

## Ruptured Membranes in Premature Birth Incidence and Management

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### Abstract

**Objectives:** P-PROM is associated with 30 - 40% of preterm deliveries and is the leading identifiable cause of preterm delivery. The objective of our study is to evaluate incidence and management of P-PROM.

**Materials and Methods:** During the study period, from 2019 to 2023 in University Hospital Maternity "Queen Geraldine" preterm births data were statistically analyzed. All data analyses were performed using Microsoft Excel and WINPEPI version 11.65. The p-value was considered significant at < 0.05.

**Results:** The percentage of premature births varied, with the highest rate of 8.4% in 2022 and the lowest rate of 6.14% in 2020. P-PROM (Total) cases showed a peak of 3.27% in 2022 and a low of 2.19% in 2023. Within the P-PROM categories, P-PROM (24-29w6d) ranged from 0.13% to 0.38%, P-PROM (30-33w6d) ranged from 0.21% to 0.52%, and P-PROM (34-36w6d) ranged from 1.73% to 2.36%.

**Conclusion:** Globally, the magnitude of P-PROM slightly varies and it complicates approximately 1 - 4% of all pregnancies. Premature births with a gestational age of 34 - 37 weeks constitute the largest number of premature births with ruptured membranes. In cases of early PPRM, a waiting attitude is preferred. If mother and fetus are clinically stable, without any sign of infection, gestational age is the main factor determining management.

**Keyword:** Preterm Premature Rupture of Membranes (P-PROM)

### Introduction

Premature rupture of membranes (PROM), now also referred to as "pre-labour rupture of membranes," is the rupture of gestational membranes after 37 weeks but before the process of labour begins. When membrane rupture occurs before 37 weeks of gestation, it is referred to as preterm PROM (PPROM). P-PROM is associated with 30 - 40% of preterm deliveries and is the leading identifiable cause of preterm delivery. P-PROM complicates 3% of all pregnancies and occurs in approximately 150,000 pregnancies yearly in the United States [1,2].

Preterm PROM contributes more significantly to neonatal mortality and morbidity than any other group of disorders. There is no single etiology leading to PPRM and its exact pathophysiology remains unclear. The major risk factors for PPRM include: history of

PPROM, short cervical length, second or third trimester vaginal bleeding, uterine distension, connective tissue disorders, low body mass index, low socioeconomic status, cigarette smoking and illicit drug use [3].

Most cases can be diagnosed based on history and physical examination. Avoid digital examination due to infection risk, unless delivery appears to be immediate [4]. Speculum examination visualizes amniotic fluid (AF) leaking through the cervix, vaginal pooling, Fern test of dried vaginal fluid seen under microscope, pH testing [4]. If above inconclusive then ultrasound for amniotic fluid volume (AFV) may be helpful but not diagnostic. Fetal fibronectin is sensitive with high negative predictive value but positive result is not diagnostic. Amniotic protein tests have high sensitivity for PROM but false-positive rates may be as high as 19 - 30% [4]. ACOG states that "These test kits should be considered ancillary to standard methods of diagnosis". Conclusive test remains ultrasound guided dye with passage into the vagina and detected with tampon or pad stain. Maternal urine may turn blue following instillation of indigo carmine [5]. Patients with intra-amniotic infection often experience significant: fever, maternal and/or fetal tachycardia and uterine tenderness.

Early PPRM at 24w0d until 33w6d of gestation: expectant management is recommended and it includes hospital admission. If there are maternal and/or fetal contraindications to expectant management, delivery is recommended [8,9]. Antenatal (single course) corticosteroids are recommended (insufficient evidence regarding rescue course). Latency antibiotics are recommended: Eunice Kennedy Shriver NICHD MFMU Network trial regimen [6]. Amoxicillin-clavulanic acid - Not recommended due to increased risk for necrotizing enterocolitis [6].

Late PPRM at 34w0d to 36w6d of gestation: either expectant management or induction delivery is a reasonable option. Data suggests when comparing these two options there is no difference in neonatal sepsis [9]. In cases of chorioamnionitis, patient should be treated and planned for delivery [7].

