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ORIGINAL RESEARCH

A Longitudinal Observational Study on Amniotic Fluid Index and Perinatal Fetal Outcome

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ABSTRACT

Introduction: The amniotic fluid index (AFI) plays a crucial role in predicting the optimal timing for delivery and assessing the risks of adverse outcomes for both the mother and fetus. Therefore, our study aimed to investigate whether a low AFI during pregnancy could serve as a predictor of adverse perinatal outcomes in normally progressing pregnancies, and to identify a specific AFI threshold that could reliably predict such outcomes. **Materials and Methods:** This observational study enrolled 145 pregnant women at term gestation presenting at the Department of Obstetrics and Gynecology. Comprehensive history-taking and clinical examinations were performed, and AFI was assessed using ultrasound imaging. **Results:** Among the 100 pregnant women included in the study, 37.93% had an AFI of less than 5. A low AFI was significantly associated with the need for cesarean section (LSCS), as well as a negative fern test ($p<0.05$). Furthermore, a low AFI was significantly linked to lower birth weight, reduced APGAR scores at 1 and 5 minutes postpartum, and an increased likelihood of neonatal intensive care unit (NICU) admission ($p<0.05$). The receiver operating characteristic (ROC) curve analysis demonstrated that the AFI <5 demonstrated optimal sensitivity and specificity for predicting NICU admission, followed by LSCS ($p<0.05$). **Conclusion:** The AFI serves as a critical factor in determining adverse outcomes for both the mother and fetus during pregnancy. An AFI of less than 5 is associated with increased maternal risks such as higher rates of operative delivery, and adverse fetal outcomes including low birth weight, meconium-stained amniotic fluid, low APGAR scores, and an elevated likelihood of NICU admission. Comprehensive intrapartum monitoring and fetal surveillance strategies are essential to mitigate these adverse perinatal outcomes.

Key Words: Amniotic Fluid Index, Fetal Outcome, Cesarean Section, Women

INTRODUCTION

Assessment of amniotic fluid is a crucial aspect of antepartum evaluation, particularly during the third trimester of pregnancy. The typical volume of amniotic fluid during this period ranges from 700 to 800 ml. Oligohydramnios, defined as a significantly reduced volume of amniotic fluid for the gestational age, is a condition that complicates approximately 3-5% of pregnancies [1-3]. The "amniotic fluid index" (AFI) is utilized to evaluate oligohydramnios and determine the adequacy of amniotic fluid volume. Ultrasonography can measure the AFI, providing both qualitative (e.g., reduced amniotic fluid volume) and quantitative (e.g., AFI ≤5 cm, single deepest pocket <2 cm) assessments [4-6].

Various methods exist for evaluating the AFI, including the four-quadrant, single deep pocket, and two-diameter pocket techniques. The four-quadrant method, first described by Phelan et al. in 1987, uses transabdominal ultrasonography for AFI assessment [7]. According to this method, an AFI between 8 and 20 cm is considered normal, while an AFI between 5 and 8 cm is considered borderline, and an AFI below 5 cm is considered low [3].

A reduced AFI is often an important indicator of potential fetal abnormalities or maternal health conditions. Oligohydramnios may result from congenital fetal anomalies, maternal hypertension, diabetes, preterm rupture of membranes (PROM), and intrauterine growth restriction (IUGR). A low AFI (<5) is associated with adverse maternal and neonatal outcomes and a higher likelihood of operative interventions. The increased risk of perinatal morbidity and mortality is likely due to the

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diminished cushioning effect of amniotic fluid, leading to cord compression and utero-placental insufficiency. The AFI can be a significant predictor for determining the timing of delivery and potential adverse maternal and fetal outcome, though this association is not fully confirmed [8-10]. Thus, this study aimed to determine whether a low antepartum AFI predicts adverse perinatal outcomes in normal pregnancies and to establish a threshold AFI level that could predict such outcomes.

MATERIAL AND METHODS

This observational study included 145 antenatal women at term pregnancy (37 to 40 weeks of gestation) with singleton pregnancies, cephalic presentation, amniotic fluid index (AFI) ranging from 0 to 20 cm, and intact membranes. Exclusion criteria comprised patients with ruptured membranes, fetal malpresentations, and polyhydramnios.

