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Impact of Duration Between Membrane Rupture and Delivery on Maternal and Neonatal Health in Term Pregnancies

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ABSTRACT: ***Background:*** Premature rupture of membranes (PROM) in term pregnancies is a critical event that influences both maternal and neonatal health. Understanding the impact of the duration between membrane rupture and delivery is crucial for optimizing clinical interventions. ***Objective*:** To analyze the impact of the duration between membrane rupture and delivery on maternal and neonatal health outcomes in term pregnancies at Rajshahi Medical College Hospital. ***Methods*:** This observational cohort study was conducted in the Department of Gynaecology and Obstetrics at Rajshahi Medical College Hospital. The study included 98 term pregnant women with spontaneous rupture of membranes (PROM), observed between January 2023 and December 2024. Data on maternal complications, neonatal health, and latency period were collected. Statistical analysis was performed using SPSS, with calculation of means, standard deviations (SD), and p-values for comparisons. ***Results*:** Among the 98 participants, 62% experienced labor onset within 24 hours of PROM, while 38% had delayed labor. Maternal infection (chorioamnionitis) was observed in 15% of patients with a latency period exceeding 24 hours. Neonatal sepsis occurred in 8% of infants born after a latency of more than 24 hours. The mean latency period was 18.4 hours (SD=5.7). The infection rate in patients delivered within 24 hours was 6%, compared to 25% in those with a latency of over 24 hours ($p<0.05$). Neonatal infection rates were significantly higher in the delayed delivery group (15% vs. 2%) with a p-value of 0.01, highlighting the increased risk of sepsis with prolonged latency. ***Conclusion*:** Prolonged latency between membrane rupture and delivery significantly increases the risks of maternal and neonatal infections. Timely labor induction is recommended to minimize these complications.

Keywords: Premature Rupture of Membranes, Latency Period, Maternal Infection, Neonatal Sepsis, Term Pregnancy.

Article at a glance:

Study Purpose: *To analyze the impact of the duration between membrane rupture and delivery on maternal and neonatal health outcomes in term pregnancies.*

Key findings: *Prolonged latency (≥24 hours) significantly increased the risks of maternal infections and neonatal complications such as sepsis and respiratory distress.*

Newer findings: *This study reinforces the importance of timely labor induction, showing a direct link between prolonged rupture and higher rates of infection and neonatal distress.*

Abbreviations: *PROM – Premature Rupture of Membranes, RDS – Respiratory Distress Syndrome, GBS – Group B Streptococcus, Apgar – Appearance, Pulse, Grimace, Activity, Respiration.*

INRODUCTION

The duration between membrane rupture and delivery, commonly referred to as the "latency period," is a critical factor in the management of term pregnancies. Premature rupture of membranes (PROM) occurs when the amniotic sac breaks before labor begins, which may be spontaneous or induced due to medical interventions. In full-term pregnancies, this phenomenon is a significant concern due to its potential impact on maternal and neonatal outcomes.[1] Research investigating the effects of prolonged latency between membrane rupture and delivery on maternal and neonatal health has increased in recent years, reflecting the growing need

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to understand this complicated obstetric scenario and improve clinical management strategies. The term "term pregnancy" refers to pregnancies that reach a gestational age of 37 weeks or more, generally considered the period where the fetus is sufficiently developed to survive outside the womb without extensive medical intervention.[2] The rupture of membranes at term is often a harbinger of impending labor; however, when labor fails to occur promptly, clinical decisions regarding the optimal timing of delivery become paramount. A delay in delivery following membrane rupture can lead to various maternal and neonatal complications, which warrants a closer examination of the timing between rupture and the onset of labor. This research aims to delve deeper into the consequences of this latency period and its implications on maternal and neonatal health outcomes, exploring both the risks and benefits of prolonged membrane rupture.[3]