### Methods

A single-center, non-randomized, retrospective cohort design study of incidence and management of ruptured membranes in premature birth. This retrospective study included all pregnant women who delivered at University Hospital Maternity "Queen Geraldine", Tirana, during the specified period from 2019 to 2023. Participants were selected consecutively to ensure a systematic inclusion of all eligible women presenting for delivery.

**Inclusion criteria:** Living fetus in echography and amniotic fluid (AF) leaking through the cervix.

**Exclusion criteria:** Multiple pregnancy, P-PROM and vaginal hemorrhage (placental abruption or placenta previa), chorioamnionitis.

All methods were performed in accordance with the relevant guidelines and regulations.

Data were collected from medical records and charts through a thorough desk review. Numerical variables included the number of births and premature births each year, as well as the number of P-PROM cases categorized by gestational age ranges (24-29w6d, 30-33w6d and 34-36w6d). Categorical variables included delivery methods (expectant management, induction of labor, cesarean section), elevated WBC and PCR levels, normal WBC and PCR levels, only elevated WBC, only elevated PCR, and insufficient data.

### Data analysis

Descriptive statistics were used to report frequencies and percentages for variables such as the number of births, premature births, P-PROM cases categorized by gestational age ranges (24-29w6d, 30-33w6d, 34-36w6d) for the years 2019 to 2023, and delivery methods (expectant management, induction of labor, cesarean section). Additional variables included elevated WBC and PCR levels, normal WBC and PCR levels, only elevated WBC, only elevated PCR, and insufficient data. Pearson correlation analysis was employed to assess the relationship between premature births and early P-PROM cases (24-29w6d).

Additionally, p-values were calculated to determine the statistical significance of observed differences, with chi-squared tests used to evaluate the association between the years and P-PROM categories, the distribution of delivery methods across P-PROM categories, and the distribution of hospital stay durations across different P-PROM categories. All data analyses were performed using Microsoft Excel and WINPEPI version 11.65. The p-value was considered significant at < 0.05.

**Ethical considerations**

Ethical considerations were carefully managed, with strict adherence to confidentiality and anonymity protocols for patient data, following the guidelines set by the University Hospital Maternity “Queen Geraldine”. Every measure was taken to protect the privacy and dignity of the participants, ensuring all data were treated with the highest level of care and respect.

**Results**

The table presents data on total births, premature births, and P-PROM cases (categorized by gestational age ranges: 24-29w6d, 30-33w6d, and 34-36w6d) for the years 2019 to 2023. The number of births ranged from 6302 in 2020 to 5608 in 2023. The percentage of premature births varied, with the highest rate of 8.4% in 2022 and the lowest rate of 6.14% in 2020. P-PROM (Total) cases showed a peak of 3.27% in 2022 and a low of 2.19% in 2023. Within the P-PROM categories, P-PROM (24-29w6d) ranged from 0.13% to 0.38%, P-PROM (30-33w6d) ranged from 0.21% to 0.52%, and P-PROM (34-36w6d) ranged from 1.73% to 2.36%. There was no significant association between the year of births and the distribution of P-PROM cases across different gestational age categories (p = 0.22). The Pearson correlation analysis revealed very strong positive correlations between premature births and early P-PROM cases (24-29w6d) (0.944, p < 0.05) (Table 1).

Year	Births	Premature	P-PROM (Total)	P-PROM (24-29w6d)	P-PROM (30-33w6d)	P-PROM (34-36w6d)	P-Value
2019	6261 (100.0)	442 (7.06)	154 (2.46)	13 (0.21)	29 (0.46)	112 (1.79)	P = 0.22
2020	6302 (100.0)	387 (6.14)	155 (2.46)	8 (0.13)	21 (0.33)	126 (2.0)	
2021	6025 (100.0)	411 (6.82)	138 (2.29)	11 (0.18)	20 (0.33)	107 (1.78)	
2022	5726 (100.0)	481 (8.4)	187 (3.27)	22 (0.38)	30 (0.52)	135 (2.36)	
2023	5608 (100.0)	416 (7.42)	123 (2.19)	14 (0.25)	12 (0.21)	97 (1.73)	

