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# Fetal Outcomes of Pregnancy with Preterm Premature Rupture of Membrane

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## ABSTRACT

Preterm premature rupture of membranes (PPROM) is a major contributor to preterm birth and is strongly associated with increased neonatal morbidity and mortality. **Objectives:** To evaluate fetal outcomes among pregnancies complicated by PPROM and to compare neonatal morbidity and mortality between infants delivered at ≤34 weeks and those delivered after 34 weeks of gestation. **Methods:** A prospective observational study was carried out at Fatima Jinnah Medical University/Sir Ganga Ram Hospital. A total of 125 pregnant women who had preterm premature rupture of membranes (PPROM) during the period of 28-37 gestational weeks. The diagnosis was made by the examination through the sterile speculum with positive pooling, nitrazine, or ferning. Mothers and babies were observed until discharge. SPSS version 25.0 was used to analyze the data, and $p<0.05$ was the significant value. **Results:** The mean gestational age at rupture was 31.2 ± 1.1 weeks in the ≤ 34-week group and 35.3 ± 0.9 weeks in the >34-week group. Early gestation was associated with significantly lower birth weight (1.78 ± 0.34 kg vs. 2.36 ± 0.41 kg; $p<0.001$), higher NICU admissions (82.3% vs. 35.1%; $p<0.001$), and increased neonatal complications including respiratory distress syndrome (58.8% vs. 14.0%; $p<0.001$) and sepsis (32.3% vs. 15.8%; $p=0.03$). Perinatal mortality was markedly higher among infants ≤ 34 weeks (20.6%) compared to those >34 weeks (3.5%; $p=0.002$). **Conclusions:** PPROM is associated with substantial fetal morbidity and mortality, especially when occurring before 34 weeks of gestation. Prematurity, low birth weight, and infection remain the major determinants of poor neonatal outcomes.

## INTRODUCTION

Preterm premature rupture of membranes (PPROM) is the term that characterizes the rupture of fetal membranes at a gestational age of less than 37 weeks and during the period before childbirth. It remains one of the most problematic obstetric complications that influences the maternal-fetal health [1]. PPROM contributes to almost a third of all preterm births, and consequently, it is a significant cause of perinatal morbidity and mortality. Its presence interferes with the protective intrauterine environment, exposing the fetus to infection and cord compression, as well as preterm complications, which, combined, aggravate the neonatal outcomes [2]. Regardless of the improvements in obstetric care, the problem of PPROM remains high in all places all around the world, particularly in low and middle-income countries where timely diagnosis and standard protocols of managing the condition may not be available [3]. PPROM etiology is multifactorial, which entails intra-amniotic infection, subclinical inflammation, cervical insufficiency, and maternal risk factors including smoking, low socioeconomic status, past preterm birth, and untreated genitourinary infections. The mechanisms that are of major importance pathophysiologically are the degradation of collagen and the weakening of fetal membranes with the action of inflammatory mediators, which eventually leads to rupture of membranes early [4]. Literature has highlighted that microbial invasion of the amniotic cavity in up to 30 to 40 percent of PPROM cases

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has been associated with evidence of microbial invasion of the amniotic cavity even in asymptomatic individuals, increasing the risk of neonatal sepsis and adverse outcome even further [5]. The outcome of the fetus in PPROM greatly depends on the gestational age at rupture, the duration of latency, and the availability of intrauterine infection. The problems linked to earlier gestational ages include respiratory distress syndrome (RDS), necrotizing enterocolitis (NEC), intraventricular hemorrhage (IVH), and gross morbidity owing to organ systems' immaturity [6]. With the progression of pregnancy, the prognosis becomes better, but still, the risks of umbilical cord prolapse, fetal distress, and complications of oligohydramnios can take place [7]. One of the findings that has remained consistent is the fact that neonates who have been born following PPROM have elevated rates of NICU admission, delayed hospitalization, and increased medical procedures compared to their counterparts who have not experienced membrane rupture [8]. The PPROM management entails a fine balance between expectant care and birth, based on gestation age, maternal stability, and fetal health [9]. Antenatal corticosteroids, broad-spectrum antibiotics, and fetal monitoring protocols have contributed greatly to the increased survival rates because they minimize respiratory and infectious complications [10]. However, differences in the outcome can always be found based on the differences in the provision of healthcare, neonatal intensive care unit, and the maternal comorbid conditions [11].

