

Assessment of Communication AFI and Uterocervical Angle with Pregnancy Duration in Patients with Preterm Premature Rupture of Membranes 24-34 Weeks

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Article Info

doi: [10.30699/jogcr.7.6.489](https://doi.org/10.30699/jogcr.7.6.489)

Received: 2021/10/27;

Accepted: 2022/01/19;

Published Online: 09 Sep 2022;

Use your device to scan and read the article online



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ABSTRACT

Background & Objective: Premature rupture of membranes (PROM) and preterm delivery are the most important problems observed in pregnancies that can cause many consequences. The present study investigated the relationship between amniotic fluid index (AFI) and uterocervical angle in patients with PROM between 24 and 34 weeks of gestation.

Materials & Methods: This study was a cohort study carried out on 50 pregnant women with PROM. Inclusion criteria were 24 to 34 weeks of gestation and singleton deliveries. Demographic characteristics and pregnancy history of the subjects were determined through interviews and examinations. Moreover, AFI and uterocervical angle were determined based on ultrasound results. Subjects were followed up until delivery.

Results: Mean age of the patients was 25.14±5.32 years; 23 patients (46%) had delivery latency less than 7 days. The mean uterocervical angle in the delivery latency group ≤ 7 was significantly higher than that in the group more than 7 days ($P < 0.001$). Moreover, the mean AFI in the delivery latency group ≤ 7 was significantly higher ($P < 0.001$). The uterocervical angle above 107.7 with a sensitivity of 87% and a specificity of 88.9% had a predictive power and its area under curve (AUC) was 0.912 ($P < 0.001$). The mean AFI below 5.4 with a sensitivity of 81.5% and a specificity of 65.5% had a predictive power (AUC: 0.866, $P < 0.001$).

Conclusion: Uterocervical angle and AFI can be good predictors for assessing delivery latency in women with PROM. Furthermore, the mean uterocervical angle in the delivery latency group ≤ 7 days is significantly higher than that in the group more than 7 days, but conversely AFI is less.

Keywords: Premature Rupture of Membranes, Pregnancy, AFI, Uterocervical Angle



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Introduction

Premature rupture of membranes (PROM) refers to the occurrence of rupture of fetal membranes before the onset of labor symptoms and is one of the most important problems observed in pregnancy (1, 2). This complication has a prevalence of 6 to 10%, 80% of which occur after 37 weeks of gestation. If the rupture of the membranes occurs before 37 weeks, it is called PPRM, which is a more serious problem and occurs in 1 to 2% of pregnancies (3, 4). The etiology of PROM is complex and is influenced by a variety of factors. Two-thirds of cases occur spontaneously or for unknown reasons (5, 6). Some of the risk factors are bleeding in pregnancy, twin pregnancy, genitourinary tract infections, smoking, low maternal weight, mechanical injuries, low sexual intercourse rate, low

economic and social status, malnutrition, amniocentesis, fetal defects, cervical dilatation, and so on, however the most important cause of PROM is its history in previous pregnancies (5, 7, 8). Fetal and neonatal complications associated with PROM include prematurity, neonatal sepsis, neonatal respiratory distress syndrome (NRDS), intraventricular hemorrhage, risk of fetal and neonatal mortality, and increased risk of infection in the fetus and neonate (8, 9). Prolonged delay between the rupture of the membranes and the onset of labor may reduce neonatal complications (10, 11). In the past, fetal mortality was high in PROM deliveries. Today, with the identification of these pregnancies and proper care of the mother and fetus, the fetal mortality rate in these

pregnancies has been reduced (12, 13). The gestational age of 22 to 32 weeks is a critical and important period. The increase of gestational age every week during this period will reduce mortality by 5 to 15% (14). If the membranes rupture occurs before 24 weeks, it can cause hypoplasia (15).

