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BORDERLINE AFI IN LAST TRIMESTER AND PERINATAL OUTCOME

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Abstract

Background: Amniotic fluid index (AFI) is an important marker of fetal well-being in the last trimester of pregnancy. While oligohydramnios (AFI ≤ 5 cm) is well documented to be associated with adverse perinatal outcomes, the clinical significance of borderline AFI (5.1–8 cm) remains controversial. Identifying its impact on perinatal outcomes is crucial for obstetric management and neonatal care.**Aim**: To evaluate the association between borderline AFI in the last trimester and perinatal outcomes among pregnant women admitted at Government Medical College (GMC) Kathua from January 2024 to June 2024. **Methods**: This prospective observational study included 100 singleton pregnancies at ≥ 36 weeks gestation. Women were divided into two groups: Borderline AFI (5.1–8 cm) and Normal AFI (> 8–24 cm). Data collected included maternal demographics, mode of delivery, intrapartum events, and neonatal outcomes such as birth weight, Apgar scores, and NICU admissions. Statistical analysis was done using chi-square and t-tests, with $p < 0.05$ considered significant. **Results**: Women with borderline AFI had higher rates of caesarean sections for fetal distress (30% vs 12%), increased meconium-stained amniotic fluid (36% vs 18%), lower mean birth weight (2.70 ± 0.45 kg vs 3.10 ± 0.40 kg), higher NICU admissions (24% vs 8%), and more neonates with Apgar < 7 at 5 minutes (22% vs 6%). These differences were statistically significant.**Conclusion**: Borderline AFI in the last trimester is significantly associated with adverse perinatal outcomes including fetal distress, meconium-stained liquor, low birth weight, and increased NICU admissions. Close surveillance and timely obstetric intervention are recommended to improve neonatal outcomes in pregnancies with borderline AFI.

Keywords: Borderline AFI, amniotic fluid index, last trimester, perinatal outcome, NICU admission, Apgar score.

Introduction

Amniotic fluid performs multiple essential functions in fetal development: it cushions the fetus, allows for movement, supports lung maturation, protects the umbilical cord from compression, and helps regulate temperature and volume balance. In the third trimester, an adequate volume of amniotic fluid is crucial for fetal well-being. Amniotic fluid index (AFI) measured by the four-

quadrant method is commonly used; oligohydramnios (often AFI ≤5.0 cm) is associated with adverse perinatal outcomes such as fetal distress, low birth weight, increased rates of caesarean section, and greater neonatal intensive care unit (NICU) admissions. [1]

However, there is a zone between "normal" AFI and oligohydramnios, often called borderline AFI (typically defined as AFI \~5.1-8.0 cm, or in some studies 5-10 cm). The clinical significance of this borderline range in low-risk pregnancies, especially in the last trimester, has been variably reported. Some studies suggest substantial risk even in this borderline range; others report minimal or no significant adverse effects after adjusting for confounders.

In a meta-analysis of observational cohort studies comparing low-risk singleton pregnancies with borderline oligohydramnios (AFI 5.1-8.0 cm) versus normal AFI, the pooled results showed that borderline oligohydramnios is associated with increased risks of overall cesarean delivery (OR \~2.20), cesarean due to fetal distress (OR \~2.70), 5-minute Apgar <7, low birth weight (LBW), and NICU admission. [2]

Soo Ran Choi et al. (2016) studied uncomplicated term singleton pregnancies and found that, compared to normal AFI (8.1-24 cm), borderline AFI (5.1-8.0 cm) was not significantly associated with increased cesarean for non-reassuring fetal status, meconium staining, low 5-minute Apgar, or NICU admissions, though rates of small for gestational age neonates and induction of labour were higher.[1]

A prospective observational study from Eastern India (Sharma, Gupta, Kothari et al., 2024) with term pregnancies (37-40 weeks) found that borderline AFI (5-8 cm) was associated with significantly higher rates of fetal distress requiring caesarean delivery, meconium-stained amniotic fluid, NICU admissions, lower birth weights, and more early neonatal complications compared to normal AFI.[3]

In Sri Lanka, Jayasinghe, Gunawardana, and Fernandupulle (2019) in a retrospective cohort of 303 low-risk term pregnancies (AFI 5-10 cm borderline vs AFI 10-24 cm normal) reported that borderline AFI was associated with significantly higher rates of emergency caesarean due to fetal distress, meconium-stained amniotic fluid, and neonatal unit admission.**[4]**

Another study in Nigeria among low-risk women showed that those with borderline AFI had significantly higher incidence of fetal distress, low Apgar at 5 minutes (<7), and birth weight less than 2.5 kg.**[5]**

