

**Study of Ultrasonic Assessment of Cervical Length and Amniotic Fluid Index in Predicting Delivery Latency Following Premature Preterm Rupture of Membranes**

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**Background**

**Abstract:** Preterm premature rupture of membrane (PPROM) is among the most important causes of perinatal morbidity and mortality. We sought to determine whether cervical length and amniotic fluid index, individually or in combination, can predict the pregnancy outcome in cases of PPRM. **Aims and Objectives:** To study the role of amniotic fluid index (AFI) and cervical length in the prediction of delivery latency period among women with premature preterm rupture of membranes. **Material and Method:** This was a prospective observational study performed during July 2022 to July 2023 in the Department of Obstetrics and Gynecology, NCMCH, Panipat, on 100 singleton pregnant women between 28 weeks and 34 weeks gestation with cephalic presentation and preterm premature rupture of membranes. All the women were subjected to ultrasound to determine AFI and cervical length and were followed up until delivery. **Results:** Out of 100 women, 86 women who underwent spontaneous labor were included in the study. 41 women delivered within 7 days of the test, and 45 delivered afterwards. Out of 41 women, 29 (67.44%) had amniotic fluid index of  $\leq 5$ cm and 28 (65.12)% women had cervical length of  $\leq 2$  cm. The sensitivity, specificity, positive and negative predictive value of AFI alone in predicting delivery within 7 days were 72.14%, 64%, 67.22%, 70.15% respectively. The sensitivity, specificity, positive and negative predictive value of cervical length alone in predicting delivery within 7 days were 68%, 73%, 76% and 69% respectively. Out of 86 women, 30 had both the characteristics, (amniotic fluid index  $\leq 5$ cm and cervical length  $\leq 2$  cm), out of them, 22(75.86%) delivered with 7 days. The sensitivity, specificity, positive and negative predictive value of combination of both in predicting delivery within 7 days were 73%,55%,77% and 49% respectively. The PPV of cervical length  $\leq 2$ cm and AFI  $\leq 5$ cm alone in predicting delivery within 7 days were 76% and 70.15%, whereas combination of both is 77%. For AFI  $> 5$  the total number of women who had not delivered within 7 days were 36 out of which 29 women (80.56% ) had CL of  $> 2$  cm. The NPV of AFI  $> 5$  cm and TVCL  $> 2$ cm was 82%, means women with these two characteristics would remains undelivered within 7 days. **Conclusion:** This study concluded that cervical length and amniotic fluid index both independently predict the delivery latency period following preterm premature rupture of membranes and combination of both factors improves predictive ability.

**Keywords:** Preterm premature rupture of membranes, latency period, Transvaginal cervical length, Amniotic fluid index, Prediction of preterm delivery

## Introduction

Preterm premature rupture of membranes (PPROM) is defined by spontaneous rupture of the fetal membranes before 37 completed weeks and prior to labor onset [1]. The incidence of PPRM is approximately 3% of all pregnancies [2]. In a term pregnancy, membrane rupture can result from shearing force due to uterine contractions and weakened state by physical stretching [3, 4]. India is the biggest contributor to the world's prematurity burden with almost 3.6 million premature births accounting for 23.6% of around 15 million global preterm births reported each year (WHO). Preterm premature rupture of membrane (PPROM) is a breach in the chorioamniotic membrane prior to the onset of labour at <37 weeks of gestation. PPRM complicates 3% of all deliveries and is associated with 30-40% of preterm deliveries. It is an important risk factor for perinatal mortality and morbidity. [5]