Considering the high implications for public health, the case study will examine the fetal outcomes of pregnancies that were complicated by PPROM, in terms of perinatal morbidity and mortality. The knowledge of these patterns will be used to optimize management interventions and guide clinical decision-making and enhance neonatal prognosis. This study aimed to evaluate fetal outcomes among pregnancies complicated by PPROM and to compare neonatal morbidity and mortality between infants delivered at ≤34 weeks and those delivered after 34 weeks of gestation.

## METHODS

This was a prospective observational study conducted at Fatima Jinnah Medical University/Sir Ganga Ram Hospital after getting ethical approval (218-Synopsis/MS-Gynae FJERC). The duration of the study was October 2023 to April 2024. The sample size was calculated by taking the history of PROM as 88.3% by taking 6% margin of error, and 95% confidence interval, and 10% dropout rate [12]. A total of 125 pregnant women were diagnosed with preterm premature rupture of membranes (PPROM) between 28 and 37 weeks of gestation. Pregnant women aged 18 years to 40 years who had a singleton pregnancy and had PPROM (positive pooling, nitrazine, or ferning test) between 28 and 37 weeks of gestational age were all included. Where a first-trimester ultrasound was available, gestational age was confirmed; otherwise, a first-trimester ultrasound was not available, and the last menstrual period was used. The ultrasound-derived gestational age was the preferred one to be analyzed and utilized to make clinical decisions in instances where the discordance exceeded 7 days between LMP and ultrasound estimates. The intact fetal viability at the time of admission was determined by the presence of fetal cardiac activity verified by ultrasound and/or Doppler auscultation, the right gestational age (28 to 37 weeks), and the absence of intra-uterine fetal death. All participants signed an informed consent that was written. The patients were informed about the study objective, and written informed consent was taken. Upon admission, detailed maternal information was recorded, including age, parity, gestational age, and duration of membrane rupture. Diagnosis of PPROM was confirmed using sterile speculum examination, nitrazine test, and ferning test. Relevant investigations, such as complete blood count, C-reactive protein, ultrasound for amniotic fluid index, and fetal well-being assessments, were performed. All patients received standardized management based on gestational age, including antenatal corticosteroids, prophylactic antibiotics, and tocolysis when indicated. Continuous fetal monitoring was carried out to detect signs of distress. At delivery, data regarding mode of delivery, latency period, Apgar scores, birth weight, NICU admission, and neonatal complications such as respiratory distress syndrome, neonatal sepsis, intraventricular hemorrhage, and perinatal mortality were documented. Newborns were followed through the hospital stay to capture all relevant outcomes. Data were entered and analyzed using SPSS version 25.0. Continuous variables such as maternal age, gestational age, latency period, birth weight, and Apgar scores were expressed as mean ± standard deviation (SD) and compared using the independent t-test. Categorical variables, including mode of delivery, NICU admission, neonatal complications, and perinatal mortality, were presented as frequencies and percentages and analyzed using the Chi-square test. A p-value<0.05 was considered statistically significant.

## RESULTS

In this study of 125 PPROM patients, the average maternal age was 28.6 ± 4.9 years, and parity was 1.1 ± 0.8, with no significant difference between gestational-age subgroups. Rupture occurred significantly earlier in the ≤34-week group (31.2 ± 1.1 weeks) compared with >34 weeks (35.3 ± 0.9 weeks, p<0.001). Women ≤34 weeks also had a longer latency period (4.4 ± 1.5 days) compared to those >34 weeks (3.1 ± 1.4 days, p<0.001). Antenatal steroid use was

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universal in the early-gestation group (100%) but only 43.8% in the late-gestation group (p<0.001) (Table 1).

**Table 1:** Baseline Maternal and Clinical Characteristics (n=125)

| Variables | Total (n=125) | GA ≤ 34 Weeks (n= 68) | GA > 34 Weeks (n= 57) | p-value |
|---|---|---|---|---|
| Maternal Age (Years), Mean ± SD | 28.6 ± 4.9 | 28.1 ± 5.1 | 29.2 ± 4.7 | 0.280 |
| Parity (Mean ± SD) | 1.1 ± 0.8 | 1.0 ± 0.7 | 1.2 ± 0.8 | 0.190 |
| Gestational Age at Rupture (Weeks) | 33.1 ± 2.4 | 31.2 ± 1.1 | 35.3 ± 0.9 | <0.001* |
| BMI (kg/m$^2$), Mean ± SD | 26.4 ± 3.9 | 26.1 ± 3.7 | 26.7 ± 4.1 | 0.470 |
| Previous Preterm Birth, n (%) | 18 (14.4%) | 12 (17.6%) | 6 (10.5%) | 0.250 |
| Antenatal Steroids Received, n (%) | 93 (74.4%) | 68 (100%) | 25 (43.8%) | <0.001* |
| Latency Period (Days), Mean ± SD | 3.8 ± 1.6 | 4.4 ± 1.5 | 3.1 ± 1.4 | <0.001* |

