

The Relation of Intrapartum Amniotic Fluid Index to Perinatal Outcomes

Intrapartum Amniyos Sıvısı İndeksinin Perinatal Sonuçlarla İlişkisi

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ABSTRACT

AIM: To grade and classify the severity of decreased amniotic fluid index (AFI) in term parturients in relation with intrapartum and perinatal outcomes.

METHODS: Term parturients (n=700) with intact amniotic membranes were studied in four amniotic fluid index (AFI) groups: 1) $3\text{cm} \leq \text{AFI}$; 2) $3\text{cm} < \text{AFI} \leq 5\text{cm}$; 3) $5\text{cm} < \text{AFI} \leq 8\text{cm}$ and 4) $8 < \text{AFI} \leq 24\text{cm}$. Demographic, physical and ultrasonographic findings and perinatal outcomes were analyzed.

RESULTS: AFI decreased by the advancing gestational age. Advancing severity of the decreased AFI levels correlated strongly with the increased rates of cesarean birth, meconium in the amniotic fluid, abnormal fetal hearth rate trace findings, fetal distress and the post date pregnancies. The demographics and the initial cervical examinations were unrelated with the AFI measurements.

CONCLUSION: In low risk pregnancies advancing severity of the decrease in amniotic fluid volume, gestational age dependent or not, increases the ratios of pathological fetal hearth rate trace changes, diagnosis of fetal distress and the fetal distress indications which lead to cesarean deliveries. The AFI of $\leq 3\text{cm}$ influences negatively the 1st minute Apgar score.

Key words: labor and delivery, antenatal care and diagnosis, fetal monitoring, amniotic fluid index, perinatal outcome, oligohydramnios, intrapartum ultrasonography

ÖZET

AMAÇ: Miadında gebelerde azalmış amniyos sıvısı indeksini intrapartum ve perinatal sonuçlarla ilişkilendirerek derecelendirmek ve sınıflamak

YÖNTEM: Miadındaki gebeler (n=700) amniyos sıvısı indeksi (ASI) gruplarının 1) $3\text{cm} \leq \text{ASI}$; 2) $3\text{cm} < \text{ASI} \leq 5\text{cm}$; 3) $5\text{cm} < \text{ASI} \leq 8\text{cm}$ and 4) $8 < \text{ASI} \leq 24\text{cm}$ olmasına göre incelendiler. Demografik, muayene ve ultrasonografi bulguları ve perinatal sonuçlar analiz edildi.

BULGULAR: ASI ilerleyen gebelik haftasıyla birlikte azaldı. ASI azalmasının şiddetlenmesi Sezaryen doğum, amniyos sıvısında mekonyum, fetal kalp hızı traselerinde anormal bulgu, fetal distress ve miad aşımı oranlarının artışlarıyla güçlü korelasyonlar gösterdi. Demografik bulgular ve başlangıç servikal muayene bulgularıyla ASI arasında ilişki saptanmadı.

SONUÇ: Düşük riskli gebelerde amniyos sıvısı hacminin azalması, gebelik yaşına bağlı ya da bağımsız, patolojik fetal kalp hızı bulguları, fetal distress tanısı ve fetal distress tanılı sezaryen doğum oranlarını artırır. $\text{ASI} \leq 3\text{cm}$ olduğunda 1. dakika Apgar skoru da olumsuz etkilenir.

Anahtar kelimeler: doğum eylemi ve doğum, antenatal bakım ve tanı, fetal monitorizasyon, amniyos sıvısı indeksi, perinatal sonuçlar, oligohidramnios, intrapartum ultrasonografi

The detection of antepartum or intrapartum oligohydramnios has been reported to increase the risks of meconium stained amniotic fluid, abnormal fetal heart rate traces, and fetal distress related operative deliveries¹⁻⁹. A significant decrease of amniotic fluid volume (AFV) below 1 cm detected by using the approach of vertical measurement of the deepest amniotic fluid pouch has also been defined as abnormal for biophysical profile studies⁶. Several studies have demonstrated the negative effects of oligohydramnios on postterm pregnancy outcomes⁹⁻¹² and a frequent association with intrauterine growth restriction (IUGR)^{9,13-15}. Nevertheless, other researchers have found oligohydramnios associated with IUGR to be a poor predictor of peripartum complications¹⁶.

