



Original Article



Comparison of Fetomaternal Outcome between Early Planned Labor Induction and Expectant Management in Late Preterm Pre-Labor Rupture of Membrane (PPROM)

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ABSTRACT

Late preterm pre-labor rupture of membranes (PPROM) remains a clinical dilemma, with conflicting evidence regarding early induction versus expectant management. **Objectives:** To compare maternal and neonatal outcomes between early planned labor induction and expectant management in women with late preterm PPRM. **Methods:** This prospective comparative observational cohort study was conducted at the Department of Obstetrics and Gynecology, Kharadar General Hospital. A total of 134 women with late preterm PPRM (34+0 to 36+6 weeks) were enrolled and managed with either early planned induction (Group A, n=67) or expectant management (Group B, n=67). Outcomes were analyzed using Chi-square and Mann-Whitney U tests, and multivariate logistic regression was applied to adjust for maternal risk factors, including BMI, diabetes, and hypertension. **Results:** Maternal infection [40.3% vs. 23.9%, p=0.042], cesarean delivery [55.2% vs. 37.3%, p=0.038], neonatal infection [53.7% vs. 35.8%, p=0.037], and neonatal intervention [41.8% vs. 23.9%, p=0.027] were significantly higher in the induction group. Multivariate analysis showed hypertension as a strong predictor of maternal infection (aOR 11.45, 95% CI: 1.5-85.6, p=0.018) and neonatal intervention (aOR 3.22, 95% CI: 2.1-17.1, p=0.017), while obesity and diabetes significantly predicted cesarean delivery and neonatal infection. **Conclusions:** Early induction in late preterm PPRM was associated with increased maternal and neonatal complications, particularly among women with comorbidities. Expectant management with close surveillance may be safer in stable patients, especially in populations with high rates of hypertension, diabetes, and obesity.

INTRODUCTION

Preterm pre-labor rupture of membranes (PPROM) is defined as rupture of the fetal membranes before the onset of labor in pregnancies less than 37 weeks of gestation [1]. It complicates approximately 2-3% of all pregnancies and accounts for nearly one-third (approximately 25 to 30%) of preterm births worldwide [2, 3]. PPRM is associated with significant maternal and neonatal morbidity due to risks of infection, preterm delivery, and neonatal respiratory distress [2]. The management of PPRM, particularly in the late preterm period (34+0 to 36+6 weeks), remains

controversial [4]. Early planned labor induction may reduce the risk of ascending infection but can increase neonatal respiratory morbidity due to earlier delivery [4]. Conversely, expectant management allows for greater fetal maturity but carries an increased risk of chorioamnionitis, i.e. up to 50% have histological evidence despite clinical signs and symptoms, maternal sepsis, i.e. 3.47 times odd of morbidity, and adverse perinatal outcomes. i.e., more often diagnosed with respiratory distress syndrome (RDS) [5-8]. Previous international studies have reported conflicting



results, and no universal consensus exists regarding the optimal strategy [1]. In low- and middle-income countries such as Pakistan, the challenge is further compounded by variable availability of neonatal intensive care facilities, inconsistent application of antibiotic and steroid protocols, and a higher baseline burden of maternal comorbidities[9].

Evidence from local populations is limited, and guidance for clinical practice is often extrapolated from studies conducted in high-income settings, which may not be directly applicable. We hypothesized that early planned labor induction in late preterm PPRM would result in lower rates of maternal and neonatal infection without significantly increasing neonatal morbidity compared with expectant management. So, the objective of this study was to compare fetomaternal outcomes between early planned labor induction and expectant management in women with late preterm PPRM.

