

Borderline Amniotic Fluid Index in Late Pregnancy and its Relationship with Perinatal Outcome

Dr. Nibras Ali Raheem

*M.B.Ch.B., C.A.C.M.S. \ (Obstetrician and Gynecologist), Iraqi Ministry of Health, Basrah Health Directorate, Al-Mawani Teaching Hospital, Basrah, Iraq
nibrasali679@yahoo.com*

Dr. Wijdan Adnan Khudhair

*M.B.Ch.B., C.A.C.M.S. \ (Obstetrician and Gynecologist), Iraqi Ministry of Health, Basrah Health Directorate, Al-Fayhaa Teaching Hospital, Basrah, Iraq
mayahajdan@gmail.com*

Dr. Samah Jaber Khudhur

*M.B.Ch.B., C.A. B.O.G. \ (Obstetrician and Gynecologist), Iraqi Ministry of Health, Basrah Health Directorate, Basrah Maternity and Children Hospital, Basrah, Iraq
ahmedalhaddad78@gmail.com*

Annotation: The volume of the amniotic fluid is an important indicator of fetal health during late pregnancy. Overt oligohydramnios is an established risk factor that is associated with unfavorable outcomes. This study sought to compare birth outcomes of pregnancies whose AFI is borderline and those whose AFI is normal at term (37–41) weeks.

A cross-sectional study of 105 singleton pregnancies was carried out. The participants were stratified into two cases, namely Borderline AFI (n=50) and Normal AFI (n=55). We analyzed the two groups on clinical outcomes, labor and delivery data, neonatal biometric parameters, Apgar scores, umbilical artery pH, and neonatal morbidity.

All baseline demographics were similar except that there was a greater percentage of preeclampsia in the borderline AFI group (14.0% vs. 3.6%). Borders AFI pregnancies had much greater labor induction (56.0% vs. 32.7%) and cesarean delivery due to fetal distress (20.0% vs. 7.3%). There were also reduced mean birth weight (3050 g vs. 3280 g), increased small-for-gestational-age (24.0% vs. 9.1%), reduced 1-minute Apgar (median eight vs. 9), and reduced umbilical artery pH (7.23 vs. 7.26) in the borderline group of neonates. AFI value had a positive relationship with the percentile of birth weight ($r=0.32$, $p=0.001$).

The statistically significant symptoms of borderline AFI during late pregnancy are a statistically significant rise in obstetric operations, restricted fetal growth, and worse neonatal outcomes, including a composite outcome of perinatal morbidity. The results indicate that borderline AFI is no longer a benign form of normal and should be placed under more careful antenatal examination.

Keywords: AMNIOTIC FLUID INDEX (AFI); DELIVERY OUTCOMES OF PREGNANT WOMEN, AND MORBIDITY CHARACTERISTICS OF NEONATAL.

Introduction

Amniotic fluid plays a significant role in the development of the fetus since it is a form of protection, giving the fetus the ability to move, develop lungs, and maintain body temperature, and safeguard the fetus against external trauma [1, 2]. An ultrasonographic index is normally applied to determine the size of the amniotic fluid, and the normal range is between 5 and 25 cm in amniotic fluid index (AFI) [3]. However, it is a contentious parameter in clinical practice as borderline AFI is a grey zone in

between the conventional limits (typically 58 cm or 2425 cm), the meaning of which with regard to the perinatal outcomes is ambiguous [4]. Whereas the existence of oligohydramnios (AFI 5 cm or less) and polyhydramnios (AFI 25 cm or more) is obviously a risk factor in the scenario concerning adverse pregnancy results, the usefulness of borderline AFI during late pregnancy is less explicit. [5]

The volume of the amniotic fluid is critical in the third trimester of pregnancy, which is a crucial time due to the fact that fetuses produce urine, learn to swallow food, and the placental functioning [6]. A range of AFI is not in the expected range, which can be a sign of placental insufficiency, constriction of fetal growth, or congenital anomalies. Borderline AFI is a diagnostic trap since it might be a temporary physiologic reaction, or an initial sign of pathophysiological events [7]. Those females with borderline-low AFI (5 to 8 cm) are more susceptible to non-reassuring fetal conditions, low birth weight, and neonatal intensive care unit (NICU) hospitalization, but the borderline-high AFI may be linked to macrosomia or gestational diabetes. [8, 9]