PPROM is associated with preterm delivery in 30 to 40% of cases (3, 4). Premature birth is a very important problem in many countries, and despite many advances in prenatal care in the last four decades, including diagnostic and treatment technologies, not only the rate of preterm birth has not improved, but also the rate of preterm birth in the United States and Canada has increased by 20% (16). Premature infants have many complications such as functional disabilities, growth retardation, and seizures in infancy (17). The time interval between the rupture of the amniotic sac and the onset of labor pains is called the latent phase (18). This time is very important for the health of mother and fetus because 75% of perinatal deaths are related to infants died at the shorter latent phase of preterm labor (19). In order to prevent preterm labor, various treatment methods have been evaluated, all of which are aimed at delaying preterm labor and reducing fetal complications (20). Pharmacological inhibition of premature uterine contractions is one of the most widely available methods, however there is still disagreement about the best treatment and diagnosis

(21-25). The main purpose of treatment and follow-up of patients with PROM is to maintain the health of mother and fetus (26, 27). In this regard, the use of non-invasive indices such as amniotic fluid index (AFI), cervical length, and uterocervical angle in some studies has shown good efficiency (9, 28). The benefits of using transvaginal ultrasound (TVU) to determine cervical length in order to predict the risk of preterm delivery with a healthy membrane in singleton and twin pregnancies have been demonstrated in previous studies (29-32). Several studies have reported that cervical length <2 cm may be associated with a shorter latent phase (33-35). Previous studies have also shown that low AFI (< 5) in patients with PPRM is associated with a shorter latent phase compared to the women with normal AFI (18, 36-39). Due to the importance of the subject, especially in PPRM patients, we decided to investigate the relationship between AFI and uterocervical angle in patients with PROM between 24 and 34 weeks of gestation.

Methods

This study was a cohort study performed on 50 pregnant women with PPRM referred to the hospitals affiliated to Iran University of Medical Sciences in 2019. According to a study by Mehra *et al.* (28), and using the following formula, 50 patients were selected.

$$n = \frac{(Z1-\alpha/2 + Z1-\beta)^2 [(S1)^2 + (S2)^2]}{(X1 - X2)^2} \rightarrow n = \frac{(1.96 + 1.28)^2 [(1)^2 + (2)^2]}{(5-7)^2}$$

Inclusion criteria were gestational age between 24 and 34 weeks and singleton pregnancies. Exclusion criteria were fetuses with abnormal ultrasound and multiple cases and gestational age over 34 weeks, patients with cervical dilatation, patients with cervical insufficiency, patients with cerclage, patients with evidence of vaginal infection, people with high erythrocyte sedimentation rate (ESR) and positive C-reactive protein (CRP). All patients were treated with: azithromycin 1 gr orally until delivery single dose, ampicillin 2 gr intravenous (IV) every 6 hours up to 8 doses, then amoxicillin 500 mg every 8 hours orally up to 15 doses, and betamethasone 12 mg intramuscular (IM) every 24 hours up to two doses. Weekly examination with speculum, AFI, and differential complete blood cell count (CBC) were performed twice a week and participants were followed up until delivery and the interval between rupture of membranes and delivery was recorded for all individuals.

The first part of the data collection form included demographic characteristics such as age, parity, gravidity, height, and weight, and the second part included clinical information. The two AFI and uterocervical angle were determined and recorded

based on the ultrasound results. The sensitivity and specificity were calculated by receiver operating characteristic (ROC) test for AFI and uterocervical angle.

Ethical Issues

This study was reviewed and approved by the Ethics Committee of Iran University of Medical Sciences (IR.IUMS.FMD.REC.1399.191). Before entering the study, written consent was obtained from all the patients and sufficient information about the objectives of the plan, how to implement it and review the consequences and benefits of the study for patients were provided to the patients.

Statistical Analysis

Descriptive results were presented as mean and standard deviation, frequency, and percentage. Independent t-test was used to compare the two means. Chi-square test was also used to evaluate the differences between the qualitative variables. ROC test was applied to determine the predictive power and cut point. $P < 0.05$ was considered statistically significant. All data were analyzed using the SPSS software version 25.

Results

Mean age of the patients was 25.14 ± 5.32 years. Patients were divided into two groups of delivery latency ≤ 7 days and > 7 days. Twenty-three (46%)

patients had delivery latency ≤ 7 days. Based on the results, there was no statistically significant difference between the two groups in terms of baseline characteristics ($P > 0.05$). [Table 1](#) shows the basic characteristics of the patients studied in the two groups.

Table 1. Baseline data of the patients with delivery latency ≤ 7 days and > 7 days

Variable	Delivery		P-value
	$\leq 7, n=23$	$>7, n=27$	
Age (year)	26.30 \pm 6.16	23.96 \pm 4.14	0.117
BMI (kg/m ²)	27.44 \pm 3.33	28.15 \pm 2.98	0.432
Parity	0	13(44.8)	16(55.2)
	1	8(47.1)	9(52.9)
	2	2(50.0)	2(50.0)
Gravidity	1	8(42.1)	11(57.9)
	2	9(60.0)	6(40.0)
	3	6(37.5)	10(62.5)

The mean uterocervical angle for the two groups of delivery latency ≤ 7 days and > 7 days was assessed using the independent t-test ($P < 0.001$). [Table 2](#)

displays the mean and standard deviation of the uterocervical angle for the two delivery latency groups.