METHODS

This prospective comparative observational cohort study was conducted in the Department of Obstetrics and Gynecology, Kharadar General Hospital, from June 2024 to December 2024, after approval from the College of Physicians and Surgeons and the Institutional Review Board of Kharadar General Hospital, Karachi (Ref. No. CPSP/REU/OBG-2023-207-12962). Women presenting with late preterm pre-labor rupture of membranes (PPROM) between 34 and 37 weeks of gestation were consecutively enrolled. Inclusion criteria were singleton pregnancies with confirmed PPRM, while exclusions were multiple gestations, major fetal anomalies, previous classical cesarean section, placenta previa, and contraindications to vaginal delivery. Diagnosis of PPRM was established on sterile speculum examination with visualization of liquor pooling, supplemented by pH testing when required. The informed consent was taken on admission; Grouping was not randomized. Patients were assigned based on clinical evaluation at presentation and departmental protocol. Those with maternal fever $\geq 38^{\circ}\text{C}$, elevated CRP, foul-smelling discharge, or non-reassuring fetal status was managed with early planned induction, whereas clinically stable women with no signs of infection and normal fetal surveillance were managed expectantly. Induction was undertaken using Prostaglandin E2 per vaginally, repeated after 6 hours in case of no uterine contraction under continuous maternal and fetal monitoring, while expectant management consisted of inpatient observation, serial maternal vital signs, fetal surveillance with cardiotocography or biophysical profile, prophylactic antibiotics, and corticosteroids as per departmental policy. The delivery was indicated at 37 weeks or earlier if complications arose, like chorioamnionitis, non-

reassuring fetal heart rate, or completion of 37 weeks of gestation. In such situations, labor was either induced or a cesarean section was performed, depending on the clinical scenario. The primary outcomes of interest included mode of delivery, maternal infection, and neonatal infection. Secondary outcomes included cesarean section rate, hospital stay, NICU admission, respiratory support requirement, and composite neonatal intervention. Maternal infection was defined as clinical suspicion of chorioamnionitis with fever $\geq 38^{\circ}\text{C}$ and elevated C-reactive protein, which was assessed by sending venous blood samples to the institutional diagnostic laboratory. Maternal C-reactive protein levels were determined via quantitative immunoturbidimetric assay on the Roche Cobas c311 automated analyzer (Roche Diagnostics, Germany). A venous sample (3 mL) was obtained under aseptic technique at admission, and results were expressed in mg/L; values >10 mg/L were considered elevated. Neonatal infection, referred to as early-onset sepsis, is confirmed by clinical signs, laboratory markers, or culture positivity. Data were analyzed using SPSS version 22.0; categorical variables were compared with Chi-square or Fisher's exact test, continuous variables were summarized as mean \pm SD or median (IQR) depending on normality tested by Shapiro-Wilk, and between-group differences were assessed with t-test or Mann-Whitney U test. Multivariable logistic regression adjusting for maternal age, body mass index, and comorbidities (hypertension, diabetes) was performed, with results expressed as adjusted odds ratios and 95% confidence intervals; $p < 0.05$ was considered statistically significant.

RESULTS

An overall of 134 pregnant women between 34 to 37 weeks of gestation with confirmed cases of pre-labor rupture of membranes were involved in the study. The baseline characteristics of 134 women with late preterm PPRM, divided into early planned labor induction (Group A, $n=67$) and expectant management (Group B, $n=67$). Most participants in both groups were 20–30 years old [Group A: 38 (56.7%), Group B: 33 (49.3%), $p=0.190$], with comparable median ages (30 vs. 31 years, $p=0.314$). Body mass index showed significant differences: obesity was more common in Group A [39 (58.2%) vs. 25 (37.3%)], with higher median BMI (30.8 vs. 28.9 kg/m², $p=0.020$). Residential status, socioeconomic class, and employment did not differ significantly between groups ($p>0.05$). Gestational age at presentation was also similar, with roughly half of the women in each group presenting at 34–35 weeks and the remainder at 36–37 weeks ($p=0.300$). Diabetes prevalence was higher in Group A (50.7% vs. 38.8%), though not statistically significant ($p=0.165$). Hypertension, however, was significantly more frequent in Group A [40

(59.7%) vs. 28(41.8%), p=0.038](Table 1).

