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Clinical Analysis of Premature Rupture of Membranes in Late Pregnancy and the Risk of Maternal and Neonatal Infections

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Abstract: *Objective*: To explore the relationship between premature rupture of membranes (PROM) in late pregnancy and diseases related to maternal and neonatal infections. *Methods*: A retrospective analysis was conducted on the clinical data of 300 cases of PROM puerperas (Group A) and 200 cases of normal delivery puerperas (Group B) who gave birth at Datong Fifth People's Hospital from January 2021 to December 2023. The amniotic fluid contamination, placental pathology, maternal and neonatal infection indicators, and the incidence of perinatal infectious diseases were compared between the two groups. *Results*: The degree of amniotic fluid contamination in the PROM group was lower than that in the control group ($P < 0.01$), but the incidence of bloody amniotic fluid was higher ($P < 0.05$). The infiltration rate of inflammatory cells in the placenta was significantly higher in Group A than in Group B ($P < 0.01$). In Group A, the white blood cell count, neutrophil percentage, and procalcitonin levels of the puerperas were significantly increased ($P < 0.05$). The incidence of intra-amniotic infection, neonatal respiratory distress syndrome, and meconium aspiration syndrome was higher in Group A ($P < 0.05$). The white blood cell count and neutrophil indicators of neonates were significantly elevated in Group A. *Conclusion*: Premature rupture of membranes in late pregnancy significantly increases the risk of maternal and neonatal infections. Joint monitoring of multiple laboratory indicators and rational use of antibiotics are important for improving outcomes.

Keywords: Premature rupture of membranes; Maternal and neonatal infections; Chorioamnionitis; Perinatal medicine

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1. Introduction

Premature rupture of membranes in late pregnancy refers to the rupture of the chorion and amnion due to various external factors from 28 weeks of gestation to before the onset of labor. PROM is a major cause of maternal and neonatal infections and deaths. PROM can easily induce puerperal infections, including uterine cavity infections, tubal and ovarian infections, thrombophlebitis, and septicemia, which can be life-threatening

to the mother in severe cases [1]. Simultaneously, PROM is highly correlated with the morbidity and mortality of perinatal infants, such as fetal distress, neonatal asphyxia, hypoxic-ischemic encephalopathy, infectious pneumonia, and sepsis. Therefore, it is very meaningful to pay sufficient attention to PROM, ensure the safety of mothers and children as much as possible, study the amniotic fluid situation, placental pathology, maternal infection indicators, perinatal infectious diseases, and neonatal infection indicators of puerperas with PROM in late pregnancy, and conduct a clinical analysis of the risk of maternal and neonatal infections. The research results are reported below.

2. Materials and methods

2.1. General information

The study subjects were parturient women in our hospital from January 2021 to December 2023, including 300 cases of premature rupture of membranes as the observation group (Group A) and 200 cases of normal pregnant women as the control group (Group B).

Inclusion criteria: those who meet the diagnostic criteria of the "Guidelines for the Diagnosis and Treatment of Premature Rupture of Membranes (2015)" issued by the Obstetrics Group of the Obstetrics and Gynecology Branch of the Chinese Medical Association [2], and whose first diagnosis upon admission is compatible with premature rupture of membranes, with complete clinical data.

Exclusion criteria: pregnancy complicated by respiratory infection; pregnancy complicated by acute appendicitis, cholecystitis, pancreatitis, or other systemic infectious diseases; pregnancy complicated by important organ diseases such as cardiovascular and cerebrovascular diseases; blood system diseases. The case data retrieved in this study for research analysis were obtained with the informed consent of the parturient's family members, by medical ethics standards, and approved by the hospital ethics committee.

2.2. Diagnostic basis for premature rupture of membranes

(1) The pregnant woman complains of vaginal fluid flow or wet underwear;
(2) Vaginal examination reveals the formation of an amniotic fluid pool in the posterior fornix or amniotic fluid flowing out of the cervical os;
(3) The amniotic fluid test paper or pad turns blue;
(4) Microscopically, the fluid in the posterior fornix shows fern-like crystals [1].

2.3. Statistical methods

SPSS 22.0 was used for analysis. Measurement data were expressed as mean ± standard deviation (SD). The *t*-test and chi-square test were used for comparison between groups. $P < 0.05$ was considered statistically significant.