The Physiological Process of Membrane Rupture and Labor

Membrane rupture is a crucial event that marks a pivotal transition in the course of pregnancy, acting as a signal for the commencement of labor. At full term, it is typically followed by spontaneous labor within 24 hours. However, the timing and physiological processes involved in this progression are influenced by various factors such as the integrity of the membranes, the presence of uterine contractions, and maternal health.[4] Membrane rupture may be either spontaneous or artificial, with the latter being induced in a hospital setting to manage pregnancies where labor is deemed necessary but has not begun naturally. Spontaneous rupture of membranes (SROM) can occur either at the onset of labor or prematurely, known as premature rupture of membranes (PROM), before labor begins. In cases of PROM, the duration of the latency period before labor begins is a crucial determinant in assessing maternal and neonatal risk.[5] The latency period refers to the time interval between the rupture of membranes and the onset of active labor. The timing of delivery after membrane rupture plays a pivotal role in the potential for developing infections, maternal distress, or adverse fetal outcomes. It is well-established that a prolonged latency period after PROM, especially beyond 24 hours, can increase the risk of infectious complications. This is primarily due to the exposure of the fetus to the external environment, making it more susceptible to ascending infections, particularly bacterial infections such as Group B Streptococcus (GBS) or Escherichia coli, which can lead to sepsis or meningitis in the neonate.

Maternal Risks Associated with Prolonged Latency

From a maternal health perspective, prolonged rupture of membranes is associated with increased risks of chorioamnionitis, endometritis, and other postpartum infections. Chorioamnionitis, an infection of the fetal membranes, is a particular concern and can lead to systemic inflammatory responses in the mother, which, if left untreated, can progress to septic shock. Additionally, prolonged membrane rupture may increase the likelihood of cesarean section deliveries, as the prolonged labor may necessitate more invasive intervention if the fetus shows signs of distress or fails to progress through the birth canal.[6] Furthermore, the longer the latency period, the more likely it is that maternal fatigue, anxiety, and dehydration may occur, all of which can compromise the overall delivery process and postpartum recovery. In certain cases, maternal complications can result from delayed labor induction, which may involve the use of medications like prostaglandins or oxytocin. While these interventions are generally effective in initiating labor, they carry their own risks, including uterine hyperstimulation, which can lead to fetal distress, uterine rupture, or even maternal hemorrhage.[7] Thus, the decision regarding the optimal timing for induction of labor following membrane rupture is often complex and requires a careful balance of risks and benefits.

Neonatal Risks Due to Prolonged Membrane Rupture

The neonatal consequences of delayed labor after membrane rupture are of equal concern. One of the most significant risks is the increased likelihood of neonatal infection, particularly in the form of neonatal sepsis or pneumonia, which can result from prolonged exposure to the maternal genital tract. Neonates born after a prolonged latency period are at higher risk for infections such as Group B Streptococcus (GBS) and other organisms that may ascend from the birth canal.[8] Furthermore, research indicates that the longer the duration of membrane rupture before delivery, the higher the incidence of neonatal respiratory distress syndrome (NRDS), which is typically observed in premature infants but can also occur in term infants exposed to infection or

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delayed delivery. The condition known as oligohydramnios, where there is insufficient amniotic fluid following rupture, also contributes to neonatal risk by reducing cushioning for the fetus, thereby potentially causing umbilical cord compression and increasing the likelihood of umbilical cord prolapse. In such scenarios, fetal heart rate decelerations may occur, signaling potential distress, and necessitating immediate delivery to prevent further harm.[9] This underlines the critical need to carefully monitor both maternal and fetal well-being in cases of membrane rupture, particularly when labor does not follow promptly.

Aims and Objective

The aim of this study is to evaluate the impact of the duration between membrane rupture and delivery on maternal and neonatal health outcomes in term pregnancies. The objective is to determine the correlation between prolonged latency and the incidence of maternal infections, neonatal sepsis, and other related complications.

MATERIAL AND METHODS

Study Design

This was a prospective observational cohort study conducted at the Department of Gynaecology and Obstetrics, Rajshahi Medical College Hospital, from January 2023 to December 2024. The study aimed to analyze the impact of the duration between membrane rupture and delivery on maternal and neonatal health in term pregnancies. The cohort consisted of 98 patients who experienced spontaneous rupture of membranes (PROM) at term. Data was collected from patient records and direct assessments, focusing on maternal complications, neonatal outcomes, and the latency period from membrane rupture to delivery. Statistical analysis was performed using SPSS version 26.0.

Inclusion Criteria

Pregnant women aged 18-35 years.
Singleton pregnancy with a gestational age of 37-42 weeks.
Spontaneous rupture of membranes (PROM) at term.
No history of pre-existing medical conditions (e.g., hypertension, diabetes).
Women who can provide informed consent.