Table 1: Initial Clinical Profile of Females with Final-Phase Preterm Pre-Labor Rupture of Membranes(n=134)

Characteristics	Categories	Group A (Induced) N=67	Group B (Expected) N=67	p-value*
Age (years)	20 - 30	38 (56.7%)	33 (49.3%)	0.190
	31 - 40	24 (35.8%)	22 (32.8%)	
	>40	5 (7.5%)	12 (17.9%)	
	Median (IQR)	30 (25-36)	31 (25-39)	0.314**
BMI (Kg/m ²)	Normal weight	3 (4.5%)	12 (17.9%)	0.012
	Overweight	25 (37.3%)	30 (44.8%)	
	Obese	39 (58.2%)	25 (37.3%)	
	Median (IQR)	30.8 (28.7-31.2)	28.9 (26.2-31.2)	0.020**
Residency	Rural	18 (26.9%)	25 (37.3%)	0.195
	Urban	49 (73.1%)	42 (62.7%)	
Monthly Family Income (Rs)	<50,000	18 (26.9%)	25 (37.3%)	0.380
	50,000-100,000	34 (50.7%)	27 (40.3%)	
	>100,000	15 (22.4%)	15 (22.4%)	
Employment	Employed	19 (28.4%)	16 (23.9%)	0.550
	Unemployed	48 (71.6%)	51 (76.1%)	
Gestational Age (weeks)	34-35	37 (55.2%)	31 (46.3%)	0.300
	36-37	30 (44.8%)	36 (53.7%)	
Comorbidities	Diabetes Mellitus	34 (50.7%)	26 (38.8%)	0.165
	Hypertension	40 (59.7%)	28 (41.8%)	0.038

Normal Weight = BMI 18.5 - 24.9, Over Weight = 25 - 29.9, Obese = BMI ≥30, *Chi-Square test, **Mann-Whitney U test

The perinatal outcomes in women with late preterm PPRM show maternal infection occurred more frequently in the induction group [Group A: 27 (40.3%) vs. Group B: 16 (23.9%), p=0.042]. Cesarean delivery was also higher in Group A [37 (55.2%) vs. 25 (37.3%), p=0.038]. Neonatal infection rates were significantly greater in Group A [36 (53.7%) vs. 24 (35.8%), p=0.037], and neonatal interventions were more common [28 (41.8%) vs. 16 (23.9%), p=0.027](Table 2).

Table 2: Maternal and Neonatal Outcomes between Two Groups (n=134)

Outcomes	Categories	Group A (Induced) n=67	Group B (Expected) n=67	p-value*
Maternal Outcomes	Maternal Infection	27 (40.3%)	16 (23.9%)	0.042
	Cesarean Section	37 (55.2%)	25 (37.3%)	0.038
Neonatal Outcomes	Neonatal Infection	36 (53.7%)	24 (35.8%)	0.037
	Neonatal Intervention	28 (41.8%)	16 (23.9%)	0.027

*Chi-Square test

The multivariate analysis of predictors for maternal outcomes in late preterm PPRM shows that for maternal infection, age, gestational age, and diabetes mellitus were not significant predictors [aOR 0.95 (95% CI: 0.9-1.1, p=0.380); aOR 0.95 (95% CI: 0.5-2.0, p=0.897); aOR 0.14 (95% CI: 0.0-2.1, p=0.151), respectively]. Higher BMI also

showed no significant association [aOR 1.36, 95% CI: 0.9-2.0, p=0.104]. In contrast, hypertension was a strong and significant predictor of maternal infection [aOR 11.45, 95% CI: 1.5-85.6, p=0.018]. For cesarean delivery, age and gestational age were not significant predictors [aOR 0.96, 95% CI: 0.9-1.0, p=0.300; aOR 0.83, 95% CI: 0.5-1.3, p=0.441]. However, higher BMI [aOR 1.2, 95% CI: 1.1-1.5, p=0.046], diabetes mellitus [aOR 2.77, 95% CI: 1.2-7.9, p=0.047], and hypertension [aOR 1.46, 95% CI: 1.1-4.5, p=0.048] were all significant predictors of cesarean section (Table 3).