The relationship between the borderline AFI and the perinatal outcomes is further complex because of the variances in the practice of clinical care in the areas of monitoring and management [10]. There are more clinicians supporting surveillance, which includes non-stress tests and biophysical profiles, and some are conservative because of the chance of false-positive diagnoses leading to unnecessary interventions [11]. In addition to the gestational age of the time of detection, maternal comorbidities and fetal growth patterns may change the risks of borderline AFI, which puts forward the significance of a more complicated and personalized assessment [12]. The objective of the study is to determine the relationship between the amniotic fluid index during late pregnancy on subsequent perinatal outcomes, mode of delivery, fetal distress, birth weight, Apgar scores, and neonatal morbidity.

Method

It was a cross-sectional study that was carried out over a period of 12 months in a tertiary care maternity hospital in Basrah, Iraq, to determine the relationship between a borderline amniotic fluid index (AFI) in late pregnancy and perinatal outcomes. The sample used in the study was 105 singleton pregnancies that had a gestation period of 37 weeks or above and an AFI postnatal ultrasound that was carried out within seven days of delivery. The electronic medical record system of the hospital of antenatal ultrasound was used to select the study sample. According to the traditional clinical cut-offs, the key exposing variable was the AFI reading, with the scores set to the Borderline AFI Group (AFI 5.0 cm to 8.0 cm, n=50) and the Normal AFI Group (AFI 8.0 cm to 24.0 cm, n=55). The diagnosis of borderline AFI was done using the standard four-quadrant method as done by certified sonographers, and all measurements were verified by a consultant obstetrician.

The collection of data was done through a systematic review of the medical records of mothers and neonatal medical records. Essential demographic and obstetric data, like the maternal age, parity, body mass index (BMI), gestational age of AFI measurement, and comorbidity (preeclampsia and gestational diabetes), were also observed as baseline. The parameters of labor and delivery that were obtained were the rate of labor induction, mode of delivery, length of labor, and evidence of cesarean section.

The results of neonatal medical practice were considered in a comprehensive manner. Apgar scores at 1 and 5 minutes were used to measure the level of neonatal well-being and the analysis of the umbilical cord arterial blood gas (pH). The adverse perinatal outcome of interest was a composite adverse perinatal outcome, which included the following: admission to the neonatal intensive care unit (NICU), meconium-stained liquor, clinical signs of aspiration syndrome, and an umbilical artery pH of less than 7.10. The secondary outcomes were personal neonatal morbidity (hypoglycemia, hyperbilirubinemia using phototherapy) and postpartum maternal outcome (postpartum bleeding, endometritis, length of stay).

Data were statistically analyzed with the help of the SPSS application (Version 24.0). The descriptive statistics were in the form of means + SD of continuous variables, which were normally distributed, and percentages of frequencies of categorical variables. The correlation coefficient to measure the

strength of the relationship between AFI and birth weight percentile was done using the Pearson correlation coefficient. To identify independent predictors of composite adverse outcome and delay potential confounders, a multivariate logistic regression model was constructed, which included variables with p less than 0.10 in univariate analysis.

Results

The baseline traits of the 105 women based on the stratification of borderline (n=50) and normal (n=55) Amniotic Fluid Index (AFI) were mostly comparable. Mothers' age, gestational age at AFI measurement, rate of nulliparity, and pre-pregnancy Body Mass Index showed no statistically significant differences. Nonetheless, the incidence of preeclampsia was much higher in the borderline AFI group (14.0%) as opposed to the normal AFI group (3.6%, p=0.048). This observation indicates that low amniotic fluid volume is correlated with the vascular pathology of the placenta.

Table 1. Demographic and obstetric characteristics of 105 patients who enrolled in this study.

