



The Relationship Between Premature Rupture of Membranes (PROM) and Leukocyte Levels in Newborns

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Abstract

Premature Rupture of Membranes (PROM) remains a global concern in obstetrics due to its potential to cause complications such as infections that increase maternal and neonatal morbidity and mortality. PROM occurs in approximately 10–15% of pregnancies worldwide and 8–10% in Indonesia, often before 37 weeks of gestation, contributing significantly to preterm births and neonatal deaths. Risk factors for PROM include maternal age, parity, infection, and other pregnancy-related conditions. Infection resulting from PROM can be identified through leukocyte count in newborns, with leukocytosis indicating the presence of infection. This study aimed to examine the relationship between PROM and leukocyte levels in newborns at RSUD Drs. Jacobus Luna, M.Si, Bengkayang Regency, using a descriptive-analytic design with a cross-sectional approach and total sampling of 88 respondents. Results showed that among 36 newborns with elevated leukocyte levels, 28 cases (77.8%) were born from PROM pregnancies, whereas only 8 cases (22.2%) were non-PROM. Among 52 cases with normal leukocyte levels, only 11 newborns (21.2%) had PROM, while 41 (78.8%) did not. These findings indicate that newborns from PROM pregnancies tend to have higher leukocyte counts. Statistical analysis using Chi-square showed a significant relationship between PROM and leukocyte levels, with a p-value of 0.000 (< 0.05). In conclusion, PROM is a notable risk factor for increased leukocyte counts in neonates, underscoring the importance of early detection and management of PROM to reduce the risk of neonatal infection and its associated complications.

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1. INTRODUCTION

Childbirth-related complications remain prevalent worldwide, reflecting the persistent risks associated with pregnancy and labor. One significant obstetric complication is Premature Rupture of Membranes (PROM), which is considered an obstetric emergency due to its potential to cause serious complications during pregnancy and delivery, including infections that may increase maternal and neonatal morbidity and mortality. While the exact cause of PROM remains unclear, several predisposing factors have been identified that may increase its risk, including cervical incompetence, abnormal fetal position, multiple gestation (gemelli), trauma, infection, and multiparity (Ambarkasi, 2017). Maternal age and parity status also influence the incidence of Premature Rupture of Membranes (PROM). Parity refers to the number of live births or the number of pregnancies that have resulted in a fetus capable of surviving outside the uterus Maraj, & Kumari, 2021; Setyatama, 2023).

According to data from the World Health Organization (WHO), the global incidence of Premature Rupture of Membranes (PROM) is approximately 10–15% of all pregnancies, indicating that 10 to 15 out of every 100 pregnancies may experience PROM. PROM can occur at any gestational age; however, the risk is significantly higher before 37 weeks of gestation. When PROM occurs before 37 weeks, it is classified as preterm birth (WHO, 2023). PROM is one of the factors that can increase the risk of neonatal mortality (Qoyimmah, 2021). According to data from the Ministry of Health of the Republic of Indonesia, the incidence of Premature Rupture of Membranes (PROM) in Indonesia in 2022 was reported to be 8–10% of all pregnancies, indicating that approximately 8 to 10 out of every 100 pregnancies in the country experienced PROM (Puspitasari et al., 2023). Based on data from the Central Statistics Agency (BPS), the infant mortality rate (IMR) in Indonesia in 2022 was 0.51 per 1,000 live births, meaning that approximately 1 infant died for every 1,000 live births. In West Kalimantan, the IMR in 2022 was slightly higher at 0.52 per 1,000 live births (BPS Provinsi Kalimantan Barat, 2023).

