ORIGINAL ARTICLE ASIAN JOURNAL OF MEDICAL SCIENCES

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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Submission: 16-05-2022 Revision: 29-10-2022 Publication: 01-12-2022

ABSTRACT

Background: Amniotic fluid index (AFI) and cervical length (CL) can be used to predict delivery latency, maternal, and neonatal outcome in cases of preterm premature rupture of membrane (PPROM). **Aims and Objectives:** The aims of this study were to study the AFI and CL as a predictor of pregnancy outcome in cases presenting with PPROM, to determine the AFI in cases presenting with PPROM, to determine CL ultrasonographically in cases presenting with PPROM, and to measure the efficacy of these parameters as a predictor of pregnancy outcome in cases presenting with PPROM. **Materials and Methods:** This was an ambispective observational study conducted from November 2019 to July 2021 in the Department of Obstetrics and Gynecology in S. N. Medical College, Agra. A total of 100 women with singleton pregnancy and vertex presentation who presented to hospital within 12 h of spontaneous rupture of membrane (PPROM) from period of gestation 28–34^{+6} weeks were enrolled in this study. **Results:** Delivery latency was inversely related to period of gestation at pprom ($P<0.0001$). Mean AFI in Group 1 was 5.15 cm and in Group 2 was 7.12 cm and the difference between both group was statistically significant ($P<0.0001$). Thus, our study shows positive correlation between AFI and delivery latency. Mean transvaginal CL (TVCL) in Group 1 was 2.47 cm and in Group 2 was 2.99 cm. Difference in terms of TVCL between both the groups was found to be statistically significant ($P=0.00005$). Need for neonatal intensive care unit admission was higher in Group 1 than Group 2 and this difference was statistically significant ($P=0.020$). **Conclusion:** Our study shows that there was an increase in positive predictive value when we combine AFI and TVCL in prediction of delivery latency, so women with AFI ≤ 5 and TVCL ≤ 2.5 cm had 85.6% risk of delivery within 7 days after PPROM. A long CL (TVCL >2.5 cm) and AFI >5 correlated with increased delivery latency and increased risk of maternal morbidity (chorioamnionitis, abruption, and cord prolapse).

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

Access this article online

Website: http://nepjol.info/index.php/AJMS

DOI: 10.3126/ajms.v13i12.45129

E-ISSN: 2091-0576

P-ISSN: 2467-9100

INTRODUCTION

India is the biggest contributor of 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 (the World Health Organization). Preterm birth defined as birth before 37 weeks of gestation, which is the single most important determinant of adverse neonatal outcomes in terms of survival and quality of life.[1] Complications of preterm birth are the most common direct cause of death in children <5 years of age, accounting for 15% of all child deaths worldwide.[2-4]

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There are various risk factors that may contribute to preterm birth, preterm premature rupture of membrane (PPROM) is one of them. PPROM is defined as spontaneous rupture of the fetal membranes before 37 completed weeks and before labor onset.[5] PPROM 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.[6]

We investigated cases with PPROM to assess delivery latency according to the cutoff values of transvaginal cervical length (CL) and amniotic fluid index (AFI). The aim of this study was to determine whether transvaginal CL (TVCL), AFI, or a combination of both can predict delivery latency, maternal, and neonatal outcome in women presenting with PPROM. Specific and appropriate prediction of delivery latency could help direct the need for specific interventions such as hospitalization, intensive monitoring, administration of steroid for lung maturity, and MgSo4 for neuroprotection and planning timely referral to centers with neonatal intensive care unit (NICU) facility for proper management of prematurity.

Aims and objectives

To study the Amniotic Fluid Index (AFI) and Cervical Length (CL) as a predictor of pregnancy outcome in cases presenting with PPROM.

- To determine the Amniotic Fluid Index (AFI) in cases presenting with PPROM.
- To determine Cervical Length (CL) ultrasonographically in cases presenting with PPROM.
- To measure the efficacy of these parameters as a predictor of pregnancy outcome in cases presenting with PPROM.

