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The predictive value of amniotic fluid index for adverse perinatal outcome and its correlation to the biophysical profile and doppler velocimetery of umbilical artery and middle cerebral artery

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ORIGINAL ARTICLE

The Predictive Value of Amniotic Fluid Index for Adverse Perinatal Outcome and Its Correlation to the Biophysical Profile and Doppler Velocimetery of Umbilical Artery and Middle Cerebral Artery

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Abstract

Background: **Amniotic fluid surrounds the fetus during pregnancy and serves a crucial role in the fetus' development. Amniotic fluid could be observed from the very start of the extracelomic cavity's formation. Amniotic fluid represents an ultrafiltrate of maternal plasma in early pregnancy. During the start of the second trimester, it primarily consists of extracellular fluid, which diffuses into the skin of the fetus and so reflects the composition of fetal plasma. Following 20 weeks, the fetal skin cornification, which is mostly made up of fetal urine, prevents this diffusion.**

Method: **The aim of the study was to evaluate whether oligohydramnios or polyhydramnios (amniotic fluid index) may be employed as a predictor of negative perinatal outcomes in noncomplicated pregnancies at term and its correlation with BPP and Doppler velocimetry of UA and MCA. This study included 400 pregnant women who attended the Clinic of Obstetrics and Gynecology Outpatient Clinic at Al-Azhar University Hospitals and Damanhour Teaching Hospital.**

Result: **Our results showed that the AFI was less than 5 in 63 cases (15.8%) and more than 5 in 337 cases (84.3%). On comparing the two groups (<5 AFI and >5AFI) it's been discovered that there wasn't a significant difference between the two groups in terms of age, CA,. There was a significant increase in gravidity, parity and abortion in a group with AFI <5, due to the increasing of previous abortion, there was an increasing in gravidity and parity.**

Conclusion: **The current study's findings show that perinatal results could be adverse in pregnancies with borderline AFI. These pregnancies ought to be closely monitored by regular fetal evaluation, intrapartum surveillance, and neonatal care. Given the lack of agreement on fetal testing, prompt intervention, and intrapartum fetal surveillance, more research is required. In this category of pregnancies, studies using color Doppler evaluation of the cerebroplacental ratio are useful.**

Keywords: Amniotic fluid, Doppler, Perinatal outcome

1. Introduction

Contemporary obstetrics and perinatal medicine are focused on identifying fetuses at risk of damage or mortality in utero, assessing the risk, and figuring out the best timing and method of intervention. Amniotic fluid volume (AFV) clinical estimation is a crucial aspect of fetal evaluation since variations in its amount have been linked to a number of pregnancy complications.[1,2] Amniotic fluid is a complex yellowish fluid that exists between the amniotic sac and the fetus.[3] Amniotic fluid, which is so rich in nutrients and growth factors, is important for lung maturation and has a significant role in embryonic growth.[4]

Amniotic fluid volume variation has been linked to a number of pregnancy problems, making clinical measurement of this fluid's volume an essential component of fetal evaluation. Amniotic fluid quantification is a significant part of the biophysical profile in ultrasonography assessment of fetal health,

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particularly in the 3rd trimester.[2] At 42 weeks, the fluid level drops to about 250 ml. As a way to assess the health of the fetus, antepartum care frequently includes measuring the volume of amniotic fluid at term. AFI changes have always been regarded as an indication of fetal compromise.[5,6]

AF is produced from a variety of sources. Throughout gestation, each source's relative contribution varies. Investigations into patients who have AFV abnormalities can be aided by knowing the sources of the amniotic fluid. Oligohydramnios is most frequently caused by a reduction in fetal urine flow when the membranes have not ruptured; other potential causes have included a decrease in the fetal's renal blood flow and urinary tract obstruction. Amniotic fluid loss is also related to maternal dehydration and reduced placental water flow. Reduced fetal lung fluid flow, on the other hand, is not an etiologic factor in oligohydramnios.[7]

Technological advancements in equipment allowed the study of other fetal vessels like the middle cerebral artery (MCA) and renal arteries, enhancing the identification of fetal well-being disturbances. You can track fetal-placental cell changes by keeping an eye on the Doppler changes, which can help you determine the causes of various fetal co-morbidities.[8]

The study's goal was to evaluate whether oligohydraminios or polyhydramnios (amniotic fluid index) and their correlation with the biophysical profile and umbilical artery Doppler velocimetry and middle cerebral artery may be employed to predict adverse perinatal outcomes in noncomplicated pregnancies at term.