Data from RSUD Drs. Jacobus Luna, M.Si in Bengkayang Regency recorded 111 cases of newborns with Premature Rupture of Membranes (PROM) out of 1,175 deliveries between January and December 2022 (Subono, 2022). This indicates that PROM remains a significant issue that requires attention in the hospital. Efforts to reduce the incidence of PROM include regular antenatal care to detect early signs and symptoms. Early detection facilitates timely intervention and helps minimize complications (Subono, 2022). PROM during pregnancy can lead to chorioamnionitis, an infection characterized by maternal fever, maternal and fetal tachycardia, foul-smelling amniotic fluid, and leukocytosis. PROM creates a direct connection between the external environment and the intrauterine space, increasing the risk of ascending infections. The longer the latency period, the greater the likelihood of intrauterine infection. While PROM may occur physiologically during pregnancy, it can also be triggered by various risk factors such as vaginal infections, multiparity, smoking, nutritional deficiencies, cervical incompetence, polyhydramnios, a history of previous PROM, abnormalities in the amniotic membrane, fetal malpresentation, and multiple pregnancies (Ridha, 2014).

Infection assessment in neonates can be performed through laboratory tests, such as a white blood cell (leukocyte) count. Leukocytes are white blood cells produced by hematopoietic tissue and play a crucial role in the immune system, helping the body fight various infections. The normal leukocyte count for newborns ranges from 9,000 to 30,000/ μ l. An elevated leukocyte count (leukocytosis) indicates the presence of an infection or acute inflammation, while a decreased leukocyte count (leukopenia) can occur in specific infections, particularly bacterial, viral, and malaria infections. Infections in neonates can present symptoms such as respiratory distress, weakness, fever or hypothermia, and skin rashes or color changes (Ridha, 2014). The newborns born to

mothers with PROM have higher risk of developing neonatal sepsis compared to those born to mothers without PROM (Shinjo et al., 2012; Linehan et al., 2016; Hincu et al., 2024). The high incidence of deliveries with Premature Rupture of Membranes (PROM) at RSUD Drs. Jacobus Luna, M.Si, Bengkayang Regency, prompted the researcher to conduct a study on the relationship between PROM and leukocyte levels in newborns at the hospital. This is because PROM can lead to infections in newborns, requiring further intervention to ensure the safety of the infant. The aim of this study is to determine the relationship between Premature Rupture of Membranes (PROM) and leukocyte levels in newborns at RSUD Drs. Jacobus Luna, M.Si, Bengkayang Regency.

2. METHOD

This study employed a descriptive-analytic design with a cross-sectional approach, which aims to systematically, factually, and precisely describe a specific phenomenon or variable. The population of this study consisted of all newborns at RSUD Drs. Jacobus Luna, M.Si, with a total of 88 newborns, 39 of whom were delivered with the indication of Premature Rupture of Membranes (PROM). The sample was determined using a total sampling technique, meaning the entire population of 88 newborns was included as respondents.

The data collected in this study were categorized based on their nature, source, and time of collection. In terms of the nature of the data, this study utilized quantitative data. Regarding the source of data, primary data were used, and for the time of data collection, a cross-sectional approach was applied. The data obtained were then analyzed using both univariate and bivariate analyses. The univariate analysis presented the characteristics of the respondents, including maternal age, parity status, PROM status, duration of PROM, and leukocyte levels in newborns.

Bivariate analysis was performed to examine the relationship between PROM and leukocyte levels in newborns, using *Chi-Square* statistical tests. This statistical test was chosen to determine whether there is a significant association between the occurrence of PROM and the leukocyte count in the newborns, based on the data collected during the study period. This research has also received ethical approval from the Ethics Commission of the Poltekkes Kemenkes Pontianak with number: 111/KEPK-PK-PKP/III/2024.

3. RESULTS AND DISCUSSION

Table 1. Distribution of Mothers and Infants.

Characteristic	Frequency	Percentage (%)
Mother's Age		
< 20	3	3.4
20-35	71	80.7
> 35	14	15.9
Mother's Parity		
Primigravida	30	34.1
Multigravida	50	56.8
Grande Multigravida	8	9.1
Maternal PROM Status		
PROM*	39	44.3
Non-PROM	49	55.7
Duration of PROM		
> 12 Hours	15	17.0
< 12 Hours	24	27.3
No PROM	49	55.7

Newborn Leukocyte Level		
High	36	40.9
Not High	52	59.1

Notes: PROM = Premature Rupture of Membranes (KPD)

