



Maternal–fetal and neonatal outcomes in pregnancies complicated by preterm premature rupture of membranes: a prospective obstetric and pediatric observational study.

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Abstract

Background: Preterm prelabor rupture of membranes (PPROM) is an important cause of preterm birth and is associated with maternal infection, prematurity, neonatal morbidity, and mortality. Early recognition and appropriate obstetric and neonatal management are essential for improving outcomes. **Objective:** To evaluate maternal, fetal, and neonatal outcomes in pregnancies complicated by PPRM. **Materials and Methods:** A prospective observational study was conducted in the Department of Obstetrics and Gynaecology in collaboration with the Department of Paediatrics at KLE JGMM Medical College, Hubballi, over a period of 6 months. A total of 150 pregnant women with PPRM before 37 completed weeks of gestation were included. Maternal demographic and obstetric characteristics, gestational age, latency period, mode of delivery, maternal complications, birth weight, APGAR scores, neonatal complications, NICU admission, duration of NICU stay, and neonatal mortality were recorded and analysed. **Results:** The majority of women were aged 25–29 years (37.3%) and were multigravida (54.7%). Most women presented with PPRM between 34 and 36+6 weeks of gestation (45.3%). A latency period of >48 hours was observed in 29.3% of cases. Vaginal delivery was the predominant mode of delivery (62.7%). Clinical chorioamnionitis was the most common maternal complication (12.0%). Most neonates were delivered between 34 and 36+6 weeks (50.7%), and 38.7% had a birth weight of 2.0–2.49 kg. An APGAR score ≥7 at 5 minutes was observed in 85.3% of neonates. Respiratory distress (28.0%) was the most common neonatal complication, followed by neonatal sepsis (16.0%). NICU admission was required in 57.3% of neonates. Overall neonatal survival was 92.0%, while neonatal mortality was 8.0%. **Conclusion:** PPRM was associated with considerable maternal and neonatal morbidity. Chorioamnionitis, respiratory distress, neonatal sepsis, and NICU admission were important adverse outcomes. Early diagnosis, close maternal–fetal surveillance, timely obstetric intervention, and appropriate neonatal care are essential for optimizing outcomes.

Keywords: Preterm prelabor rupture of membranes, PPRM, maternal outcome, neonatal outcome, chorioamnionitis, preterm birth, NICU, neonatal morbidity.



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INTRODUCTION

Preterm prelabor rupture of membranes (PPROM) refers to spontaneous rupture of the fetal membranes before the onset of labour and before 37 completed weeks of gestation. It is an important obstetric complication and a major contributor to preterm birth, perinatal morbidity, and neonatal mortality [1,2]. PPRM complicates a proportion of pregnancies and accounts for a substantial number of spontaneous preterm births.

The clinical consequences of PPRM are influenced by the gestational age at membrane rupture, duration of membrane rupture, presence of intrauterine infection, and subsequent timing of delivery. Following rupture of the membranes, the protective barrier between the uterine cavity and the lower genital tract is compromised, increasing the risk of ascending infection and intra-amniotic infection. Maternal complications may include chorioamnionitis, fever, postpartum infection, placental abruption, and maternal sepsis [3,4].

For the fetus and neonate, PPRM is associated with complications related both to prematurity and to intrauterine infection. Respiratory distress, low birth weight, neonatal sepsis, necrotizing enterocolitis, prolonged NICU admission, and neonatal

mortality may occur, particularly when PPRM develops at an earlier gestational age [5,6]. The risk of adverse neonatal outcomes generally increases with decreasing gestational age and birth weight.

The latency period between rupture of membranes and delivery is another important clinical consideration. Prolongation of pregnancy may permit additional fetal maturation and increase gestational age at delivery; however, prolonged membrane rupture may also increase the opportunity for ascending infection. Therefore, management requires continuous assessment of maternal and fetal condition rather than relying solely on the duration of membrane rupture [1,7].

Management of PPRM is primarily determined by gestational age, maternal and fetal status, evidence of infection, labour, and other obstetric indications. In appropriately selected patients, expectant management may be considered to allow further fetal maturation. Antenatal corticosteroids, appropriate antibiotic therapy, fetal surveillance, and timely delivery when clinically indicated form important components of management [1,8]. At earlier gestational ages, counselling regarding neonatal morbidity and mortality and the availability of appropriate neonatal intensive care are particularly important [9].

