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Obstetric and Neonatal Outcomes Following Immediate Delivery Versus Expectant Management in Pregnant Women With Preterm Premature Rupture of Membranes During the Late Preterm Period in Korea

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ABSTRACT

Background: This study aimed to evaluate maternal and neonatal outcomes following immediate delivery or expectant management of preterm premature rupture of membranes (PPROM) during the late preterm period at 34^{+0}–36^{+6} weeks of gestation.
Methods: We conducted a retrospective study of singleton pregnancies with PPROM during the late preterm period using medical records from 12 tertiary medical centers in the republic of Korea between January 2007 and December 2016. Demographic characteristics and outcome measures were also recorded. The primary outcomes were maternal sepsis, neonatal sepsis, and neonatal death for neonatal outcomes.
Results: Among 1,072 women with late PPROM, 782 (72.9%) underwent immediate delivery and 290 (27.1%) received expectant management. The incidence of clinical neonatal sepsis was significantly lower in the immediate delivery group than in the expectant management group (3.8% vs. 15.8%, $P < 0.001$). There were no significant differences in culture-proven

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Disclosure

The authors have no potential conflicts of interest to disclose.

Author Contributions

Conceptualization: Yang JI, Kim YN. Data curation: Kwon H, Kang S, Ko HS, Kwon JY, Kwon HS, Kim YN, Oh KJ, Oh SY, Lee MY, Choi SR, Han YJ, Kim YN, Yang JI. Formal analysis: Kwon H, Sul AR, Jung Y, Kim J, Park JJ, Lee J, Yang JI, Kim YN. Funding acquisition: Yang JI, Kim YN. Investigation: Kwon H, Yang JI, Kim YN. Methodology: Kwon H, Kim YN, Yang JI. Software: Kwon H, Sul AR. Validation: Yang JI, Kim YN. Visualization: Kwon H, Kim YN, Yang JI. Writing - original draft: Kwon H. Writing - review & editing: Kwon H, Kim YN, Yang JI.

neonatal sepsis (P = 0.211), neonatal death (P = 0.390), or maternal sepsis (P = 0.542) between groups. Although antenatal corticosteroids were more frequently administered in the expectant management group, the need for mechanical ventilation was not significantly higher (P = 0.414). However, the need for surfactant administration was lower (P = 0.010). Expectant management was associated with a lower rate of primary cesarean section (P = 0.002) but a higher incidence of antepartum fever and elevated C-reactive protein levels (P = 0.048 and P < 0.001, respectively).

Conclusion: In women with late PPROM, expectant management does not increase the risk of severe maternal or neonatal morbidity or mortality compared to immediate delivery. Therefore, with close surveillance for complications, such as chorioamnionitis and fetal compromise, particularly clinical neonatal sepsis, expectant management can be a judicious treatment option in clinical practice.

Keywords: Preterm; Premature Rupture of Fetal Membranes; Late Preterm Period; Immediate Delivery; Expectant Management

INTRODUCTION

Preterm premature rupture of membranes (PPROM) is defined as rupture of amniotic membranes before labor onset at < 37 weeks of gestation. PPROM occurs in 2–3% of pregnancies and accounts for one-third of preterm births.[1,2] PPROM increases obstetric complications such as preterm delivery, intra-amniotic infection, placental abruption, and cord prolapse. Neonates face elevated risks of sepsis, pulmonary hypoplasia, respiratory distress syndrome (RDS), bronchopulmonary dysplasia (BPD), necrotizing enterocolitis (NEC), intraventricular hemorrhage (IVH), retinopathy of prematurity (ROP), and neonatal death.[3-5]

A prolonged latent period in women with PPROM can lower prematurity-related—neonatal morbidity and reduce the economic burden of neonatal intensive care unit (NICU) care, and several studies have reported favorable outcomes with expectant management of late PPROM.[6-8] While earlier guidelines recommended immediate delivery at 32–34 weeks, recent revisions (e.g., Greentop Guideline, American College of Obstetricians and Gynecologists Practice Bulletin) allow either immediate delivery or expectant management in late PPROM.[3,4]

Expectant management of PPROM requires stable maternal–fetal status and continuous monitoring, such as serial assessment for infection and fetal heart rate (FHR) surveillance, to detect infection or fetal compromise, with concomitant hospital charges. Furthermore, identifying the optimal time point is challenging due to variable infection and fetal compromise manifestations.

Therefore, conflicting evidence exists regarding immediate delivery and expectant management in cases of late PPROM.[6,9] Strategies for monitoring and optimal timing remain controversial because reducing neonatal prematurity and avoiding complications including intra-amniotic infection during the latent period should be considered.[7,9]

Hence, we aimed to evaluate maternal and neonatal outcomes of immediate delivery vs. expectant management of PPROM at 34^{+0}–36^{+6} weeks of gestation in Korea to determine the optimal monitoring and timing of delivery and provide clinicians with evidence to guide counseling and decision-making in late PPROM.

METHODS

Study design

We conducted a retrospective study of singleton pregnancies complicated by late PPROM using medical records from 12 tertiary medical centers in Korea from January 2007 to December 2016. The late preterm period was defined as 34^{+0}–36^{+6} weeks of gestation. All participating hospitals were referral centers, with NICUs providing comprehensive care for preterm infants. At least one obstetric specialist reviewed and confirmed medical records. Women with singleton pregnancies and clinically diagnosed ruptured membranes at 34^{+0}–36^{+6} weeks of gestation were included. Women with multiple pregnancies, active labor at admission leading to delivery within 24 hours, suspected clinical chorioamnionitis, placenta previa, placental abruption, preeclampsia, or other contraindications to pregnancy continuation were excluded (**Fig. 1**).