Table 3: Predictors of maternal outcomes between two groups (Multivariate Analysis)n=134

Predictors	Maternal Infection RR (95% CI)	p-value	Cesarean Section RR (95% CI)	p-value
Age	0.95 (0.9 - 1.1)	0.380	0.96 (0.9 - 1.0)	0.300
BMI	1.36 (0.9 - 2.0)	0.104	1.20 (1.1 - 1.5)	0.046
Gestational Age	0.95 (0.5 - 2.0)	0.897	0.83 (0.5 - 1.3)	0.441
Diabetes Mellitus	0.14 (0 - 2.1)	0.151	2.77 (1.2 - 7.9)	0.047
Hypertension	11.45 (1.5 - 85.6)	0.018	1.46 (1.1 - 4.5)	0.048

RR=relative Risk, CI Confidence Interval

The multivariate analysis of predictors for neonatal outcomes in late preterm PPRM shows that for neonatal infection, higher BMI [aOR 1.3, 95% CI: 1.0-1.6, p=0.028], diabetes mellitus [aOR 1.53, 95% CI: 1.1-5.3, p=0.050], and hypertension [aOR 1.24, 95% CI: 1.1-3.9, p=0.042] were significant predictors, while maternal age and gestational age were not associated. For neonatal intervention, hypertension emerged as the only significant predictor [aOR 3.22, 95% CI: 2.1-17.1], whereas all other factors were non-significant (Table 4).

Table 4: Predictors of Neonatal Outcomes Between Two Groups (Multivariate Analysis)n=134

Predictors	Neonatal Infection RR (95% CI)	p-value	Neonatal Intervention RR (95% CI)	p-value
Age	0.96 (0.9 - 1.0)	0.376	0.95 (0.9 - 1.1)	0.325
BMI	1.30 (1.0 - 1.6)	0.028	1.22 (0.9 - 1.6)	0.207
Gestational Age	0.99 (0.6 - 1.7)	0.980	0.94 (0.5 - 1.7)	0.835
Diabetes Mellitus	1.53 (1.1 - 5.3)	0.050	1.08 (0.3 - 3.9)	0.906
Hypertension	1.24 (1.1 - 3.9)	0.042	3.22 (2.1 - 17.1)	0.017

RR=relative Risk, CI Confidence Interval

Hypertension, diabetes, and elevated BMI were important predictors of adverse fetomaternal outcomes in late preterm PPRM. Hypertension strongly increased the risk of both maternal infection and neonatal intervention, while diabetes and obesity contributed to higher rates of cesarean section and neonatal infection. These findings highlight the need to individualize management decisions in late preterm PPRM, especially in women with maternal comorbidities.