Table 2. Eutroservical angle of the patients with delivery latency ≤ 7 days and > 7 days

Variable	Delivery	N	Mean	SD	P-value
Eutroservical angle	≤ 7	23	114.52	7.82	<0.001
	>7	27	97.11	7.98	

The mean AFI for the two groups was also assessed using the independent t-test ($P < 0.001$). [Table 3](#) shows

the mean and standard deviation of the AFI for the two delivery latency groups ≤ 7 days and > 7 days.

Table 3. Amniotic fluid index of the patients with delivery latency ≤ 7 days and > 7 days

Variable	Delivery	N	Mean	SD	P-value
Amniotic fluid index	≤ 7	23	4.54	1.97	<0.001
	>7	27	8.45	2.89	

The predictive power of uteroservical angle in the pregnant women with PPROM that were included in the two groups of delivery latency was evaluated using the ROC test. The results showed that uteroservical angle more than 107.5 had 87% sensitivity and 88.9% specificity, and the area under curve (AUC) was 0.912 ($P < 0.001$) ([Figure 1](#)).

The predictive power of AFI in the pregnant women with PPROM showed that AFI more than 5.4 had 81.5% sensitivity and 65.5% specificity. The AUC was 0.866 ($P < 0.001$) ([Figure 2](#)).

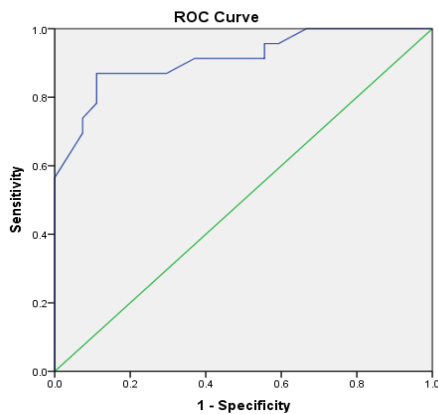


Figure 1. ROC curve for uterocervical angle in pregnant women with PPRM

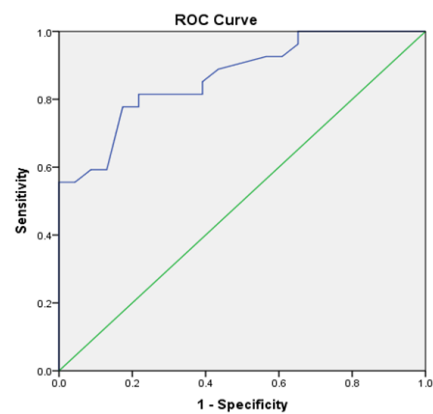


Figure 2. ROC curve for AFI in pregnant women with PPRM

The mean gestational age for the two groups of delivery latency ≤ 7 days and >7 days was assessed using the independent t-test ($P=0.433$). [Table 4](#) shows

the mean and standard deviation of the gestational age for the two delivery latency groups.

Table 4. Gestational age of the patients with delivery latency ≤ 7 days and > 7 days

Variable	Delivery	N	Mean	SD	P-value
Gestational age	≤ 7	23	31.04	2.90	0.433
	> 7	27	31.52	2.76	

Discussion

Considering that PROM is one of the most important problems observed in pregnancies that can cause consequences such as intrauterine infection and premature birth and its complications, this study aimed to investigate the relationship of AFI and uterocervical angle with gestational length in patients with PROM to use the two factors mentioned above for predicting the time of delivery. An analytical study in the United States was conducted to determine whether universal transvaginal cervical length (TVCL), AFI, or a combination of both can predict 7-day delivery latency in women with PROM. The results showed that in 48% of pregnant women with PROM, delivery occurred within 7 days after the rupture of the membranes, which was significantly associated with TVCL and AFI. AFI < 5 with a probability of 7.4 times is more likely to give birth within 7 days after the rupture of the membranes, and TVCL > 2 was associated with a 65% reduction in the rupture of the membranes. This study concluded that shorter TVCLs and AFI ≤ 5 cm independently predict labor in the next 7 days in women presenting with PPRM. A combination of AFI > 5 cm and TVCL > 2 cm predicts the potential for non-delivery within the next 7 days. These findings may be useful for counseling and optimizing maternal and neonatal care in women with PPRM (30). The results of our study were consistent with the results of this study in that the mean AFI < 5.4 with a sensitivity of 81.5% and a specificity of 65.5% was a predictive

factor. The AUC of AFI was 0.866, which is a good indicator to predict outcome. Today, delivery latency in women with PPRM can be predicted using the ultrasound parameters such as AFI, single deepest pocket (SDP) and TVCL. The combination of AFI and SDP was the most sensitive in this field and AFI was less than 7 and TVCL was less than 1.7. Therefore, AFI and SDP with TVCL can be useful parameters to predict the delay from PPRM to delivery time (34).