However, PPRM can be caused by pathologic mechanisms such as intra-amniotic infection and uterine overdistension, both of which have been widely observed in preterm gestational age. And another well-known risk factor is the history of PPRM in prior pregnancy. Additional risk factors are short cervical length, low body mass index (BMI), nutritional deficiency, cigarette smoking, and low socioeconomic status [6-8]. Clinical factors associated with PPRM include low socioeconomic status, tobacco use, history of preterm labour, urinary tract infection, vaginal bleeding at any time in pregnancy, uterine distension (e.g. polyhydramnios, multifetal pregnancy), cerclage and amniocentesis. 2-4 The major maternal risks are chorioamnionitis (35%), abruption (19%) and sepsis (<1%). 3 Placental abruption is more common if rupture of membranes occur prior to 28 wk of gestation. 5 The risk of abruption increases 24 hr after membrane ruptures, particularly in the presence of intrauterine infection or oligohydramnios. [9,10] Chorioamnionitis is also associated with gestational age at which PPRM occurs. Major fetal morbidity is pulmonary hypoplasia, RDS, sepsis, intraventricular hemorrhage and contractures. Pulmonary hypoplasia is frequent if PPRM occurs before 26 wk and the latency is prolonged for more than 5 wk. Latency, defined as the time from rupture of membranes till delivery has been described to be longer if PPRM occurs at an earlier gestational age.[11,12] Oligohydramnios as a result of PPRM has been found to be associated with shorter latency and increased neonatal morbidity, but not associated with increased maternal or neonatal infections. [13]

Management schemes exist from one extreme to the other; some use minimal testing to monitor maternal health only, whereas others suggest intensive and invasive plans that include cerclage with amnioinfusion, antibiotics, frequent fetal testing, and aggressive use of tocolytics and corticosteroids.[14] Clearly, this diversity of approach suggests substantial controversy. Prediction of the latency period could help to lessen the controversy; for example, if latency was expected to be short, then the utility of tocolytics to gain time for corticosteroid administration might be greater. A few studies reported that a cervical length of <2 cm may be associated with a shorter latency to delivery.[3,4,5] Prior studies found that a low ( $\leq 5$  cm) amniotic fluid index (AFI) in PPRM is associated with a shorter latency and a higher rate of delivery within 7 days compared to women with a normal AFI.[15-17] However, it is unclear

how these two clinical variables can be used, either independently or in combination with CL, to help predict spontaneous preterm delivery in PPRM. Hence, the aim of this study was to assess the role of transvaginal sonographic measurement of cervical length and amniotic fluid index in women with PPRM between 28 to 34 weeks in predicting the delivery latency period.

### **Material and Methods**

This was a prospective observational study performed during July 2022 to July 2023 in the Department of Obstetrics and Gynecology, NCMCH, Panipat, 100 singleton pregnant women between 28 weeks to 34 weeks gestation with cephalic presentation and preterm premature rupture of membranes. All the women were subjected to ultrasound for determining AFI and cervical length and were followed up until delivery. Women with chorioamnionitis, multifetal pregnancy, antepartum haemorrhage, and women in labour were excluded from the study. Women were admitted in the ward and they were explained regarding the management protocol and consent was taken for inclusion in study. All the women after admission were subjected to detailed history and examination. Maternal parameters like parity, maternal age at the time of admission, gestational age at the time of presentation were noted. Basic investigations were done which includes haemoglobin, total leukocyte count, differential leukocyte count, C-reactive protein, urine routine microscopy and culture sensitivity, high vaginal swab. A sterile per speculum examination was done under all aseptic condition and presence of amniotic fluid coming out through cervical OS was confirmed. At the same sitting, high vaginal swab was taken for culture sensitivity. Gestational age was calculated by last menstrual period or early trimester scan. Each of these admitted women were subjected to transabdominal ultrasound to calculate amniotic fluid index. Philips HD 11× E model ultrasound machine was used which had transabdominal probe of frequency 3-5 MHz and transvaginal probe of frequency 6-9MHz. Abdomen is divided into four compartment and each of the deep cord free vertical pocket of liquor is taken and sum up. Then after emptying, the bladder transvaginal ultrasound was done to measure cervical length. External cervical OS was identified as point at which anterior and posterior lips of cervix comes together. The point at which cervical mucosa ends is considered to be internal cervical OS.

