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# A COMPARATIVE STUDY ON EARLY VERSUS DELAYED INDUCTION OF LABOR IN PATIENTS WITH PRELABOR RUPTURE OF MEMBRANES AT TERM

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## ABSTRACT

**Objective:** To compare the maternal outcomes in terms of mode of delivery (vaginal vs. cesarean) and duration of labor in patients with prelabor rupture of membranes (PROM) at term. randomized to early versus delayed induction of labor.

**Study design:** A randomized controlled trial

**Place & duration of the study:** Obstetrics & Gynecology Department of Arif Memorial Teaching Hospital, Lahore from May 1 2025 to September 2025.

**Methods:** The study included 88 term PROM patients equally divided into early and delayed induction groups. Labor was induced using 0.5 mg PGE<sub>2</sub> gel. Maternal outcomes such as mode of delivery and duration of labor were compared between two groups.

**Results:** The maternal age was comparable between the two groups ( $30.75 \pm 3.58$  years in early induction vs.  $31.53 \pm 4.06$  years;  $p = 0.194$ ). The duration of labor was significantly shorter in the early induction group ( $13.02 \pm 2.26$  hours) than in the delayed group ( $19.65 \pm 2.01$  hours;  $p < 0.001$ ). Normal vaginal delivery was more frequent with early induction (39.2% vs. 18.6%), while cesarean section rates were higher in the delayed induction group (31.4% vs. 10.8%;  $p < 0.001$ ). When the data were stratified by age, gestational age, BMI, and parity, the same pattern was observed, all with p-values  $< 0.05$  in each subgroup.

**Conclusion:** The current study contributes valuable data supporting early induction as a safe and effective approach for managing term PROM and provides a foundation for developing standardized clinical guidelines in similar settings.

**Keywords:** Pre-labor rupture of membranes, Early induction, Delayed induction, Term pregnancy, Duration of labor, Mode of delivery, Prostaglandin E<sub>2</sub>, Maternal outcomes

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## INTRODUCTION

Premature rupture of membranes (PROM) is termed as the loss of integrity of amniotic membranes, resulting in leakage of amniotic fluid before the initiation of labor in pregnancies  $\geq 37$  weeks of gestation.<sup>1,2</sup> PROM complicates

about 8-19% of pregnancies at term.<sup>3</sup> It is typically linked with overdistension of the uterus due to multiple pregnancy or polyhydramnios, cigarette smoking, altered mechanical properties of the amniotic membranes, frequent digital examinations, coitus, and infection. However, it is not clear whether these actually cause PROM.<sup>4</sup> Immediate risks of PROM include cord prolapse, cord compression, and placental abruption, while late risks include maternal and neonatal

infection, and increased risk of interventions such as instrumental vaginal delivery and caesarean delivery.<sup>5,6</sup>

Intact membranes protect the fetus from pathogens present in its surrounding environment. However, the scenario is totally different in PROM where the fetus is exposed to micro-organisms, increasing chances of infection and rate of consequent morbidity.<sup>7</sup> To decrease this risk, labor is usually induced. But, the timing of induction is still controversial. Approximately 90% have spontaneous labor within 24 hours of PROM. However, at the same time, this delay in labor increases the risk of both maternal and infection, creating confusion about whether to wait for the onset of labor or to induce labor immediately.<sup>8</sup> Early induction often results in short PROM–delivery interval, reduced likelihood of infection, and shorter hospital stay. Nonetheless, it is also associated with increased risks of failed induction, fetal distress, and caesarean delivery.<sup>9</sup>

Several studies have been conducted to address this question, but provided conflicting results. Some studies have supported early induction, showing shortened PROM to delivery interval and reduced maternal and neonatal infection,<sup>10</sup> while other studies have supported expectant management for 12 to 24 hours as a reasonable option, with reassuring maternal and fetal outcomes.<sup>11,12</sup> Awkadigwe et al. found that patients, who were induced early, showed higher caesarean section rates compared to patients who were induced after a period of expectant management (30% vs. 21%).<sup>13</sup> While other study conducted by Zutshi V et al. showed opposite results with lower caesarean section rates of 16% in early induction group and 30% in delayed induction group. They also reported shorter duration of labor in early induction group (6 hours vs. 10 hours).<sup>14</sup> With concern to the above-mentioned conflicting results, the current study aims to fill this gap by comparing maternal outcomes between early- and late-induced women with term PROM, specifically focusing on the mode of delivery.

