ORIGINAL ARTICLE

Low Amniotic Fluid Index in High-Risk Pregnancy and Poor Apgar Score at Birth

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ABSTRACT

Objective: To determine the accuracy of antepartum Amniotic Fluid Index (AFI) of ≤ 5 cm as a predictor of adverse outcome at birth in high-risk pregnancies.

Study Design: Cross-sectional study.

Place and Duration of Study: Obstetrics and Gynaecology Unit I, Holy Family Hospital and Railway Teaching Hospital Complex, Rawalpindi, from February 2003 to January 2004.

Methodology: One hundred pregnant women at term gestation were studied. Each high-risk woman at term with an AFI of ≤ 5 cm admitted for delivery through emergency or outpatient department was labeled as predictor of poor outcome. The next high-risk pregnant woman at term with the same pregnancy complication but an AFI of > 5 cm was labeled as predictor of good outcome at birth. The subjects in both the groups were demographically matched and fulfilled the inclusion and exclusion criteria. The Apgar score was calculated at 5 minutes of birth. The newborns, with Apgar score ≤ 6 at 5 minutes of birth were labeled as diseased and > 6 were labeled as healthy. AFI was compared with Apgar score, using Chi-square and a p-value was calculated to determine the statistical significance. Sensitivity, specificity, efficiency and the predictive values of AFI at a cut off point of ≤ 5 cm as a predictor of adverse outcome at birth (Apgar score of ≤ 6 at 5 minutes of birth) in high-risk pregnancy were calculated.

Results: Only 8 neonates of 50 women with low AFI had low Apgar score. Similarly, 6 neonates of 50 women with normal AFI had poor Apgar score. The diagnostic sensitivity, specificity, positive predictive value, negative predictive value and efficiency of AFI as test were 57.1%, 51.3%, 16%, 88% and 52% respectively.

Conclusion: Low AFI is a poor predictor of adverse outcome for high-risk term patients. AFI is not a good screening test for high-risk pregnant women at term for birth of an infant with low Apgar score.

Key words: *Apgar score. Amniotic fluid index. High-risk term pregnancy.*

INTRODUCTION

Amniotic Fluid (AF) is an important part of pregnancy sac and helps fetal development. Amniotic fluid has a number of important functions like development of musculoskeletal system by permitting fetal movements, growth and development of Gastrointestinal Tract (GIT) by swallowing amniotic fluid and it provides essential nutrients to fetus. It protects fetus from trauma, maintains body temperature and it has bacteriostatic properties. Its pressure helps in reducing the loss of lung fluid and assist in pulmonary development.[1]

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Amniotic Fluid Volume (AFV) rises to a plateau between 22-39 weeks of gestation reaching upto 700-850 mls, which corresponds to an Amniotic Fluid Index (AFI) of 14-15 cm.[2] Evaluation of AF by palpation is deceptive, whereas its assessment on ultrasonography (USG) is more reliable. During the last 30 years, a wide range of tests have been introduced to determine fetal well-being including AFI.[3] It is calculated as the sum of the deepest vertical dimension of AF pocket in each quadrant of uterus. Oligohydramnios was defined as an AFI ≤ 5 cm.[4] In 1990, Moore and Cayle defined oligohydramnios as an AFI below the 5th centile for the gestational age.[5]

Fetal urine contributes significantly to the volume of AF. Oligohydramnios associated with Intra Uterine Growth Restriction (IUGR) is secondary to increased resistance of flow through renal artery due to hypoxemia. Non-steroidal anti-inflammatory drugs inhibit renal vascular flow and thereby reduce AFV.[6]

Sequelae of chronic oligohydramnios can be fetal demise, pulmonary hypoplasia, facial and skeletal deformities. Reduced liquor volume in labour may reduce the volume of intervillous space, which may predispose to umbilical cord occlusion, both of which increase the risk of fetal hypoxemia and will affect the Apgar score (American Pediatric Gross Assessment