The Amniotic Fluid Index (AFI), which was designed by Phelan and better reflects the intrauterine content, seems to be more advantageous than the measurement of the single deepest amniotic fluid pouch¹⁷. However, there are contradictory studies

emphasizing the result of AFI measurement which causes more interventions in comparison to the single deepest pocket technique^{18,19}. Some authors have even concluded that no improvement in the perinatal outcome was achieved even when AFV was determined in patients in early labor²⁰.

According to Sarno, in pregnancies with an AFI less than 5cm, the chances of fetal distress related cesarean deliveries and low 1st minute Apgar Scores increase³. However, an AFI of less than 5 cm is below the 1st percentile of normal pregnancy between 37-43 weeks²¹.

Previous studies have stated that a decreased AFI increases the incidence of meconium stained amniotic fluid and the number of cesarean deliveries complicated by fetal distress^{3,5,22}. However, the pregnant groups included in these studies were relatively small and also included both pregnancies with uncompleted fetal maturity and pregnancies that could interfere with neonatal outcomes.

In one well-conducted study, researchers were unable to identify pregnancies at risk of an adverse outcome using AFV measurements taken by AFI and the single deepest vertical pocket measurement²³. In order to further investigate these conflicting facts, we decided to study AFI in a low risk term pregnancy group. We hypothesised that increasing severity of oligohydramnios in pregnant women with intact membranes would increase the rates of fetal distress and cesarean deliveries.

Materials and Methods

The study was performed in Bakırköy Maternity, Women's and Children's Health Educational Hospital /Istanbul. Pregnant women (n=700) evaluated in the active phase of labour with intact amniotic membranes were included in this prospective observational study. Gestational age was established by the first date of the last menstrual period and confirmed by first trimester sonography. Exclusion criteria included the rupture of membranes, and maternal or fetal complications. Maternal complications included hypertensive pregnancy disorders, gestational or pre-gestational diabetes, maternal vascular disease, and any known chronic illness. Fetal complications included rupture of membranes, congenital malformations, IUGR, and prematurity (< 36th gestational week)

AFI was measured within the first 30 minutes of hospitalization. Information about the demographics, gestational history, and the women's health history was obtained. AFI measurements followed vaginal digital examination and 20 minute fetal heart rate tracings.

AFI measurements were performed with a real time ultrasound instrument (Toshiba Sonolayer SSA 270A) equipped with a 3,5 mHz linear array transducer. All measurements were performed according to the "four quadrants technique" defined by Phelan and colleagues²⁴. According to the measurement of AFI, four groups were formed as: AFI ≤ 3cm (severe oligohydramnios), 3cm < AFI ≤ 5cm (oligohydramnios), 5cm < AFI ≤ 8 (borderline oligohydramnios) and 8 cm < AFI ≤ 24 cm (normal AFI). Women with an AFI of more than 24 cm were excluded from the study.

A 20 minute long fetal heart rate and tocodynamometer trace record was obtained for each hospitalized woman. Standards defined by Freeman and Colleagues²⁵ were used for the assesment of fetal heart rate and tocodynamometer traces. Follow-up fetal heart rate traces were recorded with one hour intervals, until all findings remained normal. Amniotomy was performed when the servical dilatation was 5cm or more to qualify the amniotic fluid. Mode of delivery and indications for cesarean delivery were recorded. Pregnant women who had received oxytocine, either for the purposes of induction or augmentation of labor, were excluded from the study.

Neonatal outcomes were analysed by 1st and 5th minute Apgar scores.

Statistical analyses were performed using SPSS version 16.0 software (SPSS Inc, Chicago, IL). One way analysis of variance (ANOVA) and Pearson's correlation tests were used in statistical analysis. A *P* value <0.05 was considered statistically significant.

Results

The demographics and the distribution of the pregnant women among the four groups are summarised in Tables I and II.

Although cervical dilatation and effacement were higher in women with an AFI higher than 5cm, they did not correlate with AFI measurements (*p*>0.05).

The pregnant women were compared according to their gestational weeks during delivery (Table III). Elongation of the pregnancy beyond 42 weeks caused a significant decrease in AFI measurements and a significant increase in cesarean delivery rates ($p < 0.05$).

Fetal heart rate traces were evaluated as “normal” in 582 (83,1%) of the pregnant women. There were variable decelerations in 84 (12%), late decelerations in 14 (2%), decrease or loss of beat to beat variability in 13 (1,8%), fetal tachycardia in 3 (0,4%), and fetal bradycardia in 4 (0,6%) of the traces.

