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Ultrasonographic Evaluation Of Cervical Length And Amniotic Fluid Index As Predictor Of Pregnancy Outcome In Cases Of Preterm Premature Rupture Of Membrane

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ABSTRACT

Background: In cases of preterm premature rupture of membrane (PPROM), the amniotic fluid index (AFI) and cervical length (CL) can be utilized to predict the outcome for the mother and the newborn, including delivery latency.

Aims and Objectives: The study's objectives were to measure the effectiveness of these parameters as predictors of pregnancy outcome in cases presenting with PPROM, investigate the AFI and CL as predictors of pregnancy outcome in cases presenting with PPROM, ascertain the AFI in cases presenting with PPROM, and ascertain CL ultrasonographically in cases presenting with PPROM.

Materials and Methods: This observational study was carried out in the at Vinayaka missions Kirupananda variyar medical college, between February 2024 to July 2024. This study included 100 women who had a singleton pregnancy and a vertex presentation and who arrived at the hospital within 12 hours of a spontaneous rupture of the membrane (PPROM) during the 28–34+6 week gestation period.

Results: At PPROM, the gestational period and delivery delay were inversely correlated (P<0.0001). Group 1's mean AFI was 5.15 cm, whereas Group 2's was 7.12 cm. There was a statistically significant difference between the two groups (P<0.0001). Our research thus demonstrates a favorable relationship between AFI and delivery latency. Group 1's mean transvaginal CL (TVCL)

was 2.47 cm, whereas Group 2's TVCL was 2.99 cm. It was determined that there was a statistically significant difference in TVCL between the two groups (P=0.00005). Group 1 had a greater need for admission to the neonatal critical care unit than Group 2, and this difference was statistically significant (P=0.020).

Conclusion: According to our research, combining AFI and TVCL increases the positive predictive value for predicting delivery delay. Women with AFI ≤5 and TVCL ≤2.5 cm had an 85.6% chance of giving birth within 7 days following PPROM. Maternal morbidity (chorioamnionitis, abruption, and cord prolapse) and delivery latency were associated with longer CLs (TVCL >2.5 cm) and AFI >5.

Key words: Amniotic fluid index; Delivery latency; Preterm premature rupture of membrane; Transvaginal cervical length

INTRODUCTION

With over 3.6 million premature births, or 23.6% of the approximately 15 million preterm births reported globally each year, India is the country that contributes the most to the global prematurity burden (the World Health Organization).

Preterm birth is defined as a baby born before 37 weeks of pregnancy. It is the primary factor that determines a baby's poor survival and quality of life after birth. Preterm delivery complications are the leading cause of death for children under five years old, making for 15% of all child fatalities globally.

Preterm premature rupture of the membrane (PPROM) is one of the risk factors that can lead to preterm birth. The spontaneous rupture of the fetal membranes before 37 full weeks and before to the commencement of labor is known as PPROM. Thirty to forty percent of preterm deliveries are linked to PPROM, which complicates 3% of all deliveries. It is a significant contributor to prenatal morbidity and death risk.

In order to determine delivery latency based on the transvaginal cervical length (CL) and amniotic fluid index (AFI cutoff values), we looked into cases with PPROM. The purpose of this research was to ascertain if, in women presenting with PPROM, transvaginal CL (TVCL), AFI, or a combination of both could predict delivery delay, maternal, and newborn prognosis. The need for particular interventions, such as hospitalization, intensive monitoring, the administration of steroids for lung maturity and MgSo4 for neuroprotection, and the timely referral to centers with neonatal intensive care unit (NICU) facilities for the proper management of prematurity, could be guided by specific and appropriate prediction of delivery latency.

AIMS AND OBJECTIVES

to investigate the relationship between the Amniotic Fluid Index (AFI) and Cervical Length (CL) and the prognosis of pregnancy in patients with PPROM.

- To calculate the Amniotic Fluid Index (AFI) in patients who exhibit postpartum haemorrhage.
- To use ultrasonography to measure cervical length (CL) in patients who appear with postpartum haemorrhage.
- To assess how well these characteristics predict the fate of pregnancies in cases where PPROM is present.

MATERIALS AND METHODS

This observational study was carried out in the at Vinayaka missions Kirupananda variyar medical college, between February 2024 to July 2024. Out of the prenatal cases that presented to the labor room, one hundred

cases that satisfied the inclusion and exclusion criteria were chosen.