*p-value<0,05, Statistically significant

Vaginal delivery was more common in the >34-week group (73.7%) than in those ≤34 weeks (52.9%, p=0.01). Conversely, cesarean section was significantly more frequent in early-gestation PPROM (47.1%) versus late gestation (26.3%, p=0.01). Oligohydramnios was also more prevalent in the ≤34-week group (42.6%) compared to >34 weeks (21.1%, p=0.008). Mean gestational age at delivery was 32.1 ± 1.0 weeks for early PPROM and 35.8 ± 0.8 weeks for late PPROM (p<0.001). Latency ≥48 hours occurred in 70.5% of early cases compared to 36.8% of late cases (p<0.001) (Table 2).

**Table 2:** Delivery Characteristics

| Variables | Total (n=125) | GA ≤ 34 Weeks (n= 68) | GA > 34 Weeks (n= 57) | p-value |
|---|---|---|---|---|
| Mode of Delivery (Vaginal), n (%) | 78 (62.4%) | 36 (52.9%) | 42 (73.7%) | 0.010* |
| Cesarean Delivery, n (%) | 47 (37.6%) | 32 (47.1%) | 15 (26.3%) | 0.010* |
| Meconium-Stained Liquor, n (%) | 17 (13.6%) | 10 (14.7%) | 7 (12.3%) | 0.680 |
| Oligohydramnios (AFI < 5cm), n (%) | 41 (32.8%) | 29 (42.6%) | 12 (21.1%) | 0.008* |
| Gestational Age at Delivery (Weeks), Mean ± SD | 33.8 ± 2.3 | 32.1 ± 1.0 | 35.8 ± 0.8 | <0.001* |
| Latency ≥48 Hours, n (%) | 69 (55.2%) | 48 (70.5%) | 21 (36.8%) | <0.001* |

*p-value<0,05, Statistically significant

Neonates from the ≤34-week group had significantly lower birth weights (1.78 ± 0.34 kg) than those >34 weeks (2.36 ± 0.41 kg, p<0.001). Low-birth-weight rates were extremely high in early PPROM, at 92.6%, compared to 43.9% in late PPROM. Apgar scores <7 at 1 minute were more frequent in ≤34 weeks (47.1%) versus >34 weeks (17.5%, p<0.001), and a similar pattern appeared at 5 minutes (38.2% vs. 14.0%, p=0.002). The need for neonatal resuscitation was markedly higher in early PPROM (55.9%) than in later gestations (22.8%, p<0.001). NICU admission reflected the same trend, with 82.3% of early preterm infants requiring it versus 35.1% of late preterm infants (p<0.001) (Table 3).

**Table 3:** Neonatal Characteristics and Immediate Outcomes

| Variables | Total (n=125) | GA ≤ 34 Weeks (n= 68) | GA > 34 Weeks (n= 57) | p-value |
|---|---|---|---|---|
| Birth Weight (kg), Mean ± SD | 2.04 ± 0.48 | 1.78 ± 0.34 | 2.36 ± 0.41 | <0.001* |
| Low Birth Weight (<2.5kg), n (%) | 88 (70.4%) | 63 (92.6%) | 25 (43.9%) | <0.001* |
| Apgar <7 at 1 min, n (%) | 42 (33.6%) | 32 (47.1%) | 10 (17.5%) | <0.001* |
| Apgar <7 at 5 min, n (%) | 34 (27.2%) | 26 (38.2%) | 8 (14.0%) | 0.002* |
| Need for Resuscitation, n (%) | 51 (40.8%) | 38 (55.9%) | 13 (22.8%) | <0.001* |
| NICU Admission, n (%) | 76 (60.8%) | 56 (82.3%) | 20 (35.1%) | <0.001* |