Characteristic	Total Cohort (N=105)	Borderline AFI Group (n=50)	Normal AFI Group (n=55)
Maternal Age (years)	28.4 ± 4.7	28.1 ± 4.9	28.7 ± 4.5
Gestational Age at AFI (weeks)	38.9 ± 1.1	39.1 ± 1.0	38.7 ± 1.2
Nulliparity, n (%)	44 (41.9%)	23 (46.0%)	21 (38.2%)
Body Mass Index (kg/m ²)	26.1 ± 3.8	26.5 ± 3.9	25.7 ± 3.7
Preeclampsia, n (%)	9 (8.6%)	7 (14.0%)	2 (3.6%)
Gestational Diabetes, n (%)	12 (11.4%)	6 (12.0%)	6 (10.9%)

The most widespread sign in the borderline AFI group was suspicion of fetal growth retardation (suspected SGA/poor growth) at 42.0, almost twice as common as in the normal AFI group (25.5%). On the other hand, the normal AFI group had more frequent routine assessments (43.6% vs. 32.0%). The suspicions of clinicians in terms of compromised fetal condition (growth problems, reduced movements) were more frequently supported by a result of borderline AFI, whereas a normal scan was more common in regular examinations.

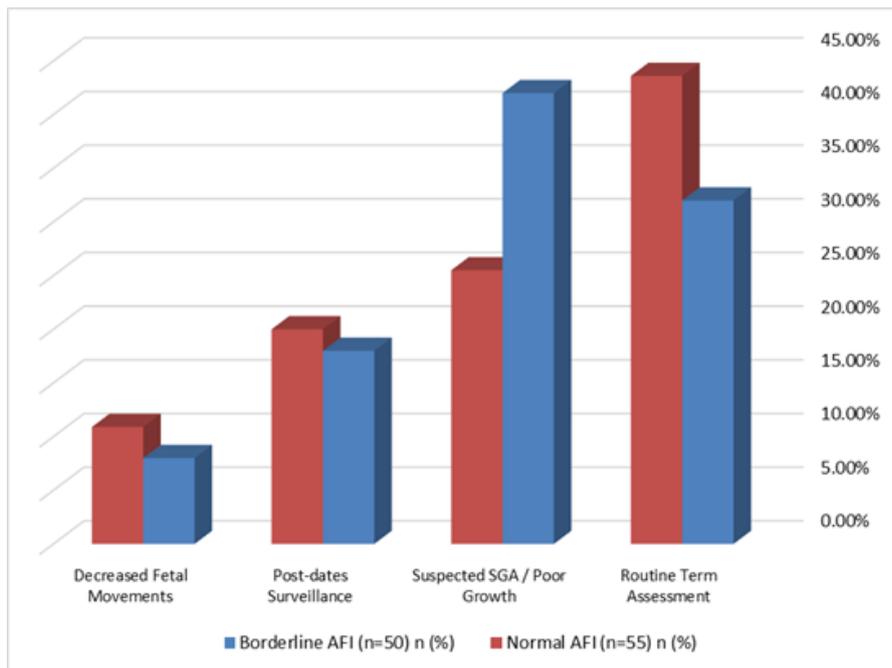


Figure 1. Determining the main indicators in the amniotic fluid index intervention.

Borderline AFI was closely interconnected with a more complicated labor course. The induction rate of this group was much higher (56.0% vs. 32.7%, $p=0.017$), which is suggestive of a standard clinical intervention of oligohydramnios. Women who developed the borderline AFI had a longer labor (9.2 vs. 7.8 hours, $p=0.026$) and were more likely to encounter a cesarean section because of fetal distress (20.0% vs. 7.3%, $p=0.049$) after being in labor. The overall cesarean section rate was also greater (32.0% vs. 18.2%), though it had a tendency towards a significant difference ($p=0.098$). These results present the direct impact of borderline AFI on intrapartum management and outcomes.

Table 2. Enroll clinical outcomes of labor and delivery in the 105 patients.