INCLUSION CRITERIA

The study's inclusion criteria included the following:

- Cases wanting to participate in our study.
- Cases presenting within 12 hours of membrane rupture.
- Solitary pregnancies.
- Cases between 28 and 34+6 weeks presenting with PPROM.
- Vertex presentation.

EXCLUSION CRITERIA

The following standards were excluded by the research:

- Those who are in active labor.
- Malpresentation.
- Multiple pregnancies.
- Chorioamnionitis symptoms.
- Antepartum haemorrhage.
- Cervical cerclage surgery.
- Congenital malformation of the foetus.
- Pregnancy with medical sickness.
- Intrauterine device.

Within 12 hours of admission, TVCL was carried out on all hospitalized women with empty bladders. The front and posterior walls of the cervix were sonographically opposed, thus the location of the calipers was determined by taking the shortest technically optimal measurement. It was observed that funneling was present. At the moment of the TVCL measurement, AFI was noted.

Tocolysis was not administered. Four times a day, patients were observed using cardiotocography and vital signs to identify any indicators of fetal discomfort or imminent labor. For the purpose of early infection identification, complete blood counts and C-reactive protein levels are repeated 48 hours after membrane breach and then once a week after that. The patients were observed until they entered spontaneous labor or were induced at 34 weeks total, whichever occurred first, and the results were documented. The term "latency" refers to the interval between membrane rupture and delivery.

Group 1 consisted of individuals with delivery delays within 7 days, whereas Group 2 included those with delivery delays longer than 7 days. We contrasted the outcomes for the two groups.

METHOD

Measurement of AFI

Using a probe at a frequency of 3.5–5 MHZ, we calculated the AFI using a four-quadrant approach. The total of the deepest, open, and vertical fluid pocket lengths in each quadrant is the four quadrant technique. Fetal components and the umbilical cord should not be present in any pocket.
a. Using the umbilicus as the horizontal axis and the linea nigra as the vertical axis, divide the uterus into four quadrants.

b. In each quadrant, the pocket with the largest vertical dimension is measured.

c. AFI is the sum of the four measurements.

AFI Value

<5 cm = Very low (oligohydramnios)

5.1–8 cm= Low

8.1–25 cm= Standard

>25 cm= Polyhydramnios.

TVCL calculation

Women are placed in a dorsal lithotomy position and a transvaginal probe with a frequency of 5 MHz is used to perform transvaginal sonography. The bladder should be empty for women. To obtain a sagittal view of the cervix, we insert the probe into the anterior vaginal fornix. The cervical canal, endocervical mucosa, internal and external OS will all be identified. The location of the calipers should be where the cervix's anterior and posterior walls are sonographically opposed. The distance between the internal and exterior OS is now being measured. The best and shortest measurement of CL should be recorded after three measurements.

Table 1: Demographic and obstetric parametersby delivery latency at 1week

Parameters		**Group I (≤7days[n=64])**	**Group II (>7days[n=36])**
Maternal age(years)			
18–24	06	9.3%	8.3%
25–32	53	82.8%	86.1%
>32	05	7.9%	5.6%
Gravida			
Primi gravida	20	31.2%	30.6%
G-2	26	40.6%	22.2%
G-3	12	18.8%	30.6%
≥G-4	06	9.4%	16.6%
Residential area			
Rural	45	70.3%	61.1%
Urban	19	29.7%	38.9%
Socioeconomic status			
Upper	08	12.5%	5.5%
Middle	24	37.5%	38.9%
Lower	32	50%	55.6%
Body mass			

index(kg/m^2)			
<25	32	50%	55.6%
25–28	18	28.1%	27.8%
>28	14	21.9%	16.6%
Past obstetric history			
History of abortion	13	20.3%	19.4%
History of preterm birth	20	31.2%	16.6%
History of PPROM	13	20.3%	8.3%
Associated conditions			
Urinary tract infection	12	18.8%	19.4%
Genital tract infection	21	32.8%	30.6%
Upper respiratory infection	08	12.5%	11.1%
Dental infection	06	9.3%	5.6%
Anemia	47	73.4%	25

