Prevalence of bacterial infection in pregnant women with recent prelabour rupture of membranes

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Abstract

Background: Prelabour rupture of membranes (PROM) refers to membrane rupture that occurs prior to the initiation of labor. PROM occurs most commonly at term (thirty-seven weeks or longer of pregnancy).

Objectives: To estimate the infection's prevalence of pregnant females presented with PROM and isolate the causative infective pathogens.

Patients and methods: This cohort cross sectional observational investigation was conducted on 100 pregnant women (≥ 32 weeks of gestation) presented with recent preterm PROM (pPROM) or PROM and referred to the Obstetrics and Gynecology Department, Qena University Hospital, South Valley University, from October 2021 to October 2023.

Results: The gestational age of studied cases with PROM ranged from 32 to 40 weeks, with a mean ± SD of 34.02 ± 4.01 weeks. Positive culture (bacterial growth) was reported in 11% of women, while 89% of them showed no bacterial growth. Those women who reported bacterial growth, 5% of them had gram +ve cocci (Staph. Aureus), 4% had gram -ve bacilli (E. coli), while 2% cases had gram + ve cocci (Staph. Heamolyticus). There wasn't a statistically significant relationship between culture's results and age ($p > 0.05$).

Conclusion: PROM may develop due to bacterial infections. Factors such as maternal risk factors, rupture length, gestational age, and local epidemiology can affect its prevalence. Diagnostic tests like amniotic fluid analysis can help identify infections, causative infective pathogens, and guide treatment.

Keywords: PROM; Bacterial infection; Gestational age; Staph aureus.

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Introduction

Prelabour rupture of membranes is defined as a membrane rupture occurring prior to the initiation of labor. PROM occurs most frequently at term (thirty-seven weeks or more into the pregnancy), with a total prevalence of eight percent at term **(Garg and Jaiswal, 2023).**

Typically, spontaneous labor begins within twenty-four hours after term PROM; seventy-nine percent of women undergo spontaneous labor within twelve hours, and ninety-five percent within twenty-four hours **(Middleton et al., 2017).**

Despite unfavorable cervix conditions, the majority of women undergo spontaneous labor within a period of twenty-four hours. However, in the event that the females decline to have labor within a period of twenty-four hours, the onset of labor may be delayed for a maximum of seven days following membrane rupture. Nulliparous females can experience raised latent periods **(Girault et al., 2022)**.

The PROM at full term can be controlled either through elective delivery or by stimulation of labor. Generally, planned elective preterm birth is referred to as active or planned management. Expectant management includes delaying the initiation of labor and carrying out management decisions (e.g., inducing labor) if it fails to occur naturally within a certain period of time **(Bond et al., 2017)**.

The PROM during pregnancy has been linked to maternal infections, including endometritis and chorioamnionitis, which are inflammations of the membranes and typically occur after childbirth, respectively. Serious morbidity and mortality in neonates, chronic lung illness, and cerebral palsy, in addition to severe morbidity in the mother, may result from these infections **(Surgers et al., 2013)**. In contrast, results have been published regarding the correlation among the duration of time among membrane rupture and birth and the likelihood of maternal and fetal infection developing **(Cammu et al., 1990).**

The decision to induce labor or not may be influenced by the condition of the cervix; a premature cervix can prolong the laboring process, as failure to induce labor may necessitate a caesarean section **(Tadesse et al., 2022).**

Urinary tract rupture has been documented, but infrequently. Compared to expectant management, induction of labor for females with PROM at term may incur fewer expenses. **Mukharya et al. (2017)** found that females appear to be more content with their care when the time between PROM and delivery is short.

Similarly, to spontaneous preterm birth, additional risk factors for pPROM involve a short cervical duration, bleeding during the second and third trimesters, a low body mass index, a low socioeconomic status, cigarette smoking, and illicit use of drugs. Despite the fact that each of these risk factors is correlated with neonatal pre-labor rupture of membranes, the condition frequently manifests without identifiable risk factors or an obvious etiology **(Mercer, 2003).**

The aim of this research was to identify the prevalence of infection among pregnant women who presented with prelabour rupture of membranes as well as the pathogens that caused the infection.

Patients and methods

This cross-sectional study was performed on 100 pregnant women (≥ 32 weeks of gestation) who presented with recent prelabour rupture of membranes and were referred to the Obstetrics and Gynecology Department at Qena University Hospital, South Valley University, from October 2021 to October 2023.