Characteristic	Borderline AFI (n=50)	Normal AFI (n=55)	p-value
Induction of Labor, n (%)	28 (56.0%)	18 (32.7%)	0.017
Cesarean Delivery, n (%)	16 (32.0%)	10 (18.2%)	0.098
Cesarean for Fetal Distress, n (%)	10 (20.0%)	4 (7.3%)	0.049
Duration of Labor (hours), mean \pm SD	9.2 \pm 3.8	7.8 \pm 3.1	0.026

Newborn children of mothers with borderline AFI had evident signs of fetal growth restriction. They were born with a mean birth weight of 230 (3050 g vs. 3280 g, $p=0.001$) lower and were much more likely to be diagnosed with Small for Gestational Age (SGA) (24.0% vs. 9.1%, $p=0.034$). This was also supported by a difference in mean birth length (48.7 cm vs. 49.5 cm, $p=0.024$). The circumference of heads had a new tendency of being smaller, which was not significant. The results prove that borderline AFI is a clinically significant indicator of suboptimal fetal development.

Table 3. Identify neonatal clinical outcomes during the birth period.

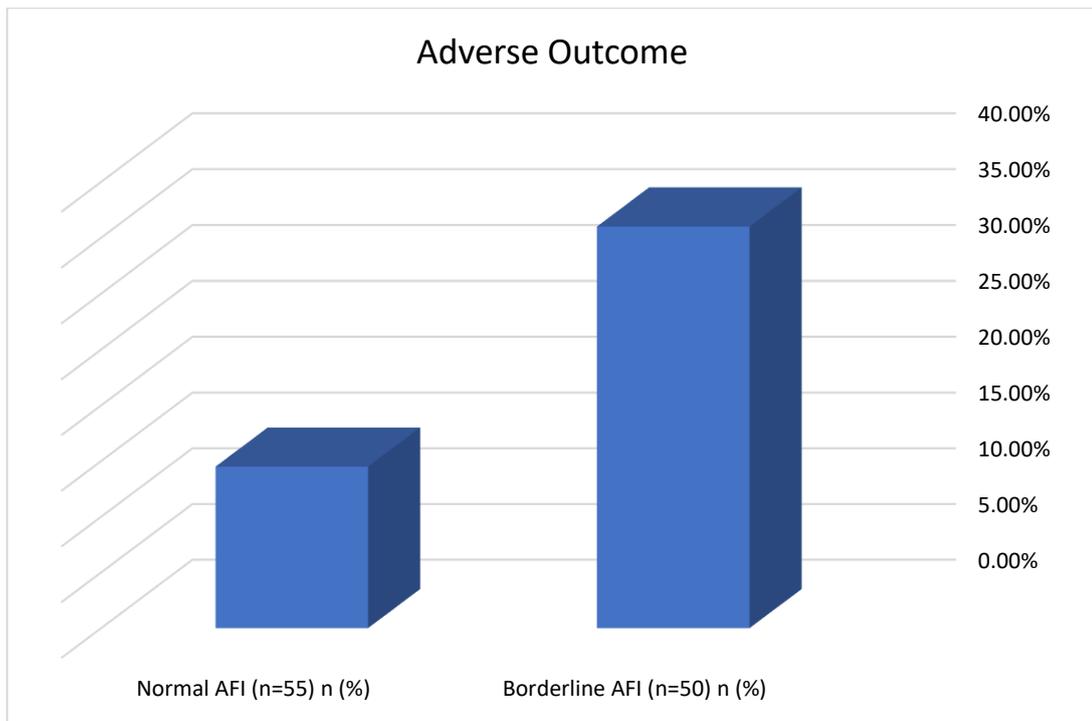
Parameters	Borderline AFI (n=50)	Normal AFI (n=55)	p-value
Birth Weight (grams)	3050 \pm 385	3280 \pm 350	0.001
Birth Weight <10th %ile (SGA), n (%)	12 (24.0%)	5 (9.1%)	0.034
Birth Weight >90th %ile (LGA), n (%)	3 (6.0%)	7 (12.7%)	0.226
Birth Length (cm)	48.7 \pm 2.1	49.5 \pm 1.8	0.024
Head Circumference (cm)	33.8 \pm 1.2	34.2 \pm 1.1	0.071

Their median 1-minute Apgar was lower (8 vs. 9), and, more to the point, their umbilical artery pH was lower (7.23 vs. 7.26), which is a higher level of fetal acidemia. Whereas the prevalence of severe depression (Apgar score <7 at 1 min, pH less than 7.10) was high in the borderline group.