Participants meeting the inclusion criteria were enrolled, and written consent was obtained from each. Detailed histories were taken using a structured proforma, and any complications in the current pregnancy were recorded. Participants underwent thorough clinical examinations. Ultrasound examinations were conducted for all participants to assess fetal well-being, and the AFI was measured. Additionally, some patients with suspected complications underwent further evaluation using non-stress tests (NST) and fetal Doppler studies.

Based on their AFI values, participants were categorized into three groups: AFI <5 cm, AFI 5-8 cm, and AFI >8 cm. The groups were then compared regarding maternal and neonatal outcomes. Statistical analysis was conducted using SPSS 20.0 with P value significance set at 0.05.

RESULTS

The study included 100 antenatal females with a mean age of 24.8 ± 4.2 years, most of whom were primiparous. Of these, 37.93% had low AFI (1-5), 13.79% had borderline AFI (5.1-8), and 2.76% had anhydramnios (Table 1).

No significant differences were observed in age, parity, or gestational age among the three groups. Decreased AFI was the primary reason for admission in cases with AFI less than 5 and 5.1-8, whereas spontaneous labor was the reason in 84.62% of cases with AFI 8 to 20 (Table 2).

The primary reason for the termination of pregnancy in most cases with low and borderline AFI was decreased AFI. Most females with low AFI delivered via LSCS, whereas 50% of those with borderline AFI required induction. The association between AFI and the reason and mode of termination, as well as the negative fern test, was statistically significant (Table 3).

There was a significant association between low AFI and low birth weight, poor APGAR scores at 1 and 5 minutes, and a higher risk of NICU admission. ROC curve analysis indicated that a cutoff value of <5 was a better predictor of adverse perinatal outcomes. The area under the curve, sensitivity, and specificity at this cutoff were highest for NICU admission, followed by LSCS (Tables 4 and 5).

Table 1: Distribution of AFI among study participants

AFI	n	%
0	4	2.76
0.1-5	55	37.93
5.1-8	20	13.79
>8	66	45.52

Table 2: Association between baseline parameters and AFI

Baseline Parameters	AFI < 5 (n=59)	AFI 5-8 (n=20)	AFI 8-20 (n=66)	P value
	n (%)	n (%)	n (%)	
Age				0.31
< 20 years	4 (6.78)	1 (5.00)	13 (19.70)	
21-25 years	37 (62.71)	9 (45.00)	29 (43.94)	
26-30 years	17 (28.81)	7 (35.00)	16 (24.24)	
31-35 years	0 (0.00)	3 (15.00)	6 (9.09)	
> 35 years	1 (1.69)	0 (0.00)	1 (1.52)	
Mean (years)	25 ± 3.41	26.7 ± 3.91	25.45 ± 4.78	
Gestational Age				0.28
37-38 weeks	31 (52.54)	6 (10.17)	33 (55.93)	
39-40 weeks	28 (47.46)	14 (23.73)	32 (54.24)	
Parity				0.49
Primipara	39 (66.10)	10 (50.00)	44 (66.67)	
Multipara	20 (33.90)	10 (50.00)	22 (33.33)	
Indication for Admission				<0.01
Decreased AFI	54 (91.53)	19 (95.00)	1 (1.54)	

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Safe confinement	4 (6.78)	1 (5.00)	9 (13.85)	
Spontaneous onset of labour	1 (1.69)	0 (0.00)	55 (84.62)	

Table 3: Association between maternal outcomes and AFI

Maternal Outcome	AFI < 5	AFI 5-8	AFI 8-20	P value
	n (%)	n (%)	n (%)	
Fern Test				
Negative	31 (52.54)	13 (22.03)	66 (100.00)	<0.01
Positive	28 (47.46)	7 (11.86)	0 (0.00)	
Mode of Delivery				
FTVD Spontaneous	15 (25.42)	11 (55)	52 (78.79)	<0.01
FTVD Induced	4 (6.78)	1 (5)	7 (10.61)	
LSCS	40 (67.8)	8 (40)	7 (10.61)	
Indications of LSCS				
Deceleration in CTG	29 (49.15)	6 (10.17)	1 (1.52)	
Thick MSL	4 (6.78)	0 (0.00)	0 (0.00)	0.29
NPOL	3 (5.08)	1 (1.69)	4 (6.06)	
Previous LSCS	7 (11.86)	1 (1.69)	1 (1.52)	
Reason for Termination				
Liquor nil	1 (1.69)	0 (0.00)	0 (0.00)	<0.01
Decreased AFI	57 (96.61)	16 (27.12)	4 (6.06)	
Spontaneous labour	1 (1.69)	4 (6.78)	62 (93.94)	