Inclusion criteria: pregnant women ≥ 32 weeks of gestation who presented with

rupture of membranes in the past 48 hours. For the purpose of the research, we adopted the following criteria for the diagnosis of PROM: Histories and physical assessments. It is essential that examinations be conducted in a way that reduces the potential for infection transmission. Digital cervical examinations, due to their elevated risk of infection and limited informational value in comparison to speculum examinations, are generally contraindicated unless the patient shows evidence of active labor or imminent delivery. A sterile speculum examination, on the other hand, enables the assessment of cervical dilatation and effacement, prolapse of the umbilical cord or fatal components, and the acquisition of cultures when deemed necessary. The sterile pad test is commonly used to detect amniotic fluid leakage in pregnant women. However, in cases of membrane rupture, conventional clinical evaluation is typically sufficient to confirm the diagnosis. This evaluation involves observing amniotic fluid pooling in the vagina and moving through the cervical canal.

Exclusion criteria: women with antepartum hemorrhage, fetal malformations, multiple pregnancies, U/S done before the onset of PROM showing oligo/polyhydramnios, and presence of signs and symptoms of chorioamnionitis clinically.

Method

All cases were exposed to: complete history taking including personal history, date and time of rupture, colour and odor of the amniotic fluid, obstetric and surgical history, history of insertion of medical devices or presence of vaginal discharge before PROM. Clinical examination including general and obstetric examination (inspection, palpation, fundal height, lie, presentation, liquor volume, engagement) was performed to all patients. All cases were exposed to investigations including:

1. **Abdominal ultrasound**

Using a CHISON Ultrasound model D3C60L with S/N: 2210460126 which is (CHISON Medical Technologies Co., Ltd, China) a bladder that is completely filled would give an optimal acoustic window through which the uterus could be observed in these cases. To maintain dryness from the ultrasound gel, the case should be positioned supine on a stretcher, keeping her abdomen exposed. Towels should be tucked around the margins of the gown and undergarment. When operating the ultrasound machine, dominant right-handed operators should position it at the anatomic right of the cases and ensure that it is plugged in and turned on. Dim the lights to the greatest extent possible. In general, for assessing amniotic fluid volume and fetal well-being during pregnancy, a mid-frequency ultrasound transducer is commonly used. Frequencies in the range of 5 to 7.5 MHz are often employed for abdominal ultrasound examinations. This frequency range provides a good balance between depth penetration and image resolution, allowing for adequate visualization of fetal structures and amniotic fluid levels **(Dascanio, 2014).**

2. **Amniotic fluid analysis:** A sample of the amniotic fluid was collected vaginally by introducing a sterile swab in the posterior vaginal fornix using a sterile speculum and under aseptic conditions. The sample was preserved in a sterile container and sent for culture. The sample was cultured for aerobic and anaerobic bacteria using nutrient agar and Mac Conkey's agar. A small amount of the amniotic fluid sample was streaked onto both nutrient agar and Mac Conkey's agar plates using a sterile inoculating loop. The inoculated agar plates were then placed in an incubator set at the appropriate temperature and conditions for the growth of bacteria, typically around 37°C for 24-48 hours. After the incubation period, the agar plates were examined for the presence of bacterial

growth. Colonies of different shapes, sizes, colors, and textures were observed.

Follow-up

The patients were followed up for signs and symptoms of chorioamnionitis over 48 hours of admission or 24 hours after delivery, which was closer.

Outcome Measurements

Primary (main): To clarify the prevalence of infection as an etiology of PROM and assess the possible causative microorganisms.

Secondary (subsidiary): To assess the overall incidence of chorioamnionitis in cases with PROM.

Ethical Considerations

There was no risk of participation in this research**.** Data wasn't disseminated outside the researchers. Informed consent was filled out by each patient included with the proposal on its original form. The investigation was carried out only by personnel who possessed scientific qualifications and training. (Ethical Approval Code: SVU/MED/OBG024/1/21/11/268).

Statistical Analysis

SPSS software (version 24.0) was utilized to conduct the statistical analysis, the t-test for abnormal distributed data and the Pearson Chi-square test (X^2.test). A P-value less than or equal to 0.05 was considered significance, Kolmogorov-Smirnov test was used to test data normality.

Results

(**Table.1**) shows that the age of studied cases with PROM varied from 17 to 44 years, with a mean ± SD of 28.66 ± 6.65 years and a median of 29 years. The most common age group was 18–30 years, representing 64%, followed by the 18–30-year group in 32% of cases, and the > 40-year group in 4% of cases. The gestational age of studied cases with PROM varied from 26 to 40 weeks with mean ± SD was 34.02 ± 4.01 weeks. L.S.C.S was reported in 86% women while 14% of them showed NVD, nullipara was reported in 24% women, 26 % of them was primipara, and 50% was multipara, 100% of women was reported with leakage of water from vaginal, 3% had diabetes, no women reported with vaginal discharge, 39% had PROM, 61% had pPROM, 100% had 1 foetuses, mean time between PROM and delivery was 4.36 ± 6, and mean time between PROM and sampling was 13.79 ± 10.82.