Pregnancy management

Diagnosis of PPROM was based on maternal history (timing of amniotic fluid leakage), sterile speculum examination confirming amniotic fluid drainage from the cervical os with nitrazine paper color change, or biochemical testing if unceratin.[10] Eligible women were divided into two groups: immediate delivery or expectant management. Immediate delivery was defined as induction or cesarean within 24 hours of membrane rupture. Expectant management was defined as observation with monitoring for maternal and fetal complications, continued until 37 weeks or until indications for delivery arose, such as a non-reassuring FHR, onset of labor, or suspected intrauterine infection. Medical records were reviewed to confirm use of antenatal corticosteroids and antibiotics during the latent period. The decision between immediate delivery and expectant management was based on clinical discretion, considering guidelines and individual maternal–fetal factors, such as fetal lung maturity, antenatal corticosteroid administration, and gestational age at PPROM. All women were hospitalized until delivery, with labor progression and fetal well-being monitored by continuous cardiotocography and ultrasound. Delivery during the latent period was indicated for labor onset or progression, suspected clinical chorioamnionitis, or signs of fetal compromise.

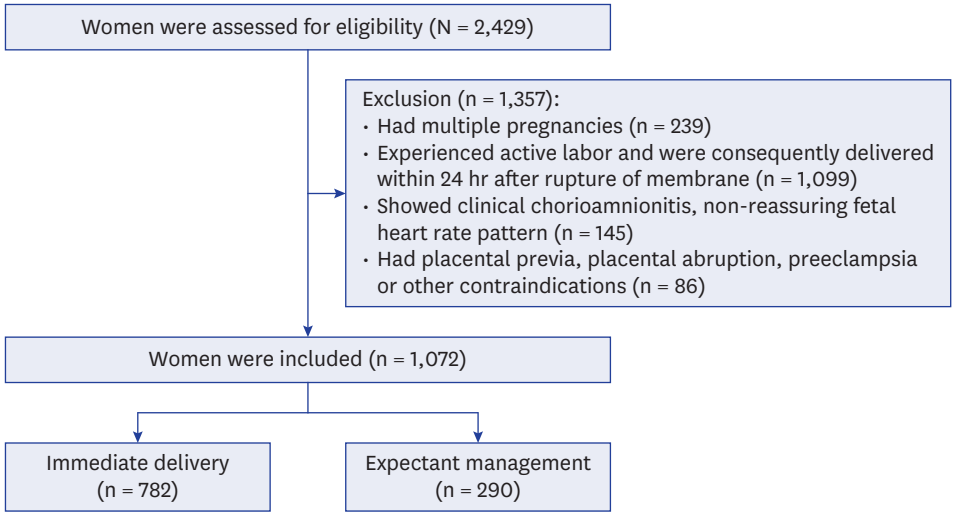

Fig. 1. Study population.

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Maternal, obstetrics and neonatal outcomes

Clinical data, including maternal demographics and obstetric and neonatal outcomes, were obtained from electronic medical records. Maternal demographics, obstetric outcomes, and the incidence of complications such as maternal sepsis, endometritis, postpartum hemorrhage, and wound infection were collected. Neonatal outcomes included admission to the NICU, Apgar score, surfactant administration, and neonatal complications during hospital stay. Labor progression was defined as cervical change during regular labor. Clinical chorioamnionitis was defined as the presence of ≥ 2 of the following symptoms: maternal pyrexia, leukocytosis, uterine tenderness, maternal or fetal tachycardia, and malodorous vaginal discharge.[11] Suspected fetal compromise was defined as non-reassuring FHR or abnormal Doppler findings, such as absent or reversed end-diastolic flow in the umbilical artery.

The primary outcomes were rate of maternal sepsis as a maternal outcome and incidence of either clinical or culture-proven neonatal sepsis and neonatal death as neonatal outcomes. Maternal sepsis was defined as presence of clinical infectious signs such as fever > 38°C, heart rate > 90 beats per minute (bpm), breathing rate > 20 bpm, oliguria, and probable or confirmed infection by blood culture.[12] Clinical neonatal sepsis was defined as presence of infection signs such as abnormal C-reactive protein (CRP), temperature instability, diminished spontaneous activity, less vigorous sucking, apnea, bradycardia, respiratory distress, vomiting, diarrhea, abdominal distention, jitteriness, seizures, and jaundice.[13] Culture-proven neonatal sepsis was defined as a positive culture of known pathogen from blood or cerebrospinal fluid and presence of ≥ 1 clinical signs of infection such as respiratory distress, apnea, lethargy, abnormal level of consciousness, circulatory compromise including hypotension, poor perfusion, need for inotropic support, volume expansion, temperature instability (< 36°C or ≥ 38°C), or a combination thereof.[14,15] Antibiotic therapy was continued for 7–10 days in these neonates.

Secondary neonatal outcomes included other neonatal morbidities such as mechanical ventilation, RDS, BPD, surfactant administration, grade 3–4 IVH, periventricular leukomalacia (PVL), convulsions, NEC, ROP, admission to the NICU, and duration of stay in the NICU. Mechanical ventilation included Synchronized Intermittent Mandatory Ventilation, Continuous Mandatory Ventilation, and High-Frequency Ventilation, all involving endotracheal intubation. RDS was defined as respiratory distress confirmed by chest radiography and need for ventilator support during clinical examination. NEC was diagnosed based on clinical symptoms, including poor oral feeding, blood in stool, frequent vomiting of bile-colored fluid, abdominal distention, and radiographic findings.[16] ROP was diagnosed and graded according to the International Classification of Retinopathy of Prematurity revisited.[17]

Secondary maternal outcomes were antepartum and postpartum complications. Antepartum complications included antepartum fever, CRP elevation, antepartum hemorrhage, cord prolapse, and intrauterine fetal death. Postpartum complications included primary cesarean section, endometritis, postpartum hemorrhage, wound infection, deep vein thrombosis, and chorioamnionitis. A primary cesarean section was defined as total percentage of cesarean deliveries for women without a history of previous cesarean delivery.[18] Chorioamnionitis was an exclusion criterion at trial entry, but maternal outcomes included cases with positive amniotic fluid culture or inflammatory changes on placental examination in both groups after delivery.