Table 4: Association between fetal outcomes and AFI

Fetal Outcome	AFI < 5	AFI 5-8	AFI 8-20	P value
	n (%)	n (%)	n (%)	
APGAR @ 1 minute				
Good	43 (72.88)	17 (85.00)	62 (93.94)	<0.05
Poor	16 (27.12)	3 (15.00)	4 (6.06)	
APGAR @ 5 minute				
Good	45 (76.27)	17 (85.00)	63 (95.45)	<0.05
Poor	14 (23.73)	3 (15.00)	3 (4.55)	
Color of Liquor				
Clear	46 (77.97)	17 (85.00)	59 (89.39)	0.42
Meconium stained	13 (22.03)	3 (15.00)	7 (10.61)	
Birth Weight (kg)				
< 2	19 (32.2)	1 (5.00)	6 (9.09)	<0.05
2-2.5	20 (33.9)	6 (30.00)	29 (43.94)	
> 2.5	20 (33.9)	13 (65.00)	31 (46.97)	
NICU Admission				
No	16 (27.12)	17 (85.00)	59 (89.39)	<0.01
Yes	43 (72.88)	3 (15.00)	7 (10.61)	
Indication for NICU Admission				
Poor APGAR	10 (16.95)	0 (0)	3 (4.55)	
Grunting	4 (6.78)	0 (0)	1 (1.52)	0.91
Tachypnea	9 (15.25)	1 (50)	0 (0.00)	
LBW	1 (1.69)	0 (0)	0 (0.00)	
RD	19 (32.2)	1 (50)	3 (4.55)	
Medical Complications				
No	58 (98.31)	20 (0.00)	66 (100.00)	0.52
Yes	1 (1.69)	0 (0.00)	0 (0.00)	
Neonatal Outcome				
Uneventful	58 (98.31)	20 (0.00)	66 (100.00)	0.52
Death	1 (1.69)	0 (0.00)	0 (0.00)	
Long-term Problem				0.14
Nil	55 (93.22)	20 (0.00)	66 (100.00)	

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Surfactant requirement	4 (6.78)	0 (0.00)	0 (0.00)	

Table 5: ROC analysis for poor neonatal and maternal outcome

Outcome	Sensitivity (%)	Specificity (%)	P value	95% CI Lower	95% CI Upper
APGAR 1 min	68	61.3	<0.01	0.58	0.852
APGAR 5 min	67.5	63.5	<0.01	0.574	0.835
LSCS	82.5	69.9	<0.01	0.763	0.931
NICU admission	82.1	77.4	<0.01	0.788	0.944

DISCUSSION

Amniotic fluid acts as a protective medium, providing cushioning for the fetus, facilitating physical and musculoskeletal growth, promoting lung development, and preventing umbilical cord compression [11,12]. Low AFI has been linked to adverse fetal and maternal outcomes. This study included 145 antenatal women. The prevalence of oligohydramnios is estimated to be about 1-5% at term, but can reach up to 37% in the presence of fetal anomalies or other pregnancy complications [13,14]. In this study, anhydramnios was found in 3% of cases, oligohydramnios in 38%, and borderline AFI in 14%. Naik et al. reported a much lower prevalence of oligohydramnios at 3.39% [15], while Locatelli et al. documented an 11% prevalence [16].

Given that all cases presented at term, termination of pregnancy was advised based on their condition. A significantly higher proportion of women in the low and borderline AFI groups required termination due to decreased AFI. Cesarean sections (LSCS) were significantly more common in women with low AFI compared to those with normal AFI. Induction was often necessary for those with borderline AFI. The most common indication for LSCS in both low and borderline AFI groups was deceleration in CTG. Similar findings were observed by Gandotra et al., who reported an increased risk of LSCS in pregnancies with oligohydramnios [17]. Sharma et al. reported a cesarean section rate of 23.33% in patients with oligohydramnios, primarily due to fetal distress (60.72%) [18]. Radhamani et al. also documented higher LSCS rates in oligohydramnios cases, with 13.8% elective and 30.8% emergency LSCS [19]. Das et al. noted a significantly higher LSCS rate (60%) in the study group compared to the control group (20%), with fetal distress being the most common indication (31%) [20].

