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# Trans-Vaginal Cervical Length and Amniotic Fluid Index in Prediction of Delivery Latency Following Preterm Pre-Labor Rupture of Membranes

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Fatima Ossama Fetouh  
Mohamed Morsy<sup>1</sup> MBBCH,  
Hazem Mohamed Sammor<sup>1</sup> MD,  
Mohamed Samir Eid Sweed<sup>1,2</sup>  
MD, Ahmed Mohamed Abbas  
Mohamed Sadek<sup>1</sup> MD

<sup>1</sup>Department of Obstetrics  
and Gynecology, Faculty of  
Medicine, Ain Shams University,  
Cairo, Egypt

<sup>2</sup>Department of Obstetrics  
and Gynecology, Faculty of  
Medicine, Badr University, Cairo,  
Egypt

## **Abstract**

**Background:** After premature pre-labor rupture of membranes (PPROM), it is challenging to forecast with precision the time to delivery (latency). Predicting delivery delay may be useful in determining when to recommend hospitalization, close observation, prenatal steroid use, and magnesium sulfate for neuroprotection. In women who report with preterm pre-labor rupture of membranes (PPROM), our goal is to ascertain if transvaginal cervical length (TVCL), amniotic fluid index (AFI), or a combination of both can predict delivery latency.

**Methods:** 70 pregnant women presented with PPROM between the gestational age of 28 weeks and 36 weeks +6 days were enrolled. Transvaginal ultrasound measurement of cervical length and amniotic fluid index was performed within 24 hours of admission, to assess number of women reached latency period of 7 days or more and assess other maternal and fetal parameters as number of women reached 36 +6 weeks, mode of delivery, development of chorioamnionitis, gestational age at PPROM and delivery, birthweight at delivery, presence of neonatal sepsis, Apgar score at 1 and 5 minutes and need for NICU admission and indication.

**Results:** The best sensitivity of TVCL in prediction of delivery latency was 100 % at TVCL>3 cm in women with AFI >5 cm. On the other hand, the best specificity was 80.5% at TVCL>3 cm in women with AFI ≤5 cm.

**Conclusion:** When a woman presents with preterm pre-labor rupture of the membranes, it is recommended to employ either transvaginal cervical length, amniotic fluid index, or both to forecast delivery delay.

**Key words:** Cervical Length, Amniotic Fluid Index, Delivery Latency, PPROM.

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### **Corresponding author:**

Fatima ossama fetouh Mohamed  
Morsy  
Mobile number:01118853776  
Email address:Fatima.  
osama2020@gmail.com

## **INTRODUCTION**

When the chorioamniotic membrane bursts before 37 weeks of pregnancy or before labor begins, it is known as preterm pre-labor rupture of membranes, or PPRM. Just 2% of pregnancies are complicated by PPRM, although it is linked to 30% of preterm births.<sup>1</sup>

Individuals diagnosed with premature parental loss of offspring (PPROM) sometimes require prolonged hospital stays and newborn critical care.<sup>2</sup> The patient and the healthcare professional can become confused due to the complexity of predicting the time to delivery, also known as latency. Determining the length of the delivery delay could help establish whether specific treatments—like hospitalization, close observation, prenatal steroids when necessary, and magnesium sulfate for neuroprotection—are required.<sup>3</sup>

It has been demonstrated that utilizing transvaginal ultrasonography to measure cervical length (CL) in singletons and twin gestations is a useful method for predicting the likelihood of a preterm delivery with intact membranes in women who have previously experienced a preterm birth (PTB).<sup>4</sup>

Serial transvaginal ultrasound has been shown to be not associated with increased risk in women with PPRM, with no noticeable rise in endometritis, chorioamnionitis, or neonatal infection.<sup>5</sup> However, since transvaginal ultrasound was historically ignored in the case of ruptured membranes, it has only been studied infrequently in the management of PPRM.<sup>6</sup>

Both abdominal and translabial ultrasound have been shown in studies to be ineffective in accurately measuring CL. CL measured with a translabial ultrasound was not linked to the length of the delay time after PPRM. A CL of less than 2 cm has been linked to a shorter time to delivery in a few trials.<sup>7</sup>

A lower amniotic fluid index (AFI) in PPRM (less than 5 cm) has been associated in the past with a shorter delay and a greater rate of

delivery within 7 days compared to women with a usual AFI. It is unclear, nevertheless, how these two clinical parameters would be combined or utilized alone to predict transmission delay.<sup>8</sup>

## **METHODS**

From February 2022 to February 2023, the Obstetrics and Gynecology Department of the Faculty of Medicine at the Maternity Hospitals of Ain Shams University conducted this prospective observational study. Following their agreement, seventy pregnant women were enrolled in total.