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Statistical analysis

Continuous variables were expressed as means and standard deviations, while categorical variables were expressed as numbers and percentages. Shapiro-Wilk and Kolmogorov-Smirnov tests were used to assess normal distribution of data. To evaluate differences in outcomes according to management, continuous variables were analyzed using the two-sample *t*-test or Wilcoxon rank-sum test. Categorical variables were compared using the χ^2 test or Fisher's exact test. The association between delivery timing in women with PPROM and neonatal outcomes was evaluated by calculating adjusted odds ratios (ORs) using logistic regression analysis. The reference group was the immediate delivery group, and OR was adjusted for maternal age and gestational age at the time of PPROM diagnosis. All statistical analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA). Statistical significance was set at $P < 0.05$.

Ethics statement

Institutional Review Board (IRB) of each hospital approved the protocol of this study (approval No. Donguk University Ilsan Hospital 2017-01-054; Busan Paik Hospital, College of Medicine, Inje University 17-0071; Konkuk University Medical Center, Konkuk University School of Medicine,

KUH1040063; Seoul National University Bundang Hospital B-1705/396-103; CHA Bundang Medical Center, CHA University, 2017-04-019-008; Samsung Medical Center, Sungkyunkwan University School of Medicine 2017-04-071; Seoul St. Mary's Hospital, College of Medicine, The Catholic University of Korea, KC17RCDI0245; Asan Medical Center, University of Ulsan College of Medicine, 2017-0538; Yonsei University Health System, Severance Hospital: 4-2017-0252; Ajou University School of Medicine, AJIRB-MED-MDB-17-113; CHA Gangnam Medical Center, CHA University, CGH-IRB-2017-20, and Inha University Hospital, Inha University College of Medicine, 2017-04-018). Informed consent was waived because of the retrospective nature of the study.

RESULTS

Demographic and obstetric outcomes in the study population

A total of 2,429 eligible women were screened, and 1,072 were enrolled. Of these, 782 were assigned to the immediate delivery group and 290 to the expectant management group (**Fig. 1**).

The mean maternal age was 33.4 ± 4.7 years and 686 (64.0%) women were nulliparous. The mean gestational age was 35.5 ± 0.9 weeks of gestation at the time of PPROM and 35.6 ± 0.8 at delivery. Tocolysis was administered to 9.2% (99/1,072) of the women, primarily for PPROM at 34–35 weeks or for preterm labor < 34 weeks. Ritodrine was the most frequently administered agent. Antibiotics were administered to 89.3% (957/1,072) of the women, mainly for prophylaxis against intrauterine infection. Ampicillin, ampicillin/sulbactam, and second-generation cephalosporins were used either individually or in combination and maintained until delivery. Clinical or culture-proven neonatal sepsis occurred in 78 (7.3%) of the 1,072 neonates. Two neonatal deaths occurred in the immediate-delivery group. An infant born at 36^{+6} weeks of gestation by emergency cesarean section developed respiratory distress requiring mechanical ventilation and died on day 18 due to sudden unexplained early neonatal death. Another infant, delivered vaginally at 34^{+1} weeks, died of culture-proven neonatal sepsis on day 1 of life.

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Table 1. Demographic characteristics and obstetric outcomes of the study groups

Variables	Immediate delivery (n = 782)	Expectant management (n = 290)	*P* value
Maternal age, yr	33.8 ± 4.6	32.5 ± 4.7	< 0.001
Gestational age at PPROM, wk	35.6 ± 0.8	35.0 ± 0.7	< 0.001
34.0–34.6	177 (22.6)	158 (54.1)	
35.0–35.6	280 (35.8)	91 (31.7)	
36.0–36.6	325 (41.6)	41 (14.2)	
Nulliparous	473 (60.5)	213 (73.4)	< 0.001
Diabetes	46 (5.9)	21 (7.2)	0.414
Chronic hypertension	5 (0.6)	1 (0.3)	1.000
Prior preterm delivery history	47 (6.0)	10 (3.5)	0.096
Previous CS	151 (19.3)	13 (4.5)	< 0.001
ART	64 (8.2)	20 (6.9)	0.618
Cervical or vaginal swab at diagnosis[a]	106 (13.6)	90 (31.0)	
Any culture, positive	45/106 (42.5)	30/90 (33.3)	0.238
Group B streptococcus, positive	5/106 (4.7)	1/90 (1.1)	0.144
Antepartum corticosteroid	26 (3.3)	42 (14.5)	< 0.001
Antibiotics treatment	671 (85.8)	286 (98.6)	< 0.001
Use of tocolytics	29 (3.7)	70 (24.1)	< 0.001
Induction of labor[b]	446 (782)	165 (56.8)	0.963
AFI at diagnosis of PPROM	9.63 ± 8.07	9.32 ± 6.61	0.645
Obstetric outcomes			
Gestational age at delivery, wk	35.7 ± 0.8	35.4 ± 0.7	< 0.001
34.0–34.6	159 (20.3)	84 (29.0)	
35.0–35.6	272 (34.8)	129 (44.5)	
36.0–36.6	345 (44.1)	75 (25.8)	
≥ 37.0	6 (0.8)	2 (0.7)	
Latent period[c], day	0.5 ± 0.9	2.8 ± 2.9	< 0.001
Mode of delivery			< 0.001
VD	385 (49.2)	222 (76.6)	
CS	397 (50.8)	68 (23.4)	
Birthweight, g	2,592.6 ± 347.5	2,490.1 ± 318.3	< 0.001

Data are represented as mean ± standard deviation or number (%).
PPROM = preterm pre-labor rupture of membranes, CS = cesarean section, ART = assisted reproductive technology, AFI = amniotic fluid index, VD = vaginal delivery.
[a]Cervical or vaginal swabs were positive for *Candida albicans*, *Ureaplasma urealyticum*, *Ureaplasma parvum*, *Mycoplasma hominis*, *Chlamydia tracomatis*, *Gardnerella vaginalis*, *Escherichia coli*, *Leclercia adecarboxylata*, and *Group B streptococcus*.
[b]Induction of labor was performed within 24 hours of membrane rupture in the immediate delivery group, and at 37 weeks of gestation or earlier if indications for delivery arose in the expectant management group.
[c]The latent period was defined as the period from diagnosis of membrane rupture to delivery.