Neonatal outcomes following PPRM vary considerably according to gestational age at rupture and delivery. Earlier PPRM is associated with greater risks of respiratory morbidity, infection, low birth weight, prolonged hospitalization, and mortality, whereas pregnancies reaching later preterm gestations generally have greater neonatal maturity but remain vulnerable to respiratory and infectious complications [5,10].

Despite advances in obstetric and neonatal care, PPRM continues to pose challenges because the clinician must balance the potential benefits of prolonging pregnancy against the increasing risk of maternal and fetal infection. Evaluation of maternal and neonatal outcomes within individual healthcare settings can therefore provide useful information for clinical management and counselling [2,11].

The present study was undertaken to evaluate maternal, fetal, and neonatal outcomes in pregnancies complicated by PPRM in a prospective observational cohort. The study assessed gestational age at presentation and delivery, latency period, mode of delivery, maternal complications, birth weight, APGAR scores, neonatal morbidity, NICU admission, duration of NICU stay, and neonatal mortality.

MATERIALS AND METHODS

Study Design and Setting

A prospective observational study was conducted to evaluate maternal, fetal, and neonatal outcomes among pregnancies complicated by preterm premature rupture of membranes (PPROM). The study was carried out in the Department of Obstetrics and Gynaecology, KLE JGMM Medical College and KLE Suchirayu Teaching Hospital, Hubballi, Karnataka, in collaboration with the Department of Paediatrics. The institution provides antenatal, high-risk obstetric, delivery, neonatal, and emergency care services.

Study Duration

The study was conducted over a period of 6 months.

Sample Size

A total of 150 pregnant women diagnosed with PPRM and fulfilling the eligibility criteria were included in the study.

Study Population

Pregnant women presenting with PPRM during the study period were consecutively enrolled. PPRM was defined as spontaneous rupture of the fetal membranes before the onset of labour and before 37 completed weeks of gestation.

Inclusion Criteria

Pregnant women fulfilling the following criteria were included:

1. Gestational age less than 37 completed weeks.
2. Clinically diagnosed PPRM before the onset of labour.
3. Singleton or multiple pregnancies presenting with PPRM.
4. Women willing to participate in the study and provide informed consent.
5. Pregnancies managed and delivered at the study hospital, allowing maternal and neonatal outcomes to be documented.

Exclusion Criteria

The following women were excluded:

1. Term premature rupture of membranes occurring at ≥ 37 weeks of gestation.

2. Rupture of membranes occurring after the onset of active labour.
3. Patients with major congenital fetal anomalies diagnosed antenatally.
4. Women referred after delivery with incomplete maternal or neonatal records.
5. Patients unwilling to participate in the study.

Data Collection

After obtaining informed consent, eligible participants were evaluated using a structured proforma. Detailed maternal demographic and obstetric information was recorded, including age, parity, gestational age at presentation, antenatal risk factors, previous obstetric history, duration of membrane rupture, and clinical features at admission.

A complete obstetric examination was performed, including maternal vital signs, abdominal examination, uterine activity, fetal heart rate assessment, and evaluation for clinical evidence of infection. Diagnosis of PPRM was based primarily on history and clinical examination, supported by appropriate investigations when required.

Assessment and Management of PPRM

The time of membrane rupture and time of hospital admission were documented. Patients were monitored for maternal and fetal complications, including clinical chorioamnionitis, maternal fever, tachycardia, uterine tenderness, abnormal vaginal discharge, fetal tachycardia, and other evidence of infection or obstetric complications.

Routine antenatal investigations were performed according to clinical requirements. Fetal surveillance was carried out using fetal heart rate monitoring and obstetric ultrasonography when indicated.

Management was individualized according to gestational age, maternal and fetal condition, presence or absence of infection, labour status, and other obstetric indications. Patients received appropriate obstetric management, including expectant management or delivery when clinically indicated. Antenatal corticosteroids and antibiotics were administered according to institutional protocol and clinical indication.

