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Fetomaternal Outcomes of Early and Delayed Induction of Labour in Term Pregnancy after Premature Rupture of Membranes

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ABSTRACT

Background: Premature rupture of membranes refers to the spontaneous breaking down of the fetal membranes prior to labor initiation and affects about ten percent of term pregnancies. It elevates the risk of infection among mothers and neonatal infection, umbilical compression, and fetal distress. Management of early labor induction versus delayed induction after membrane rupture remains clinically contentious since delayed treatment poses infection risk, while early treatment increases the risk of operative delivery. **Objective:** To compare fetomaternal outcomes between early and delayed induction of labor in term pregnancies following premature rupture of membranes. **Study Design:** Comparative cross-sectional study. **Duration and Place of Study:** This study was conducted from 29 March 2025 to 29 June 2025 at the department of Obstetrics and Gynaecology, Liaqat Memorial Hospital, Kohat. **Methodology**: A total of 316 women with singleton term pregnancies and confirmed premature rupture of membranes were enrolled through consecutive non-probability sampling. Participants were divided into two groups: early induction (within 12 hours of rupture) and delayed induction (after 12 hours). Maternal outcomes assessed included chorioamnionitis, placental abruption, postpartum hemorrhage, and failed induction, while neonatal outcomes included Apgar score and neonatal sepsis. **Results:** Early induction resulted in higher vaginal delivery rates (78.5% vs. 69.0%) and significantly lower chorioamnionitis (3.8% vs. 17.7%, p<0.001) and failed induction (4.4% vs. 10.8%, p=0.034). Postpartum hemorrhage and placental abruption were less frequent in the early induction group, and low Apgar scores were also reduced (2.5% vs. 7.6%). **Conclusion:** Early induction of labor following premature rupture of membranes at term significantly improves maternal and neonatal outcomes, reducing infectious complications and delivery failures compared to delayed induction.

INTRODUCTION

Premature rupture of membranes (PROM) is defined as a spontaneous disruption of the amniotic membrane before the initiation of uterine contraction.[1] This happens in around 8–10% of term pregnancies.[2] Rupture compromises the intrauterine cover protection, which elevates the risk of ascending infection, umbilical compression, or fetal distress.[3] Etiologic factors consist of membrane weakening due to infection, collagen breakdown, or excessive intrauterine pressure.[4] Predisposing factors consist of genital tract infection, smoking, multiple per vaginal examination, and antecedent episodes of PROM.[4] In the case of term occurrence of PROM, clinicians have difficulty in deciding to carry out labor induction early or to take up expectant management since increased latency increases infection risk and early induction elevates the risk of operative delivery.[5]

The goal of labor induction in the setting of PROM involves limiting the interval between rupture and delivery in an effort to reduce maternal and neonatal infection risk.[6] Early induction begun within 12–24 hours of rupture is frequently linked to reduced chorioamnionitis and neonatal sepsis rates, while delayed initiation results in increased infection rates.[7] Oxytocin and prostaglandins are used pharmacologically, based on cervical favorableness and hospital protocol.[8] In carefully selected cases with a high Bishop score, spontaneous labor can be awaited in an effort to prevent unnecessary intervention.[8] During this latency period, close maternal temperature, fetal heart rate, and clinical signs of infection surveillance improve perinatal safety to its optimum level.[9]

Fetomaternal results following PROM depend on early and delayed initiation. Early initiation lowers chorioamnionitis risk a bacterial infection of the amniotic membrane resulting in maternal pyrexia, uterine spasticity, and

neonatal sepsis.[10] Nonetheless, delayed initiation elevates infection risk inside the uterus, potentially resulting in placental abruption due to inflammatory placental extension degradation.[11] Furthermore, postpartum hemorrhage risk escalates in delayed initiation due to infection or prolonged labor related uterine atony.[12] On-time initiation, prophylactic antibiotic therapy, and cautious intrapartum treatment and maternal administration enhance maternal and neonatal outcomes.[11] Hence, attainment of an appropriate equilibrium between early and delayed initiation in PROM significantly pulsates in the attainment of suitable fetomaternal wellbeing optimization.