2. Patients and methods

This study has been performed on 400 pregnant women attending the Clinic of Obstetrics and Gynecology Outpatient Clinic at Al-Azhar University Hospitals and Damanhour Teaching Hospital. A full history was taken from all patients with special attention to their menstrual history, medical treatment for any systemic diseases such as (diabetes mellitus, renal diseases, liver diseases, and heart disease), use of contraception, past history of any investigation, or any operation and family history of importance. General, abdominal examinations, pelvic examination and laboratory investigations 'CBC, random blood sugar, urine analysis for ketone bodies and proteins, …etc' was done. Pelvic examination was done in the form of inspection gestational age '34–40 weeks', digital palpation, and bimanual examination to detect any sign of infection or any abnormality. All patients were directed for transvaginal ultrasound to detect the ultrasonographic criteria of the gravid uterus.

The amniotic fluid index was determined using the Phelan's technique at the onset of labor. Using that technique, an AFI of 5 cm or less is defined as oligohydramnios. Quantification of amniotic fluid is an important component of the biophysical profile in ultrasound evaluation of fetal well-being, especially in the third trimester. Links have been found between decreased amniotic fluid volume and the nonreactive nonstress tests, FHR declarations, cesarean sections for fetal distress and low APGAR scores. The amniotic fluid index has been measured by placing the pregnant women in the supine position. The uterus has been divided into 4 quadrants using the maternal sagittal midline vertically and an arbitrary transverse line approximately midway between the pubic symphysis and the upper edge of the uterine fundus. Deepest, unobstructed, clear pocket of amniotic fluid has been visualized in each quadrant, and all the 4 pockets of measurement has been summed together to determine the AFI with the transducer held vertically. The patient positioning is supine with the understanding that some of the gravid patients may become very uncomfortable lying horizontally. Accuracy is ensured by establishing fetal lie, natural tilt of the uterus, and size of the uterus. Near term, the umbilicus is a common center point for determining quadrants in the AFI.

The gestational age of the pregnancy and fetal size, this landmark can be deceiving, and probe positioning should be adjusted to achieve four roughly equal quadrants. The curvilinear probe is used with the depth ranging from 10 to 15 cm for most patients. Again, to ensure accuracy and reproducibility in the fluid assessment, the probe should be held in the sagittal plane and parallel to the bed, taking care not to angle the probe cephalad or caudal. Measurements are taken in the vertical plane in a pocket of fluid that does not contain limbs or umbilical cord.

At the time of delivery, the following variables has been collected: the nature of the liquor were clear, thin or thick meconium, fetal heart rate monitoring by CTG (Cardio Tocography), mode of delivery. The end points used to judge perinatal outcome are fetal distress, 1 min and 5-min APGAR score judged by independent observer-pediatrician. APGAR score <7 was considered as abnormal, birth weight, frequency of admission to NICU, perinatal death-death of the baby in the first 7 days, collected data was analyzed with the appropriate statistical test for final outcome.

3. Result

This study has been performed on 400 pregnant women attending the Clinic of Obstetrics and Gynecology Outpatient Clinic at Al-Azhar University Hospitals and Damanhour Teaching Hospital. Age

ranged from 24 to 38 with mean value 31.27 ± 4.18 and GA ranged from 34 to 40 with mean value 36.92 ± 2.07 as in (Table 1, Fig. 1).

Gravidity 3 was higher 122 (30.5%) followed by gravidity 4 with 105 (26.3%). Parity 3 was higher 112 (28%) followed by parity 2 with 104 (26%). Cases without previous abortion were higher with 365 (91.3%), cases without medical treatment were higher with 353 (88.3%) and cases without operative history were higher with 365 (91.3%) as described in (Table 2, Fig. 2).

AFI >5 was higher with 337 (84.3%). Clear nature of liquor was higher with 173 (43.3%) followed by thin 171 (42.8%) and thick 56 (14%) as described in (Table 3, Fig. 3).

Cases with NVD delivery were higher 205 (51.3%), normal fetal heart rate monitoring CTG was higher 326 (81.5%), cases without fetal distress were higher 325 (81.3%), normal APGAR 1 min was higher 326 (81.5%), normal PGAR 5 min was higher 326 (74%), cases with normal weight were higher 327 (81.8%), cases without NICU were higher 348 (87%) and cases without perinatal mortality with 7 days were higher 361 (90.3%) as in (Table 4, Fig. 4).