MATERIALS AND METHODS

This was an ambispective observational study conducted from November 2019 to July 2021 in Department of Obstetrics and Gynecology in S. N. Medical College, Agra. The study was approved by Institutional Ethics Committee. One hundred cases were selected from the antenatal cases presenting to labor room who met the inclusion and exclusion criteria.

Inclusion criteria

The following criteria were included in the study:

- Antenatal cases between 28 and 34^{+6} weeks presenting with PPROM
- Singleton pregnancy
- Vertex presentation
- Cases willing to enroll in our study
- Cases presenting within 12 h of rupture of membranes.

Exclusion criteria

The following criteria were excluded from the study:

- Those in active labor
- Malpresentation
- Multiple pregnancy
- Showing signs of chorioamnionitis
- Antepartum hemorrhage
- Cervical cerclage operation
- Congenital malformed fetus
- Pregnancy with medical illness
- Intrauterine device.

All women were hospitalized and TVCL was performed with empty bladder within 12 h of admission. Calipers were placed where the anterior and posterior walls of the cervix were sonographically opposed and the shortest technically best measurements were used. The presence of funneling was noted. AFI was recorded at the time of the TVCL measurement.

Prophylactic antibiotics used included ampicillin 2 g IV every 6 h, gentamycin 2 mg/kg IV every 8 h, and metronidazole 500 mg IV every 8 h for 2 days, followed by oral erythromycin 250 mg 4 times a day for a maximum of 10 days or until the women is in established labor. Two doses of 12 mg betamethasone were given i.m 24 h apart for fetal lung maturation. No tocolysis was given. Patients were monitored by cardiotocography and vital signs 4 times a day to detect fetal distress or imminence of labor. Complete blood count and C-reactive protein repeated on 48^{th} h following rupture of membrane, and then once a week for the early detection of impending infection. Patients were monitored until they went into spontaneous labor or were induced at 34 completed weeks whichever was earlier and the outcomes were recorded. Latency defined as the time from rupture of membrane till delivery.

We assigned those with delivery latency within 7 days in Group 1 and those with delivery latency >7 days in Group 2. We compared the results in both the groups.

Method

Measurement of AFI

AFI was estimated by a four quadrant technique by USG machine ESAOTE with a probe of frequency 3.5–5 MHZ. Four quadrant technique is the sum of deepest, unobstructed, and vertical length of pocket of fluid in each quadrant. Each pocket should be free of umbilical cord and fetal parts.

a. Divide the uterus into four quadrants using the linea nigra as the vertical axis and the umbilicus as the horizontal axis.
b. The pocket with largest vertical dimension is measured in each quadrant.
c. Sum of all four measurement=AFI.

Value

<5 cm=Very low (oligohydramnios)
5.1–8 cm=Low
8.1–25 cm=Normal
>25 cm=Polyhydramnios.

TVCL measurement

Transvaginal sonography is performed with the women laid in a dorsal lithotomy position with transvaginal probe of frequency 5 MHz. Women should have an empty bladder. We place the probe in the anterior vaginal fornix to ensure a sagittal view of cervix. We will identify internal OS, external OS, cervical canal, and endocervical mucosa. Calipers should be placed, where the anterior and posterior walls of the cervix are sonographically opposed. Now, we measure the distance between internal and external OS. We should take three measurements and record the best shortest measurement of CL.

RESULTS

This study was conducted on 100 antenatal women with PPROM who met the inclusion and exclusion criteria. There were 64 women delivered within 7 days of PPROM assigned in Group 1 and 36 women delivered after 7 days of PPROM assigned in Group 2.