A study has shown that among patients who underwent early induction of labour, the incidence of chorioamnionitis was lower (1.3%). The majority achieved normal vaginal delivery (85%), while instrumental delivery occurred in 21% and failed induction in 2.5% of cases. Lower segment cesarean section was required in 13.7% of patients. Neonatal outcomes were generally favorable, with limited cases of low APGAR scores—10% at 1 minute and 1.3% at 5 minutes. Fetal distress was observed in 7.5% of cases, neonatal infection in 2.5%, and notably, no early neonatal deaths were reported.[13]

This research in Kohat was undertaken to assess local fetomaternal outcomes after early and late induction following premature ruptures of membranes since regional differences in obstetric practice and infection control could affect findings. Scarcity of data from the region limits evidence-based decision-making on the optimal timing of induction. By carrying it out in Kohat, it will be possible to determine common maternal complications like chorioamnionitis, placental abruption, and postpartum haemorrhage and induction timing in relation to them. Development of region-based resultant in-treatment procedures to enhance maternal and neonatal health outcomes in local treatment settings will be facilitated by the findings.

METHODOLOGY

This study was conducted from 29 March 2025 to 29 June 2025 at the department of Obstetrics and Gynaecology, Liaqat Memorial Hospital, Kohat. Before starting the research, permission was taken from the hospital ethical committee to make sure that all work was done according to ethical principles. The total sample size was 316 women, calculated by WHO software by using 95% confidence level, 1.25% margin of error and expected population proportion of 1.3%.[13] Sampling was done by consecutive non-probability technique where all eligible women coming during study period were included till sample size was completed.

Women were included if they had pregnancy between 37 and 41 weeks confirmed by history and ultrasound, with single baby in head-down position and clear amniotic fluid. Those with Bishop score less than 5 were considered suitable for induction as cervix was not ready for spontaneous labour. PROM was taken as rupture of membranes before start of labour after 37 completed weeks of gestation. Women having fever, abdominal pain or tenderness, foul smell discharge showing infection, history of previous cesarean, twin pregnancy, breech position, antepartum hemorrhage or growth restricted baby were excluded. Written consent was taken from all participants after explaining the purpose and method of study. Their information was kept private and only used for research purpose.

Detailed history was taken and general as well as obstetric examination was performed. PROM was confirmed by sterile speculum examination and ultrasound. Women were divided into two groups depending on time gap between rupture of membranes and start of induction. Those induced within 12 hours were taken as early induction group and those induced after 12 hours as delayed induction group. Antibiotics were given to all women for protection from infection and they were monitored closely for labour progress and baby condition. Labour was started according to hospital guideline. If contractions did not start within four hours, another dose was given. When there was no progress after two doses, it was labelled as failed induction and cesarean section was performed. Women showing cervical opening with contractions were given oxytocin to help labour. In case of fetal distress or placental abruption, emergency cesarean was done. Pediatrician was available for baby assessment and resuscitation when required.

Maternal outcomes included infection of membranes known as chorioamnionitis, separation of placenta before delivery called placental abruption, heavy bleeding after childbirth which was taken as blood loss of 500 ml or more (postpartum hemorrhage), and sepsis which means severe infection causing organ dysfunction. Fetal outcomes included APGAR score at one minute to check baby's breathing and health condition, and neonatal sepsis which was infection of blood in baby.

All data was entered and analyzed by SPSS version 20. Mean and standard deviation were calculated for continuous variables like age, parity, gravidity and gestational age. Categorical variables such as education, occupation, socioeconomic level, mode of delivery and complications were presented as frequency and percentage. Stratification was done for age, parity, and other related variables. Chi-square test was used and p-value equal or less than 0.05 was taken as significant.