In another study by Mubarak *et al.*, women with PPRM were examined and found that 44.7% delivered within 7 days after rupture of the membranes, with a sensitivity of 52.6% for TVCL and 71.1% for AFI (40). In a study by Daskalakis *et al.*, it was stated that the uterocervical angle with a cut-off of 95 or 105 degrees is useful in predicting the gestational length (41). Consistent with these results, the uterocervical angle above 107.7 with a sensitivity of 87.0% and a specificity of 88.9% was a predictive factor and its AUC was 0.912, which is a large number to show the predictive power. In our study, the predictive power of AFI was less than the uterocervical angle. A prospective study was conducted by Kathir *et al.* on a pregnant women with PROM at 34-38 weeks of gestation. This study concluded that posterior cervical angle assessment using vaginal ultrasound is a useful tool in assessing the delay in women with PPRM; so

it can be helpful in counseling and planning timely referral to centers (42).

Kansara *et al.* conducted a study in 2020 in India to evaluate the role of AFI and cervical length in predicting delivery latency in women with PROM. This study concluded that both cervical length and AFI independently predict the latency of labor following the PROM and the combination of both factors improves predictability (43). The results of this study were consistent with those of the present study. We know that fetal umbilical artery Doppler pulsatility index may be a valid tool to predict neonatal outcomes of women with PPRM showing that indices can be useful for predicting the outcome of interest (44).

In a similar study in the United States, Knight *et al.* surveyed 259 pregnant women and found that a uteroservical angle of more than 110 degrees with a sensitivity of 80% and a specificity of 82% could help predict gestational lengths of less than 32 weeks in twin pregnancies. Finally, this study concluded that uteroservical angles greater than 110 degrees were better than the cervical length in predicting preterm birth in twin pregnancies (45). Similar to our study, these studies indicate the possibility of using two indicators of uteroservical angle and AFI.

Tavassoli *et al.* compared the results of pregnancy in PROM with AFIs less than and more than 5. The results showed that in the group AFI < 5, the applied latency phase was significantly shorter ($P=0.049$) and also the number of cesarean sections due to higher fetal distress ($P=0.008$), first minute Apgar score ($P=0.0127$), and neonatal mortality in the first week were higher ($P=0.045$) (46). These results were consistent with the results of our study since the mean AFI was less than 5.4 in our study.

Limitations

Due to the COVID-19 pandemic, it was not possible to evaluate a larger number of patients. Most of the

patients referred with PROM did not meet the inclusion criteria, including patients with cervical dilatation or age more than 34 weeks or less than 24 weeks, and so on. Moreover, in some patients, before the ultrasound, they had emergency conditions to be transferred to the operating room or labor.

Conclusion

Uterocervical angle and AFI can be helpful in diagnosing the time of delivery. Gravity, parity, body mass index, and age have no effect on the diagnosis of delivery latency. The mean uteroservical angle in the delivery latency group ≤ 7 was significantly higher than that in the group > 7 days; conversely, the mean AFI in the delivery latency group less than 7 was significantly lower than that in the group of more than 7 days. Further studies are required to determine the predictive power of the two indices of uteroservical angle and AFI.

Acknowledgments

The authors would like to thank the deputy research and vice chancellor of Iran University of Medical Sciences for supporting this study. This study was extracted from residential thesis of Farzaneh Abedini, at the department of gynecology of Iran University of Medical Sciences.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Conflict of Interest

The authors declare that there is no conflict of interest in this study.

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How to Cite This Article:

Abedini F, Eshraghi N, Mohammadian Amiri M, Danaei M. Assesment of Communication AFI and Uterocervical Angle with Pregnancy Duration in Patients with Pretem Premature Rupture of Membrans 24-34 Weeks. *J Obstet Gynecol Cancer Res.* 2022; 7(6):489-96.

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