Regarding the demographic and obstetric outcomes of the study groups (**Table 1**), the expectant management group included a significantly higher proportion of women diagnosed with PPROM at 34^{+0}–34^{+6} weeks (54.1% vs. 22.6%, $P < 0.001$). The rates of antenatal corticosteroid (14.5% vs. 3.3%, $P < 0.001$), antibiotic (98.6% vs. 85.8%, $P < 0.001$), and tocolytic agent administration (24.1% vs. 3.7%, $P < 0.001$) were significantly higher in the expectant management group.

The immediate-delivery group showed a significantly higher incidence of cesarean delivery (50.8% vs. 23.4%, $P < 0.001$). Neonates in the expectant management group had significantly lower birth weights ($P < 0.001$). Other maternal demographic and obstetric outcomes were similar between groups.

Primary maternal and neonatal outcomes

The incidences of overall and clinical neonatal sepsis were significantly higher in the expectant management group (both $P < 0.001$); however, culture-proven neonatal sepsis showed no significant differences between groups ($P = 0.211$). Overall neonatal mortality ($P = 0.390$) and maternal sepsis did not differ significantly between groups (**Table 2**).

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Table 2. Neonatal and maternal outcomes

Variables	Immediate delivery (n = 782)	Expectant management (n = 290)	*P* value
Primary outcomes			
Maternal sepsis	1 (0.13)	0 (0.0)	0.542
Neonatal sepsis	32/771 (4.2)	46/284 (16.2)	< 0.001
Clinical	29/771 (3.8)	45/284 (15.8)	< 0.001
Culture-proven	5/771 (0.6)	4/284 (1.4)	0.211
Neonatal deaths	2/778 (0.3)	0/287 (0.0)	0.390
Secondary outcomes			
Neonatal outcomes			
Mechanical ventilation[a]	54/773 (7.0)	16/286 (5.6)	0.414
Respiratory distress syndrome	53/766 (6.9)	17/282 (6.0)	0.609
Bronchopulmonary dysplasia	1/770 (0.1)	0/282 (0.0)	0.164
Surfactant administration	47/767 (6.1)	8/278 (2.9)	0.010
Periventricular leukomalacia	37/769 (4.8)	17/281 (6.0)	1.000
Convulsion	9/769 (1.2)	2/282 (0.7)	0.303
Necrotizing enterocolitis	0/769 (0.0)	1/282 (0.4)	0.087
Retinopathy of prematurity	1/760 (0.1)	1/263 (0.4)	< 0.001
Apgar score < 7 at 1 min	107/781 (13.7)	34/288 (11.8)	0.417
Apgar score < 7 at 5 min	10/781 (1.3)	6/288 (2.1)	0.338
Admission to NICU	303/775 (39.1)	191/287 (66.6)	< 0.001
Mean length of NICU stay	8.41 ± 7.5	9.07 ± 6.3	0.052
Hypoglycaemia	43/768 (5.6)	15/279 (5.4)	0.111
Hyperbilirubinemia	318/768 (41.4)	184/283 (65.0)	< 0.001
Antibiotics given	246/769 (32.0)	229/285 (80.4)	< 0.001
Duration, days	5.12 ± 3.15	4.84 ± 2.96	0.331
Maternal outcomes			
Antepartum complications			
Antepartum fever	28 (3.6)	18 (6.2)	0.059
Antepartum CRP elevation	70 (9.0)	62 (21.4)	< 0.001
Cord prolapse	1 (0.1)	0 (0.0)	0.542
Postpartum complications			
Primary cesarean section[b]	246 (31.5)	55 (19.0)	< 0.001
Postpartum fever	33 (4.2)	19 (6.6)	0.114
Postpartum endometritis	0 (0.0)	1 (0.3)	0.100
Postpartum hemorrhage	5 (0.6)	1 (0.3)	0.566
Wound infection	3 (0.4)	0 (0.0)	0.291
DVT	0 (0.0)	1 (0.3)	0.104
Chorioamnionitis[c]	27 (3.5)	12 (4.1)	0.595

Data are represented as mean ± standard deviation or number (%).
NICU = neonatal intensive care unit, CRP = C-reactive protein, DVT = deep vein thrombosis.
[a]Mechanical ventilation included Synchronized Intermittent Mandatory Ventilation, Continuous Mandatory Ventilation, and High-Frequency Ventilation, all involving endotracheal intubation.
[b]Primary cesarean section was defined as a cesarean delivery in women who had not undergone a previous cesarean section.
[c]Chorioamnionitis was diagnosed by positive culture in the amniotic fluid or histological inflammatory changes in the gross/microscopic evaluation of the placenta.

Secondary neonatal outcomes

Neonates born in the immediate delivery group had a significant need for surfactants compared to those delivered after expectant management (6.1% vs. 2.9%, $P = 0.010$). The incidences of ROP, hyperbilirubinemia, NICU admission, and antibiotic administration were significantly higher in neonates born in the expectant management group (all $P < 0.001$). The duration of NICU stay was significantly longer in the expectant management group ($P = 0.005$). Other neonatal outcomes were not significantly different between the groups. Grade 3-4 IVH did not occur in either group (**Table 2**).

Secondary maternal outcomes

Regarding secondary maternal outcomes, the proportion of primary cesarean sections was significantly higher in the immediate delivery group than in the expectant management

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group (31.5% vs. 19.0%, $P < 0.001$). Women in the expectant management group had a higher frequency of elevated CRP levels during the latent period (21.4% vs. 9.0%, $P < 0.001$). Other antenatal and postpartum complications did not differ between the groups. Antepartum hemorrhage or intrauterine fetal death did not occur in either group (**Table 2**).