Table 1. Clinical data in the studied mothers

Parameters		Studied women (100)	
		No.	%
Age groups	**18-30 years**	64	64.0%
	31-40 years	32	32.0%
	>40 years	4	4.0%
Age (years)	**Mean± SD**	28.66 ± 6.65	
	Median	29.0	
	Range	17.0 - 44.0	
Gestational age (weeks)	**Mean± SD**	34.02 ± 4.01	
	Median	35.0	
	Range	32.0- 40.0	
Mode of delivery	**L.S.C.S**	86	86%
	NVD	12	12%
	Discharged after follow up	2	2%
Parity	**Primigravida**	24	24%

	Multigravida	76	76%
Complaint	**Leakage of water from vagina**	100	100%
Associated medical conditions	**Diabetes**	3	3%
Vaginal discharge		0	0%
Number of fetuses	1	100	100%
Time between PROM and delivery	**Mean± SD**	4.36 ± 6	
	Median	3	
	Range	1 - 48	
Time between PROM and Sampling (hours)	**Mean± SD**	13.79 ± 10.82	
	Median	12	
	Range	0.5 - 36	

SD: standard deviation, L.S.C.S: lower (uterine) segment Caesarean section, NVD: normal vaginal delivery, PROM: Prelabor rupture of membranes.

(**Table.2**) and **Fig.1** show that positive culture (bacterial growth) was reported in 11% women while 89% of them showed no bacterial growth. Those women who reported bacterial growth, 5% of them had gram +ve cocci (Staph Aureus), 4% had gram -ve bacilli (E. coli), and 2% of cases had gram + ve cocci (Staph. Heamolyticus).

Table 2. Culture's Results among the studied women

Parameters No (%)		**Studied women No. (100%)**	
Culture's Results	**No growth (Negative)**	89	89.0%
	Growth (Positive)	11	11.0%
	• **Gram +ve Cocci (Staph. Aureus)**	5	5.0%
	• **Gram -ve Bacilli (E. coli)**	4	4.0%
	• **Gram + ve Cocci (Staph. Heamolyticus)**	2	2.0%

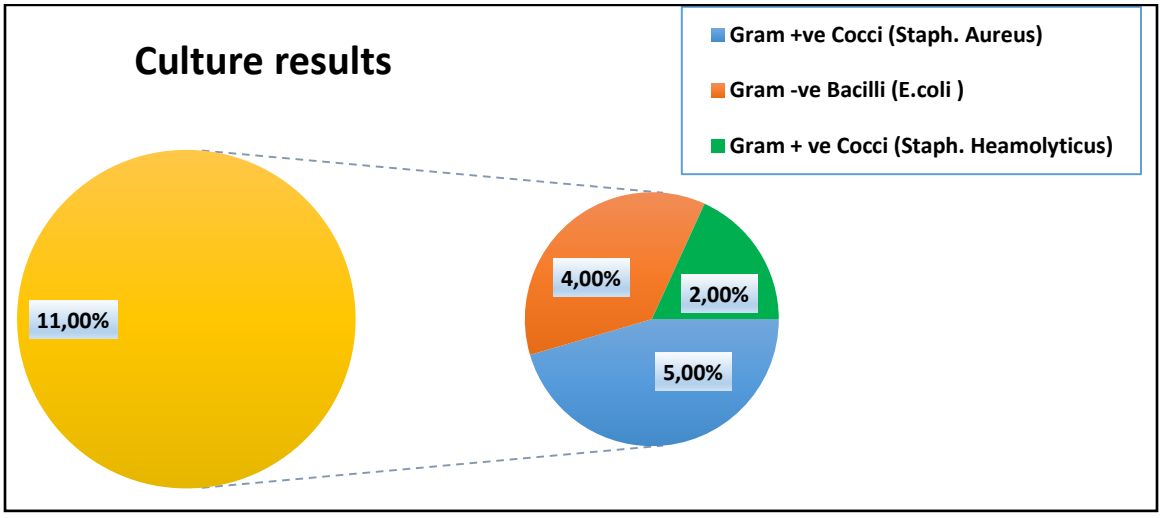

Fig.1. Culture's Results among the studied women

(**Table.3**) show that respiratory distress was reported in 57% women while 43% of them showed no complications in fetal outcome, and 100% showed no complications in maternal outcome.