Table 1. The summary of the demographics and the physical findings during hospital admission.

N=700	Mean \pm Standard deviation	Median (Minimum-Maximum)
Maternal Age (Years)	24.91 \pm 4.66	24 (16-40)
Gravidity	1.98 \pm 1.27	2 (1-11)
Parity	0.69 \pm 0.88	0 (0-5)
Miscarriages	0.19 \pm 0.47	0 (0-3)
Induced abortions	0.10 \pm 0.33	0 (0-3)
Ectopic pregnancy	0.01 \pm 0.08	0 ((0-1)
Amniotic fluid index (cm)	11.00 \pm 4.62	11 (0-24)
Cervical dilatation (cm)	3.54 \pm 1.43	3 (1-8)
Cervical effacement (%)	60.10 \pm 14.09	60 (10-100)

Table 2. The summary of the comparison of the four study groups. The data were presented as mean \pm standard deviation* or median**.

	AFI>8cm N=534 (76%)	8cm \geq AFI>5cm N=69 (10%)	5cm \geq AFI>3cm N=57 (8%)	3cm>AFI N=40 (6%)	p-value
Maternal Age (Years)*	24.85 \pm 4.83	24.39 \pm 3.57	25.46 \pm 4.45	25.87 \pm 4.26	0.329
Gravidity**	2	2	2	2	0.746
Parity**	0	1	1	1	0.630
Miscarriages**	0	0	0	0	0.076
Induced abortions**	0	0	0	0	0.880
Ectopic pregnancy**	0	0	0	0	0.647
AFI (cm)*	12.80 \pm 3.59	7.29 \pm 0.77	4.68 \pm 0.47	2.30 \pm 0.85	0.000
Cervical dilatation (cm)*	3.50 \pm 1.48	4.46 \pm 0.92	3.24 \pm 1.37	2.90 \pm 0.59	0.000
Cervical effacement (%)*	60.13 \pm 14.42	65.07 \pm 7.79	56.49 \pm 17.47	56.25 \pm 9.52	0.001

AFI: Amniotic fluid index

Table 3. The comparison of the pregnant women according to the gestational weeks during delivery. The data were presented as mean \pm standard deviation* or median**.

	36 \leq GW \leq 40 N=597 (85%)	40<GW \leq 42 N=79 (11%)	42<GW N=24 (4%)	p-value
Maternal Age (Years)*	24.76 \pm 4.56	25.48 \pm 5.02	26.75 \pm 5.65	0.063
Gravidity**	2	2	2	0.401
Parity**	0	1	1	0.228
Miscarriages**	0	0	0	0.632
Induced abortions**	0	0	0	0.359
Ectopic pregnancy**	0	0	0	0.121
AFI (cm)*	11.22 \pm 4.34	10.49 \pm 6.18	7.12 \pm 3.60	0.000
Cervical dilatation (cm)*	3.50 \pm 1.40	3.68 \pm 1.59	4.12 \pm 1.39	0.069
Cervical effacement (%)*	59.98 \pm 13.66	60.38 \pm 16.98	62.08 \pm 14.44	0.761
Cesarean Delivery (%)*	0.08 \pm 0.27	0.13 \pm 0.33	0.29 \pm 0.46	0.001

GW: Gestational week; AFI: Amniotic Fluid Index

Amniotic fluid was observed as *clear, meconium stained, or blood stained* in 610 (87,1%), 81 (11,6%) and 9 (1,3%) of the pregnant women during amniotomy.

634 (90,6%) of the women had vaginal deliveries and 66 (9,4%) cesarean. The indications for cesarean delivery were as follows: 22 (33,3%) fetal distress, 14 (21,2%) arrest of labor progression, 14 (21,2%) cephalo-pelvic disproportion, 2 (3%) uterine anomaly, 5 (7,6%) fetal macrosomia, 2(3%) breech presentation, 3 (4,5%) fetal distress and arrest of labor progression, 1 (1,5%) fetal distress and cephalo-pelvic disproportion, and 1 (1,5%) fetal macrosomia and breech presentation.