Fetal distress and NICU had the higher ratio in sensitivity 85.6% and 84%, specificity 82.4% and 80.1%, accuracy 83.8% and 82.3%, respectively as in (Table 5).

Table 1. Distribution of the group under study concerning their age and gestational age.

	Number (%)
Age (years)	
<30	148 (37.1)
30–35	180 (45.1)
>35	72 (18.1)
Range	24–38
Mean ± S.D.	31.27 ± 4.18
GA (weeks)	
<35	124 (31)
36–38	156 (39.1)
>38	120 (30)
Range	34–40
Mean ± S.D.	36.92 ± 2.07
Total	400 (100.0)

Table 2. Distribution of the studied patients groups regarding maternal and medical history.

	Number (%)
Gravidity	
1	78 (19.5)
2	95 (23.8)
3	122 (30.5)
4	105 (26.3)
Parity	
1	87 (21.8)
2	104 (26.0)
3	112 (28.0)
4	97 (24.3)
Previous abortion	
No	365 (91.3)
Yes	35 (8.8)
Medical treatment	
No	353 (88.3)
Yes	47 (11.8)
Operative history	
No	365 (91.3)
Yes	35 (8.8)
Total	400 (100.0)

Low APGAR score and perinatal mortality had the higher ratio in sensitivity 79% and 78.4%, specificity 82% and 81.4%, accuracy 79.5% and 78.9%, respectively as in (Table 6).

The fetal distress and perinatal mortality had the higher ratio in sensitivity 79.4% and 78.3%, specificity 84.4% and 83.3%, accuracy 81.9% and 82.8%, respectively as in (Table 7).

4. Discussion

The development and growth of the fetus are significantly influenced by amniotic fluid. It offers a safe, low-resistance environment that is ideal for the fetus' development and growth. It acts as a cushion against the tightening constraints of the gravid uterus, enabling the fetus room for movement and growth while also shielding it from external damage. It aids in the maintenance of fetal body temperature and fluid balance and the prevention of joint contractures by allowing limb extension.[9]

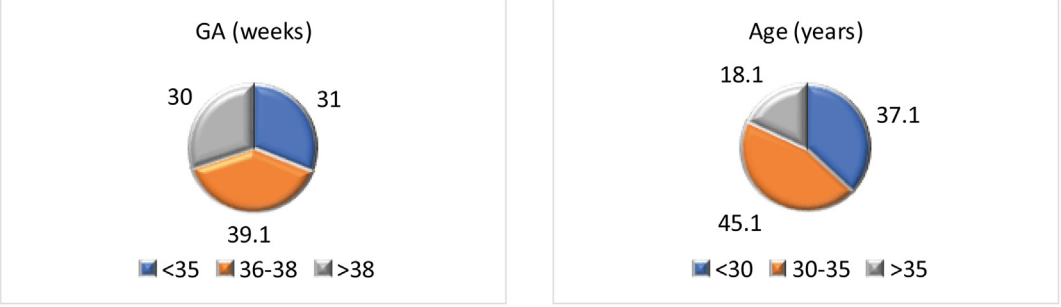

Fig. 1. Distribution of the studied group regarding their age and gestational age.