Table 4. Assessment the outcomes of Apgar scores and umbilical artery blood gas.

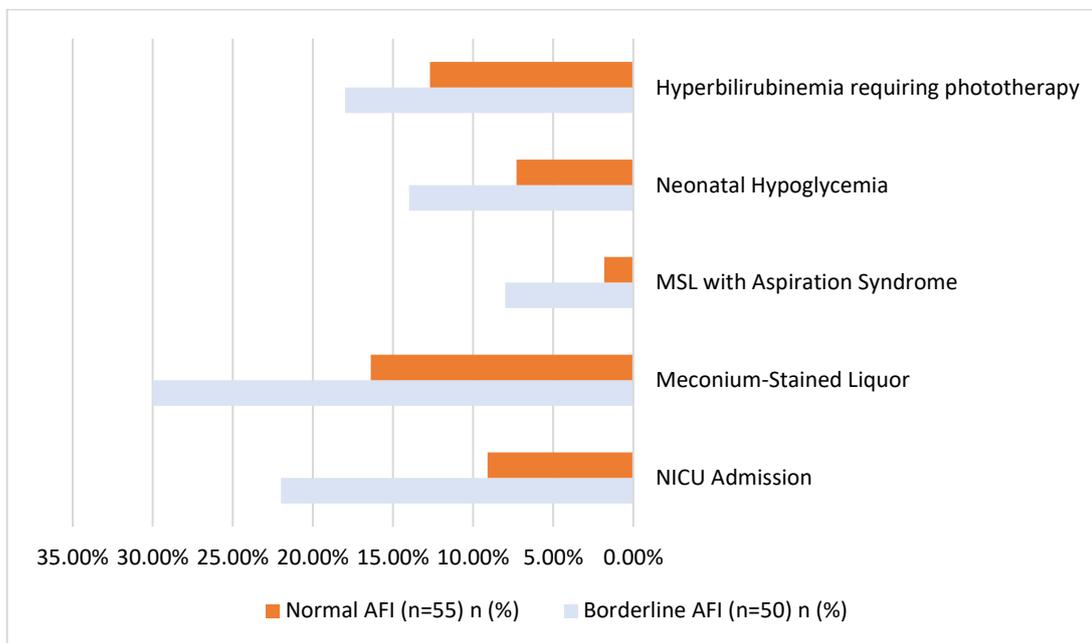
Variables	Borderline AFI (n=50)	Normal AFI (n=55)	p-value
Apgar Score at 1 min, median [IQR]	8 [7-9]	9 [8-9]	0.038
Apgar Score <7 at 1 min, n (%)	6 (12.0%)	2 (3.6%)	0.092
Apgar Score at 5 min, median [IQR]	9 [9-10]	9 [9-10]	0.415
Umbilical Artery pH, mean \pm SD	7.23 \pm 0.06	7.26 \pm 0.05	0.004
Umbilical Artery pH <7.10, n (%)	5 (10.0%)	1 (1.8%)	0.061

Adverse outcomes, including the major neonatal morbidities, happened more than twice in the borderline AFI cohort (36.0% vs. 14.5%, $p=0.010$). There were also reduced mean birth weight (3050 g vs. 3280 g), increased small-for-gestational-age (24.0% vs. 9.1%), reduced 1-minute Apgar (median eight vs. 9), and reduced umbilical artery pH (7.23 vs. 7.26) in the borderline group of neonates.