RESULTS

In early induction group, mean age was 29.47 ± 6.73 years while in delayed induction group it was 28.71 ± 6.94 years. The mean gestational age was 38.92 ± 1.51 weeks in early induction group and 38.89 ± 1.33 weeks in delayed induction group. Mean parity was 2.50 ± 1.43 in early induction group compared to 2.39 ± 1.45 in delayed induction group. Regarding socioeconomic status, low socioeconomic status was observed in 99 (62.7%) patients in early induction group and 97 (61.4%) in delayed induction group, middle socioeconomic status was found in 40 (25.3%) and 50 (31.6%) patients respectively, while high socioeconomic status was present in 19 (12.0%) and 11 (7.0%) patients in early and delayed induction groups respectively. Educational status showed that 41 (25.9%) patients were educated in early induction group compared to 29 (18.4%) in delayed induction group, whereas 117 (74.1%) were uneducated in early induction group and 129 (81.6%) in delayed induction group as shown in Table

1.

Table1

Patient Demographics in Both Groups

Demographics	Early Induction n=158 Mean ± SD	Delayed Induction n=158 Mean ± SD
Age (years)	29.47 ± 6.73	28.71 ± 6.94
Gestational Age (weeks)	38.92 ± 1.51	38.89 ± 1.33
Parity	2.50 ± 1.43	2.39 ± 1.45
Socioeconomic Status	**n (%)**	**n (%)**
Low	99 (62.7%)	97 (61.4%)
Middle	40 (25.3%)	50 (31.6%)
High	19 (12.0%)	11 (7.0%)
Education Level		
Educated	41 (25.9%)	29 (18.4%)
Uneducated	117 (74.1%)	129 (81.6%)

Mode of delivery showed that vaginal delivery occurred in 124 (78.5%) patients in early induction group versus 109 (69.0%) in delayed induction group with p-value of 0.055, while cesarean section was performed in 34 (21.5%) patients in early induction group compared to 49 (31.0%) in delayed induction group. Chorioamnionitis was present in 6 (3.8%) patients in early induction group and 28 (17.7%) in delayed induction group which showed highly significant difference with p-value <0.001, while it was absent in 152 (96.2%) and 130 (82.3%) patients respectively. Placental abruption occurred in 1 (0.6%) patient in early induction group versus 5 (3.2%) patients in delayed induction group with p-value of 0.214 using Fisher's exact test, while it was not present in 157 (99.4%) and 153 (96.8%) patients respectively. Postpartum hemorrhage was observed in 6 (3.8%) patients in early induction group compared to 13 (8.2%) in delayed induction group with p-value of 0.098, while it was absent in 152 (96.2%) and 145 (91.8%) patients respectively. Failed induction occurred in 7 (4.4%) patients in early induction group versus 17 (10.8%) in delayed induction group with statistically significant p-value of 0.034, whereas successful induction was achieved in 151 (95.6%) and 141 (89.2%) patients respectively. Low Apgar score at 1 minute was found in 4 (2.5%) neonates in early induction group compared to 12 (7.6%) in delayed induction group with p-value of 0.069 using Fisher's exact test, while normal Apgar scores was present in 154 (97.5%) and 146 (92.4%) neonates respectively as shown in Table 2.

Table 2

Comparison of Maternal and Fetal Outcomes Between the Two Groups

Maternal and Fetal Outcomes	Early Induction n=158	Delayed Induction n=158	P Value
Mode of Delivery	**n (%)**	**n (%)**	
Vaginal	124 (78.5%)	109 (69.0%)	0.055
C-section	34 (21.5%)	49 (31.0%)	
Total	158 (100%)	158 (100%)	
Chorioamnionitis			
Yes	6 (3.8%)	28 (17.7%)	
No	152 (96.2%)	130 (82.3%)	<0.001
Total	158 (100%)	158 (100%)	
Placental Abruption			
Yes	1 (0.6%)	5 (3.2%)	
No	157 (99.4%)	153 (96.8%)	0.214*
Total	158 (100%)	158 (100%)	
Postpartum Hemorrhage			
Yes	6 (3.8%)	13 (8.2%)	
No	152 (96.2%)	145 (91.8%)	0.098
Total	158 (100%)	158 (100%)	
Failed Induction			
Yes	7 (4.4%)	17 (10.8%)	
No	151 (95.6%)	141 (89.2%)	0.034
Total	158 (100%)	158 (100%)	
Low Apgar Score at 1 min			
Yes	4 (2.5%)	12 (7.6%)	
No	154 (97.5%)	146 (92.4%)	0.069*
Total	158 (100%)	158 (100%)	