### **Study population:**

Pregnant women with PPRM who underwent TVCL measurement after admission attending Ain Shams University Maternity Hospital with the following criteria:

### **Inclusion criteria:**

Women not in labor, age between 18 and 40 years, women with singleton gestation, women present with PPRM between the gestational age (GA) of 28 weeks and 36 weeks +6 days, women with BMI not exceed 30 kg/m<sup>2</sup>.

### **Exclusion criteria:**

Women who have chorioamnionitis or are in active labor (characterized as having regular, effective, painful contractions that last between 30 and 70 seconds and occur 5 to 10 minutes apart and have a cervical dilatation of at least 3 cm, as confirmed by digital examination). The main clinical signs of clinical chorioamnionitis include purulent or foul-smelling amniotic fluid, fever, uterine fundal discomfort, and maternal and fetal tachycardia (>100/min and >160/min, respectively). The most significant clinical indicator of chorioamnionitis is maternal fever, women with medical disorders with pregnancy (HTN, DM, etc.), insufficient diagnostic criteria for PPRM, women with Cerclage, patients with previous cervical

operation as cervical biopsy, multifetal pregnancy, placenta Previa, cervical length measurement not performed within 24 hours of admission, women who delivered before ultrasound performed, gestational age reassigned by ultrasound at admission and did not meet inclusion criteria, women who left hospital against medical advice, women with unknown delivery outcomes, women refused to participate in the study.

The patient gave her agreement to participate in the clinical study prior to enrollment after being given a clear explanation of its purpose, scope, and potential outcomes. In the case report, the patient's initials were the only information included. The investigators stored any other documents containing the patient's name in a safe location. To make records identifiable, the scientists kept a personal patient identification list, which included patient initials matched to patient names.

The protocol and all related documents were declared for ethical and research approval by the council of the OB/GYN department at Ain Shams University prior to the start of the study and any compliance with the local regulation followed. There was no proof that ultrasound scanning had any negative effects.

Women were enrolled in the study in accordance with the inclusion and exclusion criteria following protocol clearance. A history and physical examination, which included recording pooled vaginal fluid acquired by sterile speculum inspection, were used to diagnose PPROM. The last day of a regular menstrual cycle and, if an ultrasound was available in the early stages of pregnancy, that date were used to determine the gestational age. Every woman was admitted to the hospital and given modified bed rest. TVCL was carried out utilizing the vaginal probe of the E-CUBE 6 ultrasonic imaging equipment, which has a frequency of 5 MHz, within 24 hours of admission by ALPINION MEDICAL SYSTEMS Co., Ltd., Korea.

Three readings of CL were obtained, and the median was computed once the mother's bladder was empty and the endocervical canal was fully visible for three to five minutes. Where the anterior and posterior walls of the cervix were sonographically opposed, calipers on the internal and external os were positioned. There were no distorting fibroid, polyp, or sutures present. On a few occasions, funneling was observed.

Using an E-CUBE 6 ultrasound imaging equipment from ALPINION MEDICAL SYSTEMS Co., Ltd., Korea with an abdominal probe and a frequency of 3.5 MHz, an AFI measurement was carried out. The lineanigra and a mediolateral line that passes through the umbilicus served as the uterus's vertical and horizontal axis, respectively, dividing it into four hypothetical quadrants. The vertical dimension of the deepest pocket free of fetal remains and an umbilical cord was measured. The four pockets are measured in millimeters. The AFI is the total of the four quadrant measures.

Ampicillin 2 g intravenously every 6 hours and azithromycin 500 mg twice daily for 48 hours were administered as prophylactic antibiotics. These were followed by oral amoxicillin 250 mg every 8 hours and azithromycin 500 mg twice daily for 5 days. Dexamethasone (6 mg) will be injected intramuscularly four times, separated by 12 hours.