When analyzing individual morbidities, the trends were consistently in favor of the normal AFI group, although not all of them were statistically significant. NICU admission rates (22.0% vs. 9.1%) and meconium-stained liquor (30.0% vs. 16.4%) were significantly higher in the borderline AFI group, with a p-value of $p= 0.047$ and $p= 0.053$, respectively. Other conditions, such as aspiration syndrome, hypoglycemia, and hyperbilirubinemia, were also more prevalent with borderline AFI.

Figure 2. Distributing the outcomes of adverse perinatal rates.



The distribution of the mode of delivery indicates that there was no longer spontaneous vaginal delivery among the borderline AFI group. Only 48.0 percent of these women delivered spontaneously through the vagina, as was done in normal AFI (67.3 percent). This disparity was balanced with an increment in the instrumental vaginal delivery (20.0% vs. 14.5%) and cesarean delivery (32.0% vs. 18.2%).

Figure 3. Distribution of the neonatal morbidity of the patients who enrolled in this current study.

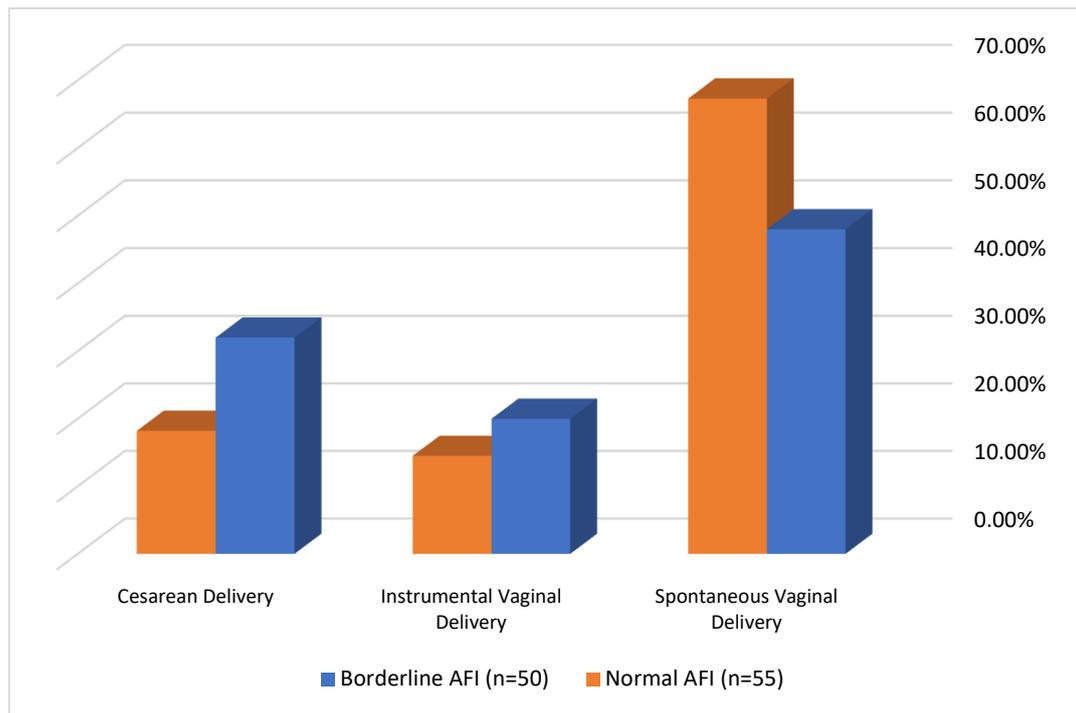


Figure 4. Delivery findings of patients among both groups.

The maternal outcomes were mostly alike, and there was no significant difference between the rates of postpartum bleeding or endometritis. Yet, an interesting observation was that mothers in the borderline AFI group of patients had a significantly longer postpartum hospitalization (3.2 vs. 2.7 per day, $p=0.008$).

Table 5. Establishing of postpartum outcomes of maternal.