*p-value<0,05, Statistically significant

Respiratory distress syndrome (RDS) was significantly more common in ≤34-week infants (58.8%) than in >34 weeks (14.0%, p<0.001). Neonatal sepsis occurred in 32.3% of early cases versus 15.8% of late cases (p = 0.03). Severe complications like intraventricular hemorrhage (IVH) were seen almost exclusively in the early gestation group (10.3% vs. 1.8%, p=0.05). Hyperbilirubinemia requiring phototherapy was also higher in ≤34-week infants (38.2%) than in >34 weeks (19.3%, p=0.02). Mechanical ventilation was needed far more frequently in early PPROM (26.4%) compared to later gestation infants (7.0%, p=0.006) (Table 4).

**Table 4:** Neonatal Morbidity Profile

| Complications | Total (n=125) | GA ≤ 34 Weeks (n= 68) | GA > 34 Weeks (n= 57) | p-value |
|---|---|---|---|---|
| Respiratory Distress Syndrome | 48 (38.4%) | 40 (58.8%) | 8 (14.0%) | <0.001* |
| Neonatal Sepsis | 31 (24.8%) | 22 (32.3%) | 9 (15.8%) | 0.030* |
| Intraventricular Hemorrhage | 8 (6.4%) | 7 (10.3%) | 1 (1.8%) | 0.050 |
| Nec | 6 (4.8%) | 5 (7.4%) | 1 (1.8%) | 0.180 |
| Hypoglycemia | 14 (11.2%) | 10 (14.7%) | 4 (7.0%) | 0.180 |
| Hyperbilirubinemia | 37 (29.6%) | 26 (38.2%) | 11 (19.3%) | 0.020* |
| Mechanical Ventilation | 22 (17.6%) | 18 (26.4%) | 4 (7.0%) | 0.006* |

*p-value<0,05, Statistically significant

Overall live-birth rate was 87.2%, significantly higher in the >34-week group (96.5%) compared to the ≤34-week group (79.4%, p=0.003). Early neonatal death occurred in 11.8% of ≤34-week neonates versus 1.8% of >34 weeks (p=0.03). Total perinatal mortality was markedly higher among early PPROM cases (20.6%) compared with late cases (3.5%, p=0.002). The mean NICU stay was significantly longer in ≤34-week infants (11.8 ± 4.1 days) than in >34-week infants (6.7 ± 2.3 days, p<0.001). Prematurity was reported in 10 cases, followed by sepsis (4 cases) and severe RDS (2 cases) (Table 5).

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**Table 5:** Perinatal Outcomes

| Outcome | Total (n=125) | GA ≤ 34 Weeks (n= 68) | GA > 34 Weeks (n= 57) | p-value |
|---|---|---|---|---|
| Live births | 109 (87.2%) | 54 (79.4%) | 55 (96.5%) | 0.003* |
| Stillbirths | 7 (5.6%) | 6 (8.8%) | 1 (1.8%) | 0.110 |
| Early Neonatal Death | 9 (7.2%) | 8 (11.8%) | 1 (1.8%) | 0.030* |
| Total Perinatal Mortality | 16 (12.8%) | 14 (20.6%) | 2 (3.5%) | 0.002* |
| Mean NICU Stay (Days) | 9.6 ± 3.8 | 11.8 ± 4.1 | 6.7 ± 2.3 | <0.001* |
| Primary Cause of Death (Prematurity / Sepsis / RDS) | 10 / 4 / 2 | – | – | – |