3. Results

3.1. Amniotic fluid and placenta conditions

In Group A, 86.00% of the amniotic fluid was clear, and the pollution level was significantly lower than that of Group B (69.00%, $P < 0.01$). However, the incidence of bloody amniotic fluid was higher (2.33% vs. 0.00%, $P < 0.05$). There was no significant difference in the incidence of no amniotic fluid between the groups. The infiltration rate of inflammatory cells in placental tissue was 48.33% in Group A, which was significantly

higher than the 14.5% in Group B ($P < 0.01$), indicating a higher incidence of intrauterine inflammation in the premature rupture of membranes group (**Table 1**).

Table 1. Comparison of amniotic fluid and placenta detection between the premature rupture of membranes group and the normal control group

Group	*n*	Amniotic fluid status [*n* (%)]						Placental pathology [*n* (%)]	
		Clear	I°	II°	III°	Blood-stained amniotic fluid	No amniotic fluid	Inflammatory cell infiltration	Non-inflammatory cell infiltration
Group A	300	258 (86.00%)	5 (1.67%)	14 (4.67%)	5 (1.67%)	7 (2.33%)	11 (3.67%)	145 (48.33%)	155 (51.67%)
Group B	200	138 (69.00%)	14 (7.00%)	27 (13.50%)	18 (9.00%)	0 (0.00%)	3 (1.50%)	29 (14.50%)	171 (85.50%)
χ^2		21.052	9.337	12.439	14.705	-	1.350	60.540	
P		0.000004	0.002	0.0004	0.0001	0.045	0.245	7.208E-15	

3.2. Infectious indicators of puerperas

The levels of WBC (10.64 ± 3.45), neutrophil percentage (76.08 ± 6.82), and PCT (0.50 ± 2.09) in Group A were higher than those in Group B (WBC: 7.63 ± 2.82; neutrophil percentage: 74.37 ± 9.00; PCT: 0.07 ± 0.13), and the differences were statistically significant ($P < 0.05$). There was no significant difference in NEUT# and CRP between the two groups, suggesting that WBC, neutrophil percentage, and PCT have more predictive value for intrauterine infection (**Table 2**).

Table 2. Comparison of laboratory indicators between the premature rupture of membranes group and the normal control group

Group	*n*	WBC count (×10⁹/L)	Neutrophil count (×10⁹/L)	Neutrophil percentage (%)	Procalcitonin (ng/mL)	CRP (mg/L)
Group A	300	10.636 ± 3.447	8.408 ± 4.402	76.079 ± 6.822	0.502 ± 2.089	15.728 ± 26.105
Group B	200	7.628 ± 2.823	10.070 ± 3.056	74.369 ± 9.000	0.073 ± 0.134	16.090 ± 27.241
t		2.413	1.921	2.287	2.380	-0.157
P		0.0162	0.055	0.022	0.018	0.875

3.3. Perinatal outcomes

The intra-amniotic infection rate in Group A was 50.33%, which was significantly higher than that in Group B (21.00%, $P < 0.01$). Neonatal respiratory distress syndrome (3.33% vs 0%, $P < 0.01$) and meconium aspiration syndrome (0.67% vs 3.5%, $P < 0.05$) were also significantly increased. There were no significant differences in other outcomes such as neonatal asphyxia, pneumonia, hyperbilirubinemia, and death (**Table 3**).

Table 3. Comparison of the incidence of perinatal-related diseases between the premature rupture of membranes group and the normal control group

Group	Fetal distress	Intra-amniotic infection	Neonatal asphyxia	Meconium aspiration syndrome	Neonatal Respiratory distress syndrome	Neonatal Pneumonia
Group A	34 (11.33%)	151 (50.33%)	6 (2.00%)	2 (0.67%)	10 (3.33%)	23 (7.67%)
Group B	13 (6.50%)	42 (21.00%)	2 (1.00%)	7 (3.50%)	0 (0.00%)	11 (5.50%)
χ^2	3.291	43.566	0.259	3.965	-	0.889
P	0.070	4.0988E-11	0.611	0.046	0.007	0.346
Group	**Neonatal hyperbilirubinemia**	**Hypoxic-ischemic encephalopathy**	**Neonatal mortality**	**Neonatal erythema**	**Neonatal pustulosis**	
Group A	134 (44.67%)	12 (4.00%)	3 (1.00%)	14 (4.67%)	5 (1.67%)	
Group B	79 (39.50%)	6 (3.00%)	0 (0.00%)	11 (5.50%)	2 (1.00%)	
χ^2	1.310	0.346	-	0.175	0.054	
P	0.252	0.557	0.279	0.675	0.816	