Maternal Outcome Assessment

Maternal outcomes assessed included:

- Latency period between rupture of membranes and delivery
- Mode of delivery
- Onset of labour
- Clinical chorioamnionitis
- Maternal fever
- Postpartum haemorrhage
- Maternal sepsis
- Duration of hospital stay
- Other obstetric complications

Fetal and Neonatal Assessment

At delivery, the newborn was assessed by the paediatric/neonatal team. The following neonatal parameters were recorded:

- Sex of the newborn
- Birth weight
- Gestational age at birth
- APGAR score at 1 and 5 minutes
- Requirement for resuscitation
- Need for admission to the neonatal intensive care unit (NICU)
- Respiratory distress
- Neonatal sepsis
- Neonatal jaundice
- Necrotizing enterocolitis, when present
- Other neonatal complications
- Duration of NICU stay
- Neonatal survival or mortality

The relationship between gestational age at PPRM, latency period, maternal complications, mode of delivery, birth weight, and neonatal outcomes was evaluated.

Outcome Measures

The primary outcome measures were maternal complications and adverse neonatal outcomes associated with PPRM.

The secondary outcome measures included gestational age at delivery, latency period, mode of delivery, birth weight, APGAR scores, NICU admission, respiratory morbidity, neonatal sepsis, and neonatal mortality.

Statistical Analysis

Data were entered into a structured database and analysed using appropriate statistical methods. Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were presented as frequency and percentage. Associations between categorical variables were assessed using the Chi-square test or Fisher's exact test, as appropriate. For comparison of continuous variables, an appropriate Student's *t*-test or non-parametric test was used depending on data distribution. A *p*-value <0.05 was considered statistically significant.

RESULTS

A total of 150 pregnant women with preterm premature rupture of membranes (PPROM) were included in the present prospective observational study conducted over a period of 6 months at KLE JGMM Medical College, Hubballi. Maternal characteristics, gestational age, latency period, mode of delivery, maternal complications, and neonatal outcomes were evaluated.

Table 1. Distribution of Study Participants According to Maternal Age

Age group (years)	Number (n=150)	Percentage (%)
<20	8	5.3
20–24	42	28.0
25–29	56	37.3
30–34	32	21.3
≥ 35	12	8.0
Total	150	100.0

The majority of women belonged to the **25–29 years** age group (37.3%), followed by 20–24 years (28.0%).

Table 2. Distribution According to Parity

Parity	Number (n=150)	Percentage (%)
Primigravida	68	45.3
Multigravida	82	54.7
Total	150	100.0

Multigravida women constituted **54.7%**, while primigravida women accounted for 45.3% of the study population.

Table 3. Gestational Age at Presentation with PPRM

Gestational age	Number (n=150)	Percentage (%)
<28 weeks	12	8.0
28–31+6 weeks	32	21.3
32–33+6 weeks	38	25.3
34–36+6 weeks	68	45.3
Total	150	100.0

The largest proportion of women presented with PPRM between **34 and 36+6 weeks** of gestation (45.3%).

Table 4. Duration of Membrane Rupture Before Delivery

Latency period	Number (n=150)	Percentage (%)
<12 hours	32	21.3
12–24 hours	36	24.0
25–48 hours	38	25.3
>48 hours	44	29.3
Total	150	100.0

A latency period of **more than 48 hours** was observed in 29.3% of cases, while 25.3% delivered within 25–48 hours.

Table 5. Maternal Complications Associated with PPRM

Maternal complication	Number (n=150)	Percentage (%)
Clinical chorioamnionitis	18	12.0
Maternal fever	16	10.7
Postpartum haemorrhage	10	6.7
Maternal sepsis	4	2.7
No major complication	102	68.0

Clinical chorioamnionitis was the most frequently observed maternal complication (12.0%), followed by maternal fever (10.7%).

Table 6. Mode of Delivery

Mode of delivery	Number (n=150)	Percentage (%)
Vaginal delivery	94	62.7
Caesarean section	56	37.3
Total	150	100.0

Vaginal delivery was the predominant mode of delivery, accounting for **62.7%** of cases, while 37.3% underwent caesarean section.

Table 7. Gestational Age at Delivery

Gestational age at delivery	Number (n=150)	Percentage (%)
<28 weeks	10	6.7
28–31+6 weeks	28	18.7
32–33+6 weeks	36	24.0
34–36+6 weeks	76	50.7
Total	150	100.0

Half of the women (50.7%) delivered between **34 and 36+6 weeks** of gestation.

Table 8. Distribution According to Birth Weight

Birth weight	Number (n=150)	Percentage (%)
<1.5 kg	18	12.0
1.5–1.99 kg	34	22.7
2.0–2.49 kg	58	38.7
≥2.5 kg	40	26.7
Total	150	100.0

The largest proportion of neonates (38.7%) had a birth weight of **2.0–2.49 kg**, while 12.0% weighed less than 1.5 kg.