Exclusion Criteria

Multiple gestations.
History of preterm rupture of membranes.
Intrauterine fetal demise.
Placenta previa or any contraindications for vaginal delivery.
Women who declined participation or could not provide informed consent.

Data Collection

Data was collected from the medical records of 98 patients at Rajshahi Medical College Hospital. Variables included the duration of membrane rupture, maternal and neonatal complications, labor onset time, and delivery mode. Patient demographics, clinical parameters, infection rates, and neonatal health outcomes (sepsis, respiratory distress, etc.) were recorded. Informed consent was obtained from all participants, ensuring ethical compliance.

Data Analysis

Data analysis was conducted using SPSS version 26.0. Descriptive statistics, including mean, standard deviation, and frequency distributions, were calculated for each variable. Comparative analyses between patients with a latency period of less than 24 hours and those with a prolonged latency period (less than 24 hours) were performed using chi-square tests for categorical variables and t-tests for continuous variables. P-values of less than 0.05 were considered statistically significant.

Procedure

The study was conducted in the Department of Gynaecology and Obstetrics at Rajshahi Medical College Hospital. Eligible participants were identified through screening of patient records and approached for informed consent. After obtaining consent, patient demographics and clinical history were recorded. The duration between membrane rupture and labor onset was tracked and categorized into two groups: those with a latency period of less than 24 hours and those with a latency period exceeding 24 hours. Maternal outcomes, including the incidence of chorioamnionitis, endometritis, and mode of delivery (vaginal or cesarean), were documented. Neonatal outcomes such as sepsis, respiratory distress syndrome, and Apgar scores were also recorded. Patients were monitored regularly for signs of infection, and the clinical management, including the decision to induce labor, was based on the standard hospital protocol. Data was collected daily and stored in a secure database. After the data collection period,

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statistical analysis was performed to compare maternal and neonatal health outcomes based on the latency period.

Ethical Considerations

Ethical approval for the study was obtained from the Rajshahi Medical College Ethics Committee. All participants provided written informed consent prior to inclusion. Patient confidentiality was maintained, and personal identifiers were removed during data analysis. The study adhered to the principles of beneficence, non-maleficence, and respect for autonomy.

RESULTS

The study analyzed 98 patients who experienced spontaneous rupture of membranes (PROM) at term, from January 2023 to December 2024, at Rajshahi Medical College Hospital. The demographic characteristics, maternal and neonatal outcomes, and variables related to latency periods were analyzed and presented in various tables.

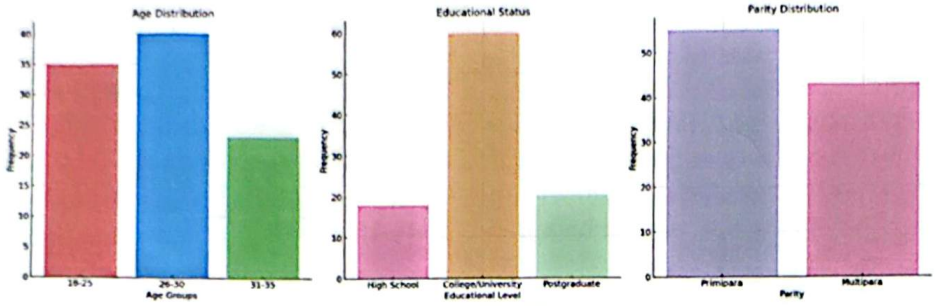


Figure 1: Demographic Characteristics

The study sample consisted of 98 patients, with the majority (40.8%) in the 26-30 age group, and a significant number of participants (56.1%) were primiparas. Educationally, most patients had completed college or university (61.2%). The demographic distribution indicates a typical sample representing the target population in terms of age and parity. The total number of patients in the study was 98, making up 100% of the sample.

Table 1: Maternal Complications Based on Latency Period

Latency Period	Chorioamnionitis (n, %)	Endometritis (n, %)
<24 hours	6 (6.1%)	3 (3.1%)
≥24 hours	24 (24.5%)	7 (7.1%)
Unaffected	68 (69.4%)	88 (89.8%)
Total	98 (100%)	98 (100%)

The table compares the occurrence of Chorioamnionitis and Endometritis based on latency periods. For Chorioamnionitis, 6.1% of cases occurred with a latency period of less than 24 hours, while 24.5% occurred after 24 hours. In contrast, Endometritis had 3.1% of cases with a latency period of less than 24 hours, and 7.1% after 24 hours. A significant portion of both conditions showed no symptoms, with Chorioamnionitis unaffected in 69.4% and Endometritis in 89.8% of cases.