Cardiotocography and vital signs were used to monitor the patients in order to identify any indicators of impending labor or fetal distress. Following membrane rupture, a full blood cell count and C-reactive protein titre were measured upon admission on the 48th day, and then once a week after that. The expectant mother was cared for till 36 weeks and 6 days of pregnancy. Factors such as GA at PPROM, history of preterm prelabor rupture of membranes or preterm delivery, tobacco and drug use, history of cervical procedures, visual cervical dilation at admission, presence of vaginal bleeding,

and presence or absence of funneling at the TVCL assessment were recorded along with other demographic, medical, obstetrical, sonographic, and delivery variables.

The main result was Many women experienced a seven-day or longer period of latency. The time interval (measured in days) between PPROM and the infant's delivery was called delivery delay. The secondary results were Maternal: Prolonged interval between ROMs and TVUS, quantity of women reaching 36 + 6 weeks, style of delivery (vaginal OR caesarean), occurrence of chorioamnionitis. The fetal APGAR scores at 1 and 5 minutes, gestational age at PPROM, gestational age at delivery, birthweight at delivery, presence of neonatal sepsis, necessity for NICU hospitalization, and indication.

**Statistical Analysis**

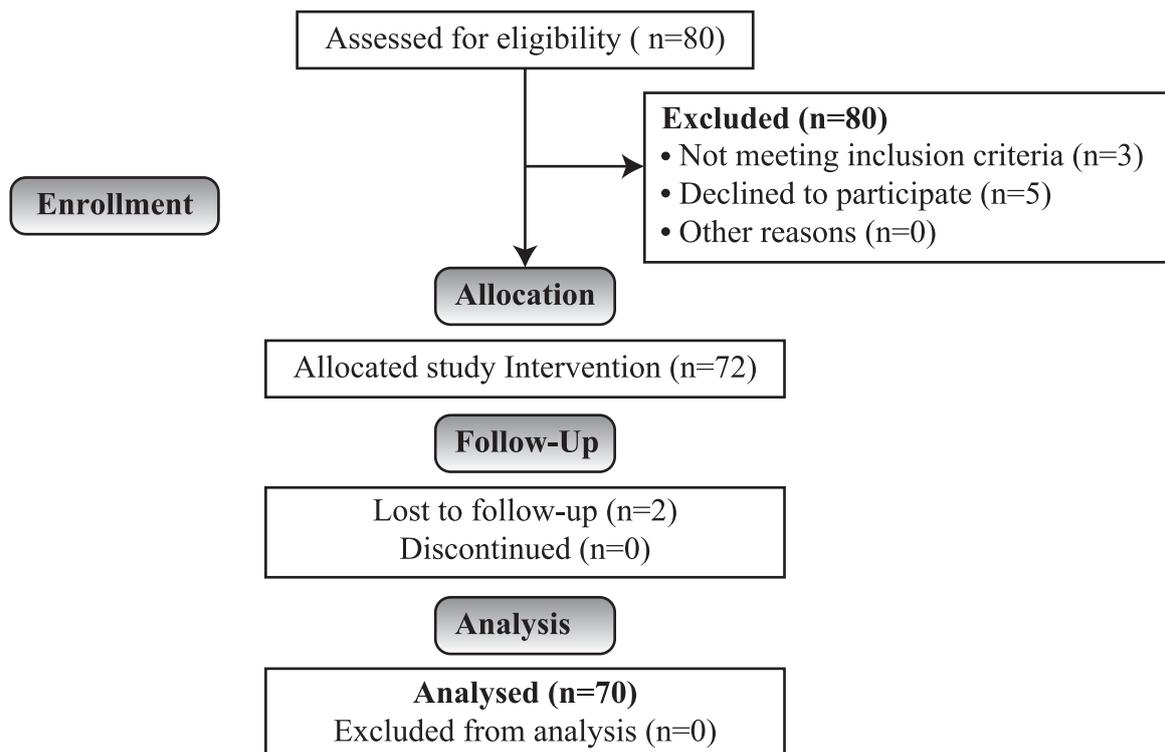
Every piece of information was recorded into a database and confirmed by another, impartial party. Demographics, maternal characteristics, neonatal outcomes, and delivery delay at seven days were all subjected to statistical analysis. Fisher's exact test

and the Wilcoxon rank sum test were used to find parameters that showed statistically significant differences between the two groups. A receiver operating characteristic (ROC) curve and the Youden index were used to generate cut-off values in order to examine the correlations between TVCL, AFI, and both of them during a seven-day latency period. We estimated the median delay time based on these findings, taking into account the cut-off value of each parameter. The study used sensitivity, specificity, and predictive values to investigate the potential impact of TVCL factors, AFI, or a combination of both on the likelihood of delivery within a 7-day period. We conducted comparative assessments to see whether other factors influence latency.

