnancy, patients with history of preterm rupture of membranes, patients with pre-eclampsia and uncontrolled gestational diabetes, and delivery after 4 days of evaluation of AFI.

Amniotic fluid measurements were performed by ultrasound on targeted patients. Equipment used in this study included Acuson model machine which was equipped with 3.5 and 5.0-MHz curvilinear transducers.

Estimates of amniotic fluid volume were recorded by means of AFI described by Phelan et al. Briefly, the technique for assessing amniotic fluid volume began by dividing the pregnant uterus into 4 quadrants. The transducer head was then placed on the maternal abdomen along the longitudinal axis. The vertical diameter of the largest amniotic fluid pocket in each quadrant was measured with the transducer head held perpendicular to the floor. These measurements were summed in millimeters and the results reported as the AFI.

The AFI at the last examination or not more than 4 days before delivery was used for the analysis. AFI values of < or = 50 mm were interpreted to represent oligohydramnios. All outcome variables of these pregnancies were recorded on printed proformas in the hospital, which were shifted to computer for analysis. Outcome variables included: spontaneous vaginal delivery, abnormal non-stress test - either with decelerations or non-reactive, instrumental delivery for fetal distress (forceps delivery, cesarean delivery)**,** 1 minute Apgar score <or= to 6 (1 min < or = to 6), 5 minute Apgar score <or= to 7 (5 min < or= to 7), presence of meconium, resuscitation, birth weight, and neonatal intensive care unit admission (NICU).

The data analysis was computer based using SPSS statistical package. AFI was evaluated as a predictor of neonatal outcome by calculating % positive and negative predictive values of AFI for selected outcomes by using formulas. By the same data % specificity and sensitivity of the test was also calculated.

On the basis of division of patients with AFI < or = 50 mm and the particular outcome, tables were constructed and the relative risk for each calculated. Oligohydramnios was defined as amniotic fluid index < or = to 50 mm. Perinatal outcomes in pregnancies with oligohydramnios were compared with those with an amniotic fluid index of > 50mm.

The significance of difference or comparison of means was measured by Chai-square test (by Yats corrections). Probability values of < or = 0.05 were considered significant.

Results

On the basis of AFI measurements patients were divided in 2 groups, those who have AFI > 50 mm and ≤ 50 mm; nearly 70% of patients showed values of AFI above 50 mm and 29% of patients showed AFI value of ≤ 50 mm (Oligohydramnios).

The selected outcomes showed significant variations in both groups (table 1). As far as sensitivity and specificity of the test was concerned, the AFI showed 48.299% sensitivity

Table 1: *Selected Outcomes in Women with ≤ 50 mm (Oligohydramnios) and Women with AFI > 50 mm.*

Outcomes	**AFI ≤ 50 mm (n = 147) (29.4%)**	**AFI > 50 mm (n = 353) (70.6%)**	**Statistical Significance**
1. Induction of labor	61 (41%)	77 (22%)	p > 0.1*****
2. Gestational age 42 weeks	12 (8%)	37 (10.4%)	p < 0.001******
3. Non-reassuring fetal heart rate	7 (4.7%)	10 (2.8%)	p > 0.5*
4. Deceleration of fetal heart rate	71 (48%)	137 (38.8%)	p < 0.001**
5. Meconium.	9 (6%)	30 (8.5%)	p < 0.001**
6. Caesarean delivery	47 (32%)	81 (23%)	p < 0.01**
7. Apgar score < 6 at 1 min.	12 (8%)	4 (1.1%)	p > 0.05*
8. Apgar score < 7 at 5 min.	9 (6%)	2 (0.56%)	p > 0.05*
9. Resuscitation required.	5 (3.4%)	3 (0.84%)	p > 0.5*
10. Admission to Intensive Care Nursery.	10 (7%)	6 (1.7%)	p > 0.3*
11. Birth weight 2.5 to 3.9 Kg.	90 (61%)	285 (80.7%)	p < 0.001**
12. Birth weight ≥ 4 Kg.	4 (2.7%)	35 (10%)	p < 0.001**

***** Not-Significant
****** Significant

and 61.189% specificity for the deceleration of fetal heart rate, 4.76% sensitivity and 97.167% specificity for non reassuring fetal heart rate, 31.973% sensitivity and 77.05% specificity for the operative mode of delivery (caesarean delivery), 8.163% sensitivity and 98.866% specificity for Apgar score < 6 at 1 min, and 6.122% sensitivity and 99.433% specificity for Ap-gar score < 7 at 5 min (table 2).

Finally, the predictive values of AFI were calculated for all the selected outcomes (table 3). According to statistics Amniotic Fluid Index showed significant positive predictive values for poor infants Apgar score i.e. < 6 at 1 min (75%) PPV Vs 72% NPV) and < 7 at 5 min (81% PPV Vs 71.78% NPV). For the chances of operative delivery it showed only 36.72% PPV but 73.118 % NPV and for the impending fetal distress it had 73.97% NPV and only 34% PPV. So, there were more likely poor predictive values of AFI for the selected outcomes.