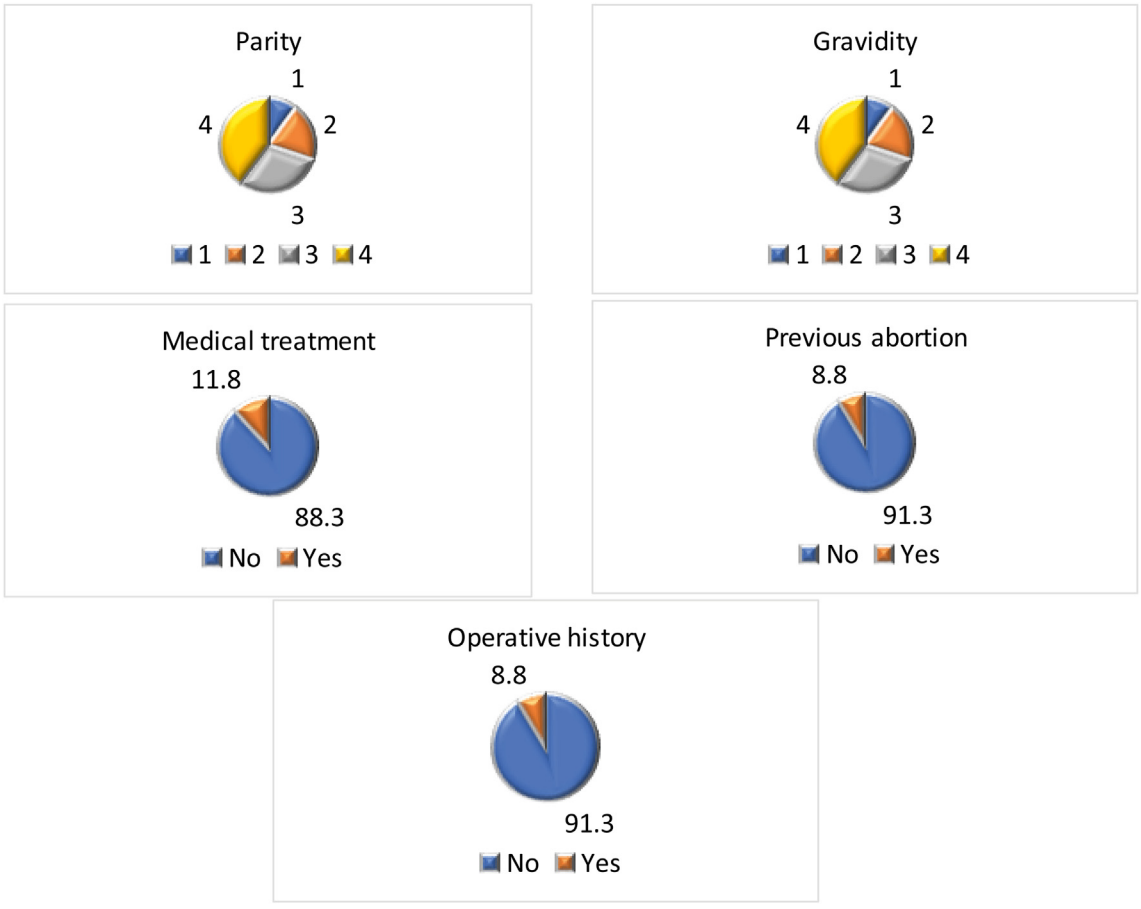

Fig. 2. Distribution of the studied patients groups regarding maternal and medical history.

Table 3. Distribution of the studied group regarding AFI and nature of liquor.

	Number (%)
AFI	
<5	63 (15.8)
>5	337 (84.3)
Nature of liquor	
Clear	173 (43.3)
Thin	171 (42.8)
Thick	56 (14.0)
Total	400 (100.0)

The fetus is shielded from vascular and nutritional impairment because it prevents umbilical cord compression. Fluid volume anomalies could, therefore directly interfere with fetal development or be an indirect symptom of an underlying illness, including fetal hypoxia, neural tube abnormalities, or gastrointestinal blockage. Oligohydramnios is defined as having an amniotic fluid index (AFI) of ≤5 cm, as first documented by.[10]

Several studies have demonstrated the link between oligohydramnios and a number of

Fig. 3. Distribution of the studied group regarding AFI and nature of liquor.

Table 4. Distribution of the studied group regarding mode of delivery and fetal outcome.

	Number (%)
Mode of delivery	
NVD	205 (51.3)
CS	195 (48.8)
Fetal heart rate monitoring CTG	
Normal	326 (81.5)
Abnormal	74 (18.5)
Fetal distress	
No	325 (81.3)
Yes	75 (18.8)
APGAR 1 min	
Normal	326 (81.5)
Low	74 (18.5)
PGAR 5 min	
Normal	326 (81.5)
Low	74 (18.5)
Birth weight	
Normal weight	327 (81.8)
Low birth weight (<2.5 Kg)	73 (18.3)
NICU	
No	348 (87.0)
Yes	52 (13.0)
Perinatal mortality with 7 days	
No	361 (90.3)
Yes	39 (9.8)

unfavorable pregnancy results, including fetal distress, low birth weight, perinatal illness, perinatal death, and a higher need for c-sections. Nevertheless, several studies demonstrate that AFI is a poor indicator of negative outcomes, and the existence of an entity such as the solitary term oligohydramnios was called into question by certain writers. So, the purpose of this study is to determine if an antepartum AFI of 5 cm or lower is a reliable indicator of poor pregnancy outcomes.[11]

While numerous ranges were proposed for its definition, the majority of investigations have adopted the 5–8 cm range. Several studies regarded the definition as between 5 and 10 cm, while others employed the percentile range of 2.5–5. Borderline AFI appears to have a more widely accepted range of 5–8 cm.[12]

