Maternal and Neonatal Outcomes of Expectantly Managed Pregnancies of Healthy Cases with Previable Rupture of Membranes at Qena University Hospital

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Abstract

Background: Preterm rupture of membranes (PROM) affects 3% of pregnancies, with 0.4% experiencing second-trimester ROM. Gestational age at PROM strongly influences outcomes. Neonatal survival rates vary by gestational age. Short latency (<48 hours) after viability (>24 weeks) is associated with adverse outcomes.

Objectives: Analyze maternal and neonatal outcomes in patients with previable rupture of membranes (PPROM) between 20-28 weeks of pregnancy.

Patients and methods: Retrospective study at Qena University Hospital (June 2020-June 2022) on singleton pregnancies with PPROM. Inclusion criteria: no active labor, chorioamnionitis, fetal anomalies, iatrogenic ROM, or multiple gestations. Data collected: maternal demographics, obstetric history, gestational age at ROM, delivery, interventions; neonatal data including birth weight, Apgar scores, NICU admission, diagnoses, survival.

Results: The mean age 26.72 ± 5.51 years and BMI 25.18 ± 4.44 kg/m^2, with 9.38% underweight, 37.5% normal weight, 34.38% overweight, and 18.75% obese. The average gravidity was 3 with a range of 0-8. Parity averaged 2 with a range of 0-7. The mean number of abortions was 1 with a range of 0-5, with 26.56% history of preterm labor. Maternal complications included chorioamnionitis (12.5%), sepsis (4.69%), and cord prolapse (7.81%). Neonatal viability was 67.19%. Among viable fetuses (N = 43), Apgar scores (1 min: 6.7 ± 2.32, 5 min: 7.07 ± 2.45), NICU admission (62.79%, stay: 8.01 ± 5.94 days), and NICU survival (37.21%, N = 35), with 74.42% overall viability.

Conclusion: Challenges in early preterm births highlight the need for tailored care. Adverse neonatal outcomes underscore the necessity of targeted strategies for this vulnerable population.

Keywords: Maternal outcomes, Neonatal outcomes, ROP, Pregnancy Management

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Introduction

Preterm rupture of membranes (PROM) occurs in 3% of pregnancies **(Bracha et al., 2021).** Around 0.4% of pregnancies are complicated by second trimester ROM **(Sorano et al., 2020).** Prenatal outcome is strongly correlated with gestational age at PROM. Second trimester ROM can cause fetal death, significant preterm, and maternal problems **(Oğlak et al., 2023; Kraft et al., 2022).**

The newborn prognosis for second trimester ROM is dismal. Expectant PROM care between 14-24 weeks has a 26.3% neonate survival rate to discharge **(Pendse et al., 2021).** The range of newborn survival for PROM before 20 weeks gestation is 0-33%, while between 20-23 weeks it is 8-50% **(Shanbhag et al., 2020).**

The 2nd trimester PROM challenges patient counseling and management decisions. In 143 second-trimester PROM pregnancies, gestational age at PROM and latency duration were the most critical factors affecting newborn survival to discharge **(Ronzoni et al., 2022).**

The literature suggests factors affecting PROM delay after viability (>24 weeks). A short latency period (<48 hours) is linked to higher cervical dilatation at admission, nulliparity, fetal growth restriction, and oligohydramnios in PROM occurring between 24-34 weeks gestation, and is inversely associated with gestational age at rupture **(Can et al., 2022; Boettcher et al., 2020).** Twin gestation and chorioamnionitis have also been linked to shorter delay after PROM after 24 weeks **(Shazly et al., 2020).**

There is little research on whether these clinical conditions also cause delay after second trimester PROM. We looked for clinical factors that may be associated with delivery before viability after second trimester PROM to predict at presentation whether a patient can achieve a long enough latency period to deliver beyond viability **(Neamah et al., 2020; Sim et al., 2020).**

This study aimed to analyze maternal and neonatal outcomes in patients with previable rupture of membranes (PPROM) between 20_28 weeks of pregnancy to identify potential outcome predictors.

