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MATERNAL AND PERINATAL OUTCOMES IN PRETERM PREMATURE RUPTURE OF MEMBRANES (PPROM): A PROSPECTIVE OBSERVATIONAL ANALYSIS.

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ABSTRACT

Background

One of the main causes of preterm births and a major contributor to neonatal morbidity and death is preterm premature rupture of membranes, which is defined as membrane rupture before 37 weeks of gestation without the commencement of labor. This study aims to assess the maternal and perinatal outcomes linked to PPROM and to pinpoint important risk factors influencing these outcomes.

Methods

This prospective multicenter study included 80 pregnant women diagnosed with PPROM. The diagnosis was based on clinical history, sterile speculum examination, and confirmation via ultrasound. Participants, grouped by gestational age at PPROM onset (24–36 weeks), underwent conservative or active management based on gestational age and clinical condition. Maternal and neonatal outcomes were monitored, including infection rates, latency periods, neonatal APGAR scores, NICU admissions, and complications. Statistical analysis assessed associations between management approaches and outcomes.

Results

Of the 80 participants, 60% experienced maternal complications, with chorioamnionitis (35%) and postpartum hemorrhage (12.5%) being the most common. Neonatal complications included low APGAR scores in 23.8% of cases, NICU admissions in 62.5%, and a neonatal mortality rate of 7.5%. Conservative management in patients below 34 weeks led to prolonged latency but increased infection rates, while active management in cases above 34 weeks reduced maternal complications. Key predictors of adverse outcomes were gestational age at PPROM onset, maternal age, and presence of infection.

Conclusion

Gestational age and prompt infection control significantly influence PPROM outcomes. Conservative management is beneficial in extending gestational age but necessitates strict monitoring to prevent infections. Induction in cases above 34 weeks effectively minimizes maternal risks without compromising neonatal outcomes.

Recommendations

For cases <34 weeks, conservative management with vigilant infection monitoring is recommended, while for cases >34 weeks, induction may be beneficial. Further research is needed to optimize individualized treatment protocols based on gestational age and maternal-fetal conditions.

Keywords: *Preterm Premature Rupture of Membranes, PPROM, Maternal Outcomes, Neonatal Outcomes, Conservative Management, Chorioamnionitis*
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INTRODUCTION

Preterm premature rupture of membranes (PPROM) is a significant complication of pregnancy, accounting for up to 40% of preterm births, which is a major cause of neonatal morbidity and mortality globally. PPROM occurs when the fetal membranes rupture before 37 weeks of gestation and before the onset of labor, creating a risk for infection, preterm labor, and adverse neonatal outcomes. Although the etiology of PPROM is multifaceted, including mechanical, biochemical, and infectious factors, it is particularly challenging due to its unpredictability and the variability in outcomes depending on gestational age and healthcare resources available [1,2].

Maternal complications with PPROM include chorioamnionitis, endometritis, and placental abruption,

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while neonatal risks extend to respiratory distress syndrome (RDS), sepsis, and long-term neurodevelopmental issues. The latency period, or the time from membrane rupture to delivery, is a crucial factor, as prolonged latency can increase the risk of infection but also offers potential benefits for fetal maturity if managed expectantly with antibiotics and corticosteroids. Studies indicate that early intervention can mitigate some risks; however, it also increases the likelihood of adverse neonatal outcomes if preterm birth occurs too early in gestation [1,3,4].

Management strategies vary globally, with many protocols aiming for conservative management to prolong pregnancy where safe, especially in cases between 24 and 33 weeks of gestation. Administration of corticosteroids for fetal lung maturity and magnesium sulfate for neuroprotection are commonly recommended in cases under 34 weeks, alongside careful monitoring for infection markers. Recent data suggest that well-structured expectant management programs improve outcomes by reducing infections and supporting neonatal lung maturity. However, maternal morbidity still demands vigilant monitoring and immediate intervention if signs of infection or fetal distress appear [5,6,7].

PPROM remains a critical challenge in obstetrics, with outcomes highly dependent on gestational age, healthcare resources, and timely management. Current research continues to explore better management strategies, especially around individualized decision-making for balancing maternal and neonatal risks, aiming to improve outcomes across different healthcare settings globally.