The findings on the potential risks of borderline amniotic fluid are inconsistent. Asgharnia et al. found that pregnancies with borderline amniotic fluid were more likely to result in preterm delivery, labor induction, low Apgar scores (IUGR), and neonatal (NICU) admission; however,[13] did not reach the same conclusion in a recent study.[12–14]

AFIs of 5 cm or less have been used as the standard definition of oligohydramnios in most research, and the complications they cause for the mother and the fetus have been established. About the borderline AFI range, there are several opinions. A borderline AFI is described as falling between 5 and 8 cm in a study by Phelan et al. A borderline AFI is additionally described by Gumus and Banks as an AFI between 5.1 and 10.[9–16]

Despite conflicting findings on borderline AFI in various studies, there are divergent opinions on how it affects maternal and fetal problems as well as fetal health care. When compared to control individuals who had normal amniotic fluid levels (8.1–18 cm) (8–10, 14–16), pregnant women with borderline AFI of 5–10 cm had outcomes like nonreactive nonstress tests, FHR deceleration, meconium aspiration, immediate caesarean section, low Apgar score, LBW, NICU admission, and SGA. Moreover, a low amniotic index may boost the rate of surgical delivery.[17] Hence, despite a large number of studies, it is not totally clear if borderline AFI predicts an unfavorable pregnancy outcome, and prenatal evaluation in women with borderline AFI is not advised.[11] The majority of research, however, indicates that borderline AFI values ought to be carefully interpreted and that a diagnostic sonography ought to be performed to verify SGA and IUGR even, while there is not enough data or indication to start antenatal testing.[11] Due to inconsistencies and limited data regarding delivery depending on a borderline AFI, more research is required. After controlling for confounding factors, the present study compares the pregnancy results of women with borderline versus normal AFIs.[13]

Our results showed that the AFI was less than 5 in 63 cases (15.8%) and more than 5 in 337 cases (84.3%). On comparing the two groups (<5 AFI and > 5AFI) it's been discovered that there wasn't a significant difference between the two groups in terms of age, CA. There was a significant increase in gravidity, parity and abortion in a group with AFI <5, due to the increasing of previous abortion, there was an increasing in gravidity and parity. The medical treatment an operative history was significantly higher in the AFI <5 group. Regarding the nature of liquor, there was a significant increase in clear liquor in group AFI >5, on the other side, the thick liquor was significantly higher in AFI <5, also, there was a significant increase in CS in AFI <5 group more than the AFI >5.

In our results, the fetal outcome it was found that abnormal fetal heart rate and increasing fetal distress was found in the AF <5 group more than AFI >5. On the other hand, the APGAR score at 1 and 5 min and birth weight show a significant decrease in AFI K < 5 group. The incidence of NICU and perinatal mortality within 7 days was significantly higher in AFI <5 group. The umbilical and middle cerebral artery pulsatility index shows a significant relation with AFI <5. The AFI had a high