Patients and Methods

The technical design of the study entails a retrospective observational cohort study. It was conducted at the Obstetrics and Gynecology Department of Qena University Hospital over a period from June 2020 to June 2022 with ethical code: **SVU/MED/OBG024/1/23/7/689.** The study focused on patients meeting specific criteria. Inclusion criteria comprised healthy cases with no systemic diseases who received care at Qena Woman Hospital, with singleton pregnancies, experiencing previable rupture of membranes (ROM), and gestational ages ranging from 20 to 28 weeks. Conversely, exclusion criteria included signs of active labor before or at the onset of previable ROM, signs of active chorioamnionitis upon admission, visible fetal structural anomalies on ultrasound examination, iatrogenic rupture of membranes (within 2 weeks of amniocentesis or chorionic villus sampling), pre-labor rupture of membranes occurring after viability, a latency period of less than 24 hours, and multiple fetal gestations.

The operational design of the study involved a thorough review of medical records to identify eligible pregnancies. Specifically, women with a singleton pregnancy complicated by second-trimester premature rupture of membranes (PROM) were considered for inclusion if the rupture of membranes occurred between 20 and 28 weeks of gestation and if they achieved a latency period of at least 24 hours. To establish previable rupture of membranes (ROM), various diagnostic methods were employed, including visual inspection of amniotic fluid passing from the cervical

canal and pooling in the vagina via sterile speculum examination, a basic pH (positive nitrazine) test of vaginal fluid, or an amniotic fluid index (AFI) of less than 4 cm, coupled with patient-reported history indicating significant loss of vaginal fluid prior to 28 weeks of gestational age. Exclusion criteria were applied to ensure the integrity of the study sample, with women being excluded if there was clinical evidence of chorioamnionitis upon presentation, if labor ensued within 24 hours of rupture, if the pregnancy was complicated by a major fetal anomaly, or if PROM occurred within 2 weeks of chorionic villus sampling/amniocentesis. Additionally, women who opted for immediate delivery at the time of PROM diagnosis were also excluded from the analysis, thereby ensuring the homogeneity of the study population and the reliability of the findings.

The study extensively collected data from the medical records of patients, encompassing various facets of maternal and obstetric care. Standard interventions for preterm premature rupture of membranes (PPROM) following readmission were meticulously recorded, including the administration of latency antibiotics, a course of glucocorticoids for fetal lung maturity, and magnesium sulfate for fetal neuroprotection. Throughout the period from readmission to delivery, inpatient observation was maintained, ensuring comprehensive monitoring of maternal health and well-being.

Maternal data obtained from the records included demographic characteristics such as age, race, ethnicity, and body mass index (BMI). Additionally, gravidity, which represents the total number of pregnancies irrespective of outcome, and parity, indicating the number of viable offspring delivered beyond 20 weeks of gestation, were documented. Any history of previous preterm deliveries was also noted. Obstetric data provided valuable insights into the timing of events, including the gestational age at rupture of membranes and delivery. The latency period, defined as the number of days from rupture of membranes to delivery, was carefully recorded. Information regarding the receipt of antibiotics prior to delivery, the route of delivery (vaginal or cesarean section), and any complications encountered during the pregnancy, such as chorioamnionitis, maternal sepsis, and cord prolapse, was meticulously documented. Moreover, the maternal length of stay in the hospital, encompassing initial observation, readmission, delivery, and postpartum inpatient care, was calculated to assess the duration of hospitalization and resource utilization.

The study meticulously collected neonatal data, encompassing various vital aspects of newborn health and outcomes. This included documenting instances of intrauterine fetal demise, which refers to the death of a baby while in the mother's uterus after the 20th week of pregnancy. Furthermore, neonatal birth weight, measured to the nearest 0.01 kg using a digital scale, provided crucial insights into the infants' growth and development trajectory. Apgar scores at 1 and 5 minutes after birth were carefully recorded, with scores ranging from 0 to 10, where higher scores indicated better overall health and adaptation to the extrauterine environment (**Table.1, Simon et al., 2017).**

Additionally, the study captured the need for admission to the neonatal intensive care unit (NICU), reflecting the severity of neonatal conditions and the level of medical care required. The length of stay in the NICU was also documented, indicating the duration of specialized medical attention. Neonatal survival parameters were comprehensively assessed, including admission to the NICU with survival until

discharge, admission to the NICU followed by neonatal death prior to discharge, or neonatal death without NICU admission.