Associated risk of expectant management compared to immediate delivery

Compared with immediate delivery, expectant management was associated with a reduced risk of surfactant administration in premature infants (OR, 0.27; 95% confidence interval [CI], 0.12–0.61) and primary cesarean section (OR, 0.56; 95% CI, 0.39–0.81). However, neonates born from mothers managed expectantly were associated with a higher risk of clinical neonatal sepsis (OR, 3.02; 95% CI, 1.68–4.75), NICU admission (OR, 1.76; 95% CI, 1.26–2.46), hyperbilirubinemia (OR, 2.11; 95% CI, 1.55–2.88), and antibiotic administration (OR, 6.40; 95% CI, 4.41–8.98). Women in the expectant management group had a significantly increased risk of fever and CRP elevation during latent period (OR, 1.90; 95% CI, 1.01–3.66 and OR, 2.31; 95% CI, 1.53–3.48, respectively). However, there was no significant increase in the risk of culture-proven neonatal sepsis in the expectant management group (**Table 3**).

Subgroup analysis

Subgroup analysis was performed in women diagnosed with PPROM at 34^{+0}–34^{+6} weeks of gestation. Of the 335 women, 52.8% (177/335) underwent immediate delivery after diagnosis of PPROM and 47.2% (158/335) were managed expectantly. Women in the immediate delivery

Table 3. Adjusted odds ratio of outcomes in expectant management compared to those in the immediate delivery group

Variables	Odd ratio (95% CI)	*P* value
Neonatal outcomes		
Neonatal sepsis	2.83 (1.68–4.75)	< 0.001
Clinical	3.02 (1.79–5.25)	< 0.001
Culture proven	1.54 (0.37–6.49)	0.557
Mechanical ventilation[a]	0.94 (0.82–1.08)	0.252
Respiratory distress syndrome	0.57 (0.31–1.05)	0.070
Surfactant administration	0.27 (0.12–0.61)	0.002
Periventricular leukomalacia	0.90 (0.46–1.75)	0.750
Convulsion	0.40 (0.08–2.01)	0.269
Retinopathy of prematurity	4.85 (0.25–94.70)	0.297
Low Apgar score[b]	1.00 (0.35–2.91)	0.998
Admission to NICU	1.76 (1.26–2.46)	< 0.001
Hypoglycemia	0.72 (0.37–1.42)	0.347
Hyperbilirubinemia	2.11 (1.55–2.88)	< 0.001
Antibiotics administration	6.40 (4.41–8.98)	< 0.001
Maternal outcomes		
Primary cesarean section[c]	0.56 (0.39–0.81)	0.002
Antepartum fever	1.90 (1.01–3.66)	0.048
Antepartum CRP elevation	2.31 (1.53–3.48)	< 0.001
Postpartum hemorrhage	0.37 (0.04–3.48)	0.385
Chorioamnionitis[d]	0.77 (0.36–1.66)	0.511

Odds ratios adjusted for maternal age, pre-pregnancy body mass index, gestational age at preterm premature rupture of membranes, maternal antibiotic use, and oligohydramnios.
CI = confidence interval, NICU = neonatal intensive care unit, CRP = C-reactive protein.
[a]Mechanical ventilation included Synchronized Intermittent Mandatory Ventilation, Continuous Mandatory Ventilation, and High-Frequency Ventilation, all involving endotracheal intubation.
[b]Low Apgar score was defined as an Apgar score of < 7 at 5 minutes.
[c]Primary cesarean section was defined as a cesarean delivery in women who had not undergone a previous cesarean section.
[d]Chorioamnionitis was defined as a positive culture of the amniotic fluid or inflammatory changes in the postpartum visual/microscopic evaluation of the placenta.

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Table 4. Outcomes and adjusted odds ratio of expectant management compared to the immediate delivery group in women diagnosed with preterm premature rupture of membranes between 34 weeks and 34 weeks and 6 days of gestation

Variables	Immediate delivery (n = 177)	Expectant management (n = 158)	Odds ratio (95% confidence interval)	*P* value
Neonatal outcomes				
Neonatal sepsis	15/174 (8.6)	29/156 (18.6)	1.91 (0.94–3.90)	0.074
Clinical	14/174 (8.0)	29/156 (18.6)	2.34 (1.10–4.99)	0.028
Culture proven	3/174 (1.7)	1/156 (0.6)	0.30 (0.03–3.18)	0.317
Neonatal death	1/177 (0.3)	0/157 (0.0)		0.346
Mechanical ventilation[a]	29/175 (16.4)	8/156 (5.1)	0.33 (0.14–0.76)	0.009
Respiratory distress syndrome	32/174 (18.4)	9/156 (5.8)	0.33 (0.15–0.72)	0.006
Surfactant administration	28/174 (16.1)	4/152 (2.6)	0.15 (0.05–0.45)	< 0.001
Periventricular leukomalacia	20/173 (11.6)	14/155 (9.0)	0.91 (0.41–2.01)	0.822
Convulsion	5/174 (2.9)	1/155 (0.6)	0.27 (0.03–2.46)	0.246
Low Apgar score[b]	5/177 (2.8)	4/158 (2.5)	1.00 (0.25–4.03)	0.998
Admission to NICU	137/175 (78.3)	119/157 (75.8)	0.71 (0.41–1.33)	0.312
Mean length of NICU stay, day	12.70 ± 8.91	11.30 ± 6.52		0.158
Hypoglycemia	18/174 (10.3)	10/154 (6.5)	0.70 (0.29–1.72)	0.441
Hyperbilirubinemia	96/174 (55.2)	109/156 (69.9)	2.08 (1.26–3.43)	0.004
Antibiotics administration	99/175 (56.6)	137/156 (87.8)	5.45 (2.76–10.33)	< 0.001
Duration, day	5.66 ± 3.29	4.86 ± 2.68		0.041
Maternal outcomes				
Antepartum complications				
Antepartum fever	5 (2.8)	8 (5.1)	1.50 (0.47–4.72)	0.492
Antepartum CRP elevation	22 (12.4)	39 (24.7)	2.77 (1.47–5.20)	0.002
Postpartum complications				
Maternal sepsis	0 (0.0)	0 (0.0)		1.000
Primary cesarean section[c]	58 (32.8)	21 (13.3)	0.27 (0.15–0.51)	< 0.001
Postpartum endometritis	0 (0.0)	1 (0.6)		0.289
Postpartum hemorrhage	1 (0.6)	1 (0.6)	1.29 (0.07–22.94)	0.860
DVT	0 (0.0)	1 (0.6)		0.289
Chorioamnionitis[d]	13 (7.3)	6 (3.8)	0.42 (0.14–1.25)	0.119