Primigravida = First pregnancy

Multigravida = Second or more pregnancies

Grande Multigravida = Multiple previous pregnancies (usually ≥ 5)

Table 1 shows that the data reveal that the majority of mothers were aged between 20 and 35 years (80.7%), with smaller proportions under 20 (3.4%) and over 35 (15.9%). Most mothers were multigravida (56.8%), followed by primigravida (34.1%) and grande multigravida (9.1%). Regarding maternal PROM status, 44.3% experienced premature rupture of membranes (PROM), while 55.7% did not. Among those with PROM, 17.0% had it for more than 12 hours, and 27.3% for less than 12 hours. In terms of newborn health, 40.9% had high leukocyte levels, whereas 59.1% did not, suggesting a potential link between maternal and neonatal health indicators.

Table 2. Chi-Square Analysis of the Relationship Between PROM and Newborn Leukocyte Levels at Drs. Jacobus Luna Regional Hospital, Bengkayang Regency.

PROM Status	Elevated leukocyte levels				Total	p-value
	High Leukocyte		Not High Leukocyte			
	N	%	N	%	N	%
PROM	28	77.8	11	21.2	39	44.3
Non-PROM	8	22.2	41	78.8	49	55.7
Total	36	100.0	52	100.0	88	100.0

< 0.001

Table 2 shows that the *Chi-Square* analysis shows a statistically significant relationship between the occurrence of PROM (Premature Rupture of Membranes) and elevated leukocyte levels in newborns at Drs. Jacobus Luna Regional Hospital, Bengkayang Regency, as evidenced by a p-value of 0.000 in the Continuity Correction test ($p < 0.05$).

DISCUSSION

Premature rupture of membranes (PROM) is a major obstetric issue that can lead to various complications for both the mother and the newborn. One significant concern associated with PROM is the increased risk of neonatal sepsis due to exposure to infectious agents. Studies have identified common pathogens such as *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, Group B *Streptococcus*, and *Escherichia coli* in cases of neonatal sepsis that occur following prolonged membrane rupture (Alam et al., 2014). The primary contributing factors to PROM are maternal age and parity. Among the 88 respondents in this study, 39 individuals, or approximately 44.3%, experienced PROM, indicating a significant prevalence within the study population. About 55.7% of the respondents did not experience PROM. However, this does not imply that mothers who did not experience PROM are not at risk of encountering it in future pregnancies. PROM can be influenced by several factors, including maternal age, previous pregnancy history, maternal and fetal health conditions, as well as lifestyle choices (Wahyuni et al., 2020).

The results of the study show that the majority of newborns had normal (not high) leukocyte levels. Leukocytes, or white blood cells, play a vital role in the immune system, and elevated levels can indicate the presence of infection or other conditions triggering an

immune response. Among the 39 newborns with high leukocyte levels associated with PROM, 30 showed an increase in neutrophil count. The researchers assume that this neutrophil increase often occurs in response to bacterial infection or inflammation. This finding aligns with research by Puspitasari (2022), which states that neutrophils are the most dominant leukocyte population in newborns. An elevated neutrophil count (neutrophilia) commonly occurs as a response to bacterial infection or inflammatory conditions (Puspitasari, 2022). Therefore, the observation that 40.9% of newborns had high leukocyte levels may indicate the presence of certain factors affecting their health. Newborns with elevated leukocyte levels may require closer monitoring to ensure there are no serious medical conditions that necessitate further intervention.