The study meticulously documented neonatal diagnoses at the time of discharge from the neonatal intensive care unit (NICU), shedding light on the array of health issues encountered by newborns. Among these diagnoses, pulmonary hypoplasia was identified, indicating underdevelopment or incomplete growth of the lungs. Additionally, bronchopulmonary dysplasia was noted, characterized by inflammation and scarring in the lungs, often associated with mechanical ventilation and oxygen therapy. Respiratory distress, manifested as rapid breathing, grunting, flaring of nostrils, and retractions of the chest wall, was also documented.

Table 1. Apgar score (Simon et al., 2017)

	Sign	Score		
		2	1	0
A	Appearance (skin colour)	Normal over entire body	Normal except extremities	Cyanotic or pale all over
P	Pulse(heart rate)	>100 bpm	<100bpm	Absent
G	Grimace response(reflexes)	Sneezes, coughs, pulls away	Grimaces	No response
A	Activity (muscle tone)	Active	Arms and legs flexed	Absent
R	Respiration (breathing rate and effort)	Good, crying	Slow, irregular	Absent

Furthermore, intraventricular hemorrhage (IVH) was classified into grades, with Grades III and IV considered severe IVH. Grade I denoted hemorrhage limited to the germinal matrix, while Grade II indicated IVH without ventricular dilatation. Grade III represented IVH with ventricular dilatation occupying more than 50% of the ventricle, and Grade IV signified IVH with intraparenchymal hemorrhage **(Egesa et al., 2021).** Periventricular leukomalacia, characterized by white-matter brain injury and the necrosis of white matter near the lateral ventricles, was another diagnosis identified.

Additionally, cases of necrotizing enterocolitis, a severe condition involving inflammation and necrosis of the intestine, were recorded. Neonatal sepsis, attributed to confirmed bacterial infection, was meticulously assessed based on specific criteria **(Levy et al., 2003).** These criteria included body temperature higher than 38°C or lower than 36°C, heart rate exceeding 90 beats per minute, hyperventilation evidenced by a respiratory rate higher than 20 breaths per minute or PaCO2 lower than 32 mmHg, and white blood cell count higher than 12,000 cells/µL or lower than 4,000 cells/µL. Each diagnosis was rigorously defined, ensuring accuracy and consistency in the assessment of neonatal health outcomes.

Study outcomes

Primary outcome: To investigate the maternal and neonatal outcomes of conservative management of Previable ROM at 20-28 weeks gestational ages in Qena University hospital, and to determine the impact of the protocol on hospital stay (bed occupancy rate).

Secondary (subsidiary): To evaluate the quality of care delivered to women undergoing inpatient management with

PROM compared with a recently instituted hospital protocol.

Statistical analysis

Data analyzed using SPSS 25.0. Methods: Expressing data as number/percentage for qualitative variables and mean ± SD for quantitative ones. Statistical analysis included mean for central tendency and SD for dispersion. Comparison using t-test for two groups' means, checked against t-table for significance. Mann-Whitney test for non-normally distributed data, and Chi-square test for association between variables. Significance level set at $p < 0.05$, where smaller p values denote higher significance.

Results

(**Table.2**) presents demographic characteristics of the study cohort (N = 64). The mean age of the subjects was 26.72 years with a standard deviation of 5.51 years. The average BMI was 25.18 kg/m^2, with a standard deviation of 4.44 kg/m^2. In terms of BMI categories, 9.38% of participants were underweight, 37.5% were categorized as normal weight, 34.38% were overweight, and 18.75% were obese.