Odds ratios adjusted for maternal age, pre-pregnancy body mass index, maternal antibiotic use, and oligohydramnios.
NICU = neonatal intensive care unit, DVT = deep vein thrombosis, CRP = C-reactive protein.
[a]Mechanical ventilation included Synchronized Intermittent Mandatory Ventilation, Continuous Mandatory Ventilation, and High-Frequency Ventilation, all involving endotracheal intubation.
[b]Low Apgar score was defined as an Apgar score of < 7 at 5 minutes.
[c]Primary cesarean section was defined as a cesarean delivery in women who had not undergone a previous cesarean section.
[d]Chorioamnionitis was defined as a positive culture of the amniotic fluid or inflammatory changes in the postpartum visual/microscopic evaluation of the placenta.

group showed earlier gestational age at delivery (34.55 ± 0.34 vs. 34.95 ± 0.46, $P < 0.001$). Unlike in the entire cohort, expectant management for women who were diagnosed with PPROM at 34^{+0}–34^{+6} weeks of gestation was significantly associated with decreased risk of mechanical ventilation for premature neonates (OR, 0.33; 95% CI, 0.14–0.76) and neonatal RDS (OR, 0.33; 95% CI, 0.15–0.72) (**Table 4**).

DISCUSSION

In this retrospective study, we evaluated neonatal and maternal outcomes following different delivery timing strategies for the management of late PPROM. Neonates in the expectant management group required less surfactant administration; however, they had a higher risk of clinical neonatal sepsis and antibiotic administration. In women, expectant management was associated with a lower risk of primary cesarean section. Nevertheless, they were at higher risk of developing antepartum fever and elevated CRP levels. There were no significant differences in maternal or neonatal sepsis between the groups.

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Neonatal sepsis is the major cause of mortality and long-term developmental complications in preterm infants. Premature rupture of membranes (PROM) compromises the barrier against ascending infections, and a prolonged latent period may increase the risk of neonatal sepsis. In our study, the incidence of clinical neonatal sepsis was higher in the expectant management group. This contributes to the increased number of NICU admissions and antibiotic use in this group. However, the incidence of other infectious complications, including severe IVH, PVL, NEC, and neonatal death, did not increase significantly in the expectant management group.

Although several studies have attempted to clarify the benefits and risks of immediate delivery versus expectant management of neonatal sepsis in women with PPROM, the optimal management approach remains controversial. Consistent with our findings, Ocviyanti and Wahono[19] and Drassinower et al.[20] reported that a longer interval between membrane rupture and delivery was associated with an increased risk of neonatal sepsis, even after adjusting for gestational age. Conversely, other studies have demonstrated no association between a prolonged latent period and risk of neonatal sepsis.[21,22] Furthermore, randomized controlled trials such as the PPROMT trial and PPROMEXIL studies suggest that expectant management for women with PPROM has benefits without a significant increase in risk of neonatal sepsis.[6,7,23] These inconsistent findings stem from the inherent difficulty in accurately assessing clinical neonatal sepsis. Diagnosing infections in neonates based solely on clinical manifestations is unreliable because of their nonspecific nature and inaccuracy of routine laboratory values.[24,25] A high index of suspicion is crucial for early diagnosis of clinical neonatal sepsis, as diagnosis varies and depends on physician judgment. Clinical neonatal sepsis might have been diagnosed more frequently in the expectant management group because these neonates were suspected to have been exposed to infection for a longer duration during the latent period. However, limited data suggest that culture-negative sepsis is not associated with an increased risk of death. However, the effect of culture-negative sepsis on neurodevelopmental outcomes is also unclear.[5,24] Notably, there was no significant difference in the incidence of culture-proven neonatal sepsis between the groups in our study.

Neonates in the expectant management group required less surfactant after controlling for gestational age. This may be associated with the gestational age at delivery and antenatal corticosteroid administration. In our study, although the gestational age at delivery was higher in the immediate delivery group, 41.6% of women in the immediate delivery group were diagnosed with PPROM and delivered after 36 weeks of gestation, while a high proportion of women (54.1%) with expectant management were diagnosed with PPROM at 34^{+0}–34^{+6} weeks and delivered at 35^{+0}–35^{+6} weeks of gestation (44.5%). In the subgroup analysis of women with PPROM at 34 weeks of gestation, expectant management was associated with a reduced risk of surfactant administration as well as the need for mechanical ventilation and neonatal RDS. Women were managed expectantly and received a complete course of antenatal corticosteroids therapy with prolonged gestational age. This finding aligns with those of previous studies showing that an earlier gestational age is associated with more frequent neonatal respiratory complications than a longer latent period.[21,25] Although antenatal corticosteroids are known to provide significant benefits during the late preterm period, their specific implications in late PPROM have not been adequately studied. The results of our study and other studies are rational because gestational age and antenatal corticosteroid therapy at ≥ 34 weeks of gestation can improve fetal lung maturation and reduce neonatal respiratory complications.[26,27]

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Immediate delivery after PPROM resulted in a significantly higher primary cesarean section rate than expected. This may be due to unfavorable cervix and concerns regarding fetal distress with oligohydramnios during labor. Primary cesarean section is associated with increased morbidity and mortality, including placenta accrete, cesarean section scar pregnancy, and postpartum hemorrhage.[18,28] Therefore, expectant management may help reduce cesarean section–related maternal complications.