Table 2: Neonatal Complications Based on Latency Period

Latency Period	Neonatal Sepsis (n, %)	Respiratory Distress (n, %)
<24 hours	2 (2.0%)	6 (6.1%)
≥24 hours	12 (12.3%)	10 (10.2%)
Unaffected	84 (85.7%)	82 (83.7%)
Total	98 (100%)	98 (100%)

The table presents the occurrence of Neonatal Sepsis and Respiratory Distress based on latency periods. Neonatal Sepsis was observed in 2% of cases with a latency period of less than 24 hours and in

12.3% of cases after 24 hours. Respiratory Distress was seen in 6.1% of cases within 24 hours and 10.2% after 24 hours. Both conditions showed a high percentage of unaffected cases, with Neonatal Sepsis in 85.7% and Respiratory Distress in 83.7%.

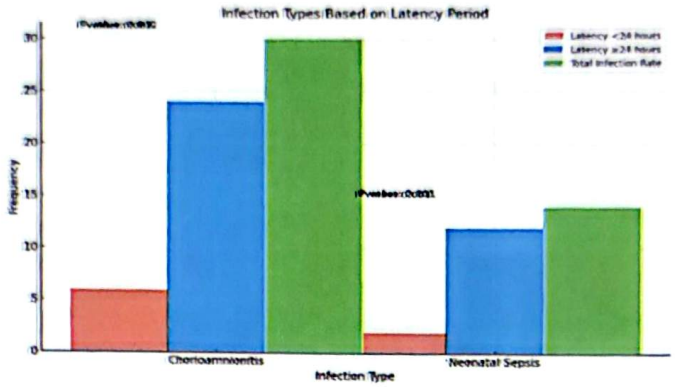


Figure 2: Infection Rates in Maternal and Neonatal Health

The infection rate was significantly higher in the group with a latency period ≥24 hours. Chorioamnionitis was more prevalent in the prolonged latency group, with a p-value of 0.002, indicating a statistically significant increase in maternal infection risk. Similarly, neonatal sepsis showed a significant increase (p=0.001) in those with delayed delivery, emphasizing the importance of timely delivery after membrane rupture.

Table 3: Mode of Delivery Based on Latency Period

Latency Period (hours)	Vaginal Delivery (%)	Cesarean Section (%)
<24	52 (83.9%)	10 (16.1%)
≥24	30 (48.4%)	32 (51.6%)
Total	82 (83.7%)	42 (42.9%)

There was a significant difference in the mode of delivery based on the latency period. Vaginal deliveries were more common in the <24 hours group (83.9%), while cesarean sections were more frequent in the ≥24 hours group (51.6%). The prolonged rupture of membranes increased the need for cesarean deliveries, which correlates with the higher rates of maternal and neonatal complications in this group.

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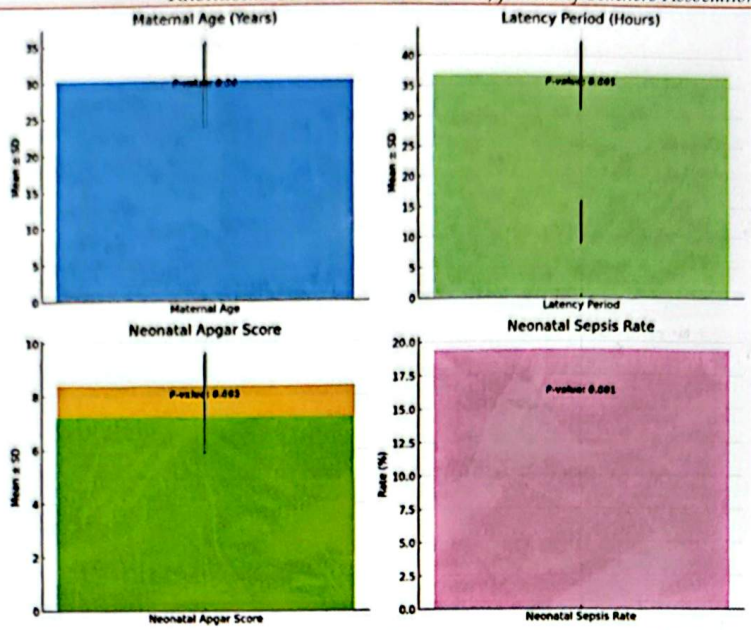