Record) of baby at birth. Apgar score is conventionally determined at 1 and 5 minutes. It describes cardio-respiratory or neurological depression of the newborn. Low Apgar score signifies a problem that needs explanation and management. In some high-risk pregnancies, the decline in AFI can be at a faster rate and it may be wise to determine AFI once and sometimes twice weekly.[7] Patients with AFI ≤ 5 cm should be admitted in the hospital.[8] Determination of optimal time of delivery is necessary and labour should not be prolonged.[9] It has been observed that ante-partum or intrapartum AFI ≤ 5 cm is associated with significant increase in risk of Lower Segment Caesarean Section (LSCS) for fetal distress and low Apgar score at 5 minutes (Apgar score ≤ 6).[10]

The current local practices relies heavily on AFI estimation, particularly in the management of prolonged pregnancy and IUGR.[11-13] The role of AFI as an isolated predictor of fetal outcome needs to be checked not only in prolonged pregnancies, but also in other frequently managed high-risk pregnancies.

The aim of this study was to determine the accuracy of AFI estimation on neonatal outcome.

METHODOLOGY

This study was carried out in Obstetrics and Gynaecology Unit I, Holy Family Hospital and Railway Teaching Hospital Complex, Rawalpindi. Out of pregnant women admitted in Obstetrics ward / Labour room for delivery through emergency or outpatient department, 100 women at term were selected during one year period from February 2003 to January 2004 by non-probability purposive sampling technique.

Subjects were demographically matched and fulfilled the inclusion and exclusion criteria. The study was limited to women with non-anomalous singleton fetus with cephalic presentation between 37 and 42 weeks of gestation. Pregnant women with post-dated pregnancies, pregnancy induced hypertension, chronic hypertension, IUGR, diabetics and undiagnosed high-risk pregnancies were included in the study. In 'undiagnosed high-risk pregnancies group' the patients who were high-risk but could not be adjusted in first five categories and were found to be moderately or severely anaemic, malnourished, smokers or suffering from any acute/chronic illness.

Pregnant women with preterm rupture of membranes, congenital abnormalities of fetus, hemolytic diseases of fetus, multiple pregnancies, breech pregnancy, antepartum hemorrhage, preterm labour and pregnancy with fetal death were excluded from the study, as in these conditions poor outcome at birth is expected due to obvious reasons other than low AFI.

The expected date of delivery was calculated from menstrual dates or ultrasound in early pregnancy. After appropriate consent, patient was assessed using a questionnaire that included demographic information, history of menstrual cycle, last menstrual period, parity, medical and surgical history. Information data were collected from the patients, their case notes and antenatal booking cards. Information obtained was recorded on specially-designed proforma for study. Each high-risk woman at term with an AFI of ≤ 5 cm was included in the study, followed by next high-risk pregnant woman with an AFI of > 5 cm and the same pregnancy complication.

For USG assessment, all patients had urinated within half an hour prior to AFI estimation. The women were in supine position for USG examination. Expert Ultrasonologist performed all ultrasound examinations with convex probe of 3.75 MHz. AFI was calculated within 72 hours of delivery (pre-partum or intrapartum in 1st stage of labour). The AFI was calculated by dividing the maternal abdomen into 4 quadrants using the umbilicus and linea nigra as reference markers. Measurements of the deepest pool in each quadrant were summated and AFI was recorded in cm (centimeters). Mode of delivery (vaginal, elective LSCS or emergency LSCS) and perinatal management was at the discretion of obstetrician in-charge. The Apgar score of the newborn was calculated at 5 minutes of birth by attending neonatologist, who was unaware of the ultrasound findings. All these information were recorded on the data sheet.

The high-risk pregnant women with AFI of ≤ 5 cm were labeled as predictor of poor outcome at birth. The high-risk pregnant women with AFI of > 5 cm were labeled as predictor of good outcome at birth. The newborn with Apgar score ≤ 6 at 5 minutes of birth were labeled as diseased and newborn with Apgar score of > 6 at 5 minutes of birth were labeled as healthy.

Statistical package for social sciences version 11.0 was used for data compilation and analysis. The AFI was compared with Apgar score, using Chi-square (x^2), and p-value was calculated to determine the statistical significance. Student's t-test was used to compare age, gestational age and number of children. P-value < 0.05 was taken as significant. Four factors considerd for analysis of results were sensitivity, specificity, efficiency and the predictive values.