Expectant-managed women showed a higher incidence of non-reassuring FHR, elevated CRP levels, and fever during the latent period. These findings may predict chorioamnionitis, which is necessary for prompt delivery.[29,30] However, low sensitivity limits their clinical utility.[31]

Regarding the optimal delivery timing in PPROM, several studies have suggested that expectant management does not increase adverse perinatal risks compared with immediate delivery. A Cochrane review found no significant difference in neonatal sepsis rates between immediate delivery and expectant management for PPROM.[9] Expectant management was associated with less neonatal RDS and need for ventilation but increased chorioamnionitis. However, this meta-analysis included a broad gestational age range (25–37 weeks), limiting its applicability to late PPROM. Several multicenter randomized controlled trials focusing on the late preterm period have supported expectant management with close monitoring and antibiotic prophylaxis, even in Group B streptococcus-positive women.[32] Based on these studies and ours, expectant management could be considered with careful monitoring for late PPROM.

Our study has some limitations. The retrospective design has limitations related to data accuracy and completeness of previously recorded information. Therefore, composite neonatal morbidity data may not appropriately represent future childhood developmental outcomes. However, this study had several strengths. To our knowledge, this is the first study in Korea to evaluate the immediate versus expectant management of late PPROM across multiple tertiary centers. As the participating centers were major referral hospitals, our findings are likely to reflect national practices in Korea. Furthermore, a major strength of our study is its exclusive focus on mothers with late PPROM, a population often underrepresented or mixed with earlier gestations in previous randomized controlled trials and systematic reviews.[6,33,34] Notably, earlier studies frequently included cases of PROM before 34 weeks of gestation or followed outdated guidelines regarding antenatal corticosteroid and antibiotic use.[33,35] In contrast, our study reflects contemporary clinical practice with high adherence to current recommendations for both corticosteroid and antibiotic administration beyond 34 weeks of gestation. Despite growing recognition of the benefits of antenatal corticosteroids in the late preterm period, their specific role in late PPROM has not been sufficiently studied. By addressing this gap, our study provides clinically relevant and up-to-date evidence that may guide obstetric decision making in similar populations.

In conclusion, we evaluated the benefits and risks of immediate delivery and expectant management in women with late PPROM. Our findings suggest that careful expectant management, including prophylactic antibiotics to reduce intra-amniotic infections and antenatal corticosteroids to reduce neonatal morbidities, warrants consideration as a judicious approach, thereby reducing respiratory morbidity attributable to prematurity and enhancing overall perinatal safety and efficacy. Periodic assessment of infection, fetal well-being, cord prolapse, and uterine contractions is essential. These findings provide a foundation for future research to determine the optimal delivery timing in late PPROM, considering both short- and long-term outcomes.

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REFERENCES

1. Nelson LH, Anderson RL, O'Shea TM, Swain M. Expectant management of preterm premature rupture of the membranes. *Am J Obstet Gynecol* 1994;171(2):350-8. PUBMED | CROSSREF
2. Navathe R, Schoen CN, Heidari P, Bachilova S, Ward A, Tepper J, et al. Azithromycin vs erythromycin for the management of preterm premature rupture of membranes. *Am J Obstet Gynecol* 2019;221(2):144.e1-8. PUBMED | CROSSREF
3. Thomson AJ; Royal College of Obstetricians and Gynaecologists. Care of women presenting with suspected preterm prelabour rupture of membranes from 24^{+0} weeks of gestation: Green-top Guideline No. 73. *BJOG* 2019;126(9):e152-66. PUBMED | CROSSREF
4. Siegler Y, Weiner Z, Solt I. ACOG Practice Bulletin No. 217: prelabor rupture of membranes. *Obstet Gynecol* 2020;136(5):1061. PUBMED | CROSSREF
5. Park JH, Bae JG, Chang YS. Neonatal outcomes according to the latent period from membrane rupture to delivery among extremely preterm infants exposed to preterm premature rupture of membrane: a Nationwide Cohort Study. *J Korean Med Sci* 2021;36(14):e93. PUBMED | CROSSREF
6. van der Ham DP, van der Heyden JL, Opmeer BC, Mulder AL, Moonen RM, van Beek JH, et al. Management of late-preterm premature rupture of membranes: the PPROMEXIL-2 trial. *Am J Obstet Gynecol* 2012;207(4):276.e1-276.e10. PUBMED | CROSSREF
7. Morris JM, Roberts CL, Bowen JR, Patterson JA, Bond DM, Algert CS, et al. Immediate delivery compared with expectant management after preterm pre-labour rupture of the membranes close to term (PPROMT trial): a randomised controlled trial. *Lancet* 2016;387(10017):444-52. PUBMED | CROSSREF
8. Major CA, de Veciana M, Lewis DF, Morgan MA. Preterm premature rupture of membranes and abruptio placentae: is there an association between these pregnancy complications? *Am J Obstet Gynecol* 1995;172(2 Pt 1):672-6. PUBMED | CROSSREF
9. Bond DM, Middleton P, Levett KM, van der Ham DP, Crowther CA, Buchanan SL, et al. Planned early birth versus expectant management for women with preterm prelabour rupture of membranes prior to 37 weeks' gestation for improving pregnancy outcome. *Cochrane Database Syst Rev* 2017;3(3):CD004735. PUBMED | CROSSREF
10. Ronzoni S, Boucoiran I, Yudin MH, Coolen J, Pylypjuk C, Melamed N, et al. Guideline No. 430: diagnosis and management of preterm prelabour rupture of membranes. *J Obstet Gynaecol Can* 2022;44(11):1193-1208.e1. PUBMED | CROSSREF
11. Gibbs RS, Castillo MS, Rodgers PJ. Management of acute chorioamnionitis. *Am J Obstet Gynecol* 1980;136(6):709-13. PUBMED | CROSSREF
12. Escobar MF, Echavarría MP, Zambrano MA, Ramos I, Kusanovic JP. Maternal sepsis. *Am J Obstet Gynecol MFM* 2020;2(3):100149. PUBMED | CROSSREF
13. Simonsen KA, Anderson-Berry AL, Delair SF, Davies HD. Early-onset neonatal sepsis. *Clin Microbiol Rev* 2014;27(1):21-47. PUBMED | CROSSREF
14. Gerdes JS. Diagnosis and management of bacterial infections in the neonate. *Pediatr Clin North Am* 2004;51(4):939-59. PUBMED | CROSSREF
15. Gerdes JS. Clinicopathologic approach to the diagnosis of neonatal sepsis. *Clin Perinatol* 1991;18(2):361-81. PUBMED | CROSSREF
16. Youn YA, Kim EK, Kim SY. Necrotizing enterocolitis among very-low-birth-weight infants in Korea. *J Korean Med Sci* 2015;30(Suppl 1):S75-80. PUBMED | CROSSREF
17. International Committee for the Classification of Retinopathy of Prematurity. The International Classification of Retinopathy of Prematurity revisited. *Arch Ophthalmol* 2005;123(7):991-9. PUBMED | CROSSREF
18. Boyle A, Reddy UM, Landy HJ, Huang CC, Driggers RW, Laughon SK. Primary cesarean delivery in the United States. *Obstet Gynecol* 2013;122(1):33-40. PUBMED | CROSSREF
19. Ocviyanti D, Wahono WT. Risk factors for neonatal sepsis in pregnant women with premature rupture of the membrane. *J Pregnancy* 2018;2018:4823404. PUBMED | CROSSREF
20. Drassinower D, Friedman AM, Običan SG, Levin H, Gyamfi-Bannerman C. Prolonged latency of preterm premature rupture of membranes and risk of neonatal sepsis. *Am J Obstet Gynecol* 2016;214(6):743.e1-6. PUBMED | CROSSREF
21. Lorthe E, Ancel PY, Torchin H, Kaminski M, Langer B, Subtil D, et al. Impact of latency duration on the prognosis of preterm infants after preterm premature rupture of membranes at 24 to 32 weeks' gestation: a national population-based cohort Study. *J Pediatr* 2017;182:47-52.e2. PUBMED | CROSSREF