Table 2. Age and BMI data of included subjects

Variables	Value (N = 64)
Age (Years)	26.72 ± 5.51
BMI (Kg/m^2)	25.18 ± 4.44
• **Underweight**	6 (9.38%)
• **Normal**	24 (37.5%)
• **Overweight**	22 (34.38%)
• **Obese**	12 (18.75%)

(**Table.3**) outlines obstetric characteristics of the study participants (N = 64). The average gravidity was 3 with a range of 0-8. Parity averaged 2 with a range of0-7. The mean number of abortions was 1 with a range of 0-5. Additionally, 26.56% had a history of previous preterm labor.

Table 3. Obstetric data of included subjects

Variables	Value (N = 64)
Gravidity	
Average	3
Range	0-8
Parity	
Average	2
Range	0-7
Abortion	
Average	1
Range	0-5
History of previous Preterm Labor	17 (26.56%)

The mean gestational age at time of delivery was 30.11±6.17 weeks, The latency period was 5.11±4.8. 30 (46.88%) women delivered by CS and 34 (53.13%) women delivered by vaginal delivery. Maternal complications included chorioamnionitis in 12.5% of cases, maternal sepsis in 4.69%, and cord prolapse in 7.81%. Regarding neonatal outcomes, 67.19% of newborns were viable at birth (**Table.4**).

Table 4. Materno-Fetal outcomes among included subjects

Variables	Value (N = 64)
Gestational age at time of delivery (Weeks)	30.11 ± 6.17
Latency period (Weeks)	5.11 ± 4.8
Mode of delivery	
• **Cesarean section (CS)**	30 (46.88%)
• **Vaginal delivery**	34 (53.13%)
Maternal complications	
• **Chorioamnionitis**	8 (12.5%)
• **Maternal sepsis**	3 (4.69%)
• **Cord prolapse**	5 (7.81%)
Neonatal outcomes	
• **Viability at birth**	43 (67.19%)

(**Table.5**) summarizes outcomes of viable fetuses (N = 43). Apgar scores at 1 minute averaged 6.7 with a standard deviation of 2.32, and at 5 minutes averaged 7.07 with a standard deviation of 2.45. Neonatal birth weight averaged 2.47 kg with a standard deviation of 0.78 kg. About 62.79% of newborns were admitted to the neonatal intensive care unit (NICU), with an average length of stay of 8.01 days and a standard deviation of 5.94 days. Among those admitted, 37.21% survived at the time of discharge from the NICU (N = 35). Common neonatal complications included pulmonary hypoplasia in 41.86% of cases, respiratory distress syndrome in 25.58%, neonatal sepsis in 20.93%, intraventricular hemorrhage in 2.33%, and pneumonia in 13.95%. Overall, 74.42% of viable fetuses survived

.Table 5. Viable fetuses outcome

Variables	Value (N = 43)
Apgar score	
• **1 minute**	6.7 ± 2.32
• **5 minutes**	7.07 ± 2.45
Neonatal birth weight (kg)	2.47 ± 0.78
Admission to NICU	27 (62.79%)
• **Length of NICU stay (days)**	8.01 ± 5.94
• **Survival at time of discharge from NICU**	16 (37.21%)
Neonatal complications	
• **Pulmonary hypoplasia**	18 (41.86%)
• **Respiratory Distress Syndrome**	11 (25.58%)

• **Neonatal sepsis**	9 (20.93%)
• **Intraventricular hemorrhage**	1 (2.33%)
• **Pneumonia**	6 (13.95%)
All survivals from viable fetuses	32 (74.42%)

Discussion

Obstetrics is complicated by preterm premature rupture of membranes (PPROM) before fetal viability. This syndrome causes spontaneous amniotic membrane rupture before 24 weeks of gestation, making expectant care difficult. Obstetric care decision-making requires knowledge of maternal and newborn outcomes in expectantly treated pregnancies with previable rupture of membranes **(Feduniw et al., 2022; Hirata et al., 2022).**

Allowing the pregnancy to continue safely while minimizing maternal and newborn problems is expected treatment. In expectantly handled instances, maternal outcomes include intrauterine infections such chorioamnionitis, hemorrhagic complications including placental abruption, and psychological stress from newborn health uncertainty. The possibility of spontaneous or induced premature birth complicates maternal health issues **(Ronzoni et al., 2022).**