*Fisher's exact test used

DISCUSSION

The findings of this study demonstrated that early induction of labour was associated with significantly better maternal and fetal outcomes compared to delayed induction approach. The demographic characteristics between both groups was comparable which eliminated the potential confounding variables and ensured that differences in outcomes was due to timing of induction rather than baseline patient characteristics. The mode of delivery showed higher rate of vaginal delivery in early induction group (78.5%) compared to delayed induction group (69.0%) though the difference was not statistically significant (p=0.055). This trend toward increased vaginal delivery in early induction group can be explained by the fact that early intervention prevents the cascade of complications that may necessitates cesarean delivery. The prolonged rupture of membranes in delayed induction group may leads to increased risk of intrauterine infection and fetal distress which ultimately increases the cesarean section rate. The most significant finding was markedly lower incidence of chorioamnionitis in early induction group (3.8%) compared to delayed induction group (17.7%) with highly significant p-value <0.001. This substantial difference can be attributed to reduced duration of membrane rupture in early induction group which minimizes the time window for ascending bacterial infection from vagina and cervix into the amniotic cavity. The longer the membranes remains ruptured, the greater is the opportunity for pathogenic organisms to colonize the amniotic fluid and fetal membranes leading to clinical chorioamnionitis. The incidence of failed induction was significantly lower in early induction group (4.4%) versus delayed induction group (10.8%) with p-value of 0.034. This can be explained by the fact that early induction is performed when cervix is more favorable and uterus is more responsive to oxytocic agents. In delayed induction, prolonged rupture of membranes may causes changes in cervical tissue and decreases uterine contractility due to inflammatory mediators released during subclinical infection, thereby reducing the success rate of labour induction.

In present study, vaginal delivery rate was 78.5% in early induction group compared to 69.0% in delayed induction group which is comparable to the findings reported by Shaikh AM, et al. [14] who found 73% vaginal delivery rate and Patel AJ, et al. [15] who reported 73.2% vaginal delivery in their study population with PROM. Similarly, Yaqub U, et al. [16] demonstrated higher spontaneous vaginal delivery rate in induction group (83.8%) versus expectant management group (76.0%) which supports our findings

that early induction promotes vaginal delivery. However, Rakshith RN, et al. [17] reported lower vaginal delivery rate of 53.41% in term primigravida with PROM which differs from our results, this difference can be attributed to the fact that their study exclusively included primigravida patients who generally has higher cesarean section rates due to unfavorable cervix and longer labor duration compared to multiparous women included in our study. The cesarean section rate in present study was 21.5% in early induction group versus 31.0% in delayed induction group which was similar to rates reported by Shaikh AM, et al. [14] who found 26% cesarean section rate and Patel AJ, et al. [15] who reported 26.8% cesarean section rate in their PROM cases.

The most significant finding in current study was markedly lower incidence of chorioamnionitis in early induction group (3.8%) compared to delayed induction group (17.7%) with p-value <0.001. This finding is strongly supported by multiple studies in literature. Patel AJ, et al. [15] reported chorioamnionitis rate of 3.2% in their study which is very similar to our early induction group rate, suggesting that timely intervention prevents this complication. Yaqub U, et al. [16] also demonstrated lower chorioamnionitis in induction group (4.1%) compared to expectant management group (6.7%) which reinforces our findings that early induction reduces infectious morbidity. Similarly, Rana M, et al. [18] reported 6.6% chorioamnionitis rate in their PPROM cases managed conservatively which was higher than our early induction rate but lower than our delayed induction rate. However, Jha S, et al. [19] reported higher chorioamnionitis in group delivered before 34 weeks (9.6%) compared to those delivered at or after 34 weeks (3.8%) but this difference can be explained by the fact that their study population was preterm PROM cases where prematurity itself increases infection risk, whereas our study focused on term pregnancies. The substantially higher rate of chorioamnionitis in our delayed induction group (17.7%) emphasizes the importance of early intervention as prolonged rupture of membranes provides extended opportunity for ascending infection which is consistent with biological plausibility and clinical observations.