The cervix was occupying approximately 50 to 75% of image. At least three measurements were obtained and shortest length was taken. Cervical measurement is done by placing the callipers between external and internal cervical OS. All the admitted women were given expectant management, which includes antibiotics and steroids. Latency for purpose of analysis was stratified into two groups  $\leq 7$  days and  $> 7$  days. After delivery, perinatal outcome was assessed. A note was made of birth weight, Apgar score at 1 and 5 minutes, duration of NICU stay and perinatal mortality. Delivery latency period in this study was time interval between performing transvaginal scan to delivery of baby which is studied among women delivered spontaneously.

### **Observation and Result**

Total 100 women, 86 delivered spontaneously, 4 underwent caesarean delivery because of fetal distress. Out of 10 women, 7 women were induced, indication being severe anhydramnios, gestational age completed 34 weeks, clinical signs and symptoms of chorioamnionitis and two were lost to follow up as their liquor was adequate and they were discharged from hospital. We had calculated the results and their statistical significance in 86 women who underwent spontaneous vaginal delivery without any intervention.

Out of 86 women, 41 (47.67%) delivered within 7 days and 45(52.33%) delivered after 7 days of performing ultrasound. We had calculated the results and their statistical significance in 86 women who underwent spontaneous vaginal delivery without any intervention. The mean age of women who delivered within 7 days was  $29.23 \pm 6.97$  years and  $29.09 \pm 5.71$  years in women who delivered after 7 days which was not significantly different. Majority of the women (34.44%) in our study who delivered within 7 days were primigravida. The mean period of gestation in women who delivered within 7 days was  $31.16 \pm 2.34$  weeks and it was  $31.2 \pm 2.25$  weeks in women who delivered after 7 days. Thus age, parity and period of gestation were not found to factors which predict delivery latency period. There was history of preterm birth in 10 women out of which 7 (70%) of these women were delivered within 7 days. 14 women had history of PPRM in previous pregnancy out of which 8 (57.14%) had delivery within 7 days in this pregnancy (p-value- 0.246). The total number of women who had amniotic fluid of less than 5 were 43, out of which 29 (67.44%) women delivered within 7 days and 16 (37.20%) women delivered after 7 days. The total number of women who had AFI of more than 5 were 43 out of which 27 (62.80%) had latency period of more than 7 days. The sensitivity, specificity, positive predictive value, negative predictive value of AFI<5 in predicting delivery latency period were 72.14%, 64%, 67.22%, 70.15% respectively.

The total number of women who had cervical length of  $\leq 2$  cm were 41, out of which 28 (65.12%) women had delivery latency period of less than 7 days. 45 women had cervical length of  $> 2$  cm out of which, 15 delivered within 7 days and 30 delivered after 7 days. The mean cervical length was 2.04 cm in women who had delivered within 7 days and 2.50cm in women who had latency period of more than 7 days ( $p < 0.001$ ). The mean AFI of women who had latency period of  $\leq 7$  days was 4.73 as compared to 6.07 in women who had not delivered within 7 days ( $p < 0.001$ ).

**Table 1: Validity of Cervical Length in Predicting Delivery Latency Period**

<b>Mean <math>\pm</math> SD</b>	<b>Delivery latency period <math>\leq 7</math> days</b>	<b>Delivery latency period <math>\geq 7</math> days</b>	<b>P - value</b>
<b>Age/years (18-38)</b>	28.95 $\pm$ 7.02	28.02 $\pm$ 6.34	0.52
<b>Parity(0-5)</b>	1.65 $\pm$ 0.14	1.67 $\pm$ 0.13	0.49
<b>Gestational age/ weeks (28 to 34)</b>	31.16 $\pm$ 2.34	31.02 $\pm$ 2.25	0.77

<b>Cervical length/cm</b>	2.04±0.10	2.50±0.47	0.001
<b>AFI/cm</b>	4.73±0.35	6.07±1.14	0.001

**Table 2: Validity of Cervical Length in Predicting Delivery Latency Period**

<b>Cervical length (cm)</b>	<b>≤ 7days</b>		<b>&gt; 7 days</b>		<b>p-value</b>
	<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>	
<b>≤ 2</b>	28	65.12	13	30.23	0.001
<b>&gt; 2</b>	15	34.88	30	69.77	
<b>TOTAL</b>	43	100	43	100	