Extreme prematurity affects neonatal outcomes in previable rupture of membranes pregnancies. These babies are at risk for respiratory distress syndrome, intraventricular hemorrhage, and bronchopulmonary dysplasia. Infections and pulmonary hypoplasia are other risks of prolonged amniotic exposure, especially when membrane rupture occurs early in gestation. Providing thorough and compassionate care to women and their newborns requires understanding these potential consequences **(Günes et al., 2022; Ronzoni et al., 2022).**

Current study examines variables affecting preterm premature rupture of membranes (PROM) latency after viability (>24 weeks). Lower gestational age, higher cervical dilatation, nulliparity, fetal development difficulties, and oligohydramnios are associated with shorter latency in the 24-34 week period. Both twin gestation and clinical chorioamnionitis decrease delay. These variables for second-trimester PROM **(Point et al., 2022; Zhou et al., 2022; Sohn et al., 2022)** are unclear.

We found a mean age of 27.39 years, gravidity of 3.46, parity of 2.2, and abortion rate of 0.93. A history of preterm labor (30.49%) and preterm premature rupture of membranes (24.39%) is noteworthy. There was no difference in mother general statistics between viable and nonviable fetuses.

Our results align with **ÖZEL & ÇAKMAK (2023)** who studied demographic and obstetric outcomes in preterm premature rupture of membranes (PPROM) before and after 24 weeks. With p values of 0.547, 0.936, and 0.985, pre-viable (n=42) and viable (n=92) PPROM patients had similar maternal ages (28 vs. 30 years), gravida (2 vs. 2), and parity (1 vs. 1).

Similarly, **Can & Oğlak (2022)** studied demographics and pregnancy outcomes in 128 patients, divided into Early PPROM (n=36) and Late PPROM (n=92). The maternal age averaged 28.1 ± 6.2 years, with no significant difference between Early (26.6 ± 6.1 years) and Late (28.7 ± 6.2 years) PPROM groups (p=0.090). Primigravida made up 26.6% of the population, 22.2% of Early PPROM and 28.3% of Late PPROM (p=0.487). Primiparous patients made up 37.5%, 33.3% in Early PPROM and 39.1% in Late PPROM (p=0.542). Preterm labor occurred in 4.7% of the population, 2.8% in Early PPROM and 5.4% in Late PPROM (p=0.523). Overall, 6.3% had PPROM, with

5.6% in Early and 6.5% in Late (p=0.83). These factors were similar in Early and Late PPROM groups.

Our investigation found problems in maternal outcomes. Chorioamnionitis was the most common at 14.63 percent, followed by maternal sepsis at 4.88 percent and cord prolapse at 7.32 percent. In contrast, **Mung-Yuen, Tsz-Kin (2018)** found 71.4% caesarean sections and 26% chorioamnionitis.

Clinical chorioamnionitis was diagnosed in 12% of patients and histological in 69%, according to **Linehan, Walsh (2016).** Sepsis was 2.4%, IV antibiotics 38%, retained placenta 21%, and postpartum hemorrhage 12%. In twin pregnancies with previable PPROM, **Ponce, Cobo (2023)** found 16.7% maternal morbidity and 22.2% chorioamnionitis.

In **Kraft, Schütze (2022),** 64.7% chose medical termination, 19.6% spontaneously aborted, and 29.4% had intraamniotic infection. Without maternal sepsis or death, **Mohan, Fatema (2018)** noted a low risk of severe maternal morbidity and mortality. Despite treatment breakthroughs, prenatal prognosis is difficult.

Neonatal outcomes showed a 69.51% viability rate, with Apgar scores at 1 minute (6.6 ± 2.28) and 5 minutes (7.04 ± 2.31). The NICU admission rate was 61.4%, and 73.68% of viable fetuses survived. Not viable fetuses had higher rates of maternal problems such chorioamnionitis, maternal sepsis, and cord prolapse.