Table 2: Maternal characteristics by deliverylatency at 1week

Characteristics	Group I (≤7days[n=64])		Group II (>7days[n=36])	
	No.	%	No.	%
Gestational age at PPROM (week)				
28^{+1}–30	07	10.9	12	33.3
30^{+1}–32	33	51.6	18	50.0
32^{+1}–34+6	24	37.5	06	16.7
Amniotic fluid index(cm)				
<5	37	57.8%	06	16.7%
5–8	24	37.5%	20	55.5%
9–12	03	4.7%	10	27.8%
>12	00	00	00	00
Cervical length(cm)				
2–2.5	34	53.1%	06	16.7%
2.5–3	20	31.3%	10	27.7%
>3	10	15.6%	20	55.6%

PPROM: Preterm premature rupture of membrane

RESULTS

One hundred pregnant women with PPROM who satisfied the inclusion and exclusion criteria were included in this study. Group 1 saw the delivery of 64 women within 7 days of the PPROM assignment, while Group 2 had the delivery of 36 women after 7 days of the PPROM assignment.

Table 1 displays the univariate associations between obstetric and demographic characteristics for latency periods of ≤7 days and >7 days. In Group 1, the mean age was 27.5±2.5 years, while in Group 2, it was 27.1±2.6 years. The majority of cases in both groups were BMI <25 kg/m2, rural area residents, multigravidae, and had lower socioeconomic position.

Shorter delivery latency was substantially linked with those with prior PPROM and premature birth. Other risk variables that were shown to be higher in Group 1 but not statistically significant included history of abortion, urinary tract infection, genital tract infection, upper respiratory tract infection, tooth infection anemia, and history of cervical surgery. With the exception of a history of a previous preterm birth and a prior PPROM, which differed significantly with delivery latency at seven days, both groups' demographic and obstetric characteristics were equivalent. Maternal characteristics in both groups are compiled in Table 2. Group 1's mean gestational age at PPROM was 31.52 weeks, whereas Group 2's was 29.64 weeks.

Group 1's mean AFI and TVCL were 5.15 cm and 2.47 cm, respectively, whereas Group 2's mean values were 7.12 cm and 2.99 cm. The difference in TVCL at PPROM, AFI, and gestational age between the two groups was determined to be statistically significant.

The majority of cases in both groups were between 30+1 and 32 weeks gestation, as Table 2 illustrates. Table 3 demonstrates that in Group 1, 19 cases (54.3%) of women with gestational ages of 30+1–32 weeks had AFI <5.In Group 2, there was only one case (6.2%) with AFI <5, while 11 cases (68.8%) had AFI 5–8 and four instances (25%) had AFI 9–12. Of these, 14 cases (40%) had AFI 5–8 and only two cases (5.7%) had AFI 9–12.

Table 4 shows that among women of gestational age 30+1–32 weeks, TVCL between 2 and 2.5 cm was present in 57.1% of instances, compared to 12.5% in Group 1 and Group 2, 28.6% versus 31.3% in Group 2, and 14.3% versus 56.2% in Group 2.

Table 5 indicates that the majority of the neonates 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.

Table 6 demonstrates that Group 1 required NICU hospitalization more frequently than Group 2, and this difference was statistically significant. Although it was not statistically significant, Group 1 had higher rates of neonatal death and morbidity.

As PPROM lengthens, there is a higher risk of chorioamnionitis, abruption, and cord prolapse; however, there was no statistically significant difference between the two groups.

DISCUSSION

Table 3: Correlation of amniotic fluid index with gestational age in both group

Amniotic fluid index	Group 1						Group 2					
	POG-28^{+1}-30week		POG-30^{+1}-32week		POG-32^{+1}-34^{+6}week		POG-28^{+1}-30week		POG-30^{+1}-32week		POG-32^{+1}-34^{+6}week	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
<5	03	42.9	19	54.3	15	68.2	03	25	01	6.2	02	25
5–8	03	42.9	14	40.0	07	31.8	06	50	11	68.8	03	37.5
9–12	01	14.2	02	5.7	00	00	03	25	04	25.0	03	37.5
>12	00	00	00	00	00	00	00	00	00	00	00	00
Total	07	100	35	100	22	100	12	100	16	100	08	100

Table 4: Correlation of cervical length with gestational age in both group

Cervical length (cm)	Group1						Group2					
	POG-28^{+1}-30week		POG-30^{+1}-32week		POG-32^{+1}-34^{+6}week		POG-28^{+1}-30week		POG-30^{+1}-32week		POG-32^{+1}-34^{+6}week	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
2–2.5	00	00	20	57.1	14	63.6	03	25.0	02	12.5	01	12.5
2.5–3	03	42.9	10	28.6	07	31.8	02	16.7	05	31.3	03	37.5
>3	04	57.1	05	14.3	01	4.6	07	58.3	09	56.2	04	50.0
Total	07	100	35	100	22	100	12	100	16	100	08	100