Furthermore, smaller case-control studies (for example at Mumbai's Bhabha Atomic Research Centre) noted significant differences in meconium staining and birth weight between borderline vs normal AFI groups, though for some other outcomes (e.g. mode of delivery, Apgar <7 at 5 min) statistical significance was not always achieved.**[6]**

Given these mixed findings, particularly varying by region, healthcare resource level, definitions of "borderline", and gestational age, there is a need for local data. In Government Medical College Kathua, Jammu & Kashmir, we undertook this study in 100 singleton last-trimester pregnancies to compare perinatal outcomes in those with borderline AFI (5.1-8.0 cm) versus those with normal AFI (>8.0-24 cm). Outcomes include mode of delivery, fetal distress, meconium staining, birth weight, Apgar scores, and NICU admission.

Materials and Methods

Study Design and Setting

This was a prospective observational study conducted in the Department of Obstetrics and Gynecology, Government Medical College (GMC) Kathua, Jammu and Kashmir, over a period of six months from January 2024 to June 2024. The study was approved by the Institutional Ethics Committee, and written informed consent was obtained from all participants.

Study Population

A total of 100 pregnant women in their third trimester (≥28 weeks of gestation) attending the antenatal clinic or admitted to the labor ward during the study period were enrolled. All cases were

singleton pregnancies with reliable gestational age assessment based on last menstrual period and/or early ultrasound.

Inclusion Criteria
* Singleton pregnancies
* Gestational age ≥28 weeks
* Borderline AFI (5.1–8.0 cm) as study group
* Normal AFI (>8.0–24 cm) as control group

Exclusion Criteria
* Pregnancies complicated by hypertensive disorders, diabetes mellitus, renal disease, or cardiac disease
* Major congenital anomalies detected on ultrasound
* Multiple gestation
* Premature rupture of membranes or chorioamnionitis
* Oligohydramnios (AFI ≤5.0 cm) and polyhydramnios (AFI ≥25.0 cm)

Methodology:
All women underwent ultrasonographic assessment of amniotic fluid index (AFI) using the four-quadrant method. The uterus was divided into four quadrants by a vertical line along the lineanigra and a transverse line through the umbilicus. The deepest, unobstructed vertical pocket in each quadrant was measured, and the sum of these four measurements gave the AFI.
The women were divided into two groups:
* Group A (Borderline AFI): AFI 5.1–8.0 cm (n=50)
* Group B (Normal AFI): AFI >8.0–24 cm (n=50)

Detailed antenatal and intrapartum monitoring was carried out. Data were recorded regarding maternal age, parity, gestational age, booking status, and socioeconomic background. Intrapartum variables studied included onset of labor, need for induction, presence of meconium-stained amniotic fluid, and evidence of fetal distress. Perinatal outcomes assessed were mode of delivery, Apgar score at 1 and 5 minutes, birth weight, NICU admission, and early neonatal morbidity.

Data Collection and Statistical Analysis:
All data were entered into a predesigned proforma and later transferred to Microsoft Excel for analysis. Continuous variables such as maternal age, gestational age, and birth weight were expressed as mean ± standard deviation, and categorical variables such as mode of delivery and NICU admission as frequencies and percentages. Comparisons between groups were performed using the chi-square test for categorical data and Student's t-test for continuous data. A p-value less than 0.05 were considered statistically significant.

Results
A total of 100 pregnant women were included in the study, divided into two groups: 50 women with borderline AFI (Group A) and 50 women with normal AFI (Group B). The baseline demographic and obstetric characteristics were compared between the groups.
The mean age of participants in Group A was 27.3 ± 4.2 years, and in Group B was 26.9 ± 3.8 years, showing no significant difference. Most participants in both groups were between 21–30 years of age. Parity distribution was comparable, with a majority being primigravidas. The mean gestational age at delivery was slightly lower in Group A (37.8 ± 1.2 weeks) compared to Group B (38.3 ± 1.0 weeks) [Table 1].

Table 1: Demographic and obstetric characteristics of the study groups

Characteristic	Group A (Borderline AFI, n=50)	Group B (Normal AFI, n=50)	p-value
Mean maternal age (years)	27.3 ± 4.2	26.9 ± 3.8	0.62
Age group <20 years	6 (12%)	4 (8%)	--
Age group 21–30 years	36 (72%)	38 (76%)	--
Age group >30 years	8 (16%)	8 (16%)	--
Primigravida	30 (60%)	28 (56%)	0.69
Multigravida	20 (40%)	22 (44%)	--
Mean gestational age (weeks)	37.8 ± 1.2	38.3 ± 1.0	0.04

The mode of onset of labor was studied in both groups. Induction of labor was more common in women with borderline AFI compared to the normal AFI group [Table 2].