The univariate relationships of demographic and obstetric parameters for ≤7 days and >7 days of latency are presented in Table 1. Mean age was 27.5±2.5 years in Group 1 and 27.1±2.6 years in Group 2. Maximum cases in both the groups were multigravida, belonged to rural area and lower socioeconomic status, and had BMI <25 Kg/m^2. Cases with prior preterm birth and prior PPROM were significantly associated with shorter delivery latency. Other risk factors such as history of abortion, urinary tract infection, genital tract infection, upper respiratory tract infection, dental infection anemia, and history of cervical surgery were found to be higher in Group 1 but not statistically significant. Both the groups were comparable in demographic and obstetric parameters except history of prior preterm birth and prior PPROM which were significantly different with delivery latency at 7 days.

Table 2 summarizes maternal characteristics in both the groups. Mean gestational age at PPROM was 31.52 weeks in Group 1 and 29.64 weeks in Group 2. Mean AFI and TVCL in Group 1 were 5.15 cm and 2.47 cm and in Group 2 was 7.12 cm and 2.99 cm, respectively. Difference between both the groups in terms of gestational age, AFI, and TVCL at PPROM was found to be statistically significant.

As shown in Table 2, most of the cases in both group were between gestational age of 30^{+1}–32 weeks. Table 3 shows

Table 1: Demographic and obstetric parameters by delivery latency at 1week

Parameters	Group I (≤7days[n=64])		Group II (>7days[n=36])	
Maternal age(years)				
18–24	06	9.3%	03	8.3%
25–32	53	82.8%	31	86.1%
>32	05	7.9%	02	5.6%
Gravida				
Primi gravida	20	31.2%	11	30.6%
G-2	26	40.6%	08	22.2%
G-3	12	18.8%	11	30.6%
≥G-4	06	9.4%	06	16.6%
Residential area				
Rural	45	70.3%	22	61.1%
Urban	19	29.7%	14	38.9%
Socioeconomic status				
Upper	08	12.5%	02	5.5%
Middle	24	37.5%	14	38.9%
Lower	32	50%	20	55.6%
Body mass index(kg/m^2)				
<25	32	50%	20	55.6%
25–28	18	28.1%	10	27.8%
>28	14	21.9%	06	16.6%
Past obstetric history				
History of abortion	13	20.3%	07	19.4%
History of preterm birth	20	31.2%	06	16.6%
History of PPROM	13	20.3%	03	8.3%
Associated conditions				
Urinary tract infection	12	18.8%	07	19.4%
Genital tract infection	21	32.8%	11	30.6%
Upper respiratory infection	08	12.5%	04	11.1%
Dental infection	06	9.3%	02	5.6%
Anemia	47	73.4%	25	69.4%
History of any cervical surgery	01	1.6%	00	00

Table 2: Maternal characteristics by delivery latency 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

that among women of gestational age 30^{+1}–32 weeks, in Group 1, 19 cases (54.3%) had AFI <5.14 cases (40%) which had AFI 5–8 and only two cases (5.7%) had AFI 9–12, and in Group 2, only one case (6.2%) had AFI <5, while 11 cases (68.8%) had AFI 5–8 and four cases (25%) had AFI 9–12.

Among women of gestational age 30^{+1}–32weeks, 57.1% versus 12.5% cases had TVCL between 2 and 2.5 cm, 28.6% versus 31.3% cases had TVCL between 2.5 and 3 cm, and 14.3% versus 56.2% cases had TVCL >3 cm in Group 1 and Group 2, respectively, are presented in Table 4.

As shown in Table 5, Apgar score (1 min) in most of the neonates of Group 1 was between 4 and 6 and in Group 2 was >6. Apgar score (5 min) in majority of neonates of both the group was >6.

As shown in Table 6, need for NICU admission was higher in Group 1 than Group 2 and was statistically significant. Neonatal mortality and morbidity was found to be higher in Group 1 but was statistically insignificant.

Risk of chorioamnionitis, abruption, and cord prolapse increases as the duration of PPROM increases, but the difference between both the groups was statistically insignificant.

