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Assessment of Maternal and Perinatal Outcomes in Pregnancies with Preterm Premature Rupture of Membranes

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A B S T R A C T

Background: Preterm premature rupture of membranes (PPROM) significantly impacts maternal and perinatal outcomes. This study evaluated outcomes and predictive factors in PPROM cases.***Methods:*** A prospective observational study of 80 women with PPROM between 24 and 36 weeks' gestation was conducted. Maternal and neonatal outcomes were analyzed, and factors affecting latency period were evaluated.***Results***: The mean gestational age at PPROM was 31.3 ± 3.4 weeks, with a mean latency period of 8.4 ± 4.2 days. Chorioamnionitis occurred in 17.5% of cases. The cesarean section rate was 42.5%, with fetal distress being the primary indication (44.1%). NICU admission was required for 60.0% of neonates, with respiratory distress syndrome affecting 35.0%. Significant correlations were found between latency period and gestational age ($r=-0.542$, $p<0.001$), cervical dilatation ($r=-0.486$, $p<0.001$), and inflammatory markers ($p<0.01$). ***Conclusion:*** PPROM outcomes are significantly influenced by gestational age and inflammatory markers. Early identification of risk factors may improve management strategies and outcomes.

Keywords: Preterm premature rupture of membranes; Chorioamnionitis; Latency period; Neonatal outcomes; Maternal morbidity; Respiratory distress syndrome.

INTRODUCTION

Preterm premature rupture of membranes (PPROM), defined as spontaneous rupture of fetal membranes before 37 weeks of gestation, represents one of the most challenging complications in obstetric practice, affecting approximately 3% of all pregnancies and accounting for nearly one-third of all preterm births [1]. This condition presents a significant clinical dilemma, as it not only increases the risk of maternal and fetal complications but also poses complex management decisions regarding the optimal timing of delivery [2].

The pathophysiology of PPROM involves a complex interplay of biological, environmental, and genetic factors that lead to the mechanical weakening and subsequent rupture of fetal membranes. Recent evidence suggests that inflammatory processes, matrix metalloproteinases, and oxidative stress play crucial roles in membrane degradation [3]. Understanding these mechanisms has become increasingly important as they inform both preventive strategies and therapeutic interventions.

Maternal complications associated with PPROM include chorioamnionitis, endometritis, and sepsis, which can significantly impact maternal morbidity and mortality [4]. The risk of infection increases proportionally with the duration of membrane rupture, creating a time-sensitive scenario that requires careful monitoring and management. Studies have shown that approximately 13-60% of women with PPROM develop clinical chorioamnionitis, with rates varying based on gestational age at rupture and latency period [5].

From a fetal perspective, PPROM poses several serious risks, including cord prolapse, cord compression, placental abruption, and most significantly, complications related to prematurity [6]. The gestational age at membrane rupture strongly correlates with neonatal outcomes, with earlier gestational ages associated with higher rates of respiratory distress syndrome, intraventricular hemorrhage, and necrotizing enterocolitis [7]. Moreover, the presence of oligohydramnios following PPROM can lead to pulmonary hypoplasia and skeletal deformities, particularly when membrane rupture occurs in early gestation [8].

Management strategies for PPROM have evolved significantly over the past decades, shifting from immediate delivery to more nuanced approaches based on gestational age and individual risk factors. Current protocols typically involve a careful balance between prolonging pregnancy to achieve fetal maturity and preventing complications associated with expectant management [9]. The use of antenatal corticosteroids, antibiotics, and careful monitoring has improved outcomes, but considerable debate remains regarding the optimal management approach in different clinical scenarios.

The timing of delivery in PPROM cases continues to be a subject of ongoing research and discussion. While early studies suggested that immediate delivery might reduce infectious complications, more recent evidence supports expectant management in selected cases, particularly before 34 weeks gestation [10]. However, the decision-making process must consider multiple factors, including gestational age, presence of infection, fetal status, and available neonatal care facilities.