Correlation analysis showed that AFI correlated negatively with the cesarean delivery rate, gestational week, abnormal fetal heart rate trace findings, meconium staining of the amniotic fluid, diagnosis of fetal distress, and the post-date pregnancy rates ($p < 0.05$). The correspondence of AFI to cesarean delivery, meconium staining, abnormal fetal heart rate trace findings, and the fetal distress rates are represented in Figure 1. The association of AFI to the Apgar scores are represented in Figure 2.

Discussion

We observed that the severity of diminished AFV increased the chance of intrapartum abnormal findings. However, it affected only the mode of delivery and the 1st minute Apgar scores in the deliveries associated with fetal distress.

The aim of intrapartum assesment of fetal well-being is to identify those fetuses at high risk. For this reason, the results of obstetricians' amniotic fluid studies are not surprising since amniotic fluid volume measurement is an indirect indicator of fetoplacental function^{10,26}. An instance of this is hypoxemia where a disturbance in renal perfusion²⁷ and decreasing fetal urine production results in a decrease in the amiotic fluid levels²⁶.

Prior to the advent of ultrasonography, amniotic fluid volume measurements could only be obtained invasively by dye dilutional methods. However, this was not practical in clinical usage. In 1933, by injecting a specific amount of Congo Red into amniotic fluid, a dye dilution method was used²⁸. Following the injection of Congo Red, amniotic fluid was obtained a few minutes later for spectrophotometric analysis to calculate the total volume. Later, scores

of investigators reproduced similar studies by using different substances instead of Congo Red.

With the advent of ultrasound, amniotic fluid could be measured non-invasively. At first, AFV measurements were dependent on non-quantitative observations. For example, some authors⁹ predicted amniotic fluid as normal when no ecogenic areas were seen between the uterine wall and the fetal body or the extremities. Other investigators tried to predict perinatal outcomes by measuring fluid pouch sizes. Amniotic fluid pouch size at levels of 0,5 cm⁸, 1 cm^{1,11,13,21} and 3 cm^{10,29} were used as an indicator of decreased amniotic fluid by some authors.

In 1987, Phelan et al. described a new method for amniotic fluid volume measurement²⁴. They divided the uterine cavity into 4 quadrants and added the measurement of the size of the largest pouch in each quadrant. A level below 5.1cm was described as oligohydramnios. Jeng et al.³⁰ demonstrated that amniotic fluid levels below 8.1cm represented levels below 5% during the third trimester gestational age. Moore and Cayle²¹ prospectively studied the AFI in 791 pregnant women, specifying the gestational age. Rather than using a snap-shot measurement, their approach was probably more objective. Compatible with their results, the AFV levels in our study decreased gradually with an increase in gestational age.

In another study, the indication for cesarean delivery of fetal distress increased in 11% of the pregnant women with an amniotic fluid level below 5.1cm². However, the AFV measurements were performed 7 days before the delivery. Baron et al.²² found the increase rate to be 4,1%; however, their study population included all pregnancies of $\geq 26^{\text{th}}$. gestational weeks. In a study by Sarno et al.³ conducted on 17 pregnant subjects with an amniotic fluid index below 5.1cm, fetal distress indication led to cesarean deliveries in 17.6% of the women. However, the size of their study group was relatively small. Robson et al.⁵, in their study, had to perform cesarean deliveries in 8 of 14 pregnant women with an AFI less than 6,3cm. However, all their subjects were in active labor and all membranes had been ruptured during AFI measurements.

Our study included low risk pregnancies of more than 36 weeks with intact membranes. Amniotomy was performed at 5 cm servical dilatation level. In this low risk pregnant group, we observed that a decrease in AFI was strongly correlated with an increase in the