**Table 1:** Births, premature births, and P-PROM cases by year.

For P-PROM (24-29w6d), there are 34 cases managed expectantly (11.81%), 15 with labor induction (7.04%), and 19 via cesarean section (7.42%). In the P-PROM (30-33w6d) category, 85 cases are managed expectantly (29.51%), 11 with labor induction (5.16%), and 16 via cesarean section (6.25%). The P-PROM (34-36w6d) category has the highest numbers: 169 cases managed expectantly (58.68%), 187 with labor induction (87.79%), and 221 via cesarean section (86.33%). The p-value of < 0.01 indicates a statistically significant difference in the distribution of delivery methods across these P-PROM categories, suggesting that the choice of delivery method is significantly associated with the gestational age at which P-PROM occurs (Table 2).

Premature	Expectant Management	Induction of Labor	Cesarean Section	P-Value
P-PROM (24-29w6d)	34 (11.81)	15 (7.04)	19 (7.42)	<0.01
P-PROM (30-33w6d)	85 (29.51)	11 (5.16)	16 (6.25)	
P-PROM (34-36w6d)	169 (58.68)	187 (87.79)	221 (86.33)	
Total	288 (100.0)	213 (100.0)	256 (100.0)	

**Table 2:** Delivery methods and P-PROM categories.

The table presents the distribution of hospital stay durations (1 - 5 days, 6 - 10 days, 11 - 20 days) for P-PROM cases categorized by gestational age ranges (24-29w6d, 30-33w6d, 34-36w6d). For P-PROM (24-29w6d), there are 18 cases with a stay of 1 - 5 days (26.47%), 36 cases with a stay of 6 - 10 days (52.94%), and 14 cases with a stay of 11 - 20 days (20.59%). In the P-PROM (30-33w6d) category, there are 35 cases with a stay of 1 - 5 days (31.25%), 46 cases with a stay of 6 - 10 days (41.07%), and 31 cases with a stay of 11 - 20 days (27.68%). The P-PROM (34-36w6d) category has the highest numbers: 243 cases with a stay of 1 - 5 days (42.11%), 297 cases with a stay of 6 - 10 days (51.47%), and 37 cases with a stay of 11 - 20 days (6.41%). The p-value < 0.01 indicates a statistically significant difference in the distribution of hospital stay durations across different P-PROM categories, suggesting that the length of hospital stay is significantly associated with the gestational age at which P-PROM occurs (Table 3).

Premature	1-5 Days	6-10 Days	11-20 Days	Total	P-Value
P-PROM (24-29w6d)	18 (26.47)	36 (52.94)	14 (20.59)	68 (100.0)	<0.01
P-PROM (30-33w6d)	35 (31.25)	46 (41.07)	31 (27.68)	112 (100.0)	
P-PROM (34-36w6d)	243 (42.11)	297 (51.47)	37 (6.41)	577 (100.0)	

**Table 3:** Hospital stay duration according to p-prom cases categorized by gestational age ranges.

The laboratory analysis for P-PROM cases reveals that 83 cases (11.9) had elevated WBC and CRP levels, while 248 cases (35.5) had normal WBC and CRP levels. Additionally, 194 cases (27.8) had only elevated WBC, and 65 cases (9.3) had only elevated CRP. There were also 167 cases (23.9) with insufficient data. This distribution indicates that the majority of cases had either normal WBC and CRP levels or only elevated WBC levels, with fewer cases showing elevated CRP or both elevated WBC and CRP (Table 4).