Aims and Objectives

The primary objective of this study was to evaluate the maternal and perinatal outcomes in pregnancies complicated by preterm premature rupture of membranes (PPROM). The specific aims included assessment of maternal infectious morbidity, analysis of neonatal complications, and determination of factors influencing the latency period between membrane rupture and delivery. Additionally, the study aimed to identify predictive factors for adverse outcomes and evaluate the effectiveness of current management protocols in improving both maternal and fetal outcomes.

Materials and Methods

Study Design and Setting

This prospective observational study was conducted at the Department of Obstetrics and Gynecology between January 2023 and December 2023. The study protocol was approved by the Institutional Ethics Committee, and written informed consent was obtained from all participants prior to enrollment.

Sample Size Calculation

The sample size was calculated using the formula for estimating a single proportion with specified precision. Based on previous studies indicating a PPROM prevalence of approximately 3% and considering a 95% confidence interval with a margin of error of 5%, the minimum required sample size was determined to be 73 patients. Accounting for potential dropouts and loss to follow-up (10%), the final sample size was set at 80 participants.

Study Population and Selection Criteria

The study included pregnant women diagnosed with PPROM between 24 and 36 weeks and 6 days of gestation. PPROM was confirmed through a combination of clinical history, sterile speculum examination demonstrating pooling of amniotic fluid in the posterior fornix, and positive nitrazine test. Gestational age was determined based on the last menstrual period and confirmed by first-trimester ultrasound dating.

Women were excluded from the study if they presented with any of the following conditions: multiple pregnancies, major fetal congenital anomalies, active labor at the time of membrane rupture, cervical cerclage in situ, chorioamnionitis at presentation, pre-existing maternal medical conditions (including chronic hypertension, pre-gestational diabetes, and autoimmune disorders), or those who declined to participate in the study.

Management Protocol

All enrolled patients were admitted to the antenatal ward and managed according to the standardized hospital protocol. Initial evaluation included complete blood count, C-reactive protein, high vaginal swab for culture, and urine

culture. Fetal well-being was assessed through daily fetal movement monitoring, twice-daily cardiotocography, and weekly ultrasound for biophysical profile and amniotic fluid index.

Prophylactic antibiotics were administered to all patients, consisting of intravenous ampicillin 2g every 6 hours for 48 hours, followed by oral amoxicillin for 5 days. Patients between 24 and 34 weeks of gestation received antenatal corticosteroids (two doses of intramuscular betamethasone 12mg, 24 hours apart) for fetal lung maturation.

Monitoring and Follow-up

Maternal monitoring included four-hourly temperature recording, vital signs assessment, and daily examination for signs of chorioamnionitis. The diagnosis of chorioamnionitis was based on the presence of maternal fever (≥38°C), along with two or more of the following: maternal tachycardia (>100 beats/min), fetal tachycardia (>160 beats/min), uterine tenderness, foul-smelling vaginal discharge, or elevated white blood cell count (>15,000 cells/mm³).

Delivery was indicated in cases of clinical chorioamnionitis, non-reassuring fetal status, or active labor. In the absence of these complications, pregnancy was allowed to continue until 34 weeks of gestation, after which delivery was considered based on individual risk assessment and hospital protocol.

Data Collection and Outcome Measures

Detailed data was collected using a standardized proforma. Maternal variables included demographic characteristics, obstetric history, gestational age at PPROM, latency period, development of chorioamnionitis, mode of delivery, and other maternal complications. Neonatal outcomes included birth weight, Apgar scores, need for NICU admission, duration of NICU stay, and complications such as respiratory distress syndrome, sepsis, and necrotizing enterocolitis.

Statistical Analysis

Statistical analysis was performed using SPSS version 25.0. Continuous variables were expressed as mean ± standard deviation or median with interquartile range, depending on the distribution of data. Categorical variables were presented as frequencies and percentages. Univariate and multivariate analyses were performed to identify factors associated with adverse maternal and neonatal outcomes. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The study included 80 pregnant women with PPROM between 24 and 36 weeks and 6 days of gestation. The mean maternal age was 28.4 ± 5.2 years, with 42.5% (n=34) being primigravidas. The mean gestational age at PPROM was 31.3 ± 3.4 weeks, and the mean body mass index was 24.8 ± 3.6 kg/m². A history of previous preterm birth was present in 15.0% (n=12) of cases, while 10.0% (n=8) had experienced PPROM in previous pregnancies.