## METHODOLOGY

This Randomized controlled trial was conducted at Obstetrics & Gynecology department of Arif Memorial Teaching Hospital, Lahore from May 2025 to September 2025. Sample size of 88 cases (44 cases in each group) was calculated with 7% level of significance, 80% power of the test, and taking the expected cesarean section rates of 16% in the early induction group and 2% in the delayed induction group<sup>15</sup> using WHO sample size calculator. Consecutive sampling technique was employed to collect the data. The study included women with a singleton pregnancy in cephalic presentation and a gestational age between 37 and 41 weeks, confirmed either by the last menstrual period or an early dating ultrasound. Only those with spontaneous premature rupture of membranes (PROM) were enrolled, as confirmed by history and sterile speculum examination. Eligible participants had a modified Bishop score of less than 6, no detectable uterine contractions on admission, clear amniotic fluid, and a duration of PROM less than six hours at the time of presentation. Patients were excluded if they had meconium-stained liquor or clinical features of chorioamnionitis such as fever, maternal tachycardia, abdominal tenderness, or foul-smelling vaginal discharge. Women with maternal medical conditions requiring urgent delivery or cesarean section, such as severe preeclampsia, renal disease, or cardiac disease, were also excluded. Additional exclusion criteria included contraindications to induction of labor such as placenta previa, vasa previa, a history of uterine surgery that increases the risk of rupture, or a previous cesarean section. After approval from hospital ethical committee (HLH/ADM/IRB/2025-013), 88 patients (44 in each group) with pre-labor rupture of membranes at term were enrolled in the study. Informed consent was obtained from all participants. Following enrollment, participants were randomized into either the early induction group (group A) or the delayed induction group (group B) through lottery method. In group A, patients were observed for 24 hours after which induction was done using 0.5 mg prostaglandin E2 (PGE2) gel in the posterior fornix of vagina. In group B, patients were immediately induced using 0.5 mg PGE2 gel. If Bishop score was not improved after 6 hours, then PGE2 gel was repeated (maximum 2 doses). Both groups were closely monitored using 4-hourly temperature recordings and 30-minute fetal heart rate auscultations. No digital vaginal examination was performed until the patient was clinically in active labor and showed signs of chorioamnionitis. Pre-labour rupture of membranes (PROM) was diagnosed on history of spontaneous drainage of clear fluid per vaginum and confirmed by pooling of fluid in the posterior vaginal fornix using a sterile speculum.<sup>10</sup> Term pregnancy was defined as a pregnancy of  $\geq 37$  weeks, determined based on the first day of the last menstrual period (LMP) and/or early ultrasound dating. Early Induction of labor was started immediately after the confirmed diagnosis of PROM with PGE2 pessary placed in posterior fornix of vagina to stimulate uterine contractions. Delayed Induction of Labor was defined when it was started more than 24 hours after the confirmed diagnosis of PROM. Outcome was measured in terms of mode of delivery and duration of labor. Mode of Delivery was the method by

which the baby was delivered either through vaginal route (vaginal delivery) or through abdominal route (caesarean section). Duration of Labor was the total time from the onset of active labor (cervix >4 cm dilated) to the delivery of the baby. Antibiotics were given to both groups every 12 hours and labor was managed according to hospital guidelines. Caesarean section was performed if there was fetal distress, non-progress of labor, and failure of induction. Failure of induction was considered if patient did not achieve active labor 6 hours after second dose of PGE2 gel. Demographic data with special attention to potential effect modifiers, including maternal age, parity, BMI, and gestational age at time of PROM was documented meticulously. All data was entered in a predesigned proforma. All relevant data was compiled and entered in SPSS v.23 for appropriate analysis. The results were illustrated in the form of tables. Continuous variables such as maternal age, BMI, gestational age, and duration of labor were presented as means with standard deviations, while categorical variables including mode of delivery were presented as frequencies and percentages. To compare the maternal outcomes between the two groups, chi-square test was used for categorical variables, and Mann Whitney U-test for continuous variable, taking  $p \leq 0.05$  as significant.