Table 2: Onset of labor and induction requirement

Parameter	Group A (n=50)	Group B (n=50)	p-value
Spontaneous onset	28 (56%)	38 (76%)	0.03
Induced labor	22 (44%)	12 (24%)	--

Intrapartum complications were observed more frequently in Group A. The most notable finding was the presence of meconium-stained amniotic fluid, which was higher in the borderline AFI group [Table 3].

Table 3: Intrapartum complications

Complication	Group A (n=50)	Group B (n=50)	p-value
Meconium-stained liquor	12 (24%)	4 (8%)	0.03
Fetal distress (CTG changes)	10 (20%)	5 (10%)	0.18
Prolonged labor	6 (12%)	3 (6%)	0.49

The mode of delivery showed notable differences between the groups. Cesarean deliveries were more common in women with borderline AFI, particularly due to fetal distress and meconium-stained liquor [Table 4].

Table 4: Mode of delivery

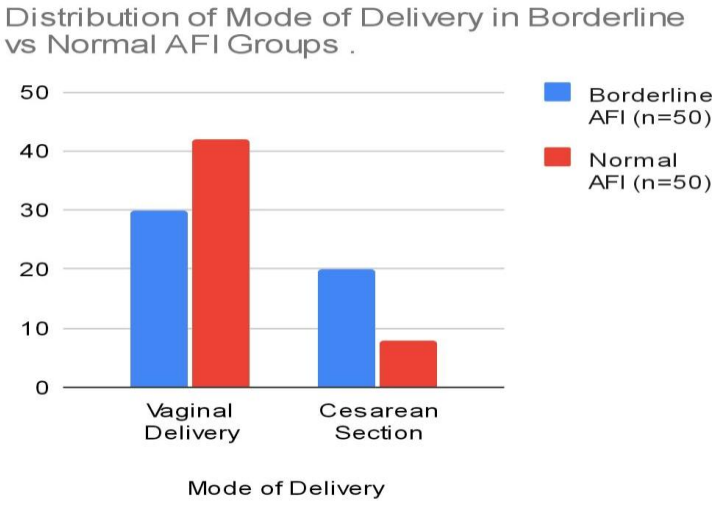
Mode of delivery	Group A (n=50)	Group B (n=50)	p-value
Vaginal delivery	28 (56%)	36 (72%)	0.11
Instrumental delivery	4 (8%)	3 (6%)	0.69
Cesarean section	18 (36%)	11 (22%)	0.04

Perinatal outcomes were assessed in terms of Apgar scores, birth weight, NICU admission, and neonatal morbidity. The mean birth weight was significantly lower in the borderline AFI group. NICU admissions were also higher in this group [Table 5].

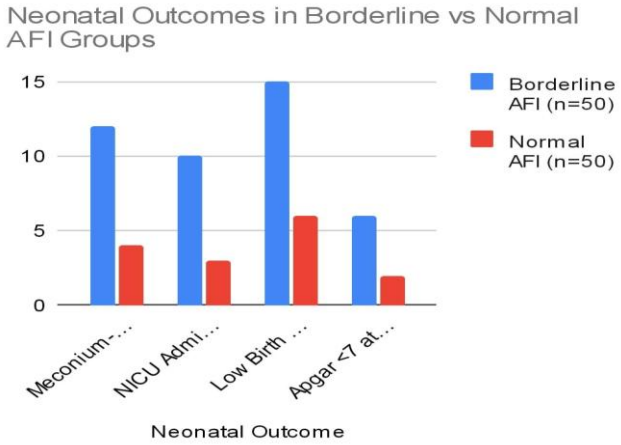
Table 5: Perinatal outcomes

Outcome	Group A (n=50)	Group B (n=50)	p-value
Mean birth weight (kg)	2.64 ± 0.38	2.85 ± 0.40	0.02
Low birth weight (<2.5 kg)	14 (28%)	8 (16%)	0.15
Apgar score <7 at 1 min	10 (20%)	4 (8%)	0.09
Apgar score <7 at 5 min	4 (8%)	2 (4%)	0.67
NICU admissions	12 (24%)	5 (10%)	0.04
Early neonatal morbidity	8 (16%)	3 (6%)	0.11

Bar graph 1: Distribution of Mode of Delivery in Borderline vs Normal AFI Groups.



Bar graph 2: Neonatal Outcomes in Borderline vs Normal AFI Groups.



Discussion

In this study of 100 singleton last-trimester pregnancies at GMC Kathua, we observed that borderline AFI (5.1-8.0 cm) is associated with increased risk of adverse perinatal outcomes including higher cesarean section rates, increased meconium-stained liquor, lower birth weight, and increased NICU admissions. Some outcomes (e.g. Apgar <7 at 1 minute) showed trends, though not always statistically significant in our sample.