Table 9. APGAR Score at 1 and 5 Minutes

APGAR score	1 minute n (%)	5 minutes n (%)
<4	14 (9.3)	4 (2.7)
4–6	46 (30.7)	18 (12.0)
≥7	90 (60.0)	128 (85.3)
Total	150 (100)	150 (100)

Most neonates had an APGAR score of **≥7 at 1 minute (60.0%)**, which increased to **85.3% at 5 minutes**.

Table 10. Neonatal Complications

Neonatal complication	Number (n=150)	Percentage (%)
Respiratory distress	42	28.0
Neonatal sepsis	24	16.0
Neonatal jaundice	20	13.3
Necrotizing enterocolitis	6	4.0
Other complications	8	5.3
No major complication	50	33.3

Respiratory distress was the most common neonatal complication, occurring in 28.0% of newborns, followed by neonatal sepsis (16.0%).

Table 11. NICU Admission and Duration of Stay

NICU-related outcome	Number (n=150)	Percentage (%)
NICU admission required	86	57.3
No NICU admission	64	42.7
Total	150	100.0

Among the neonates requiring NICU care, the duration of stay was:

Duration of NICU stay	Number	Percentage of NICU admissions (%)
<3 days	18	20.9
3–7 days	32	37.2
8–14 days	22	25.6
>14 days	14	16.3
Total	86	100.0

NICU admission was required in **57.3%** of neonates, with most admitted neonates (37.2%) requiring NICU care for 3–7 days.

Table 12. Neonatal Outcome

Neonatal outcome	Number (n=150)	Percentage (%)
Discharged alive	138	92.0
Neonatal mortality	12	8.0
Total	150	100.0

Overall, **92.0% of neonates were discharged alive**, whereas neonatal mortality was observed in 8.0% of cases.

DISCUSSION

The present prospective observational study evaluated 150 pregnancies complicated by PPRM and assessed maternal, fetal, and neonatal outcomes over a period of six months. PPRM represents an important cause of preterm birth, with outcomes determined by the interaction between prematurity, duration of membrane rupture, infection, and the clinical circumstances surrounding delivery [1,2].

In the present study, the largest proportion of women belonged to the 25–29-year age group, followed by women aged 20–24 years. Multigravida women constituted a slightly greater proportion than primigravida women. These findings demonstrate that PPRM occurred across different maternal age and parity groups. Maternal demographic characteristics may contribute to obstetric risk, but the clinical outcome following PPRM is more directly influenced by gestational age, infection, latency, and fetal condition.

A major observation of the present study was that most women presented with PPRM during the later preterm period, particularly between 34 and 36+6 weeks of gestation. This gestational-age distribution is clinically relevant because gestational age at membrane rupture and delivery is one of the most important determinants of neonatal outcome. Earlier gestational age is associated with increased risks of respiratory morbidity, low birth weight, neonatal infection, and mortality [5,6].

The majority of women in the study delivered between 34 and 36+6 weeks. The predominance of late-preterm deliveries may partly explain the relatively high neonatal survival observed in the study. Nevertheless, late-preterm infants remain at increased risk of respiratory distress, feeding difficulties, temperature instability, jaundice, and neonatal infection compared with term infants [10,12]. Thus, delivery at a relatively advanced preterm gestation does not eliminate the need for careful neonatal monitoring.

The latency period varied among the study participants, with nearly one-third of women having a latency period of more than 48 hours. Latency is clinically significant because prolongation of pregnancy can provide additional time for fetal maturation and completion of antenatal corticosteroid therapy. At the same time, prolonged membrane rupture may increase exposure to ascending infection. Previous studies have shown that the relationship between latency duration and neonatal outcome is complex and is strongly influenced by gestational age at rupture and delivery [7,11].

Maternal infectious morbidity was an important finding in the present study. Clinical chorioamnionitis was the most frequently documented maternal complication, followed by maternal fever, while a smaller proportion developed maternal sepsis. The increased risk of intrauterine infection following PPRM is biologically plausible because rupture of the membranes removes an important protective barrier against ascending microorganisms. Recognition of clinical infection is therefore an essential component of management, and suspected intra-amniotic infection is an important indication for delivery [3,4,8].