The fern test is used to confirm premature rupture of membranes (PROM), with a sensitivity and specificity of 77.8% and 79.3%, respectively [21]. In this study, the fern test was positive in a significantly higher proportion of women with low AFI. PROM is a significant cause of oligohydramnios and adverse perinatal outcomes [22].

The color of the amniotic fluid can indicate fetal distress. Oligohydramnios is associated with increased uteroplacental insufficiency, leading to a higher incidence of meconium-stained amniotic fluid [23]. We observed meconium-stained liquor in a higher proportion of women with low and borderline AFI compared to those with normal AFI. Our findings were consistent with Radhamani et al., who reported 18.5% of neonates born to mothers with low amniotic fluid had meconium-stained liquor [19]. Similarly, Das et al. documented significantly higher cases of meconium-stained liquor in oligohydramnios compared to controls [20]. Bhat et al. concluded that AFI is an important predictor of fetal tolerance during labor, with decreased amniotic fluid volume associated with increased fetal stress and meconium-stained liquor [24].

AFI is significantly associated with neonatal birth weight [13]. Consistent with this finding, most neonates with low AFI had low and very low birth weights compared to those with borderline or normal AFI. Gandotra et al. also reported a significant association between low birth weight and oligohydramnios [17]. Naik et al. similarly noted a higher incidence of low birth weight babies in cases of oligohydramnios [15].

Literature suggests that oligohydramnios is associated with adverse perinatal outcomes. This study found that oligohydramnios was significantly linked to low APGAR scores at 1 and 5 minutes and higher NICU admission rates. Although the proportions of neonates requiring NICU admission were significantly higher in the low AFI group, the indications for NICU admission were statistically similar across the three groups.

Gandotra et al. similarly found that oligohydramnios was significantly associated with low APGAR scores at 5 minutes and NICU admission [17]. Sharma et al. documented that most neonates born to mothers with oligohydramnios required resuscitation and NICU admission for more than 5 days [18]. Naik et al. reported that oligohydramnios was associated with low APGAR scores at 1 and 5 minutes, higher NICU admissions, and perinatal mortality [15].

This study also aimed to determine the threshold AFI level predictive of adverse outcomes. ROC curve analysis identified an AFI cutoff of <5 as a predictor of adverse maternal and fetal outcomes. The area under the curve, sensitivity, and specificity at this cutoff were highest for NICU admission, followed by LSCS. Previous literature has reported an AFI of less than 5 as a predictor of adverse fetal outcomes [25,26].

CONCLUSION

The amniotic fluid index (AFI) is a crucial predictor of adverse maternal and fetal outcomes. An AFI of

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less than 5 is linked to negative maternal outcomes, such as increased rates of operative deliveries, as well as adverse fetal outcomes, including low birth weight, meconium-stained amniotic fluid, low APGAR scores, and higher rates of NICU admissions. ROC analysis indicated that an AFI cutoff of <5 might be a more accurate predictor of adverse fetomaternal outcomes. Enhanced intrapartum care combined with rigorous fetal surveillance can potentially reduce these adverse perinatal outcomes.