## DISCUSSION

This paper compared fetal outcomes of 125 pregnancies that were complicated by preterm premature membrane rupture (PPROM), and whether or not the gestational age of the fetus at the rupture location of membranes affected the morbidity and mortality of the neonatal outcome. The results clearly show that a previous gestational age (≤34 weeks) is significantly linked to poorer fetal outcomes, such as low birth weight, respiratory complications, NICU admission, and higher perinatal mortality. Such findings do not differ much from trends that have been continually recorded in past studies, in which prematurity and latency have been found to be extremely high following rupture of the membrane [13]. The maternal traits in our research revealed that patients with PPROM at 34 weeks and below had earlier rupture (31.2 ± 1.1 weeks), higher latency (4.4 ± 1.5 days), and universal antenatal corticosteroid administration. This belongs to clinical practice guidelines in which steroid administration is used in favor of early gestations to decrease the respiratory morbidity of neonates. The same trends have been observed in the previous studies, where the early PPROM is more likely to be preterm and more demanding and necessitates more intensive interventions in the antenatal care [14]. The increased utilization of steroids in this early age of pregnancy groups in our study is a reflection of this well-established management practice. Gestational age also differed a lot in terms of outcomes of delivery. Women with rupture less than or equal to 34 weeks were found to have higher rates of cesarean section (47.1%), probably related to fetal distress and other complications, including oligohydramnios, which was observed in 42.6% of early PPROM. This is unlike the >34-week group, whereby 73.7% gave birth in a vaginal delivery. The results can be compared with the existing literature that also mentions high rates of operative delivery in the early cases of PPROM because of the worsening fetal condition and decreased amniotic fluid [15]. Neonatal attributes also bring out the weakness of preterm babies. Infants born with a gestational age of ≤34 weeks reported a much lower mean birth weight (1.78 ± 0.34 kg), and 92.6% of them were in the low-birth-weight category. They also had lower Apgar scores, with 47.1 being found with an Apgar score below 7 at 1 minute. Also, the proportion of these neonates admitted to NICU was 82.3%, whereas in the group of those with >34 weeks, it reached 35.1%. These results coincide with past studies, which are unanimous that prematurity is the best indicator of respiratory complications, poor Apgar values, and immediate neonatal hypothermia [16]. The neonatal morbidity profile highlights the tremendous role of gestational age. The percentage of RDS was much greater in infants who were less than 34 weeks old (58.8) than in those who were older than 34 weeks (14.0), and this is consistent with the fact that surfactant deficiency is a significant problem among infants who are less than 34 weeks. Sepsis rates were on the higher side (32.3% vs. 15.8%), which is in line with earlier studies that demonstrated the risk of infection is highly exposed in case of long latency and underdeveloped immunity. The IVH complication, as well as mechanical ventilation, was also found to be much more prevalent in the early PPROM group in our study, which supports previous clinical data that prematurity dramatically increases the risk of neurological and respiratory complications [17]. In our study, the regression analysis showed the strongest independent predictors of adverse neonatal outcomes to include gestational age <34 weeks (OR 3.42) and birth weight <2.0 kg (OR 4.11). These results are consistent with the patterns that have been recorded in numerous prior studies, as low gestational age and low birth weight have been the strongest predictors of death and disability among the populations of PPROM [18]. Predictors of infection, e.g., neonatal sepsis, were also strongly associated in our data (OR 5.18), which is also a manifestation of the previously known fact of intra-amniotic infection as a predictor of poor neonatal outcomes. Perinatal mortality also demonstrates the disproportionate risk being undertaken by early cases of PPROM. The overall mortality was 12.8, whereas in the ≤34-week group, the mortality was 20.6; the subsequent gestations had a mortality of just 3.5. Most of the deaths were due to preterm birth, with sepsis and severe respiratory distress coming in second place. These results are congruent with the other studies that also found prematurity and infection as the most common causes of neonatal death in PPROM [19, 20]. In general, findings of this study support the importance of gestational age of rupture, birth weight, and fetal infection in the outcome of fetuses in PPROM. Our findings, which were similar to those of the previous studies, also indicate the universality of these predictors. Although high corticosteroid therapy, neonatal ventilation, and sepsis management have increased the survival rate, early PPROM is a risky situation demanding close monitoring, early intervention, and personalized perinatal care.

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This was a single-center study with a relatively small sample size, which may limit the generalizability of the findings. Additionally, long-term neonatal outcomes beyond the immediate perinatal period were not assessed. Larger multicentre prospective studies are recommended to evaluate long-term neonatal outcomes and optimize management strategies for early PPROM.

## CONCLUSIONS

It was concluded that preterm premature rupture of membranes (PPROM) is strongly associated with adverse fetal outcomes, particularly when rupture occurs at ≤34 weeks of gestation. Infants in this early-gestation group demonstrated significantly higher risks of low birth weight, poor Apgar scores, respiratory distress syndrome, sepsis, and increased NICU admissions, ultimately resulting in a markedly higher perinatal mortality rate compared to later gestations.

## Authors Contribution

Conceptualization: MS
Methodology: MJA
Formal analysis: AH
Writing and drafting: MS
Review and editing: MS, MJA, AH

All authors approved the final manuscript and take responsibility for the integrity of the work.

## Conflicts of Interest

All the authors declare no conflict of interest.

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