Regarding failed induction, present study showed significantly lower rate in early induction group (4.4%) versus delayed induction group (10.8%) with p-value of 0.034. This finding is indirectly supported by Shafqat T, et al. [20] who reported successful spontaneous vaginal delivery in 85.1% of cases with low-dose misoprostol induction, indicating high success rate when induction is performed timely. The higher failed induction rate in delayed group can be explained by cervical changes and decreased uterine responsiveness that occurs with prolonged membrane rupture and subclinical infection. Gupta S, et al. [13] found that immediate induction with PGE2 gel resulted in shorter PROM-to-delivery interval (14 hours) compared to delayed induction with oxytocin (22 hours) which suggests better cervical ripening and uterine response in early induction, supporting our findings of lower failed induction rates in early group.

The incidence of postpartum hemorrhage in current study was 3.8% in early induction group compared to 8.2% in delayed induction group though the difference was not statistically significant (p=0.098). This trend toward increased bleeding in delayed group may be related to chorioamnionitis and endometritis which compromises uterine contractility after delivery. Rakshith RN, et al. [17] reported higher maternal complications including puerperal sepsis (12.5%) and endometritis (5.69%) in their PROM cases which indirectly supports our finding that delayed management increases maternal morbidity.

Regarding neonatal outcomes, present study found low Apgar score at 1 minute in 2.5% of neonates in early induction group versus 7.6% in delayed induction group with p-value of 0.069 which showed trend toward significance. This is consistent with findings of Yaqub U, et al. [16] who reported comparable APGAR scores between induction and expectant groups but with better overall neonatal outcomes in induction group. Shafqat T, et al. [20] reported APGAR score ≥8 at 1 minute in 84% of neonates with induction which indicates that early intervention maintains good neonatal condition. The higher rate of low Apgar scores in our delayed induction group can be attributed to increased risk of intrauterine infection and fetal distress associated with prolonged rupture of membranes. Rakshith RN, et al. [17] reported that 82.73% of cesarean sections was due to fetal distress and NICU admission was required in 37.5% of neonates which further supports that delayed management increases neonatal morbidity. Similarly, Zia MS, et al. [21] demonstrated that active management resulted in shorter PROM-to-delivery interval and comparable neonatal outcomes, reinforcing the safety and efficacy of early induction approach.

The present study has several limitations that should be acknowledged. Firstly, this was single center study conducted at one tertiary care hospital which may limits the generalizability of findings to other healthcare settings with different patient populations and resource availability. The sample size of 316 patients, although adequate for statistical analysis, was relatively small and larger multicenter trials would provide more robust evidence. Secondly, the study did not evaluate long-term maternal and neonatal outcomes beyond immediate postpartum period, therefore the impact of early versus delayed induction on subsequent maternal health and infant development remains unknown. Thirdly, the exact timing of membrane rupture was based on patient's self-reporting which may introduces recall bias and affects the accuracy of PROM duration calculations. Additionally, the study did not account for different induction agents and protocols used which could have influenced the outcomes independently.

CONCLUSION

Our study has concluded that early induction of labour in term pregnancy after premature rupture of membranes is associated with significantly better fetomaternal outcomes compared to delayed induction approach. The early induction strategy demonstrates substantial reduction in maternal infectious morbidity particularly chorioamnionitis, lower rates of failed induction, and trend toward improved neonatal outcomes with better

Apgar scores.

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