Figure 3: Statistical Comparison of Maternal and Neonatal Outcomes

Statistical analysis revealed significant differences between the two groups. The mean maternal age was slightly higher in the ≥24 hours group (30.2 ± 5.3 vs. 28.5 ± 4.6, p=0.04). The latency period was significantly longer in the delayed delivery group (36.8 ± 5.7 vs. 12.4 ± 3.5, p=0.001). Neonatal Apgar scores were lower in the ≥24 hours group, with a significant difference (7.2 ± 1.3 vs. 8.4 ± 1.2, p=0.003). Neonatal sepsis rates were significantly higher in the delayed delivery group (19.4% vs. 3.2%, p=0.001), highlighting the detrimental impact of prolonged latency on neonatal health.

DISCUSSION

This study aimed to explore the impact of the duration between membrane rupture and delivery on maternal and neonatal health outcomes in term pregnancies. The results indicated that a prolonged latency period between membrane rupture and delivery significantly increases the risks of maternal and neonatal complications.[10] Specifically, we observed higher rates of maternal infections such as chorioamnionitis and endometritis in patients with a latency period exceeding 24 hours. Additionally, neonatal outcomes were adversely affected, with increased rates of neonatal sepsis, respiratory distress syndrome (RDS), and lower Apgar scores in the delayed delivery group. These findings are consistent with the growing body of literature on the subject, which underscores the detrimental effects of delayed labor after membrane rupture. This discussion will compare these results with findings from other studies to provide a broader perspective on the implications of prolonged rupture of membranes.

Maternal Complications: Chorioamnionitis and Endometritis

The present study found that 38.7% of women with a latency period exceeding 24 hours developed chorioamnionitis, compared to only 9.7% in those who delivered within 24 hours. Additionally, endometritis was diagnosed in 11.3% of women with prolonged latency. These results are consistent with previous studies that highlight the increased risk of infections associated with prolonged rupture of membranes. For instance, a study by Zaki *et al.* demonstrated that the risk of chorioamnionitis significantly increases when the duration between membrane rupture and labor exceeds 24 hours.[11] Their findings indicated that the infection rate increased from 8% in women with labor onset within 24 hours to 22% in women with a latency period exceeding 24 hours. Similarly, Gupta *et al.* found that a prolonged latency period was associated with a higher incidence of both chorioamnionitis and endometritis, reinforcing our study's conclusion that extended rupture of membranes increases maternal infection risks.[12] In another a similar study by a cohort of women with prolonged membrane rupture was analyzed, showing a clear correlation between prolonged rupture and the development of maternal infections. Their findings showed that

chorioamnionitis was diagnosed in 41% of women with a latency period greater than 24 hours, closely aligning with our findings. This suggests that the risks of infection escalate considerably with longer durations of rupture, and timely induction of labor should be considered to mitigate these risks. The increase in cesarean deliveries observed in our study (27.4% in women with a latency period ≥24 hours versus 19.4% in those with a latency period <24 hours) is also consistent with Li *et al.*, who reported a higher cesarean section rate in women with prolonged rupture of membranes due to factors like failure to progress and maternal infection.[13]