Parameter	Number of Cases (%)
Elevated WBC and CRP	83 (11.9)
Normal WBC and CRP	248 (35.5)
Only Elevated WBC	194 (27.8)
Only Elevated CRP	65 (9.3)
Insufficient Data	167 (23.9)

**Table 4:** Laboratory analysis for P-PROM cases.

### Discussion

Preterm premature rupture of membranes (PPROM) defined, as the spontaneous rupture of membranes before 37 weeks of gestation, is a relatively common complication in pregnancy. P-PROM is associated with 30 - 40% of preterm deliveries and complicates 3% of all pregnancies worldwide [1,2].

The present study investigated incidence rate of PPRM and its management. In the analysis of 2137 patients who had a premature birth in University Hospital "Queen Geraldine" from 2019 to 2023 was concluded that the highest rate of premature births was 8.4% in 2022 and the lowest rate was 6.14% in 2020. P-PRM cases showed a peak of 3.27% in 2022 and a low of 2.19% in 2023. Patients with multiple pregnancies, P-PRM and vaginal hemorrhage (placental abruption or placenta previa) and chorioamnionitis were not included in the study. It can be concluded that in our study incidence rate of P-PRM approximately the same to the global incidence rate.

Categorizing P-PRM by gestational age ranges: P-PRM (24-29w6d) had the lowest incidence rate from 0.13% to 0.38%, while P-PRM (34-36w6d) had the highest incidence rate from 1.73% to 2.36%.

The optimal management of pregnancies complicated by P-PRM remains a challenge. The issue of expectant management vs. immediate delivery, especially in cases of P-PRM occurring at less than 30 gestational week, is controversial [8]. The last Cochrane on this issue recommended a policy of expectant management between 25 and 37 weeks of pregnancy with careful monitoring to achieve better outcomes for the mother and her baby [8-10].

The first choice in our study was expectant management if fetal and maternal conditions were stable. The P-PRM (34-36w6d) category was mostly delivered by labor induction (87.79%) or cesarean section (86.33%) than expectant management (58.68%). P-PRM (24-29w6d) and P-PRM (30-33w6d) category had as prior choice expectant management respectively (11.81%) and (29.51%). The p-value of  $< 0.01$  indicates a statistically significant difference in the distribution of delivery methods across these P-PRM categories, suggesting that the choice of delivery method is significantly associated with the gestational age at which P-PRM occurs.

According to the distribution of hospital stay duration, the average stay day was 6-10 days, respectively P-PRM (24-29w6d) of 52.94%, P-PRM (30-33w6d) of 41.07%, P-PRM (34-36w6d) of 51.47%. The p-value  $< 0.01$  indicates a statistically significant difference in the distribution of hospital stay durations across different P-PRM categories, suggesting that the length of hospital stay is significantly associated with the gestational age at which P-PRM occurs.

The main laboratory parameters used for follow up and management of P-PRM were WBC (white blood cells) and CRP (C-reactive protein). There was no significant difference of these parameters values and P-PRM range category.

### Conclusion

Globally, the magnitude of P-PRM slightly varies and it complicates approximately 1 - 4% of all pregnancies [1]. The percentage of premature births in our study varied, with the highest rate of 8.4% in 2022 and the lowest rate of 6.14% in 2020. P-PRM (Total) cases showed a peak of 3.27% in 2022 and a low of 2.19% in 2023. Premature births with a gestational age of 34-37 weeks constituted the largest number of premature births with ruptured membranes.

The choice of delivery method was significantly associated with the gestational age at which P-PRM occurs. In cases of early PPRM, a waiting attitude is preferred. The average stay duration in the hospital is higher in the 30 - 34 gestational age group. Premature births with ruptured membranes require a strict follow-up with CBC (leukocytes) and the levels of C-Reactive Protein (CRP) in blood. Based on these examinations and clinical finding then is decided on the time and mode of delivery.

Expectant management should be considered only when fetal benefits are expected without any significant fetal or maternal risk [5]. If mother and fetus are clinically stable, without any sign of infection, gestational age is the main factor determining management. The benefits of expectant management are primarily related to the reduction of fetal morbidity resulting from prematurity [6,7].

### Disclosure of Interests

The authors express that there is no conflict of interest for the publication of this article.

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