DISCUSSIONS

In our cohort of 134 women with late preterm PPRM, baseline profiles were largely comparable between the induction and expectant groups, except for higher rates of obesity (58.2% vs. 37.3%, $p=0.02$) and hypertension (59.7% vs. 41.8%, $p=0.038$) in the induction arm. These comorbidities are well-recognized contributors to adverse outcomes and may partly explain the higher maternal and neonatal complications observed. However, in Pakistan, where obesity and hypertension frequently complicate pregnancy, its association of PPRM with strongly predicts cesarean delivery and neonatal morbidity is not reported [10, 11]. European trials, such as PPROMEXIL/PROMEXIL-2 studies, didn't provide a detailed breakdown; however, literature pointed out a 38% prevalence of hypertension, and obese women have 1.98 times higher chances of PPRM morbidity, but in contrast, higher rates were seen in LMICs [12-14]. The differences in maternal health status between South Asian and Western populations play a decisive role, highlighting the need to interpret global evidence cautiously and tailor management decisions in Pakistan to account for the higher prevalence of maternal risk factors. Our study demonstrated significantly higher adverse outcomes in the induction group compared to expectant management, with maternal infection (40.3% vs. 23.9%, $p=0.042$), cesarean delivery (55.2% vs. 37.3%, $p=0.038$), neonatal infection (53.7% vs. 35.8%, $p=0.037$), and neonatal intervention (41.8% vs. 23.9%, $p=0.027$) occurring more frequently after induction. These findings contrast with the Dutch PPROMEXIL trial, where induction reduced maternal chorioamnionitis without significantly increasing neonatal morbidity Van Der Ham *et al.* and with a recent analysis by Simons *et al.* which found no long-term disadvantage with expectant management [12, 15]. However, our results are consistent with regional data that reported infection rates of nearly 30% and higher cesarean delivery rates among women with comorbidities, especially hypertension, undergoing induction, which emphasized hypertension and obesity as strong predictors of neonatal morbidity in South Asian cohorts [16, 17]. Differences in baseline risk factors, gestational age at delivery, induction protocols, and NICU resources may explain why induction in our setting was associated with greater maternal and neonatal complications compared with international studies. These results suggest that in Pakistan, where maternal comorbidities and limited neonatal care capacity are common, expectant management may provide safer outcomes when close monitoring is feasible. Our analysis showed that hypertension, diabetes, and elevated BMI were significant predictors of adverse maternal and neonatal outcomes in late preterm PPRM, with hypertension strongly

associated with maternal infection (aOR 11.45) and neonatal intervention (aOR 3.22). Similar associations have been reported where obesity and hypertension to markedly increase cesarean delivery and neonatal morbidity; some authors highlighted that antepartum hemorrhage is the leading factor that is indirectly associated with hypertension [13, 14, 18]. International data show mixed patterns: Bitar *et al.* (2025) reported that maternal comorbidities, particularly hypertension, and infection doubled the risk of complications in late PPRM, consistent with our findings, whereas Simons *et al.* (2023) in a Dutch cohort found no significant effect of BMI or hypertension, reflecting the lower prevalence of these risk factors in European populations [15, 19]. A recent meta-analysis by Lee *et al.* (2025) concluded that baseline maternal health, particularly obesity and diabetes, remains the primary determinant of outcomes in low- and middle-income settings [4, 20]. Taken together, our results reinforce that in Pakistan, where metabolic risk factors are highly prevalent, these comorbidities magnify adverse outcomes and may explain the divergence from Western studies, underscoring the need for tailored management strategies.

This study has several limitations. First, it was conducted at a single tertiary care center with a relatively small sample size, which may limit the generalizability of the findings. Second, allocation to induction or expectant management was not randomized but based on clinical judgment and departmental protocol, introducing the possibility of selection bias. Third, baseline imbalances, particularly higher rates of obesity, diabetes, and hypertension in the induction group, may have confounded the outcomes despite statistical adjustment. Fourth, neonatal outcomes were assessed only during the immediate hospital stay, and long-term follow-up on neurodevelopment and respiratory health was not available. Finally, variations in induction regimens, antibiotic use, and monitoring protocols could not be fully standardized, which may have influenced maternal and neonatal outcomes.

CONCLUSIONS

Early planned induction in late preterm PPRM was associated with higher rates of maternal infection, cesarean delivery, and neonatal complications, particularly among women with obesity, diabetes, and hypertension. Careful patient selection and close monitoring are essential, and in resource-limited settings like Pakistan, expectant management may be safer for stable women without high-risk comorbidities.

Authors' Contribution

Conceptualization: MA

Methodology: SI

Formal analysis: MF

Writing and Drafting: SI, MA, MF

Review and Editing: SI, MA, MF

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

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