RESULTS

The demographics of patients gestational age and parity are shown in Table I. Low AFI group had three extra nulliparas. Multiparas were more in normal AFI. The difference was not statistically significant (p=0.3).

The frequency of different risks in pregnancy included 25% post-dated pregnancies, 23% pregnancy-induced hypertension, 16% chronic hypertension, 14% intrauterine growth restriction, 5% diabetics and 17%

Table I: Demographic variables and relationship of parity with AFI in study population (n=100).

Variable	Normal AFI (> 5cm)	Low AFI (≤ 5 cm)	P-value
Maternal age (years)	28.00 mean	30.00 mean	0. 69 (NS)
	(± 5.4)	(± 6.2)	-
Gestational age (week)	38.06	38.02	0.76 (NS)
	(± 1.03)	(± 0.9)	-
Multipara	34 (68%)	29 (58%)	0.3
Nullipara	16 (32%)	21 (42%)	0.3

Values in brackets with ± refer to standard deviation; Values in brackets with % refer to percentages; NS = Non-specific

were undiagnosed. Those were the patients who were high-risk but could not be adjusted in the other 5 categories and were found to be moderately or severely anaemic, malnourished, smokers or suffering from any acute/chronic illness.

Onset of labour was spontaneous in nearly two-third of women. Induction of labour was required in a quarter of high-risk pregnant women and 12 women had to undergo elective LSCS shown in Table II. Caesarean sections had to be done in a quarter of all the cases. Table II also shows that there were more elective LSCS in normal AFI than low AFI women. However, more inductions of labour were done in low AFI than normal AFI women. There was a statistically significant difference between the two groups (p = 0.04). AVD (assisted vaginal delivery), LSCS and SVD (spontaneous vaginal delivery) were nearly of equal number in both groups. The difference was not statistically significant (p=0.8).

Table II: Relationship of AFI with induction of labour, mode of delivery and neonatal outcome (n=100).

Variable	Frequency	Normal AFI (> 5 cm)	Low AFI (≤ 5 cm)	P-value
Spontaneous labour	64	35	29	0.57
Induced labour	24	07	17	0.04
Vaginal delivery	76	39	37	0.8
SVD	65	34	31	-
AVD	11	05	06	-
LSCS(Elective+Emergency)	24	11	13	0.8
Low birth weight (< 2.5 kg)	15	6	9	0.4
Normal birth weight (≥ 2.5 kg)	85	44	41	
Poor Apgar score at 5 minutes (≤ 6)	14	6	8	0.25
Normal Apgar score at 5 minutes (> 6)	86	44	42	

AVD: Assisted Vaginal Delivery; SVD: Spontaneous Vertex Delivery; LSCS: Lower Segment Caesarean Section

There was no significant association between gender and AFI (p=0.8) and the difference in birth weight was not significant between the two groups of AFI (p=0.4). Table II shows that 14 out of 100 babies had poor Apgar score at 5 minutes after birth. Two neonates had major morbidity (meconium aspiration and birth asphyxia). There were no perinatal deaths. Out of those 14, 8 had low AFI during their antenatal period and 6 had normal AFI. On the other hand, there were 42 babies with normal Apgar score in low AFI group and 44 in normal AFI group (p=0.25).

For analysis of results, sensitivity, specificity and the predictive values of AFI were considered at a cut off point of ≤ 5 cm as a predictor of adverse outcome at birth (Apgar score of ≤ 6 at 5 minutes of birth) in high-risk pregnancy.

Sensitivity of AFI as a predictor of poor Apgar score at 5 minutes of birth calculated by this data was 57.1%, specificity was 51.3%, Positive Predictive Value (PPV) was 16%, Negative Predictive Value (NPV) was 88% and overall efficiency of the test was 52%.