The NICU subgroup analysis showed differences between viable neonates admitted and those not admitted. We found that 57.14% (20) of 35 NICU-admitted neonates survived, whereas 42.86% (15) died. NICU-admitted newborns had shorter latency and lower WGA at birth. At NICU admission, ultrasounds showed a greater frequency of moderate oligohydramnios and a considerable drop in average amniotic fluid volume.

NICU-admitted newborns had lower Apgar scores at 1 and 5 minutes, lower birth weight, and more pulmonary hypoplasia, respiratory distress syndrome, neonatal sepsis, and pneumonia. NICU survivors had longer latency periods and higher gestational ages than non-survivors. The two groups had similar maternal medication, delivery, and Apgar scores. However, infants who died had higher rates of pulmonary hypoplasia and sepsis.

Pulmonary hypoplasia (29.5%), congenital infection (56.8%), intraventricular hemorrhage (25%, causing five infant fatalities), and Potter's syndrome (15.9%) were among the neonatal sequelae in **Kiver, Boos (2018).** The newborn survival rate, excluding intentional terminations and miscarriages, was 51.5%, with 45.5% intact survival among live-born neonates. This supports our results that expectantly treated pregnancies with previable rupture of membranes have complicated and variable newborn outcomes.

In a research by Pendse and Panchal (5), gestational age at preterm premature rupture of membranes (PPROM) was compared between two groups: Group 1 with PPROM < 20 weeks and Group 2 with PPROM 20-22+6 weeks. Oligohydramnios, poorer Apgar scores at 5 minutes, greater pulmonary hypoplasia, joint contractures, and death were more common in Group 1 than Group 2. This relationship between earlier gestational age at PPROM and unfavorable outcomes emphasizes the relevance of gestational age in determining neonates' prognosis and problems.

Kraft, Schütze (2022) found 28.6% infant mortality due to one incidence of pulmonary hypoplasia. Respiratory distress syndrome (57.1%), infection (100%, with one sepsis), pulmonary hypoplasia (42.9%), pulmonary

hypertension (28.6%), bronchopulmonary dysplasia (14.3%), and septic pneumonia (14.3%) were neonatal morbidities Interestingly, 57.1% of infants were released without serious morbidity, and 80% of surviving developed normally at two and four years.

The surviving infants in **Mung-Yuen, Tsz-Kin (2018)** research had respiratory distress syndrome, neonatal sepsis, bronchopulmonary dysplasia, and intraventricular hemorrhage.

Modern prenatal and neonatal practices have improved newborn survival rates, yet they vary greatly throughout the research. **Linehan, Walsh (2016)** found that 23% of infants (10/42) were born alive and 77% (32/42) died in utero or intrapartum. Nine infants were resuscitated, but only two survived until discharge, resulting in a 95% fatality rate (40/42).

Esteves, de Sá (2016) reported 18.7% neonatal survival to PPROM discharge at GW between 18 and 20 and 42.8% between 22 and 24.

Simons, de Ruigh (2021) found a 73.3% perinatal death rate and 69.7% (23/33) of live-born neonates surviving to discharge, 26.7% of total pregnancies. No children died after discharge, and 69.2% had appropriate neurodevelopment. Over half of the youngsters had respiratory issues.

Study limitations

The retrospective nature of the study poses inherent challenges, relying on available medical records and potential variations in data documentation. The relatively small sample size may limit the generalizability of findings to broader populations. Additionally, the single-center design may introduce institutional biases and reduce the external validity of the results. The study's retrospective nature also restricts the ability to establish causal relationships, and confounding variables not accounted for in the analysis might influence the observed associations. Further, the study's focus on women who have latency of more than 24 hours which may affect the general applicability of our findings to diverse populations.

Conclusion

Our study on expectantly managed pregnancies with previable rupture of membranes highlights challenges in early preterm births. Variations in medical interventions underscore the need for tailored care. Adverse neonatal outcomes emphasize the necessity of targeted strategies for this vulnerable population, aiding clinicians and researchers in improving care.

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