Table 2: *Sensitivity and Specificity of Amniotic Fluid Index for Sele-cted Outcomes.*

Outcomes	Sensitivity	Specificity
1. Induction of labor	41.496%	78.187%
2 Gestational age 42 weeks	8.163%	89.517%
3. Non-reassuring fetal heart rate	4.76%	97.167%
4. Deceleration of fetal heart rate	48.299%	61.189%
5. Meconium.	6.124%	91.580%
6. Caesarean delivery	31.973%	77.05%
7. Apgar score < 6 at 1 min.	8.163%	98.866%
8. Apgar score < 7 at 5 min.	6.122%	99.433%
9. Resuscitation required.	3.410%	99.15%
10. Admission to Intensive Care Nursery.	6.80%	98.30%
11. Birth weight 2.5 to 3.9 Kg.	61.224%	19.263%
12. Birth weight $\geq$ 4 Kg.	2.72%	90.08%

Table 3: *Predictive Values of AFI for Selected Outcomes.*

Outcomes	Positive Predictive Value	Negative Predictive Value
1. Induction of labor	44.203%	76.243%
2. Gestational age 42 weeks	24.489%	70.066%
3. Non-reassuring fetal heart rate	41.176%	71.0%
4. Deceleration of fetal heart rate	34.134%	73.97%
5. Meconium.	23.077%	70.065%
6. Caesarean delivery	36.72%	73.118%
7. Apgar score < 6 at 1 min.	75%	72.107%
8. Apgar score < 7 at 5 min.	81.81%	71.78%
9. Resuscitation required.	62%	71.138%
10. Admission to Intensive Care Nursery.	62.5%	71.694%
11. Birth weight 2.5 to 3.9 Kg.	24%	54.4%
12. Birth weight $\geq$ 4 Kg.	10.256%	68.98%

Discussion

Since 1987 when Phelan et al described the AFI as a method of semi quantitatively estimating amniotic fluid volume, this index has been increasingly incorporated into reports of routine obstetric ultrasonography. Such widespread application of sonogram-derived estimates of amniotic fluid volume inevitably raises concerns that such information might provoke unnecessary interventions.[11-15] The study result analysis shows that the use of the AFI for clinical decision-making is problematic.

The study results show that an AFI $\leq$ 50 mm, in comparison with an AFI > 50 mm, is associated with an increased risk of caesarean delivery for fetal distress and poor Apgar score. Is this sufficient evidence that an AFI $\leq$ 50mm reflect a compromised fetus that needs to be delivered at term?

According to statistics the test showed 34% PPV for fetal distress, 36.72% PPV for caesarean delivery, and very significant 75% PPV for Apgar score < 6 at 1 min. and 81.81% PPV for Apgar score < 7 at 5 min.

But objective interpretation of fetal heart rate tracing can influence the decision to proceed with caesarean delivery. Similarly, the caesarean delivery for fetal distress would be preferable only after a fetal scalp pH value is obtained [(16)]. However, because of cervical dilatation, non-availability of the machine, or other constraints, the fetal pH may not be attainable before emergency caesarean delivery.

A low Apgar score may be the result of use of narcotics in labor, pre-term birth, or vigorous suctioning of the neonate. Similar results have been shown by Elizabeth et al[17] and Morrris et al.[18]

The possibility of treatment paradox with antenatal tests for fetal well being. According to this concept, the outcome of diagnostic testing can be falsely improved because an

abnormal finding (oligohydramnios) leads to a series of interventions (induction) that result in adverse outcomes (caesarean delivery) that the test is supposed to prevent.[19, 20]

The third and most important finding of this analysis is the lack of data on the possible association between AFI and neonatal acidosis, the only objective means to assess fetal well being. In the largest study correlating antepartum AFI and umbilical arterial pH < 7.20, Hoskins et al[21] noted an increased risk of acidosis only if an AFI $\leq$ 50 mm is associated with severe variable decelerations. Recent evidence indicates that injury related to hypoxic – ischemic encephalopathy does not occur unless the arterial pH is < 7.0.[22] Only one study determine the link between intrapartum AFI and umbilical arterial pH < 7.0 showed a poor correlation between the two.

Besides AFI, other methods of untrasonographic assessment of AFV include subjective assessment, single deepest pocket, an isolated pocket of at least 2 x 2 cm, 1 x 1 cm and 2 diameters pockets.[23] One randomized study to compare the techniques was by Alfirevic et al.[24] These authors concluded that, although the neonatal outcomes were similar in both groups, the incidence of oligohydramnios and subsequent induction was significantly higher among those who had AFI determinations rather than deepest vertical pocket measurements. The largest prospective study to date to provide normative data for each of three ultrasonographic techniques (AFI, single deepest pocket and two diameter pockets) used to assess AFV is by Magann et al.[25] They concluded that single deepest pocket appears be the preferable method, because its use is least likely to lead to the false positive diagnosis of either oligohydramnios or hydramnios and consequently the possibility of treatment paradox with the antenatal tests for fetal well being may be eliminated. Thus, instead of the AFI, alternative technique of ultrasonographically assessing amniotic fluid may be used in clinical practice.

Conclusion

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