The mean latency period from membrane rupture to delivery was 8.4 ± 4.2 days, with significant variation observed across different gestational ages. The majority of patients (40.0%, n=32) delivered between 2-7 days after PPROM, while 37.5% (n=30) had a latency period exceeding 7 days. A shorter latency period was significantly associated with advanced gestational age ($r=-0.542$, $p<0.001$), greater cervical dilatation at admission ($r=-0.486$, $p<0.001$), and elevated inflammatory markers including initial WBC count ($r=-0.324$, $p=0.008$) and CRP levels ($r=-0.398$, $p=0.003$).

Regarding maternal complications, chorioamnionitis was the most frequent, occurring in 17.5% (n=14) of cases, followed by endometritis in 7.5% (n=6) and wound infection in 6.25% (n=5). Placental abruption complicated 5.0% (n=4) of cases, while maternal sepsis developed in 2.5% (n=2) of the study population. The mode of delivery analysis revealed that 57.5% (n=46) of women underwent vaginal delivery, while 42.5% (n=34) required cesarean section. The primary indication for cesarean delivery was fetal distress (44.1%, n=15), followed by malpresentation (23.5%, n=8) and failed induction (17.6%, n=6).

Neonatal outcomes analysis showed a mean birth weight of 1842 ± 428 grams. NICU admission was required for 60.0% (n=48) of neonates, with a mean NICU stay of 12.3 ± 6.8 days. Respiratory distress syndrome was the most common neonatal complication, affecting 35.0% (n=28) of newborns, followed by early-onset sepsis in 20.0% (n=16). More severe complications included intraventricular hemorrhage in 7.5% (n=6) and necrotizing enterocolitis in 5.0% (n=4) of cases. The overall neonatal mortality rate was 3.75% (n=3), with all deaths occurring in neonates born before 28 weeks of gestation.

Statistical analysis revealed significant correlations between adverse neonatal outcomes and several maternal factors. The development of chorioamnionitis was significantly associated with increased rates of neonatal sepsis

(χ^2=8.24, p=0.004) and longer NICU stays (t=3.86, p<0.001). Gestational age at PPROM demonstrated a strong negative correlation with the duration of NICU stay (r=-0.624, p<0.001) and the incidence of respiratory distress syndrome (χ^2=12.46, p<0.001).

Table 1: Demographic and Baseline Characteristics of Study Population (N = 80)

Characteristic	Value
Maternal age (years)	28.4 ± 5.2
Gestational age at PPROM (weeks)	31.3 ± 3.4
Primigravida, n (%)	34 (42.5)
BMI (kg/m²)	24.8 ± 3.6
Previous preterm birth, n (%)	12 (15.0)
Previous PPROM, n (%)	8 (10.0)
Socioeconomic status, n (%)	
• Low	28 (35.0)
• Middle	42 (52.5)
• High	10 (12.5)

Values expressed as mean ± SD.

Table 2: Maternal Outcomes and Complications (N = 80)

Outcome	n (%)
Chorioamnionitis	14 (17.5)
Endometritis	6 (7.5)
Placental abruption	4 (5.0)
Sepsis	2 (2.5)
Wound infection	5 (6.25)
Mean latency period (days)	8.4 ± 4.2
Latency period distribution	
• <48 hours	18 (22.5)
• 2–7 days	32 (40.0)
• >7 days	30 (37.5)

p < 0.001 for correlation between gestational age and latency period. Values expressed as mean ± SD.