Outcome	Borderline AFI (n=50)	Normal AFI (n=55)	p-value
Postpartum Hemorrhage (>500ml), n (%)	6 (12.0%)	4 (7.3%)	0.402
Endometritis, n (%)	2 (4.0%)	1 (1.8%)	0.502
Length of Hospital Stay (days), mean \pm SD	3.2 \pm 1.1	2.7 \pm 0.9	0.008

The multivariate analysis revealed two robust and independent variables that predicted the composite adverse outcome after the effect of possible confounders was controlled. SGA diagnosis was the most risky diagnosis with an adjusted odds ratio (aOR) of 4.5. Even with a controlling variable of SGA status, a borderline AFI in itself was a major independent predictor with an aOR of 3.1.

Table 6. Multivariable logistic regression in the prediction of adverse factors that are indicated in participants.

Variables	Adjusted Odds Ratio (aOR)	95% Confidence Interval	p-value
Borderline AFI (vs. Normal)	3.1	[1.3 - 7.6]	0.012
Gestational Age at Delivery (per week)	0.9	[0.6 - 1.3]	0.520
Small for Gestational Age (SGA)	4.5	[1.8 - 11.2]	0.001
Preeclampsia	2.8	[0.8 - 9.4]	0.098

Discussion

The third-trimester pregnancies characterized by a borderline amniotic fluid index (AFI) continued to be a matter of controversy in clinical practice [13]. This is a condition that is frequently characterized by an AFI of 5.1 cm to 8.0 cm (or between the 5th and 10th percentile on the scale of gestational age), which is a gray area between unequivocally normal and clear oligohydramnios. [14]

The current results added to an increasing number of studies that relate this purportedly small decrease in the volume of amniotic fluid to a statistically significant rise in unfavorable perinatal outcomes. [15]

Past research has always exhibited that a borderline AFI is not a harmless observation. The study has reported that an AFI range of 5.1 to 8.0 cm was related to a high risk of cesarean births as compared to normal AFI through non-reassuring fetal heart rate patterns and low Apgar scores [16,17]. The prospective cohort study established that the pregnancies of a borderline AFI had a higher induction of labor, meconium-stained amniotic fluid, and neonatal intensive care unit (NICU) admissions. Equally, a meta-analysis study concluded that a borderline AFI had a significant effect on elevating the relative risks of cesarean section with regard to fetal distress and low Apgar scores at five minutes.

In addition, fetal urine production was the major contributor to the volume of the amniotic fluid during late pregnancy, which also directly depends on placental activity and fetal blood perfusion. A marginal decrease had been an initial compensatory phase of decreased fetal renal perfusion, commonly as a result of poor uteroplacental exchange. This mild cardiac fetal hypovolemia, or redistribution of cardiac output, impaired the physiological reserve of the fetus, making them less able to withstand the effects of uterine contractions during childbirth. [18, 19]

This was the reason behind the incidence of non-reassuring fetal monitoring and operative deliveries in the past, as well as present data [20]. In addition, the correlation with meconium-stained liquor in the earlier research had some results of fetal hypoxic stress, which resulted in gastrointestinal peristalsis and relaxation of the sphincter [21]. Other previous studies suggested that regular induction of isolated borderline AFI did not add to the outcome of perinatal but instead raised the rate of cesarean delivery. [22]

Conclusion

According to the results of the paper, late pregnancy borderline amniotic fluid index (AFI) is strongly related to the elevated risks of adverse perinatal outcomes. The findings show that borderline AFI pregnancies exposed to normal ones had more labor induction, longer labor duration, and a high rate of cesarean section due to fetal distress. Being in the borderline AFI group, neonates had a low birth weight, increased SGA, a reduced 1-minute Apgar, and a more acidic umbilical artery pH. These pregnancies were at risk of the composite adverse perinatal outcome, which was 2.48 times greater, and the result was robust even after the consideration of confounders in the multivariable analysis, where borderline AFI was an independent predictor (aOR 3.1). Moreover, this also influenced the maternal outcomes, which was indicated by a much longer postpartum hospitalization. The correlation between AFI value and birth weight percentile is further positive, which again demonstrates the clinical significance of the amniotic fluid volume as an indicator of fetal health.

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