DISCUSSION

In our study, there was no statistically significant difference between both groups in terms of maternal age, parity, and body mass index. Majority of women belonged to rural area and lower class of socioeconomic status according to modified Kuppuswamy scale. Difference between both the groups in terms of history of abortion, urinary tract infection, genital tract infection, upper respiratory infection, dental infection, anemia, and history of cervical surgery was found statistically non-significant. However, the difference in terms of history of preterm birth and history of PPROM was found to be statistically significant. Therefore, delivery latency ≤7 days was found to be significantly associated with prior preterm birth and prior PPROM.

In our study, all the cases were taken from 28 weeks to 34.6 weeks of gestational age. Most of the cases in both group were between gestational age of 30^{+1}–32 weeks. The mean gestational age was 31.52 weeks in Group 1 and 29.64 weeks in Group 2. The difference between both group was found to be statistically significant (P<0.0001). Thus, we found that earlier gestational age at PPROM is significantly associated with longer delivery latency and later gestational age at PPROM is associated with shorter delivery latency. This was a supported by Mehra and Amon[7] Patil et al.,[2] Rajan and Menon[8] and Jeon et al.,[9] where delivery latency was also found to be inversely related to gestational age at PPROM.

In this study, AFI in both the groups was studied, mean AFI in Group 1 was 5.15 cm and in Group 2 was 7.12 cm. The difference between both group in terms of AFI was found to be statistically significant (P<0.0001). Thus, our study shows positive correlation between AFI and delivery latency, that is, lesser the AFI after PPROM,

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 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

Table 6: Distribution of cases according to neonatal 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%

shorter will be delivery latency; greater the AFI after PPROM, longer will be the latency. This correlation of AFI with delivery latency is probably due the fact that lesser the amniotic fluid more will be fetal pressure on chorioamnionic membrane which leads to the early initiation of labor.

This was in accordance with the study conducted by Vermillion et al.,[10] who showed that an AFI <5 cm after PPROM between 24 and 32 weeks of gestation is associated with shorter delivery latency. Similarly, in a study conducted by Mehra and Amon[7], where mean AFI in Group 1 (delivery latency ≤7 days) was 3.5 cm and in Group 2 (delivery latency >7 days) was 5.2 cm. Difference in AFI between both the group found to be statistically significant (P<0.05), and AFI <5 cm independently predicted delivery within 7 days in women with PPROM.

Our study shows the validity of AFI in predicting delivery latency in women with PPROM when cut off =5 (sensitivity=86.04%, specificity=52.63%, positive predictive value (PPV)=57.81%, NPV=83.33%, and accuracy=69.07%).

TVCL in both the group was studied, mean TVCL in Group 1 was 2.47 cm, and in Group 2 was 2.99 cm. Difference in terms of TVCL between both the groups was found to be statistically significant (P=0.00005). This shows that longer the TVCL, more is the latency period and shorter the TVCL, smaller is the latency period. CL is very important factor in retaining and also protecting the growing fetus. As the growing fetus put pressure on cervix, it is the length of cervix which bear that pressure and thus cervix remains closed. Majority of women maintains a CL between 3 and 4 cm throughout pregnancy. Pregnancy in whom CL is <2 cm is more likely to deliver preterm (before 37 completed weeks of pregnancy).

This finding is consistent with the study by Rizzo et al.,[11] who examined 92 women and reported that the median interval to delivery was 2 days when CL was <2 cm, compared to 6 days with longer cervix. Similarly, in a recent study by Mehra and Amon,[7] a shorter TVCL independently predicted delivery within 7 days in women presenting with PPROM and TVCL >2 cm greatly improved the potential to remain undelivered at 7 days following CL assessment. This finding has been supported by Kansara et al.,[2] Patil et al.,[8] and Rajan and Menon,[8] which indicates that the presence of short cervix in PPROM is related to shorter latency.