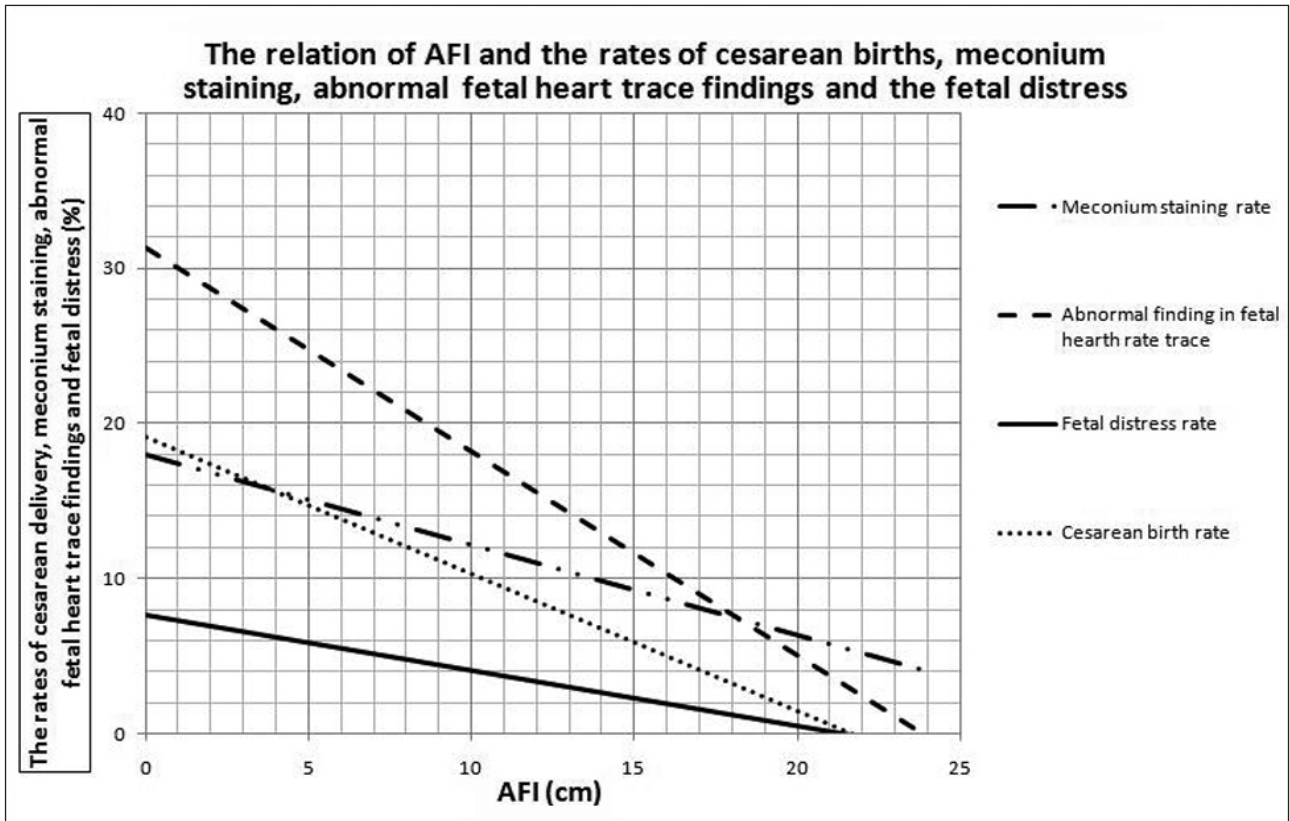


Figure 1. The relationship between AFI and the rates of cesarean births, meconium staining, abnormal fetal heart rate tracings, and fetal distress. AFI: Amniotic fluid index.