Table 6: Distribution of cases according toneonatal and maternal outcome

NICU Admission required	Group 1		Group 2	
	No.	%	No.	%
Yes	34	56.7%	10	31.2%
No	26	43.3%	22	68.8%
Neonatal Mortality	09	14.1%	03	8.3%
Neonatal Morbidity	20	31.2%	13	36.1%
Chorioamnionitis	14	21.9%	18	50%
Abruption	03	4.7%	04	11.1%
Cord Prolapse	02	3.1%	03	8.3%

Table 5: Distribution of cases according to Apgar score(1min and 5min) at the time of birth

Apgar Score	Group 1				Group 2			
	1min		5min		1min		5min	
	No.	%	No.	%	No.	%	No.	%
<4	10	15.6	07	10.9	07	19.4	05	13.9
4–6	28	43.8	27	42.2	11	30.6	06	16.7
>6	26	40.6	30	46.9	18	50	25	69.4
Total	64	100	64	100	36	100	36	100

Regarding mother age, parity, and body mass index, there was no statistically significant difference between the two groups in our study. According to the modified Kuppuswamy scale, the majority of women were from lower socioeconomic classes and lived in rural areas. It was determined that there was no statistically significant difference between the two groups with regard to history of abortion, genital tract infection, upper respiratory infection, dental infection, anemia, and history of cervical surgery. However there was a statistically significant difference between the histories of preterm birth and PPROM. Thus, there was a substantial correlation between delivery latency of ≤7 days and previous preterm birth and prior PPROM.

The cases in our study ranged in gestational age from 28 weeks to 34.6 weeks. In all groups, the majority of cases fell within the 30-plus or 32-week gestational age range. In Group 1, the mean gestational age was 31.52 weeks, while in Group 2, it was 29.64 weeks. It was determined that there was a statistically significant difference ($P<0.0001$) between the two groups. As a result, we discovered that later gestational age at PPROM is linked to shorter delivery latency and earlier gestational age at PPROM is strongly connected with longer delivery latency. Mehra and Amon Patil et al., Rajan and Menon, and Jeon et al. corroborated this, finding an inverse relationship between gestational age at PPROM and delivery latency.

AFI was examined in this study for both groups; the mean AFI for Group 1 was 5.15 cm, whereas the mean AFI for Group 2 was 7.12 cm. AFI was observed to differ statistically significantly ($P<0.0001$) between the

two groups. Our research thus demonstrates a positive association between AFI and delivery latency, meaning that the lower the AFI following PPROM,

The delivery delay will be lower; the longer the latency after PPROM, the bigger the AFI. The association between AFI and birth latency is most likely caused by the fact that fetal pressure on the chorioamnionic membrane increases with decreased amniotic fluid, which triggers labor to begin earlier.

This was consistent with the research by Vermillion et al., which demonstrated that a shorter delivery latency is linked to an AFI <5 cm after PPROM between 24 and 32 weeks of gestation. In a research by Mehra and Amon7, the mean AFI was 3.5 cm for Group 1 (delivery lag ≤7 days) and 5.2 cm for Group 2 (delivery latency >7 days). AFI differences between the two groups were found to be statistically significant (P<0.05), and in women with PPROM, AFI <5 cm independently predicted delivery within 7 days.

Our research demonstrates that, when cut off = 5 (sensitivity = 86.04%, specificity = 52.63%, positive predictive value (PPV) = 57.81%, NPV = 83.33%, and accuracy = 69.07%), AFI is a viable tool for predicting delivery latency in women with PPROM.

TVCL was measured in both groups; the mean TVCL for Group 1 was 2.47 cm, whereas the mean TVCL for Group 2 was 2.99 cm. It was determined that there was a statistically significant difference in TVCL between the two groups (P=0.00005). This demonstrates that the delay period increases with TVCL length and decreases with TVCL length. For the developing fetus to be retained and protected, CL is a crucial component. The length of the cervix bears the pressure that the developing fetus puts on it, causing the cervix to remain closed. The majority of pregnant women keep their CL between 3 and 4 cm. Pregnant women whose CL is less than 2 cm are more likely to give birth prematurely, meaning before 37 full weeks of pregnancy.