## RESULTS

The maternal age was comparable between the two groups with a mean  $\pm$  SD of  $30.75 \pm 3.58$  years in the early induction group and  $31.53 \pm 4.06$  years in the delayed induction group (median [IQR]: 31 [7] vs. 32 [5];  $p = 0.194$ ). Similarly, gestational age showed no significant

difference ( $39.22 \pm 1.40$  vs.  $39.27 \pm 1.44$  weeks, median [IQR]: 39 [3] vs. 40 [3];  $p = 0.805$ ).

Mean BMI was also equivalent ( $30.69 \pm 3.28$  vs.  $30.68 \pm 3.29$ , median [IQR]: 30.37 [6.24] vs. 30.25 [6.15];  $p = 0.997$ ).

In contrast, duration of labor was markedly shorter in the early induction group ( $13.02 \pm 2.26$  hours, median [IQR]: 13 [4]) compared to the delayed induction group ( $19.65 \pm 2.01$  hours, median [IQR]: 19 [3];  $p < 0.001$ , Mann-Whitney U test). Table -1 Stratified analysis confirmed difference across all age groups (22–30 years: 11 [3] vs. 19 [2],  $p < 0.001$ ; 31–38 years: 14 [4] vs. 19.5 [4],  $p < 0.001$ ), gestational age

strata (37–39 weeks: 13 [3.5] vs. 19 [3],  $p < 0.001$ ; 39.1–41 weeks: 12.5 [4.5] vs. 19.5 [4],  $p < 0.001$ ), BMI groups (obese: 13 [4] vs. 20 [4],  $p < 0.001$ ; non-obese: 13 [4] vs. 19 [2],  $p < 1.01$ )

, and parity ( $<3$ : 12 [4] vs. 19.5 [4],  $p < 0.001$ ;  $\geq 3$ : 13 [4] vs. 19 [2],  $p < 0.001$ ). Thus,

early induction consistently reduced the duration of labor in all subgroups. Table-2

Overall, normal vaginal delivery was significantly more frequent in the early induction group (40, 39.2%) compared to the delayed induction group (19, 18.6%), while cesarean section occurred more often in the delayed induction group (32, 31.4%) compared to the early induction group (11, 10.8%) ( $\chi^2 = 17.73$ ,  $p < 0.001$ ).

When stratified by age, gestational age, BMI, and parity, a consistent pattern emerged favoring early induction. Among women aged 22–30 years, normal delivery was achieved in 21 (58.3%) with early induction compared to only 6 (16.7%) with delayed induction, while cesarean section was required in none with early induction versus 9 (25.0%) in delayed induction ( $p < 0.001$ ).

In women aged 31–38 years, normal delivery occurred in 19 (28.8%) with early induction compared to 13 (19.7%) with delayed induction, whereas cesarean sections were more common in the delayed induction group (23, 34.8%) than in the early induction group (11, 16.7%) ( $p = 0.028$ ). A similar trend was observed across gestational age strata: at 37–39 weeks, normal delivery occurred in 23 (42.6%) with early induction versus 10 (18.5%) with delayed induction, while cesarean was higher in delayed induction (27.8% vs. 11.1%) ( $p = 0.003$ ).

At 39.1–41 weeks, 17 (35.4%) women in the early group had normal delivery compared to 9 (18.8%) in the delayed group, while cesarean was again more frequent in delayed induction (35.4% vs. 10.4%) ( $p = 0.003$ ). Similar associations were evident with BMI: in obese women, early induction resulted in 23 (41.1%) normal deliveries versus 9 (16.1%) in delayed induction, while cesarean was more frequent in delayed induction (33.9% vs. 8.9%) ( $p < 0.001$ ).

In non-obese women, 17 (37.0%) delivered normally with early induction compared to 10 (21.7%) with delayed induction, whereas cesarean was higher in delayed induction (28.3% vs. 13.0%) ( $p = 0.036$ ). Parity also influenced the association: among women with parity  $<3$ , normal delivery was achieved in 24 (41.4%) with early induction versus 10 (17.2%) with delayed induction, with cesarean more frequent in delayed induction (31.0% vs. 10.3%) ( $p = 0.001$ ).