3.4. Neonatal infection indicators

The white blood cell count (22.46 ± 8.84), neutrophil count (15.80 ± 7.69), and neutrophil percentage (66.85 ± 12.94) in Group A were significantly higher than those in Group B (white blood cell count: 18.17 ± 8.39; neutrophil count: 12.05 ± 7.32; neutrophil percentage: 62.78 ± 13.66, $P < 0.01$). There was no significant difference in PCT between the two groups, which may be related to the degree of infection and the timing of detection (**Table 4**).

Table 4. Comparison of neonatal laboratory infection indicators between the premature rupture of membranes group and the normal control group

Group	*n*	WBC count (×10⁹/L)	Neutrophil count (×10⁹/L)	Neutrophil percentage (%)	Procalcitonin (ng/mL)
Group A	300	22.460 ± 8.836	15.795 ± 7.692	66.853 ± 12.936	3.430 ± 5.857
Group B	200	18.169 ± 8.387	12.053 ± 7.317	62.776 ± 13.655	2.240 ± 5.187
t		4.838	275.739	251.084	177.296
P		2.16E-06	2.46E-06	0.004	0.114

4. Discussion

Preterm rupture of membranes (PROM) in late pregnancy is a common obstetric complication. The rupture breaks the barrier between the fetus and the external environment, providing a pathway for pathogens to ascend and infect, thus increasing the risk of infection for both mother and child [2]. The results of this study showed that although the degree of amniotic fluid pollution in the PROM group was lower than that in the control group, the incidence of bloody amniotic fluid was significantly increased, suggesting that placental dysfunction or inflammatory reactions may occur earlier. Placental pathology examination revealed that the inflammatory cell infiltration rate in the PROM group was 48.33%, significantly higher than the 14.5% in the control group, indicating that subclinical intrauterine infection is widespread in this population, and clinicians should be highly vigilant.

Regarding infectious laboratory indicators, this study confirmed that the white blood cell count, neutrophil percentage, and procalcitonin levels in the PROM group were higher than those in normal deliveries, suggesting that these indicators can serve as important references for early identification of maternal infection risk [3]. Although PCT is more specific for early bacterial infections, its changes are limited in mild or early infections and need to be judged in combination with other indicators. C-reactive protein is commonly used for clinical monitoring, but it is greatly affected by stress such as childbirth and surgery, indicating that its independent predictive value is limited. Combining literature, a multi-item joint evaluation of WBC, neutrophil percentage, and PCT has more clinical practicality [4,5].

In terms of perinatal outcomes, the incidence of fetal intra-amniotic infection, neonatal respiratory distress syndrome, and meconium aspiration syndrome in the PROM group was significantly higher than that in the control group, indicating that intrauterine inflammation has a significant impact on fetal lung development and neonatal respiratory function. This study also found that the serum white blood cell count and neutrophil ratio were elevated in newborns in the PROM group, suggesting that the fetus had already initiated an inflammatory response in utero. It is worth noting that although some newborns did not show obvious clinical symptoms, their laboratory indicators already showed an infection trend, indicating that laboratory screening has early warning significance.

In summary, preterm rupture of membranes in late pregnancy significantly increases the risk of infection for both mother and child. Clinicians should strengthen dynamic monitoring of amniotic fluid characteristics and residual volume, evaluate infection risk based on multiple laboratory indicators such as WBC, neutrophil percentage, and PCT, rationally use prophylactic antibiotics, and individually balance the relationship between infection and premature birth [6]. By optimizing management strategies, it is expected to effectively improve mother and child outcomes.

5. Conclusion

Preterm rupture of membranes in late pregnancy significantly increases the risk of infection for both mother and child. Attention should be paid to the combined detection of amniotic fluid monitoring and inflammatory indicators, rational use of antibiotics, and the development of individualized management strategies to optimize mother and child outcomes.

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Disclosure statement

The authors declare no conflict of interest.

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