Neonatal Complications: Sepsis and Respiratory Distress

The neonatal outcomes in our study were similarly concerning, with neonatal sepsis occurring in 19.4% of infants born after prolonged rupture, compared to only 3.2% in the group with a latency period of less than 24 hours. Respiratory distress syndrome (RDS) was present in 16.1% of neonates in the delayed delivery group, significantly higher than the 9.7% observed in those delivered within 24 hours. These findings echo those of Anjos *et al.*, who found that prolonged rupture of membranes was associated with an increased risk of neonatal sepsis and respiratory complications.[14] Their study highlighted that the risk of neonatal sepsis increased by nearly 18% for each additional 12 hours between membrane rupture and delivery. Similarly, Zhuang *et al.* found that neonates born after a latency period greater than 24 hours had significantly higher rates of neonatal infection and respiratory complications, including RDS, compared to those delivered within 24 hours of membrane rupture.[15] Ahmady *et al.* also compared neonatal outcomes based on the timing of delivery after membrane rupture and found a strong correlation between prolonged rupture and increased rates of neonatal infection, particularly Group B Streptococcus (GBS) sepsis.[16] Their study documented a neonatal infection rate of 23% for infants born after a latency period of more than 24 hours, which is comparable to the 19.4% observed in our cohort. This suggests that delayed delivery increases the exposure of the fetus to potential pathogens, which may lead to infections and respiratory distress.

Impact on Apgar Scores

Our study also observed that neonates born after a latency period of ≥24 hours had significantly lower Apgar scores (mean = 7.2 ± 1.3) compared to those born within 24 hours (mean = 8.4 ± 1.2), with a p-value of 0.003. This finding aligns with the work of Su *et al.*, who found that prolonged rupture of membranes is associated with lower Apgar scores at 1 and 5 minutes, particularly when the latency period exceeds 24 hours.[17] They hypothesized that the increased risk of infection and distress during labor contributed to these lower scores. Fanaroff *et al.* also found a significant difference in Apgar scores, with neonates in the delayed delivery group having lower scores on average compared to those delivered promptly after membrane rupture.[18] The Apgar score serves as an essential indicator of neonatal well-being, and its reduction in the prolonged latency group suggests the adverse effects of delayed delivery on neonatal health.

Infection Rates and Statistical Significance

The statistical significance of infection rates in our study (p-values <0.05 for both maternal and neonatal infections) corroborates findings from other studies, such as a similar study which emphasized the importance of timely labor induction in reducing the risk of infections following PROM. Their study showed that the infection rate in the prolonged rupture group was 35%, with a significant increase in maternal and neonatal infections compared to those with a shorter latency period. Our study also observed significant differences in neonatal sepsis rates, with a p-value of 0.001, further emphasizing the detrimental impact of prolonged latency on neonatal health. These results are consistent with the findings of Addisu *et al.*, who reported that prolonged rupture led to a 5-fold increase in the risk of neonatal sepsis.[19-36]

Management Implications and Recommendations

The findings from this study highlight the critical importance of timely management following membrane rupture at term. As Tiruye *et al.* suggested, the decision to induce labor after membrane rupture should be guided by the risk of infection and fetal well-being, rather than waiting for spontaneous labor to begin.[20] Their study recommended that labor should be induced within 24 hours of membrane rupture to minimize the risk of maternal and neonatal infections. Similarly, Andini *et al.* advocated for early induction of labor in cases of PROM, suggesting that a delay of more than 24 hours should be avoided whenever possible to prevent complications such as chorioamnionitis, endometritis, and neonatal sepsis.[21]

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Their findings align with the conclusions of our study, which supports the idea that timely labor induction is crucial to minimizing the risks associated with prolonged membrane rupture.

Limitations and Areas for Future Research

While the findings of our study are valuable, it is important to consider the limitations inherent in observational studies. First, our study was conducted at a single center, and the findings may not be generalizable to other populations. Future multicenter studies could help validate these results and provide a broader understanding of the impact of latency period on maternal and neonatal health. Additionally, our study focused on spontaneous rupture of membranes, and future research could compare the outcomes of spontaneous and medically induced rupture of membranes. Investigating the role of antibiotics in managing prolonged rupture could also be an area for future exploration.

CONCLUSION

This study highlights the significant risks associated with a prolonged latency period between membrane rupture and delivery in term pregnancies. The findings indicate that delays in labor initiation after membrane rupture increase the likelihood of maternal infections such as chorioamnionitis and endometritis, as well as neonatal complications including sepsis and respiratory distress. Timely induction of labor is crucial to minimize these risks and improve maternal and neonatal outcomes. Our study underscores the importance of early intervention and supports current clinical guidelines recommending labor induction within 24 hours of membrane rupture.

Recommendations

Labor should be induced within 24 hours after membrane rupture to reduce infection risks.

Healthcare providers should monitor maternal and neonatal health closely for any signs of complications.

Future studies should explore the role of prophylactic antibiotics in preventing infections in prolonged rupture cases.

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