Similarly, in women with parity  $\geq 3$ , 16 (36.4%) in the early induction group delivered normally compared to 9 (20.5%) in the delayed group, while cesarean section was again more common with delayed induction (31.8% vs. 11.4%) ( $p = 0.013$ ). Table -3

**Table -1: Comparison of age, gestational age (weeks), BMI and duration of labor (hours) in both groups in both groups**

		Groups		p-value <sup>a</sup>
		Early (n=51)	Delayed (n=51)	
<b>Age (years)</b>	Mean $\pm$ S.D	30.75 $\pm$ 3.58	31.53 $\pm$ 4.06	0.194
	Median (IQR)	31 (7)	32 (5)	
<b>Gestational age</b>	Mean $\pm$ S.D	39.22 $\pm$ 1.40	39.27 $\pm$ 1.44	0.805

<b>(weeks)</b>	Median (IQR)	39 (3)	40 (3)	
<b>BMI</b>	Mean ± S.D	30.69 ± 3.28	30.68 ± 3.29	0.997
	Median (IQR)	30.37 (6.24)	30.25 (6.15)	
<b>Duration of labor (hours)</b>	Mean ± S.D	13.02 ± 2.26	19.65 ± 2.01	<0.001
	Median (IQR)	13 (4)	19 (3)	

a) Mann Whitney U test was applied

**Table -2: Comparison of duration of labor (hours) in both groups in both groups in different strata**

		Groups	Duration of labor (hours)	
			Median (IQR)	p-value
Age groups (years)	22-30 years	Early induction (n=21)	11 (3)	<0.001
		Delayed induction (n=15)	19 (2)	
	31-38 years	Early induction (n=30)	14 (4)	<0.001
		Delayed induction (n=36)	19.5 (4)	
Gestational	37-39	Early induction (n=29)	13 (3.5)	<0.001
		Groups	Duration of labor (hours)	
			Median (IQR)	p-value
Age groups (years)	22-30 years	Early induction (n=21)	11 (3)	<0.001
		Delayed induction (n=15)	19 (2)	
	31-38 years	Early induction (n=30)	14 (4)	<0.001
		Delayed induction (n=36)	19.5 (4)	
age (weeks)	39.1-41	Delayed induction (n=25)	19 (3)	<0.001
		Early induction (n=22)	12.5 (4.5)	
		Delayed induction (n=26)	19.5 (4)	
BMI	Obese	Early induction (n=28)	13 (4)	<0.001
		Delayed induction (n=28)	20 (4)	
	Non obese	Early induction (n=23)	13 (4)	<0.001
		Delayed induction (n=23)	19 (2)	
Parity	<3	Early induction (n=30)	12 (4)	<0.001
	3 or more	Delayed induction (n=28)	19.5 (4)	
	< 3	Early induction (n=21)	13 (4)	<0.001
	3 or more	Delayed induction (n=30)	19 (2)	

**Table -3: Comparison of mode of delivery in both groups in both groups overall and in different strata**

	Mode of delivery	Groups		p-value <sup>b</sup>
		Early Induction	Delayed Induction	

		<b>Normal</b>	40 (39.2%)	19 (18.6%)	<0.001
		<b>C-section</b>	11 (10.8%)	32 (31.4%)	
<b>Age (years)</b>	<b>22–30</b>	<b>Normal</b>	21 (58.3%)	6 (16.7%)	<0.001
		<b>C-section</b>	0 (0.0%)	9 (25.0%)	
	<b>31–38</b>	<b>Normal</b>	19 (28.8%)	13 (19.7%)	0.028
		<b>C-section</b>	11 (16.7%)	23 (34.8%)	
<b>Gestational age (week)</b>	<b>37–39</b>	<b>Normal</b>	23 (42.6%)	10 (18.5%)	0.003
		<b>C-section</b>	6 (11.1%)	15 (27.8%)	
	<b>39.1–41</b>	<b>Normal</b>	17 (35.4%)	9 (18.8%)	0.003
		<b>C-section</b>	5 (10.4%)	17 (35.4%)	
<b>BMI</b>	<b>Obese</b>	<b>Normal</b>	23 (41.1%)	9 (16.1%)	<0.001
		<b>C-section</b>	5 (8.9%)	19 (33.9%)	
	<b>Non-obese</b>	<b>Normal</b>	17 (37.0%)	10 (21.7%)	0.036
		<b>C-section</b>	6 (13.0%)	13 (28.3%)	
<b>Parity</b>	<b>Parity &lt;3</b>	<b>Normal</b>	24 (41.4%)	10 (17.2%)	0.001
		<b>C-section</b>	6 (10.3%)	18 (31.0%)	
	<b>Parity ≥3</b>	<b>Normal</b>	16 (36.4%)	9 (20.5%)	0.013
		<b>C-section</b>	5 (11.4%)	14 (31.8%)	