**Results**

This A total of 80 women were assessed for eligibility before enrollment in the study; 10 of them were excluded. So, this prospective observational study was conducted on 80 with pregnant women with PPROM who underwent TVCL measurement after admission.

**CONSORT Flow Diagram**



**Table 1: Description of demographic data of all cases**

	Mean	SD	Minimum	Maximum
<b>AGE</b>	27.23	6.10	18.00	39.00
<b>BMI</b>	27.64	1.69	22.30	30.00
<b>GA at PPRM</b>	33.84	2.22	28.00	36.43
			<b>Count</b>	<b>%</b>
<b>Previous delivery</b>	<b>CS</b>		39	55.7%
	<b>NVD</b>		8	11.4%
	<b>no</b>		23	32.9%
<b>History of PPRM</b>	<b>YES</b>		12	17.1%
	<b>NO</b>		58	82.9%
<b>History of PTL</b>	<b>YES</b>		12	17.1%
	<b>NO</b>		58	82.9%

Table 1 showed that mean  $\pm$  SD of maternal age was  $27.23 \pm 6.10$  years, BMI was  $27.64 \pm 1.69$  kg/m<sup>2</sup>, and gestational age at PPRM was  $33.84 \pm 2.22$  weeks. 39 cases previously delivered by CS and 8 cases by NVD. 12 cases had a history of PPRM, 12 cases had a history of PTL.

**Table 2: Description of admission data of cases:**

	Mean	SD	Minimum	Maximum
<b>TVCL (mm)</b>	27.81	7.48	11.00	50.00
<b>AFI (cm)</b>	4.66	2.30	1.00	10.00
<b>CRP on Admission</b>	<b>Positive</b>		19	27.1%
	<b>Negative</b>		51	72.9%

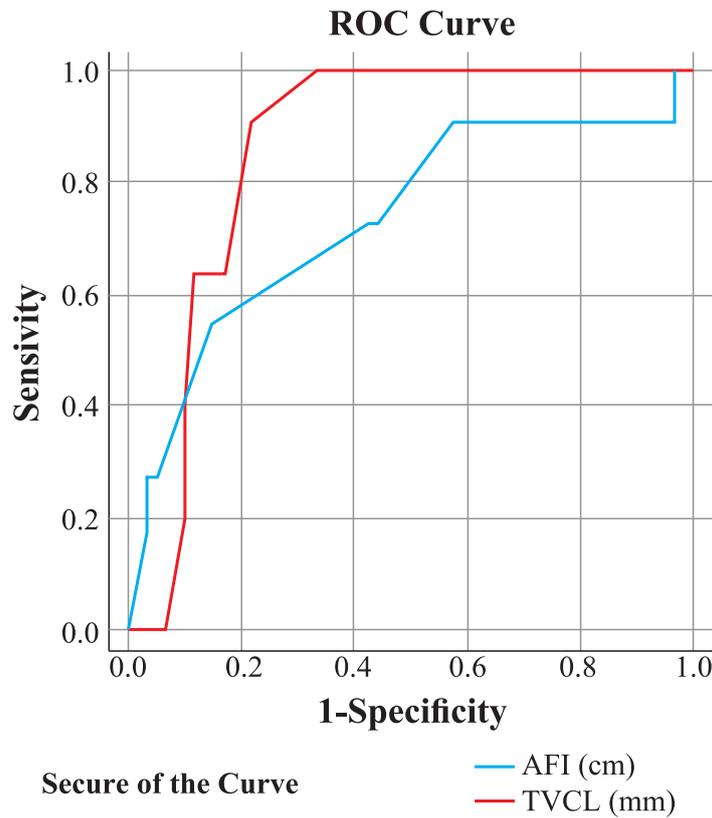
Table 2 showed that mean  $\pm$  SD of TVCL was  $27.81 \pm 7.48$  mm; AFI was  $4.66 \pm 2.30$  cm. 19 cases had positive CRP on admission.