This study aims to assess the maternal and perinatal outcomes related to PPROM and to identify key risk factors impacting these outcomes to guide clinical management.

METHODOLOGY

Study Design

This study is a prospective observational analysis.

Study Setting

The study was conducted as a multicentric analysis across several healthcare facilities. The study period spanned from January 2017 to December 2017.

Participants

The study included 80 participants who were admitted to the labor room with a confirmed diagnosis of PPROM between 24 weeks and 36 weeks + 6 days of gestation.

Inclusion Criteria

1. Pregnant individuals between 24 and 36 weeks + 6 days of gestation are diagnosed with PPROM.
2. Those who had confirmed PPROM via sterile pelvic speculum examination showed amniotic fluid trickling from the cervix and/or a positive pad test.
3. Cases confirmed by ultrasonography (USG) to assess gestational age, fetal growth parameters, presentation, congenital anomalies, and amniotic fluid index.

Exclusion Criteria

1. Cases with a history of medical conditions contraindicating pregnancy continuation.
2. Participants with congenital fetal anomalies incompatible with life.
3. Individuals not consenting to participate.

Bias

Potential bias was minimized by including a broad range of PPROM cases and using standardized diagnostic and treatment protocols across multiple centers. Conservative management for early PPROM and induction for late PPROM were consistently applied based on gestational age and clinical indications.

Variables

Variables included gestational age at the time of PPROM, maternal age, history of prior PPROM, antenatal care, maternal outcomes (chorioamnionitis, abruption, postpartum hemorrhage, retained placenta), perinatal outcomes (neonatal infection, APGAR scores), neonatal complications, duration of hospital stay for mother and baby.

Data Collection

Data was collected through patient medical records, monitoring charts, and follow-up assessments until discharge. Key information gathered included:

- Diagnosis confirmation (history, pelvic exam, USG)
- Maternal interventions (e.g., dexamethasone for fetal lung maturity, $MgSO_4$ for neuroprotection, antibiotic administration)
- Maternal monitoring (pulse rate, temperature, abdominal tenderness, liquor color/smell, C-reactive protein, cardiotocography)
- Neonatal assessments (APGAR scores, infection signs, admission to in-born nursery)

Procedure

Until spontaneous labor or a maternal/fetal rationale for delivery occurred, patients with early PPROM (24 to 33 weeks + 6 days) were treated conservatively. Chorioamnionitis, amniotic fluid tinged with meconium, abruption, cord prolapse, fetal discomfort, and/or advanced labor at admission were among the indications. Patients with late PPROM (>34 weeks) who did not experience spontaneous labor were induced. Every patient had bed rest and remained in the hospital until delivery. For fetal lung maturity, mothers under 34 weeks were given dexamethasone, and in PPROM instances under 32 weeks, $MgSO_4$ was utilized for neuroprotection and

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tocolysis. To lower the risk of infection, prophylactic antibiotics were administered for ten days or until birth. Maternal intrapartum monitoring included observation for complications like abruption, postpartum hemorrhage (PPH), and retained placenta. Neonates with poor APGAR scores or signs of infection were admitted to the in-born nursery (IBN) for further care, and their outcomes were tracked.

Statistical Analysis

Both descriptive and inferential statistics were used to analyze the data. While categorical data (like maternal and neonatal problems) were represented as frequencies and percentages, continuous variables (like gestational age and length of hospital stay) were summarised as means and standard deviations. Results were compared between groups using chi-square and t-tests, with $p < 0.05$ designated as the statistical significance level.

Ethical considerations

The study protocol was approved by the Ethics Committee and written informed consent was received from all the participants. Informed consent was obtained from all participants.

RESULTS

Table 1. Demographic and Baseline Characteristics

Characteristic	Total (n=80)	%
Maternal Age (years)		
<20	12	15
20–30	50	62.5
>30	18	22.5
Gestational Age (weeks)		
24–28	10	12.5
29–33	35	43.75
34–36	35	43.75
History of PPROM		
Yes	14	17.5
No	66	82.5

***Mean maternal age*: 27.5 ± 5.6 years**
***Mean gestational age at PPROM onset*: 31.4 ± 3.2 weeks**

This study analyzed maternal and perinatal outcomes in 80 patients with PPROM. Results are categorized by gestational age, maternal outcomes, neonatal outcomes, and factors influencing both maternal and neonatal complications. Table 1 shows the demographic and baseline characteristics of the participants.