22. Naef RW 3rd, Allbert JR, Ross EL, Weber BM, Martin RW, Morrison JC. Premature rupture of membranes at 34 to 37 weeks' gestation: aggressive versus conservative management. *Am J Obstet Gynecol* 1998;178(1):126-30. PUBMED | CROSSREF

23. Quist-Nelson J, de Ruigh AA, Seidler AL, van der Ham DP, Willekes C, Berghella V, et al. Immediate delivery compared with expectant management in late preterm prelabor rupture of membranes: an individual participant data meta-analysis. *Obstet Gynecol* 2018;131(2):269-79. PUBMED | CROSSREF

24. Cantey JB, Prusakov P. A proposed framework for the clinical management of neonatal "culture-negative" sepsis. *J Pediatr* 2022;244:203-11. PUBMED | CROSSREF

25. Rodríguez-Trujillo A, Cobo T, Vives I, Bosch J, Kacerovsky M, Posadas DE, et al. Gestational age is more important for short-term neonatal outcome than microbial invasion of the amniotic cavity or intra-amniotic inflammation in preterm prelabor rupture of membranes. *Acta Obstet Gynecol Scand* 2016;95(8):926-33. PUBMED | CROSSREF

26. Stutchfield P, Whitaker R, Russell I; Antenatal Steroids for Term Elective Caesarean Section (ASTECS) Research Team. Antenatal betamethasone and incidence of neonatal respiratory distress after elective caesarean section: pragmatic randomised trial. *BMJ* 2005;331(7518):662. PUBMED | CROSSREF

27. Gyamfi-Bannerman C, Thom EA, Blackwell SC, Tita AT, Reddy UM, Saade GR, et al. Antenatal betamethasone for women at risk for late preterm delivery. *N Engl J Med* 2016;374(14):1311-20. PUBMED | CROSSREF

28. Caughey AB, Cahill AG, Guise JM, Rouse DJ; American College of Obstetricians and Gynecologists (College)Society for Maternal-Fetal Medicine. Safe prevention of the primary cesarean delivery. *Am J Obstet Gynecol* 2014;210(3):179-93. PUBMED | CROSSREF

29. Lee SY, Park KH, Jeong EH, Oh KJ, Ryu A, Park KU. Relationship between maternal serum C-reactive protein, funisitis and early-onset neonatal sepsis. *J Korean Med Sci* 2012;27(6):674-80. PUBMED | CROSSREF

30. Vandenbroucke L, Doyen M, Le Lous M, Beuchée A, Loget P, Carrault G, et al. Chorioamnionitis following preterm premature rupture of membranes and fetal heart rate variability. *PLoS One* 2017;12(9):e0184924. PUBMED | CROSSREF

31. Stepan M, Cobo T, Musilova I, Hornychova H, Jacobsson B, Kacerovsky M. Maternal serum C-reactive protein in women with preterm prelabor rupture of membranes. *PLoS One* 2016;11(3):e0150217. PUBMED | CROSSREF

32. Schmitz T, Sentilhes L, Lorthe E, Gallot D, Madar H, Doret-Dion M, et al. Preterm premature rupture of the membranes: guidelines for clinical practice from the French College of Gynaecologists and Obstetricians (CNGOF). *Eur J Obstet Gynecol Reprod Biol* 2019;236:1-6. PUBMED | CROSSREF

33. Lee D, Lynch TA. PPROM in the late preterm period: an argument for expectant management. *Am J Obstet Gynecol MFM* 2025;7(1):101563. PUBMED | CROSSREF

34. van der Ham DP, Nijhuis JG, Mol BW, van Beek JJ, Opmeer BC, Bijlenga D, et al. Induction of labour versus expectant management in women with preterm prelabour rupture of membranes between 34 and 37 weeks (the PPROMEXIL-trial). *BMC Pregnancy Childbirth* 2007;7(1):11. PUBMED | CROSSREF

35. Committee on Practice Bulletins-Obstetrics. ACOG Practice Bulletin No. 188: prelabor rupture of membranes. *Obstet Gynecol* 2018.131(1):e1-14. PUBMED | CROSSREF