The distribution of maternal age in this study indicates that the majority of participants were within the ideal reproductive age range (20–35 years), which is generally associated with a lower risk of pregnancy complications. This finding is supported by Syarwani et al. (2020), who stated that most mothers in their study were also within a healthy reproductive age range. The age range of 20–35 years is considered optimal because female reproductive organs function most effectively during this period. Conversely, pregnancies in women under 20 years old often involve physiological immaturity, increasing the risk of abnormal amniotic membrane formation. Pregnancies in women over 35 are associated with declining reproductive function, which can affect embryogenesis and result in thinner, more fragile membranes that are prone to premature rupture (Zakirah et al., 2020). The variation in maternal age observed in this study reflects varying health risks related to PROM and leukocytosis in newborns. Although most respondents were within the ideal reproductive age, special attention is still needed for teenage and older mothers. Regarding parity, 30 respondents (34.1%) were primigravida, 50 (56.8%) were multigravida, and 8 (9.1%) were grande multigravida. Parity, in this context, does not differentiate between live or stillbirths, nor between singleton or multiple pregnancies. Increased parity can lead to cervical trauma during previous deliveries, which in turn may compromise the integrity of the amniotic membranes (Mellisa, 2021). Furthermore, Syarwani et al. (2020) found that PROM was more commonly observed among multiparous mothers. High-risk parity can contribute to complications during pregnancy, childbirth, and the postpartum period, especially in multiparous and grande multiparous women due to increased uterine mortality and reduced cervical elasticity.

An increase in leukocyte levels in cases of premature rupture of membranes (PROM) tends to be more prominent among mothers with higher parity, particularly in multiparous and grand multiparous women. Although complications often occur in primiparous mothers, not all primiparas are at high risk, as the likelihood of complications also depends on the mother's physical and psychological readiness for pregnancy (Maharrani & Nugrahini, 2020). Parity considered safe for pregnancy typically ranges between 2–3, although this threshold can vary based on individual maternal conditions. Declining reproductive organ function and increased uterine mortality contribute to a higher risk of complications during pregnancy, delivery, and the postpartum period. Maternal risk factors such as age, parity, education, occupation, diabetes, blood pressure, cervical length, history of abortion, and infection all play a role in the development of PROM and subsequent neonatal outcomes (Boskabadi & Zakerihamidi, 2018). Other contributing factors such as membrane rupture lasting more than 18 hours, gestational age under 37 weeks, cesarean delivery, and low birth weight have also been significantly associated with early-onset neonatal sepsis (Suwarna et al., 2022). The elevated leukocyte levels observed in newborns delivered after PROM suggest a heightened risk of infection or inflammatory response. High leukocyte counts in these newborns may indicate the presence of inflammation or infection. Previous research has shown that intra-

amniotic infection frequently follows PROM, suggesting that PROM can serve as an entry point for pathogens into the fetal environment..

Maternal risk factors such as age, parity, education, occupation, diabetes, blood pressure, cervical length, history of abortion, and infections play a significant role in the development of premature rupture of membranes (PROM) and subsequent neonatal outcomes. Additionally, factors such as membrane rupture lasting more than 18 hours, gestational age under 37 weeks, cesarean delivery, and low birth weight have also been associated with early-onset neonatal sepsis. In this study, the observed relationship between PROM and elevated leukocyte levels in newborns is attributed to the increased risk of infection or inflammatory response that PROM can trigger. These findings are consistent with research by Tsuda et al. (2022), which reported that newborns affected by PROM tend to exhibit higher leukocyte levels, indicating a potential increased risk of infection or inflammation. Elevated leukocyte levels in these infants may serve as a marker of underlying inflammation or infection resulting from PROM. This aligns with findings that intra-amniotic infection frequently occurs after PROM, suggesting that PROM may act as a gateway for pathogens to enter the fetal system (Tsuda et al., 2022). Supporting this, a study by Guo et al. (2023) also revealed that newborns delivered after PROM showed higher levels of inflammatory markers, including white blood cells (WBC), C-reactive protein (CRP), and procalcitonin (PCT), further indicating an elevated risk of neonatal infection and systemic inflammation.

4. CONCLUSION

In conclusion, PROM is a notable risk factor for increased leukocyte counts in neonates, underscoring the importance of early detection and management of PROM to reduce the risk of neonatal infection and its associated complications. Future research should explore additional biomarkers beyond leukocyte levels to provide a more comprehensive assessment of neonatal infections associated with PROM. Longitudinal studies are also recommended to evaluate the long-term health outcomes of neonates born following PROM. Furthermore, investigating the effectiveness of early intervention strategies and antibiotic prophylaxis in reducing neonatal morbidity and mortality related to PROM would offer valuable insights for improving clinical management and outcomes.

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