Our study shows the validity of CL in predicting delivery latency in women with PPROM when cut off=2.5 cm, with sensitivity=85%, specificity=50%, PPV=53.12%, NPV=83.33%, and accuracy=64%.

Majority of neonates in both the groups had birth weight between 1.6 and 2 kg. Maximum number of neonates in Group 1 had Apgar score (1 min) between 4 and 6 and in Group 2 had >6. In both the groups, majority of neonates had 5 min Apgar score >6. Difference in terms of 1 min and 5 min Apgar score, between both the groups, was found to be statistically non-significant.

Need for NICU admission (P=0.020) and also days of NICU admission (P=0.002) was higher in Group 1 than Group 2 and this difference between both the groups was statistically significant. This may be attributed to the prophylactic antibiotic, steroid, and $MgSo_4$ given to women with PPROM and intensive maternal and fetal monitoring. Moreover, expectant management in women with PPROM improves neonatal survival by approximately 2% for each additional day of in utero maturation.

In our study, nine cases (14.1%) of neonatal deaths were seen in Group 1 and three cases (8.3%) in Group 2, but difference between both the group was statistically non-significant (P=0.821). Neonatal morbidity was found to be higher in Group 1 than Group 2, but the difference was statistically insignificant. Major morbidity was due to sepsis followed by birth asphyxia and respiratory distress syndrome. It shows that neonatal mortality and morbidity are not due to PPROM but due to prematurity.

In our study, chorioamnionitis seen in 14 cases (21.9%) of Group 1 and 18 cases (50%) of Group 2. It was found that incidence of chorioamnionitis was higher in women with longer delivery latency, but the difference between both the group was statistically non-significant. This increased incidence of chorioamnionitis can be probably due to lower socioeconomic strata of patients coming to our hospital making this difference with an increased incidence of chorioamnionitis with longer latency. Similarly in a study by Lee et al.,[12] chorioamnionitis was seen in 24 cases (53.3%) of Group 1 (delivery latency ≤3 days) and 30 cases (55.6%) of Group 2 (delivery latency >3 days), but the difference between both the group was statistically non-significant (P=0.825). In contrast, Borna et al.,[13] and Moberg et al.,[14] found significant correlation between oligohydramnios, and higher rate of chorioamnionitis.

Risk of other maternal morbidity, that is, abruption (4.7 vs. 11.1%) and cord prolapse (3.1 vs. 8.3%) increased as the duration of PPROM increases, but the difference between both the group was statistically non-significant.

Limitations of the study

There still remains a need to evaluate multiple gestations, previable PPROM patients and combining ultrasound findings with biochemical markers to improve the prediction of delivery latency. As this is a small study, these results should be further evaluated by multicentric studies with larger sample size.

CONCLUSION

Our study shows that there was an increase in when we combine AFI and TVCL in prediction of delivery latency, so women with AFI ≤5 and TVCL ≤2.5 cm had 85.6% risk of delivery within 7 days after PPROM. Delivery latency was found to be inversely proportional to period of gestation at PPROM which means lesser the period of gestation more will be the latency period. Furthermore, we found that there was no significant association between parity and body mass index with delivery latency. A long CL and increased amount of AFI correlate with increased incidence of maternal morbidity (such as chorioamnionitis, abruption, and cord prolapse) probably due to increased latency. In this study, Neonatal mortality and morbidity is mainly due to prematurity. Based on our study, we recommend obtaining initial TVCL and AFI in women with PPROM as soon as practical after admission. By predicting delivery latency, we will be in better position to triage the patients requiring immediate referral to a higher center equipped with facilities for better maternal and neonatal care.

ACKNOWLEDGMENT

We thank all the individuals included in this study.

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NG, MA, A, NS- Concept and design of the study, prepared first draft of manuscript; Interpreted the results; reviewed the literature and manuscript preparation; Concept, coordination, preparation of manuscript and revision of the manuscript.

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Source of Support: Nil, **Conflicts of Interest:** None declared.