**Table 3: Description of maternal and fetal outcomes**

	Mean	SD	Minimum	Maximum
<b>Gestational age at delivery</b>	34.58	2.13	28.43	37.00
<b>Birthweight at delivery (gm)</b>	2278.51	616.04	1000.00	3750.00
<b>APGAR score at 1 minute</b>	6.41	1.50	1.00	9.00
<b>APGAR score at 5 minutes</b>	8.34	1.18	4.00	10.00
<b>Mode of delivery</b>	<b>LSCS</b>		45	64.3%
	<b>NVD_INDUCED</b>		3	4.3%
	<b>NVD</b>		22	31.4%
<b>Development of chorioam-nionitis</b>	<b>YES</b>		7	10.0%
	<b>NO</b>		63	90.0%
<b>NICU admission</b>	<b>YES</b>		42	60.0%
	<b>NO</b>		28	40.0%
			<b>Count</b>	<b>%</b>
<b>Latency period</b>	<b>&lt;=7 days</b>		59	84.3%
	<b>&gt;7 days</b>		11	15.7%

Table 3 showed that mean  $\pm$  SD of gestational age at delivery was  $34.58 \pm 2.13$  weeks; birthweight at delivery was  $2278.51 \pm 616.04$  gm; APGAR scores at 1 and 5 minutes were  $6.41 \pm 1.50$  and  $8.34 \pm 1.18$  respectively. 45 cases delivered by LSCS, 3 cases with induced vaginal delivery and 22 cases with NVD, 7 cases developed chorioamnionitis and 42 infants needed NICU admission, 11 cases reached  $> 7$  days latency period.

**ROC curve for prediction of Delivery Latency using TVCL (mm) and AFI (cm)**



ROC curve for prediction of Delivery Latency using TVCL (mm) and AFI (cm)

	Area under the curve	P value	95% Confidence Interval		Cutt off	Sensivity %	Specificity %
			Lower Bound	Upper Bound			
<b>TVCL (mm)</b>	0.900	< 0.001	0.827	0.972	30.5	90.9	83.1
<b>AFI (cm)</b>	0.759	0.003	0.588	0.930	6.5	54.5	88.1

At cut off 30.5 to TVCL to predict delivery latency period with sensitivity and specificity 90.1%,83.1% respectively

And for AFI cut off was 6.5 and sensitivity , specificity was 54.5%,88.1% respectively.

**Table 4: Accuracy of TVCL in prediction of delivery latency in all patients**

	Sensitivity	Specificity	PPV	NPV
TVCL>3 cm vs ≤3 cm (n=70)	10/11=90.9%	46/59=78%	10/23=43.5%	46/47=97.9%
AFI >5 cm vs ≤5 cm (n=70)	7/11=63.6%	41/59=69.5%	7/25=28%	41/45=91.1%
TVCL>3 cm vs ≤3 cm in women with AFI >5 cm (n=25)	7/7=100%	13/18=72.2%	7/12=58.3%	13/13=100%
TVCL>3 cm vs ≤3 cm in women with AFI ≤5 cm (n=45)	3/4=75%	33/41=80.5%	3/11=27.3%	33/34=97.1%

Table 4 showed that the best sensitivity of TVCL in prediction of delivery latency was 100 % at TVCL>3 cm in women with AFI >5 cm. On the other hand, the best specificity was 80.5% at TVCL>3 cm in women with AFI ≤5 cm.

**Table (5): Relation with delivery latency**

		Latency period				P value
		≤7 days		>7 days		
		Count	%	Count	%	
GA at PPRM	≤30	5	8.5%	2	18.2%	0.302
	>30	54	91.5%	9	81.8%	
History of PPRM	Yes	11	18.6%	4	36.4%	0.233
	No	48	81.4%	7	63.6%	
History of PTL	Yes	12	20.3%	4	36.4%	0.259
	No	47	79.7%	7	63.6%	
Mode of delivery	NVD_INDUCED	3	5.1%	0	0.0%	0.497
	NVD	20	33.9%	2	18.2%	
	LSCS	36	61.0%	9	81.8%	
NICU admission	Yes	35	59.3%	6	54.5%	1
	No	24	40.7%	5	45.5%	
TVCL	≤3 cm	49	83.1%	1	9.1%	< 0.001
	>3 cm	10	16.9%	10	90.9%	
AFI	≤5 cm	42	71.2%	4	36.4%	0.038
	>5 cm	17	28.8%	7	63.6%	