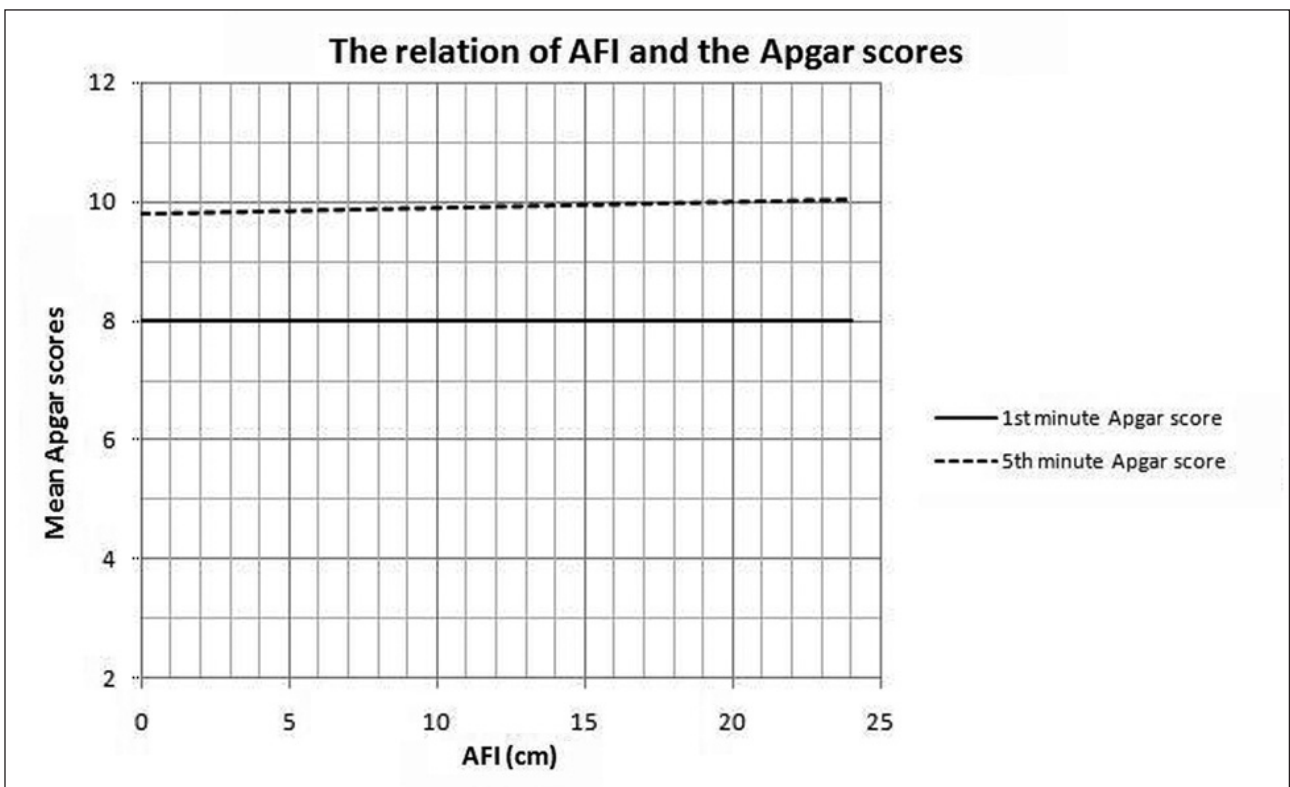


Figure 2. The relationship between AFI and Apgar scores. AFI: Amniotic fluid index.

cesarean delivery rate, gestational week, abnormal fetal heart rate trace findings, meconium staining of the amniotic fluid, diagnosis of fetal distress, 5th minute Apgar scores, and the post-date pregnancy rates.

Many authors signified high ratios of meconium staining with AFI measurements below 5,1cm.³⁻⁵. However, Baron et al. did not find similar results and concluded that dissimilarities resulted from the high ratios of postterm pregnancies in the study populations of the other investigators. In our study, the ratio of meconium staining for any predicted oligohydramnios level was not significant. However, we observed meconium staining in 7 of 17 (41%) of the pregnant women with gestations beyond 42 weeks. Meconium staining was observed in 74 of 683 (11%) of the pregnant women who had a pregnancy of 42 weeks or less. This finding supports Baron et al's account of their findings. Moreover, the ratios of pathological fetal heart rate findings and fetal distress indications for abdominal delivery were significantly higher in our study in the presence of meconium stained amniotic fluid.

Baron et al. were unable to find significant differences among their study groups when they studied the neonatal 1st and 5th minute Apgar Scores. Similarly, in our study, there were no differences observed in 1st and 5th minute Apgar Scores for any predicted AFI value. However, when we analyzed cesarean deliveries with an indication of fetal distress, we observed that 3 of 5 neonates (60%) had 1st minute Apgar Scores below 7 in the AFI \leq 3cm group. We did not obtain the same correlation for the 5th minute Apgar Scores.

In the study of Baron et al., hospital stay for neonates was longer in the oligohydramnios group, without any intra or post partum mortality. In our study, we could not observe any difference among groups for neonatal hospital stay and neonatal intensive care unit requirement. One neonate born with a congenital cardiac defect, with 1st and 5th minute Apgar Scores of 2 and 4, respectively, died on the first day of neonatal intensive care. There was no other fetal or neonatal death.

Conclusion

In low risk pregnancies, the severity of the decrease in AFV, dependent/independent of gestational age, increases the ratios of pathological fetal heart rate trace findings, diagnosis of fetal distress, and the fetal

distress indications which lead to cesarean deliveries. An AFI of \leq 3cm negatively influences the 1st minute Apgar score. Finally, meconium stained amniotic fluid is more frequently associated with fetal distress, particularly in post term pregnancies.

Conflict of interest

We declare that we have no conflict of interest

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