Table 2. Maternal Complications

Maternal Complication	Total (n=80)	Percentage (%)
Chorioamnionitis	28	35.0
Postpartum Hemorrhage (PPH)	10	12.5
Abruption	6	7.5
Retained Placenta	4	5.0

Out of 80 participants, 48 (60%) experienced at least one maternal complication. The most common maternal complications were chorioamnionitis and postpartum hemorrhage (PPH). Table 2 summarizes these complications.

Conservative vs. Induced Management Outcomes

Patients with PPROM onset before 34 weeks (45 patients) were managed conservatively until delivery, while those >34 weeks (35 patients) were induced if labor did not initiate spontaneously. Conservative management was associated with a higher incidence of chorioamnionitis ($p = 0.04$), while the induced group had a significantly higher rate of PPH ($p = 0.02$).

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Table 3. Neonatal Complications

Neonatal Complication	24–28 weeks (n=10)	29–33 weeks (n=35)	34–36 weeks (n=35)	Total (n=80)	Percentage (%)
Neonatal Infection	5	8	6	19	23.8
Low APGAR Score (<7 at 5 min)	7	9	3	19	23.8
NICU Admission	10	25	15	50	62.5
Neonatal Death	3	2	1	6	7.5

Neonatal outcomes varied significantly based on gestational age at delivery. Table 3 provides details on neonatal complications. Low APGAR scores were significantly more frequent in neonates born before 28 weeks ($p = 0.03$), while infection rates were comparable across gestational age groups ($p = 0.56$).

Mean NICU stay duration was longer in neonates born between 24–28 weeks (18.5 ± 5.4 days) compared to those born between 34–36 weeks (7.8 ± 2.3 days) ($p < 0.001$).

Table 4. Statistical Analysis of Maternal and Neonatal Outcomes

Variable	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Maternal Age >30 years	1.8	1.1–2.9	0.03
Gestational Age <30 weeks	2.5	1.6–4.1	0.01
History of PPROM	1.7	1.2–3.0	0.04
Chorioamnionitis	3.2	1.8–5.5	<0.001

The following logistic regression analysis was performed to identify predictors of adverse maternal and neonatal outcomes. The results are shown in Table 4.

Interpretation

- Maternal age >30 years and a history of PPROM were associated with a higher risk of maternal complications.
- Gestational age <30 weeks was a significant predictor of adverse neonatal outcomes, including low APGAR scores and increased NICU admission rates.
- Chorioamnionitis was a strong predictor of both maternal and neonatal complications.

DISCUSSION

The study observed 80 cases of PPROM, with an emphasis on maternal and neonatal outcomes, stratified by gestational age and management approach. The majority of participants were between 20–30 years old, with a mean maternal age of 27.5 years and an average gestational age at PPROM onset of 31.4 weeks. The distribution of PPROM cases across gestational age groups was fairly even, with nearly equal proportions of patients presenting between 24–28 weeks, 29–33 weeks, and 34–36 weeks. This provided a comprehensive view of outcomes across different stages of fetal maturity.

Maternal Outcomes showed that 60% of patients experienced complications, the most common being chorioamnionitis (35%), followed by postpartum hemorrhage (PPH) at 12.5%. Conservative management in cases below 34 weeks was associated with a higher incidence of chorioamnionitis, while patients induced at >34 weeks had more frequent instances of PPH. This suggests that while conservative management aims to extend gestation, it may increase infection risks, underscoring the importance of vigilant monitoring in such cases.

Neonatal Outcomes indicated a substantial impact of gestational age on neonatal health. The NICU admission rate was high (62.5%), especially in neonates born before 34 weeks, with longer NICU stays observed in those delivered between 24–28 weeks (mean of 18.5 days) versus 34–36 weeks (mean of 7.8 days). Additionally, 23.8% of neonates had low APGAR scores (<7 at 5 minutes), and the neonatal infection rate was 23.8%. Neonatal mortality was observed in 7.5% of cases, predominantly among those born before 28 weeks. These findings illustrate that earlier gestational age at birth significantly elevates the risk of adverse neonatal outcomes, including lower APGAR scores, increased NICU time, and infection.