Table 5 shows that there was significant relation between latency period and TVCL, AFI p value <0.001 and 0.038 respectively

**Table (6): Latency of different parameters in prediction of delivery latency**

	Latency period				P value
	≤7 days		>7 days		
	Mean	Standard Deviation	Mean	Standard Deviation	
TVCL (mm)	26.12	7.15	34.73	2.90	< 0.001
AFI (cm)	4.19	1.81	6.45	2.58	0.001

Table 6 shows that there was significant difference between latency period either < 7 or > 7 with TVCL and AFI respectively

**Table (8): Multiple logistic regression models predicting delivery latency**

Delivery latency	TVCL (mm)	0.008	1.164	1.041	1.301
	AFI (cm)	0.019	1.627	1.085	2.441

Multiple logistics regression shows significant association between TVCL ,AFI with delivery latency

## **DISCUSSION**

According to our research, for women with an AFI more than 5 cm, TVCL had the highest sensitivity of 100% when it came to predicting delivery latency at TVCL>3 cm. However, in women with AFI ≤5 cm, the best specificity was 80.5% at TVCL>3 cm. The results of this study show that AFI by itself, at the cutoff point of 6.5 cm, has a sensitivity and specificity of 54.5% and 88.1%, respectively, in predicting delivery within 7 days. Cervical length alone at the cutoff point of 30.5 mm had a sensitivity and specificity of 90.9% and 83.1%, respectively, in predicting delivery within 7 days. In terms of forecasting delivery within 7 days, the combination of TVCL>3 cm vs. ≤3 cm had the following values: 74.29%, 56.25%, 78.79%, and 50%, respectively. The combination of AFI>5 cm vs ≤5 cm had the following predictive values: sensitivity, specificity, positive and negative predictive values for delivery within 7 days: 63.6%, 71.2%, 29.2%, and 91.3%, respectively. In women with an AFI >5 cm, the combination of TVCL>3 cm vs. ≤3 cm had 100%, 82.4%, 70%, and 100% of the sensitivity, specificity, positive, and negative predictive values for predicting delivery within 7 days. In women with AFI ≤5 cm, the combination of TVCL>3 cm vs ≤3 cm had the following combinations for predicting delivery within 7 days: 75%, 83.3%, 30%, and 97.2%, respectively. Gupta et al.9 concurred with us and said that combining AFI and TVCL increased the positive predictive value for predicting delivery delay; hence, women with AFI ≤5 and TVCL ≤2.5 cm had an 85.6% chance of giving birth within 7 days following PPROM.

Ilhan et al.10 agreed with us and reported that latent period; was positively correlated with

cervical length. Cervical length was found to be the most significant factors associated with the latent period. Patients with a latent duration of 7 days or more had a statistically significantly higher cervical length than the group with an average length of >7 days (35,4 ± 8,9 ml); and patients with a latent duration between 2-7 days had higher cervical length 21,2 ± 15,0 compared to the group of 2 days or less 29.9 ± 21,8 ml.

Against our study, the study of Mehra et al.11 to predict the latent period, the combination of AFI + TVCL was evaluated, but it was not found to be significant for prediction. However, short cervical length was found to be associated with low AFI values.

In the same line with us, in Test et al.12 study, patients were retrospectively examined for 10 years, 1399 patients with PPROM were included in the study, and factors related to the latent period were discussed. Among the factors thought to shorten the latency period, oligohydramnios was found to be statistically significant.

This was in line with a study by Vermillion et al.13 that demonstrated a shorter delivery latency is linked to an AFI <5 cm after PPROM between 24 and 32 weeks of gestation.

Likewise, a recent study by Mehra et al.11 found that in women presenting with PPROM, a shorter TVCL independently predicted delivery within 7 days, while TVCL >2 cm significantly increased the likelihood of remaining undelivered at 7 days after CL evaluation.