Table 3: Mode of Delivery and Indications (N = 80)

Characteristic	n (%)
Vaginal delivery	46 (57.5)
Cesarean section	34 (42.5)
Indications for cesarean	
• Fetal distress	15 (44.1)
• Malpresentation	8 (23.5)
• Failed induction	6 (17.6)
• Chorioamnionitis	5 (14.7)

Table 4: Neonatal Outcomes (N = 80)

Outcome	Value
Birth weight (g)	1842 ± 428
Apgar score <7 at 5 min, n (%)	12 (15.0)
NICU admission, n (%)	48 (60.0)
Mean NICU stay (days)	12.3 ± 6.8
Complications, n (%)	
• Respiratory distress syndrome	28 (35.0)
• Early-onset sepsis	16 (20.0)
• Necrotizing enterocolitis	4 (5.0)
• Intraventricular hemorrhage	6 (7.5)
Neonatal mortality	3 (3.75)

Values expressed as mean ± SD.

Table 5: Factors Affecting Latency Period

Factor	Correlation Coefficient	p-value
Gestational age at PPROM	-0.542	<0.001
Cervical dilatation	-0.486	<0.001
Initial WBC count	-0.324	0.008
CRP levels	-0.398	0.003
AFI at admission	0.276	0.015

DISCUSSION

The present study examined maternal and perinatal outcomes in 80 cases of PPROM, revealing significant findings regarding latency periods, complications, and prognostic factors. The mean gestational age at PPROM of 31.3 ± 3.4 weeks aligns with findings by Pasquier *et al*., [11], who reported a mean gestational age of 30.8 ± 3.6 weeks in their multicenter study of 803 PPROM cases.

The observed chorioamnionitis rate of 17.5% was lower than the 23.9% reported in a large retrospective cohort study by Dotters-Katz *et al*., [12], possibly due to our strict adherence to prophylactic antibiotic protocols. However, this rate was higher than the 12.3% reported in a recent Japanese cohort study by Yamamoto *et al*., [13], which might be attributed to differences in population characteristics and diagnostic criteria.

The mean latency period of 8.4 ± 4.2 days demonstrated significant inverse correlation with gestational age ($r=-0.542$, $p<0.001$), consistent with findings from Wagner *et al*., [14], who reported a similar correlation ($r=-0.498$, $p<0.001$) in their study of 124 PPROM cases. Our finding that elevated inflammatory markers predicted shorter latency periods supports the observations of Chen *et al*., [15], who found that elevated CRP levels >15 mg/L were associated with delivery within 72 hours (OR 3.2, 95% CI 1.8-5.7).

The cesarean section rate of 42.5% in our study was comparable to the 45.2% reported by Lorthe *et al*., [16] in their prospective population-based cohort study. However, our rate of fetal distress as an indication (44.1% of cesarean deliveries) was higher than their reported 32.8%, possibly reflecting variations in fetal monitoring protocols and threshold for intervention.

Regarding neonatal outcomes, our NICU admission rate of 60.0% was lower than the 72.3% reported in a systematic review by Bond *et al*., [17], though our mean NICU stay duration was similar (12.3 vs 13.1 days). The respiratory distress syndrome rate of 35.0% in our cohort was significantly lower than historical reports, likely reflecting the impact of antenatal corticosteroid administration, supporting findings by Gyamfi-Bannerman *et al*., [18] who demonstrated a 40% reduction in respiratory morbidity with antenatal corticosteroids.

The neonatal mortality rate of 3.75% in our study, concentrated among births before 28 weeks, corresponds with findings from a large population-based study by Manuck*et al*., [19], who reported a 3.9% mortality rate in PPROM cases, with 85% of deaths occurring in the <28-week cohort.

A notable strength of this study was its prospective design and standardized management protocol. However, limitations included the single-center design and relatively small sample size, which may limit generalizability.

CONCLUSION

This prospective study demonstrated that PPROM continues to be associated with significant maternal and neonatal morbidity, with outcomes strongly correlated with gestational age at membrane rupture. The identification of predictive factors for shorter latency periods, including elevated inflammatory markers and advanced cervical dilatation, may help in risk stratification and management planning. The relatively low rates of maternal infectious morbidity highlight the importance of prophylactic antibiotic protocols, while the neonatal outcomes emphasize the crucial role of antenatal corticosteroids and level III neonatal care facilities. Future multicenter studies with larger sample sizes are needed to validate these findings and establish more precise predictive models for adverse outcomes.

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