b| Chi-square test

## DISCUSSION

The management of PROM at term indicates an important aspect of obstetric care, mainly in determining whether early or delayed induction of labor results in better outcomes.<sup>15</sup> The clinical decision involves the balance of risks associated with prolonged rupture and the potential advantages of allowing spontaneous labor onset.<sup>16, 17</sup> Since PROM can increase maternal and neonatal morbidity if not managed appropriately,<sup>17</sup> it is essential to evaluate the timing of induction for optimizing outcomes.

The present study was conducted to address the ongoing conflict regarding the best timing of induction in women with term PROM. Despite numerous studies, clinical practice still varies across different settings, mainly due to varying evidence on maternal and fetal outcomes associated with early versus delayed induction.<sup>16, 18</sup> The findings showed that the mean maternal age in the early induction group was 30.75 years, compared to 31.53 years in the delayed induction group. Although there was a slight numerical difference, it was not statistically significant, suggesting that both groups were comparable in terms of age distribution. Rana et al. showed the similar results where mean age was 27.1 years in early induction and 26.4 years in late induction group.<sup>18</sup>

In an Indian study, the comparison of gestational age between the early and delayed induction groups showed that early induction group had a mean gestational age of  $38.1 \pm 0.918$  weeks, while delayed induction group had a mean gestational age of  $37.9 \pm 0.851$  weeks, with a p-value of 0.127.<sup>18</sup> Similar results were found in our study where the p-value of 0.805 indicated non-significant difference, suggesting that both groups were comparable in terms of gestational age at the time of delivery.

Our results are consistent with earlier randomized controlled trials and meta-analyses that have favored early induction following PROM.<sup>14, 16, 18</sup> Our results showed that early induction significantly reduced the duration of labor ( $p < 0.001$ ) and increased the likelihood of normal vaginal delivery compared to delayed induction, without increasing cesarean section rates ( $p < 0.05$ ). In the study conducted by Rana et al., 75.3% (73) of patients in the early induction group delivered vaginally, while 24.7% (24) underwent cesarean section. In comparison, 63.9% (62) of patients in the delayed induction group delivered vaginally, and 36.1% (35) required cesarean section.<sup>18</sup> These findings support the clinical value of early intervention to make delivery outcomes better in term PROM cases.

However, that rate of cesarean section was significantly higher in early induction group ( $p = 0.049$ ).<sup>19</sup> On contrary, vaginal delivery within 24 hours of induction was achieved in 88.31% patients in immediate induction group and 70.13% in delayed induction group, with a p-value of 0.005.<sup>20</sup> However, this study is not without limitations. It was

conducted in a single-center setting with a moderate sample size, which limit the generalizability of findings. Moreover, neonatal outcomes such as Apgar scores, neonatal sepsis, and NICU admissions were not analyzed in detail, restricting conclusions to maternal parameters.

#### CONCLUSION:

The current study contributes valuable data supporting early induction as a safe and effective approach for managing term PROM and provides a foundation for developing standardized clinical guidelines in similar settings. The PROM-to-delivery interval was significantly shorter in the early induction group. Importantly, early induction did not result in elevated rate of cesarean section and was associated with better outcomes.

#### ETHICAL APPROVAL:

This study received ethical approval from the Ethical Review Committee of the Obstetrics & Gynecology department of Arif Memorial Teaching Hospital, Lahore, Pakistan (Ref. No: [HLH/ADM/IRB/2025-013](#)).

#### PATIENTS' CONSENT:

Informed consent was obtained from all participants included in the study.

#### COMPETING INTEREST:

The authors declared no conflict of interest.

#### AUTHORS' CONTRIBUTION:

SAA: Study design, data collection, analysis, and manuscript writing.

HYS: Study design and critical review. Both authors approved the final version of the manuscript to be published.

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