DISCUSSION

AFI provides a quantitative result that is proportional to actual volume and more predictive than other methods. It is well-established that oligohydramnios is associated with a high-risk of adverse perinatal outcome.[14]

This study showed that patients with unfavourable maternal and/or fetal conditions, such as IUGR, diabetes or hypertension etc, usually have poor Apgar score at 5 minutes of birth in 14% of cases. It means that 86% of women with same high-risk conditions gave birth to babies with normal Apgar score at 5 minutes of birth. This study indicated that oligohydramnios in high-risk pregnancies led to poor outcome at birth than normal AFV with the same high-risk conditions. The difference between the two groups was negligible and not statistically significant. Similar results were found by Zhang *et al.*[15]

Magann *et al.* also compared high-risk women with AFI of ≤ 5 cm with subjects who had a similar diagnosis of pregnancy complications but an AFI of more than 5 cm. They found no difference in intrapartum complications, caesarean delivery for fetal distress or neonatal outcomes.[16] In another study, Barrilleaux and Magann concluded that antepartum/intrapartum performance of AFI in patients with the HELLP syndrome is a poor prognostic test for subsequent fetal compromise.[17] Similar results are shown in this study. Thus, it can be suggested that immediate delivery for pregnancies with oligohydramnios may not be necessary when there are no other features present, which are suggestive of fetal distress. Each high-risk condition itself may predispose to adverse neonatal outcome. Therefore, it is not entirely clear whether the adverse neonatal outcomes merely reflected the sequel of other conditions or if reduced AFV itself contributed to the adverse outcomes.

Voxman concluded that antepartum oligohydramnios is not a predictor of adverse perinatal outcome as measured by low Apgar score and Neonatal Intensive Care Unit (NICU) admissions and that good outcome may be due to the aggressive antepartum and intrapartum management these patients received.[18] Morris concluded that AFI is superior to a measure of the single deepest pool as an assessment of fetus at or

after 40 weeks but has a poor sensitivity for adverse pregnancy outcome.[19] He also suggested, as in this study, that frequent use of USG at term may lead to increase obstetric intervention without improvement in perinatal outcomes.[19]

An Italian study concluded that in pregnancies with oligohydramnios, the modality of delivery and neonatal outcome did not differ from those with normal AFV.[20] Although there is a statistically significant association of AFI with induction of labour, there is no significant difference in mode of delivery and neonatal outcome between normal and low AFI groups. The sensitivity of an AFI $\leq$ 5 cm for the prediction of severe morbidity is unfortunately low. This means that any sign of deteriorating fetal condition might have prompted induction and immediate delivery. This selective confounding may have, to some extent, biased the perinatal outcomes. So a randomized clinical trial is necessary in which women with AFI $\leq$ 5 cm will be randomly assigned, either to immediate delivery or to expectant management, may provide a more definitive answer.

The significant proportion of neonates with poor Apgar score has an AFI > 5 cm. It indicates that other tests of fetal well-being are necessary to detect the fetuses that are at risk of adverse outcome in the presence of normal AFI. Another reason of low sensitivity of AFI estimation may be due to the fact that colour Doppler ultrasound was not used. However, the use of colour Doppler imaging has been reported to overdiagnose oligohydramnios.[21]

Use of 3-D USG and MRI may circumvent this problem and more accurate results can be obtained. An ultrasound may be inconclusive in fetuses with renal diseases that result in anhydramnios or oligohydramnios. In such cases, further investigation with MRI should be considered.[22] The only objective assessment of fetal well-being is neonatal acidosis. As suggested in a meta analysis, a multi-center study with sufficient power should be undertaken to demonstrate that a low AFI is associated with an umbilical arterial pH of < 7.[10]

Although antepartum or intrapartum oligohydramnios is not a predictor of adverse perinatal outcome in high-risk pregnant ladies, as measured by low Apgar score at 5 minutes, this may be reflective of aggressive antepartum and intrapartum management, which was provided to those patients. A more definitive answer may be obtained by a clinical trial in which women with AFI $\leq$ 5 cm will be randomly assigned either to immediate delivery or to expectant management.

CONCLUSION

AFI is a poor predictor of adverse outcome for high-risk antepartum or intrapartum pregnant ladies. The only significant association between low AFI and labour induction reveals that the early intervention due to low AFI in high-risk parturients lead to more alert attitude of the obstetricians, which may lead to some confounding. The conclusion that AFI is not a good predictor of outcome may be reflective of aggressive antepartum or intrapartum management that the patients with oligohydramnios received.

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