According to Kansara and Yadav14, Patil et al.15, and Rajan and Menon16, this finding suggests that shorter latency is associated with the existence of a short cervix in PPROM.



Out of 106 women, 95 went into spontaneous labor and were included in the study, according to Kansara and Yadav<sup>14</sup>. 49 women delivered after the test, and 46 women delivered within 7 days of the test. 34 (73.91%) of the 46 women had an amniotic fluid index of less than 5 cm, while 31 (67.39) of the women had a cervical length less than 2 cm.

El Sokkary et al.<sup>17</sup> determined how the cervical length, amniotic fluid index, and labor latency interval related to preterm premature rupture of the membranes (PPROM) relate to each other. They reported a considerable reduction in the amniotic fluid index and a shortening of the cervical length, which is consistent with our findings. Moreover, there was a direct correlation between the cervical length and the AFI and the latency interval. In comparison to controls, PPRM cases had a considerable reduction in AFI and a significant shortening of the cervical length. Cervical length and AFI were significantly correlated with the delay interval.

As regard maternal outcomes, our study reported that gestational age at delivery was  $34.58 \pm 2.13$  weeks, 45 cases delivered by LSCS, 3 cases with induced vaginal delivery, 22 cases with NVD, 7 cases developed chorioamnionitis and 11 cases reached > 7 days latency period with no significant relation with cervical length or amniotic fluid index.

Gupta et al.<sup>9</sup> examined the AFI and CL as predictors of pregnancy outcome in cases presenting with PPRM, measured the effectiveness of these parameters as predictors of pregnancy outcome in cases presenting with PPRM, and ascertained the AFI in cases presenting with PPRM, as well as the CL ultrasonographically. Contrary to what we said, they found a correlation between a long CL (TVCL >2.5 cm) and an AFI >5 and an increased risk of maternal morbidity, including chorioamnionitis, abruption, and cord prolapse.

In contrast, Borna et al.<sup>18</sup> and Moberg et al.<sup>19</sup> discovered a strong link between

oligohydramnios and an increased incidence of chorioamnionitis. As the length of PPRM grows, the risk of additional maternal morbidity, such as abruption (4.7 vs. 11.1%) and cord prolapse (3.1 vs. 8.3%), rose; nevertheless, the difference between the two groups was statistically non-significant.

As regard fetal outcomes, our study reported that birthweight at delivery was  $2278.51 \pm 616.04$  gm, APGAR scores at 1 and 5 minutes were  $6.41 \pm 1.50$  and  $8.34 \pm 1.18$  respectively and 42 infants needed NICU admission with no significant relation with cervical length or amniotic fluid index.

Gupta et al.<sup>9</sup> was against us and proved significant relation between cervical length or amniotic fluid index and neonatal outcomes. The majority of the newborns in Group 1 had an Apgar score of between 4 and 6, while Group 2 had a score of >6. Most newborns in both groups had an Apgar score of greater than six after five minutes. Group 1 required NICU admission at a statistically significant greater rate than Group 2. Although it was not statistically significant, Group 1 had higher rates of newborn death and morbidity.

Patil et al.<sup>15</sup> declared that, of 170, the majority (95) belonged to the group with 28+1 to 32 weeks. The gestational period had an inverse relationship with latency ( $p < 0.0001$ ). In all three groups, a longer cervical length was associated with higher latency, a higher risk of chorioamnionitis, and more newborn problems. Additionally, compared to women with PPRM having AFI  $\leq 5$  cm, who had a shorter mean latency period ( $7.63 \pm 1.07$  days) and a lower risk of developing chorioamnionitis, women with PPRM having AFI >5 cm had a greater mean latency period ( $8.32 \pm 1.25$  days) and an increased risk of developing chorioamnionitis.

Lu et al.<sup>20</sup> examined the latency period's function and possible influencing elements in order to offer guidance for the clinical management of PPRM. The incidence of low birth weight and newborn respiratory

distress syndrome (NRDS) varied significantly between the 48–168 h group and the > 168 h group with respect to neonatal outcomes (all  $p < 0.05$ ).

## **CONCLUSION**

The best sensitivity of TVCL in prediction of delivery latency was 100 % at TVCL>3 cm in women with AFI >5 cm. On the other hand, the best specificity was 80.5% at TVCL>3 cm in women with AFI ≤5 cm.

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