**Table 3: Prediction of Latency Period by Cervical Length**

<b>Sensitivity</b>	68%
<b>Specificity</b>	73%
<b>PPV</b>	76%
<b>NPV</b>	69%
<b>Accuracy</b>	71%

**Table 4: Validity of Amniotic Fluid Index in Predicting Delivery Latency**

<b>USG-AFI (cms)</b>	<b>≤ 7days</b>		<b>&gt; 7 days</b>		<b>p-value</b>
	<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>	
<b>≤ 5</b>	29	67.44	16	37.20	
<b>&gt; 5</b>	14	32.56	27	62.80	0.001
<b>TOTAL</b>	43	100	43	100	

**Table 5: Prediction of Delivery Latency by Amniotic Fluid Index**

<b>Sensitivity</b>	72.14%
<b>Specificity</b>	64%
<b>PPV</b>	67.22%
<b>NPV</b>	70.15%
<b>Accuracy</b>	68%

**Table 6: Validity of Combination of AFI ≤ 5CM and Cervical Length in Predicting the Delivery Latency Period**

Cervical length (cm)	≤ 7days		> 7 days		p-value
	N	%	N	%	
≤ 2	22	75.86	8	57.14	0.0031
> 2	7	24.14	6	42.86	
<b>TOTAL</b>	29	100	14	100	

**Table 7: Prediction of Delivery Latency Period by Combination of AFI ≤ 5cm and Cervical Length < 2CM**

<b>Sensitivity</b>	73%
<b>Specificity</b>	55%
<b>PPV</b>	77%
<b>NPV</b>	49%
<b>Accuracy</b>	66%

**Table 8: Validity of Combination of AFI > 5CM and Cervical Length**

Cervical length (cm)	≤ 7days		> 7 days		p-value
	N	%	N	%	
≤ 2	4	57.14	7	19.44	0.0023
> 2	3	42.86	29	80.56	
<b>TOTAL</b>	7	100	36	100	

**Table 9: Prediction of Delivery Latency by AFI > 5CM and Cervical Length > 2CM**

<b>Sensitivity</b>	53%
<b>Specificity</b>	82%
<b>PPV</b>	51%
<b>NPV</b>	82%
<b>Accuracy</b>	75%

## Discussion

Prediction of the latency period can be important, particularly when delivery in a hospital with tertiary level facilities is planned. Preterm premature rupture of membranes contributes to one third of preterm births[12]. Therefore prediction of latency period in these women by measuring cervical length and amniotic fluid index is helpful to estimate the time of delivery, need for hospitalization, antenatal steroids, antibiotics and nursery care.

Our study showed that Out of 100 women, 86 women underwent into spontaneous labour were included in study. 41 women delivered within 7 days of test and 45 delivered afterwards. Out of 41 women, 29 (67.44%) had amniotic fluid index of  $\leq 5$ cm and 28 (65.12)% women had cervical length of  $\leq 2$  cm. The sensitivity, specificity, positive and negative predictive value of AFI alone in predicting delivery within 7 days were 72.14%, 64%, 67.22%, 70.15% respectively. The sensitivity, specificity, positive and negative predictive value of cervical length alone in predicting delivery within 7 days were 68%, 73%, 76% and 69% respectively. Out of 86 women, 30 had both the characteristics, (amniotic fluid index  $\leq 5$ cm and cervical length  $\leq 2$  cm), out of them, 22(75.86%) delivered with 7 days. The sensitivity, specificity, positive and negative predictive value of combination of both in predicting delivery within 7 days were 73%,55%,77% and 49% respectively. The PPV of cervical length  $\leq 2$ cm and AFI  $\leq 5$ cm alone in predicting delivery within 7 days were 76% and 70.15%, whereas combination of both is 77%. For AFI  $> 5$  the total number of women who had not delivered within 7 days were 36 out of which 29 women (80.56% ) had CL of  $> 2$  cm. The NPV of AFI  $> 5$  cm and TVCL  $> 2$ cm was 82%, means women with these two characteristics would remains undelivered within 7 days.