REFERENCES

1. Kofinas A, Kofinas G. Differences in amniotic fluid pattern and fetal biometric parameters in third trimester pregnancies with and without diabetes. J Matern Fetal Neonatal Med. 2006;19:633-8.
2. Magann EF, Chauhan SP, Bofill JA, Martin JN. Comparability of the amniotic fluid index and single deepest pocket measurements in clinical practice. Aust N Z J Obstet Gynaecol. 2004;43:175-7.
3. James DK, Steer PJ, Weiner CP, Gonik B. High risk pregnancy: management options. 4th ed. 2007:197-207.
4. Beloosesky R, Ross MG, Levine D. Oligohydramnios: Etiology, diagnosis, and management. https://www.uptodate.com/contents/oligohydramnios-etiology-diagnosis-and-management-in-singleton-gestations.
5. Madendag Y, Madendag IC, Sahin E, Aydin E, Sahin ME, Acmaz G. How Well Do the Popular Ultrasonic Techniques Estimate Amniotic Fluid Volume and Diagnose Oligohydramnios, in Fact? Ultrasound Q. 2019;35:135-8.
6. Cheung CY, Roberts VH, Frias AE, Brace RA. Effects of maternal western-style diet on amniotic fluid volume and amnion VEGF profiles in a nonhuman primate model. Physiol Rep. 2018;6(20).
7. Phelan JP, Smith CV, Broussard P, Small M. Amniotic fluid volume assessment using the four-quadrant technique in the pregnancy at 36-42 weeks gestation. J Reprod Med. 1987;32:540-2.
8. Yadav S, Shah P, Patel RV, Chavda A, Shah MK. Oligohydramnios: a common problem with increasing incidence in term pregnancy and its fetomaternal outcome. World J Pharma Med Res. 2019;5:813-8.
9. Chauhan SP, Hendrix NW, Morrison JC, Magann EF, Devoe LD. Intrapartum oligohydramnios does not predict adverse peripartum outcome among high-risk parturients. Am J Obstet Gynecol. 1997;176:1130-6.
10. Casey BM, McIntire DD, Bloom SL, Lucas MJ, Santos R, Twickler DM. Pregnancy outcomes after antepartum diagnosis of oligohydramnios at or beyond 34 weeks' gestation. Am J Obstet Gynecol. 2000;182:909-12.
11. Umber A. Perinatal Outcome in Pregnancies Complicated by Isolated Oligohydramnios at Term. Annals. 2009;15:357.
12. Madaan S, Mendiratta SL, Jain PK, Mittal M. Amniotic Fluid Index and its Correlation with Fetal Growth and Perinatal Outcome. J Fetal Med. 2015;2:261-7.
13. Sherer DM, Langer O. Oligohydramnios: use and misuse in clinical management. Ultrasound Obstet Gynecol. 2001;18:411-9.
14. Coady AM. Amniotic Fluid. In: Twining's Textbook of Fetal Abnormalities. Churchill Livingstone; 2015:199-219.
15. Naik AS, Chadha MT. A Study of Effect of Oligohydramnios on the Obstetric and Perinatal Outcome. Sch J App Med Sci. 2018;6:4562-7.
16. Locatelli A, Vergani P, Toso L, Verderio M, Pezzullo JC, Ghidini A. Perinatal outcome associated with oligohydramnios in uncomplicated term pregnancies. Arch Gynecol Obstet. 2004;269:130-3.
17. Gandotra N, Mahajan N, Manhas A. Perinatal outcome associated with oligohydramnios at term. Int J Reprod Contracept Obstet Gynecol. 2020;9:3576-9.
18. Sharma ST. Clinical study of maternal and fetal outcome in pregnancies with oligohydramnios. Int J Gynaecol. 2019;71:160-4.
19. Radhamani S, Babitha A. A clinical study of feto-maternal outcome in pregnancies with oligohydramnios. Int J Reprod. 2017;6:386-9.
20. Das S, Haldar R, Sinhababu PP, Sharma M, Mahapatra B. Pregnancy Outcome in Oligohydramnios At Term: A Study of 100 Cases. IOSR J Dent Med Sci. 2017;16:53-5.
21. Rogers LC, Scott L, Block JE. Accurate Point-of-Care Detection of Ruptured Fetal Membranes: Improved Diagnostic Performance Characteristics with a Monoclonal/Polyclonal Immunoassay. Clin Med Insights Reprod Health. 2016;9:15-8.
22. Palacio M, Kühnert M, Berger R, Larios CL, Marcellin L. Meta-analysis of studies on biochemical marker tests for diagnosis of premature rupture of membranes: comparison of performance indexes. BMC Pregnancy Childbirth. 2014;14:112.
23. Moore TR. Superiority of the four-quadrant sum over the single-deepest-pocket technique in ultrasonographic identification of abnormal amniotic fluid volumes. Am J Obstet Gynecol. 1990;163:762-7.
24. Bhat S, Kulkarni V. Study of effect of oligohydramnios on maternal and fetal outcome. Int J Med Dent Sci. 2015;4:828-35.
25. Rosati P, Guariglia L, Cavaliere AF, Ciliberti P, Buongiorno S, Ciardulli A. A comparison between amniotic fluid index and the single deepest vertical pocket technique in predicting adverse outcome in prolonged pregnancy. J Prenat Med. 2015;9:125-9.
26. Nageotte MP, Towers CV, Asrat T, Freeman RK. Perinatal outcome with the modified biophysical profile. Am J Obstet Gynecol. 1994;170:1672-6.