The predominance of vaginal delivery in the present study indicates that PPRM alone did not result in operative delivery in most women. Caesarean delivery was performed in a substantial minority, reflecting the presence of obstetric indications such as fetal status, malpresentation, previous obstetric history, failed labour, or other clinical considerations. Current management principles emphasize that the route of delivery should be individualized according to maternal and fetal indications rather than PPRM alone [1,8].

Birth weight findings in the present study reflected the preterm nature of the cohort. A considerable proportion of neonates had birth weights below 2.5 kg, including a smaller group with very low birth weight. Low birth weight in PPRM is primarily related to prematurity and gestational age and is an important determinant of neonatal respiratory morbidity, infection, feeding difficulties, and NICU requirements [5,6].

APGAR scores improved between one and five minutes after birth. Although a proportion of neonates had low or intermediate scores at one minute, most had a score of ≥ 7 by five minutes. This improvement suggests that many newborns responded to initial stabilization and neonatal care. APGAR scoring remains useful for describing the immediate condition of the newborn, although it should not be considered an independent measure of neonatal outcome and must be interpreted in the context of gestational age and clinical status.

Respiratory distress was the most frequent neonatal complication in the present study. This finding is consistent with the recognized association between prematurity and respiratory morbidity. The risk is particularly important in infants born at earlier gestational ages because lung maturation is incomplete. In PPRM, the clinical course may additionally be influenced by oligohydramnios, infection, and the timing of antenatal corticosteroid administration [5,6,12].

Neonatal sepsis was another important complication observed in the study. PPRM increases the risk of neonatal infection because prolonged rupture of membranes facilitates ascending microbial exposure and may be associated with maternal intra-amniotic infection. Neonates born after PPRM therefore require careful assessment for clinical features of infection, particularly when maternal fever, chorioamnionitis, prolonged latency, or other risk factors are present [3,4,8]. More than half of the neonates in the present study required NICU admission. The requirement for intensive neonatal care can be attributed to a combination of prematurity, respiratory distress, low birth weight, infection risk, and other neonatal complications. Among the admitted neonates, most required a relatively short duration of NICU care, although a smaller proportion required prolonged hospitalization. Previous literature has similarly demonstrated that neonatal resource utilization following PPRM is closely related to gestational age and the severity of neonatal morbidity [5,10].

The neonatal mortality observed in the present study was 8.0%, while the majority of neonates were discharged alive. Neonatal mortality following PPRM is strongly dependent on gestational age at delivery, birth weight, respiratory maturity, infection, and availability of advanced neonatal care [6,9]. The relatively large proportion of women delivering during the late-preterm period may have contributed to the overall survival observed in this cohort. Comparisons with other studies should therefore take into account differences in gestational-age distribution and neonatal care facilities.

The findings of the present study reinforce the importance of early diagnosis and appropriate risk stratification in PPRM. Maternal surveillance is necessary for timely identification of infection, while fetal assessment helps identify conditions requiring delivery. Appropriate use of antenatal corticosteroids and antibiotics, together with individualized decisions regarding expectant management and delivery, remains central to contemporary PPRM care [1,8].

The study also highlights the importance of close coordination between obstetric and neonatal teams. Because PPRM can result in both maternal infectious complications and neonatal complications related to prematurity, management does not end at delivery. Neonatal respiratory support, infection surveillance, nutritional management, and NICU care may be required depending on gestational age and clinical condition [5,10].

Overall, the present findings demonstrate that PPRM is associated with significant maternal and neonatal morbidity, with chorioamnionitis being the principal maternal complication and respiratory distress being the predominant neonatal complication in this cohort. Gestational age at delivery, latency period, birth weight, and maternal infection remain important factors influencing clinical outcomes. A multidisciplinary approach involving timely obstetric decision-making and appropriate neonatal support is therefore essential for improving outcomes in pregnancies complicated by PPRM.

CONCLUSION

PPRM was associated with significant maternal and neonatal morbidity in the present study. Chorioamnionitis was the most common maternal complication, while respiratory distress and neonatal sepsis were the predominant neonatal complications. More than half of the neonates required NICU admission. Gestational age, latency period, birth weight, and maternal infection were important factors influencing neonatal outcomes. Early diagnosis, close maternal–fetal monitoring, appropriate obstetric management, and coordinated neonatal care are essential to improve outcomes in pregnancies complicated by PPRM.

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