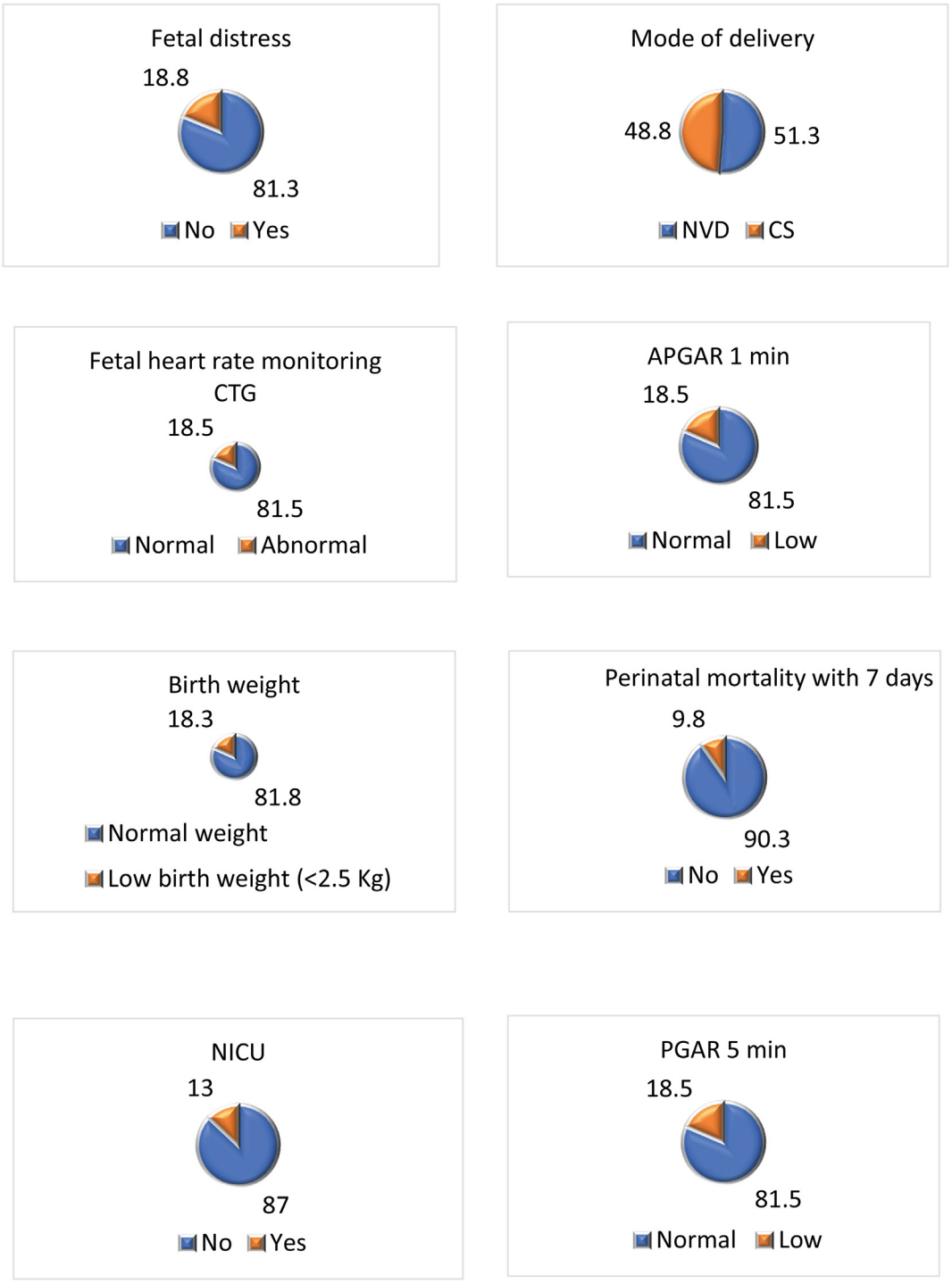

Fig. 4. Distribution of the studied group regarding mode of delivery and fetal outcome.

Table 5. Sensitivity, specificity and accuracy of AFI in predict the fetal outcome.

AFI <5	Sensitivity	Specificity	Accuracy
Fetal heart rate abnormality	82.0%	85.3%	80.1%
Fetal distress	85.6%	82.4%	83.8%
Low APGAR score	77.0%	80.0%	79.0%
Low birth weight	77.1%	83.0%	79.1%
NICU	84.0%	80.1%	82.3%
Perinatal mortality	78.5%	82.6%	80.7%

Table 6. Sensitivity, specificity and accuracy of umbilical artery pulsatility index in predict the fetal outcome.

Umbilical artery pulsatility index	Sensitivity	Specificity	Accuracy
Fetal heart rate abnormality	75.6	79.6	76.6
Fetal distress	69.5	74.5	71
Low APGAR score	79	82	79.5
Low birth weight	74.1	78.1	78.1
NICU	69.8	74.8	73.3
Perinatal mortality	78.4	81.4	78.9

Table 7. Sensitivity, specificity and accuracy of middle cerebral artery pulsatility index in predict the fetal outcome.

Middle cerebral artery pulsatility index	Sensitivity	Specificity	Accuracy
Fetal heart rate abnormality	73.4	77.4	75.4
Fetal distress	79.4	84.4	81.9
Low APGAR score	77.2	81.2	81.2
Low birth weight	72	77	73.5
NICU	68.4	73.4	70.9
Perinatal mortality	78.3	83.3	82.8

sensitivity and specificity in predict fetal heart rate abnormality, fetal distress, low APGAR score, LBW, NICU and perinatal mortality.

4.1. Conclusion

The current study's findings show that perinatal results could be adverse in pregnancies with borderline AFI. These pregnancies ought to be closely monitored by regular fetal evaluation, intrapartum surveillance, and neonatal care. Given the lack of agreement on fetal testing, prompt intervention, and intrapartum fetal surveillance, more research is required. In this category of pregnancies, studies using color Doppler evaluation of the cerebroplacental ratio are useful.

Conflicts of interest

No conflict of interest: yes.

Acknowledgements

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