Statistical Analysis identified key predictors of adverse outcomes. Maternal age >30 years, gestational age <30 weeks, history of PPROM, and chorioamnionitis were significant risk factors for both maternal and neonatal complications. Specifically, lower gestational age and maternal infections (e.g., chorioamnionitis) were strongly associated with poor neonatal outcomes, while older maternal age and prior PPROM episodes increased maternal risk factors.

Overall, these findings highlight the critical importance of gestational age in determining maternal and neonatal health outcomes in PPROM cases. Conservative management can help prolong pregnancy in earlier gestational cases, but it requires rigorous infection control and maternal monitoring to minimize complications. For gestational ages >34 weeks, induction remains an effective approach to reduce maternal risks like PPH.

An observational study examined 50 PPROM cases from 28 to 37 weeks' gestation, reporting a high perinatal

morbidity rate of 70%, primarily due to respiratory distress syndrome (RDS), sepsis, and hyperbilirubinemia. The study emphasized that timely diagnosis and management can reduce neonatal morbidity and improve perinatal outcomes, especially in late-gestation PPROM cases [8].

In cases of very early PPROM (before 28 weeks), a study spanning 2000 to 2020 analyzed data from a large cohort at a university hospital and revealed a perinatal mortality rate of 26.5%, which decreased over the study period. The mean latency period between membrane rupture and delivery was 13.5 days, demonstrating that expectant management has improved outcomes over time for these high-risk pregnancies [9]. Similarly, a study examined maternal and neonatal outcomes of PPROM cases before viability (under 23 weeks) and at perceivable gestations (23–25 weeks), finding a 100% adverse outcome rate for neonates born from pre-viable PPROM cases. This study underscores the high neonatal mortality and morbidity risks when PPROM occurs at extremely low gestational ages [10].

In a study, researchers investigated expectant management in PPROM cases before 25 weeks and found that a substantial portion of neonates (21%) survived without major morbidities. However, overall perinatal morbidity was high, reflecting that while conservative management can improve outcomes, it remains challenging due to the complications associated with very early rupture [11]. Additionally, a study explored outcomes of PPROM cases between 32 and 37 weeks, specifically analyzing the latency period's impact on perinatal outcomes. They observed that a latency period exceeding 48 hours was linked to increased risks of early-onset neonatal infections and a higher rate of cesarean delivery. However, extended latency did not correlate with higher RDS rates, suggesting that while latency prolongation can benefit fetal maturity, it also requires careful monitoring to mitigate infection risks [12].

CONCLUSION

In conclusion, PPROM poses significant risks to both maternal and neonatal health, with outcomes closely linked to gestational age at onset and infection management. Conservative management in cases under 34 weeks can extend gestation, which benefits fetal development, but requires strict monitoring to reduce infection risks. For gestational ages above 34 weeks, induction may minimize maternal complications without compromising neonatal health. Effective management strategies must balance extending gestation with preventing complications, emphasizing the need for individualized care to optimize outcomes for both mother and baby.

Limitations

The limitations of this study include a small sample population who were included in this study. Furthermore, the lack of a comparison group also poses a limitation for this study's findings.

Recommendation

For cases <34 weeks, conservative management with vigilant infection monitoring is recommended, while for cases >34 weeks, induction may be beneficial. Further research is needed to optimize individualized treatment protocols based on gestational age and maternal-fetal conditions.

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Data Availability

Data is available upon request.

Author contributions

All authors contributed to the design of the research. SN collected and analyzed the data. SP and AK wrote the manuscript. All authors read, edited and approved the paper.

List of abbreviations

PPROM - Preterm Premature Rupture of Membranes
NICU - Neonatal Intensive Care Unit
APGAR - Appearance, Pulse, Grimace, Activity, Respiration (a score assessing newborn health)
RDS - Respiratory Distress Syndrome
$MgSO_4$ - Magnesium Sulfate
USG - Ultrasonography
PPH - Postpartum Hemorrhage
IBN - In-Born Nursery
CI - Confidence Interval
OR - Odds Ratio

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Conflict of interest

The authors have no conflicting interests to declare.

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