Several recently published studies support our findings. A large prospective study "Perinatal Outcomes of Pregnancies with Borderline AFI" found that borderline AFI was significantly associated with lower birth weights, increased cesarean delivery due to fetal distress, and more meconium staining compared to normal AFI pregnancies.**[7]** Similarly, a study from Odisha, India ("Comparison of Perinatal and Maternal Outcomes in Borderline versus Normal AFI in a tertiary care center") reported that women with borderline AFI had significantly more adverse perinatal and maternal outcomes compared to those with normal AFI.**[8]** These align well with our observations concerning birth weight and NICU admissions.

Another recent study published in Ultrasound in Obstetrics &Gynecology ("Association between borderline amniotic fluid levels and adverse perinatal outcomes") examined low-risk singleton pregnancies and found that borderline oligohydramnios carries a higher risk of adverse outcomes such as cesarean delivery for fetal distress, low Apgar scores, and NICU admission.**[9]** These results are compatible with our data: in our cohort, the cesarean rate was higher in the borderline AFI group, and NICU admissions were significantly more frequent.

There are also some studies whose findings differ partially. For example, in a study in Pakistan ("Perinatal Outcome in Patients with Borderline AFI") the incidence of meconium staining, fetal distress, and NICU admission were elevated among borderline AFI pregnancies, but differences in some outcomes such as mode of delivery or Apgar at 5 minutes were either less pronounced or not statistically significant. **[10]** This is roughly similar to our findings where some parameters (such as 5-minute Apgar <7) did not show strong statistical difference. The differences may be due to sample size, obstetric care standards, intrapartum monitoring practices, or timing of AFI measurement relative to delivery.

Borderline AFI may reflect mild reductions in amniotic fluid volume that still allow some cushion and fetal movement, but not enough to fully protect against cord compression, mild placental insufficiency, or other subtle stresses. Reduced fluid volume can increase risk of oligohydramnios conditions, which are well known to be associated with poor perinatal outcomes. Mild hypoxia or subclinical stress may trigger meconium passage, fetal distress, or necessitate early delivery, contributing to increased cesarean sections. Also, compromised fluid volume may reduce fetal growth, resulting in lower birth weight, as seen in our study.

Strengths of this study include well-defined inclusion and exclusion criteria, use of standardized AFI measurement, and collection of multiple neonatal outcomes (birth weight, Apgar, NICU admissions). The sample size (n=100) is reasonable though modest for detecting smaller differences.

Limitations:

Limitations include being a single-centre study in a specific region, which may limit generalizability. The borderline AFI group had only one measurement close to delivery; serial AFI monitoring might give more insight. Some outcomes did not reach statistical significance, possibly due to limited power. Also, we did not assess other modifiers such as Doppler velocimetry, maternal nutritional status, or precise timing of AFI relative to labour onset, which could influence outcomes.

Given the observed association of borderline AFI with adverse outcomes, pregnancies with borderline AFI in the last trimester should be monitored more closely. This may include more frequent antenatal surveillance (non-stress testing, ultrasound growth scans), consideration of earlier induction of labour if signs of fetal distress arise, and ensuring delivery facilities are prepared for NICU needs. Obstetric protocols in GMC Kathua may consider borderline AFI as a risk factor warranting intensified care.

Conclusion

This study demonstrates that borderline amniotic fluid index (AFI 5.1–8.0 cm) in the last trimester is associated with increased risk of adverse perinatal outcomes. Pregnancies with borderline AFI had higher rates of cesarean section, particularly for fetal distress, increased incidence of meconium-stained amniotic fluid, lower mean birth weight, and higher neonatal intensive care unit (NICU) admissions compared to pregnancies with normal AFI. Some parameters, such as low Apgar score at 5 minutes, showed a trend but did not reach statistical significance, possibly due to sample size limitations.

The findings suggest that borderline AFI should not be considered entirely benign, even in otherwise low-risk pregnancies. Enhanced antenatal surveillance, careful intrapartum monitoring, and timely interventions may improve neonatal outcomes in this group. Local obstetric protocols may consider incorporating borderline AFI as a risk factor warranting closer observation, preparation for potential NICU support, and individualized labor management.

Further multicentric studies with larger sample sizes, serial AFI monitoring, and incorporation of additional fetal assessment tools (such as Doppler velocimetry) are recommended to better define the clinical implications and to develop standardized management guidelines for pregnancies with borderline AFI.

Conflict of interest: Nil
Funding: Nil

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