So, our study supporting by Suwan Mehra et al. in women with PPRM with gestational age between 23weeks +5days to 33weeks +6 days, cervical length of  $\leq 2$ cm was found in 40% of women. The predictive value of delivery within 7 days for a cervical length of  $\leq 2$ cm was 62%.Sensitivity, specificity and negative predictive value of the study was 51%, 71%,61% respectively, these findings were comparable to our present study. There is positive association between shorter cervical length and high rate of delivery within 7 days.[18]

Dr Megha Kansara et al. Study showed that there was an increase in PPV when we combine AFI and CL in prediction of time of labor, so women with AFI  $\leq 5$  and CL  $\leq 2$  had 78.79% risk of delivery within 7 days after PPRM. The NPV of AFI  $> 5$  cm and TVCL  $> 2$ cm was 84.85%, means women with these two characteristics would remains undelivered within 7 days. Furthermore, her found that there was no significant association between age, gestational age in weeks and parity with latency period for delivery. [19]

Tsoi et al study showed that in women with PPRM between 24 to 36 weeks of gestation, logistic regression analysis demonstrated that significant independent contribution in the prediction of delivery within 7 days was provided by cervical length (odds ratio (OR)=0.91, 95% CI 0.86–0.96, P=0.001)[20]

William E. MacMillan study found that Amniotic fluid index at initial evaluation was stratified into three groups: Low (less than 5.0), reduced (4.0 to 7.9), and normal

(8.0 or higher). Latency in days from preterm premature rupture of membranes to delivery was evaluated for these groups. A difference was noted in that latency was significantly longer in the group with normal versus low or reduced amniotic fluid index groups. significantly longer in the group with normal versus low or reduced amniotic fluid index groups with overall mean latency period of  $8.3 \pm 8.7$  days as compared to  $4.8 \pm 5$  in women with  $AFI \leq 5$ . [21]

G.Rizzo et al. Study showed that (1998) in predicting delivery latency period in women with PPRM between 24 and 32 weeks, short cervical length, presence of cervical funneling and cervical index of  $>0.5$  were significantly associated with shorter delivery latency period.[16]

Vermillion et al. showed that an  $AFI < 5$  cm after PPRM between 24 and 32 weeks' gestation is associated with shorter latency preceding delivery; this finding has been supported by several authors which indicates that the presence of oligohydramnios in PPRM is related to a shorter latency (interval between rupture of membranes and delivery) compared to PPRM without oligohydramnios [22], while Borna et al.[23] showed that  $AFI < 5$  cm did not have a shorter latency until delivery.

Juan Piazzè et al showed that a women with gestational age between 24 and 34 weeks' with PPRM. Patients were categorized into two groups on the basis of AFI value ( $AFI \leq 5$  cms or  $AFI > 5$ cms) performed at the time of admission. Latency in days from preterm PROM episode to delivery was significantly lower in the group with  $AFI < 5$  cm,  $P < 0.05$  (median 3.8 days 25–75 centiles 2–18 vs. 8.6 days) Delivery occurred by 48 h, 1 and 2 weeks in 32.4%, 63.5% and 81.7% of pregnancies, respectively in women with  $AFI < 5$ cm. [9]

Our study showed that there was an increase in PPV when we combine AFI and CL in prediction time of labor, so women with  $AFI \leq 5$  cm and  $CL \leq 2$  cm had 78.79% risk of delivery within 7 days after PPRM.

## Conclusion

Our study shows that there was an increase in PPV when we combine AFI and CL in prediction of time of labor, so women with  $AFI \leq 5$  and  $CL \leq 2$  had 77% risk of delivery within 7 days after PPRM. The NPV of  $AFI > 5$  cm and  $TVCL > 2$ cm was 82%, means women with these two characteristics would remain undelivered within 7 days. Furthermore, we found that there was no significant association between age, gestational age in weeks and parity with latency period for delivery.

**Funding:** No funding sources

**Conflicts of interest statement:** The authors have no conflicts of interest relevant to this article.

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