This result is in line with a research by Rizzo et al. that looked at 92 women and found that when CL was less than 2 cm, the median time to delivery was 2 days, while for longer cervixes, it was 6 days. Similarly, a shorter TVCL independently predicted delivery within 7 days in women presenting with PPROM, and TVCL >2 cm significantly increased the likelihood of remaining undelivered at 7 days after CL evaluation, according to a recent study by Mehra and Amon 7. The results of Patil et al., Rajan and Menon, and Kansara et al. corroborate this conclusion, which shows that a shorter latency is associated with a short cervix in PPROM.

With a cut off of 2.5 cm, our study demonstrates the validity of CL in predicting delivery latency in women with PPROM. The results indicate 85% sensitivity, 50% specificity, PPV of 53.12%, NPV of 83.33%, and accuracy of 64%.

In both groups, the majority of newborns weighed between 1.6 and 2 kg at birth. The maximum number of newborns in Group 2 had an Apgar score greater than 6, whereas in Group 1 it was between 4 and 6. Most newborns in both groups had a 5-minute Apgar score of greater than 6. The difference between the two groups' 1 and 5 minute Apgar scores was determined to be statistically non-significant.

Group 1 had a higher need for NICU admission (P=0.020) and more days of NICU admission (P=0.002) than Group 2, and this difference was statistically significant. The preventive antibiotic, steroid, and MgSo4 administered to women with PPROM along with close maternal and fetal monitoring may be to blame for this. Moreover, for every extra day of in utero maturation, expectant treatment in women with PPROM increases infant survival by about 2%.

In our study, there were three cases (8.3%) and nine cases (14.1%) of neonatal deaths in Group 1 and Group 2, respectively. However, the difference between the two groups was statistically not significant (P=0.821).

Although Group 1 had a greater rate of neonatal morbidity than Group 2, the difference was not statistically significant. Sepsis was the primary cause of morbidity, which was followed by respiratory distress syndrome and newborn asphyxia. It demonstrates that preterm, not PPROM, is the cause of newborn mortality and morbidity.

In our investigation, chorioamnionitis was seen in 18 cases (50%) and 14 cases (21.9%) of Group 1 and Group 2. Although there was a statistically non-significant difference between the two groups, it was shown that women with prolonged delivery latency had a higher prevalence of chorioamnionitis. The higher prevalence of chorioamnionitis may be caused by patients from lower socioeconomic backgrounds visiting our hospital, which may account for the difference in the prolonged latency of the illness. Similar to this, chorioamnionitis was observed in 24 instances (53.3%) of Group 1 (delivery latency ≤3 days) and 30 cases (55.6%) of Group 2 (delivery latency >3 days) in a research by Lee et al. However, there was no statistically significant difference between the two groups (P=0.825).

On the other hand, oligohydramnios was connected with a higher incidence of chorioamnionitis, according to research by Borna et al. and Moberg et al.

With an increase in PPROM duration, there was a statistically non-significant rise in the risk of other maternal morbidities, such as abruption (4.7 vs. 11.1%) and cord prolapse (3.1 vs. 8.3%).

Limitations of the study

To enhance the prediction of delivery latency, it is still necessary to assess multiple gestations, previable PPROM patients, and combine ultrasound data with biochemical markers. Due to the modest study size, multicentric investigations with a bigger sample size should be conducted to further assess these results.

CONCLUSION

Women with AFI ≤5 and TVCL ≤2.5 cm had an 85.6% chance of giving birth within 7 days following PPROM, according to our research, which also indicates that there was an increase in the prediction of delivery latency when AFI and TVCL were combined. At PPROM, it was discovered that the latency period was inversely proportional to the gestational duration, meaning that the longer the gestation period, the longer the latency period. Moreover, we discovered that delivery latency was not significantly correlated with either parity or body mass index. Maternal morbidity (chorioamnionitis, abruption, and cord prolapse) is more common in cases with lengthy CLs and high AFIs, most likely as a result of greater latency. According to this study, preterm is the primary cause of newborn mortality and morbidity. In light of our findings, we advise women with PPROM to get their first TVCL and AFI as soon as is reasonably possible following admission. We will be in a better position to prioritize the patients who need to be referred right away to a higher center with resources for superior maternity and neonatal care by forecasting delivery latency.

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