Table 3. Outcome distribution in studied women

Parameters No (%)		**Studied women No. (100%)**	
Fetal outcome	**Resp. distress**	57	57%
	No complications	43	43%
Maternal outcome	**No complications**	100	100%

As shown in (**Table .4**), there wasn't statistically significant relation among culture's results and age, gestational age, parity, complaint, associated medical condition, pPROM/PROM, number of foetuses, time between PROM and delivery, time between PROM and Sampling (hours), fetal outcome and maternal outcome ($p > 0.05$), while there was statistically significant relation among culture's results and mode of delivery ($p < 0.05$).

Table 4. Relation between culture's results and age group

Parameters		**Negative (N = 89)**		**Positive (N = 11)**			
		N	**%**	**N**	**%**	**Test value**	**P-value**
Age groups	**18-30 years**	58	65.2%	6	54.5%	X^2=1.047	0.592
	31-40 years	28	31.5%	4	36.4%		
	>40 years	3	3.4%	1	9.1%		
Age (years)	**Mean± SD**	28.27± 6.51		31.82± 7.24		t=1.622	0.105
	Median	28.0		30.0			
	Range	17.0- 43.0		19.0- 44.0			
Gestational Age (weeks)	**Mean± SD**	34.24± 3.39		32.27± 4.38		t=1.485	0.138
	Median	35.0		31.0			
	Range	32.0- 40.0		27.0- 39.0			
Mode of delivery	**L.S.C.S**	79	88.8%	7	63.6%	X^2=6.228	0.04*
	NVD	9	10.1%	3	27.3%		
	Discharged after follow up	2	1.1%	2	9.1%		
Parity	**nullipara**	21	23.6%	3	27.3%	X^2=0.397	0.82
	Primipara	24	27%	2	18.2%		
	Multipara	44	49.4%	6	54.5%		
Complaint	**Leakage of water from vagina**	89	100%	11	100%	X^2=0	1
Associated medical conditions	**Diabetes**	2	2.2%	1	9.1%	X^2=1.576	0.21
pPROM/PROM	**PROM**	37	41.6%	2	18.2%	X^2=2.252	0.13
	pPROM	52	58.4%	9	81.8%		
Number of foetuses	1	89	100%	11	100%	X^2=0	1

Time between PROM and delivery	**Mean± SD**	3.99±4.2		6.64±13.8		t = 1.3961	0.17
	Mean± SD	3.99±4.2		6.64±13.8			
	Median	3		3			
	Range	0-24		0-48			
Time (hours) between PROM and Sampling	**Mean± SD**	13.7±11		14.8±9.6		t = 1.3961	0.17
	Median	12		12			
	Range	0.5-36		0.5-24			
Fetal outcome	**Resp. distress**	51	57.3%	6	54.5%	X^2=0.03	0.56
	No complications	38	42.7%	5	45.5%		
Maternal outcome	**No complications**	89	100%	11	100%	X^2=0	1

*: significant; X^2: Qui square test; t: unpaired t test; SD: standard deviation; L.S.C.S: lower (uterine) segment Caesarean section; NVD: normal vaginal delivery; PROM: prelabor rupture of membranes; pPROM: preterm prelabor rupture of membranes.

Discussion

PROM previously known as premature rupture of membranes occurs in approximately 8%~18% pregnancies. Pregnancies with PROM were at higher risk of intrauterine infection; their neonates were at higher risk of infectious diseases **(Zhuang et al, 2022**). A significant risk of PPROM is that the baby is very likely to be born within a few days of the membrane rupture. Another major risk of PROM is development of a serious infection of the placental tissues called chorioamnionitis, which can be very dangerous for mother and baby **(Garg et al, 2023)**. Other complications that may occur with PROM include placental abruption (early detachment of the placenta from the uterus), compression of the umbilical cord, cesarean birth, and postpartum (after delivery) infection (**Gupta et al, 2020).**

Furthermore, in their investigation of the function of collagen cross-links, oxidative stress, ascorbic acid, and collagen in determining membrane integrity, **Stuart et al. (2005)** created a functional assay to evaluate the susceptibility of membranes to proteolysis. Their case-control research was conducted on females who had PROM deliveries in comparison to those who delivered at term. There were no significant variations observed in terms of the patient's age (PROM: 28.8 ± 5.6 years).

Our findings demonstrated that the age of studied cases with PROM varied from 17 to 44 years, with a mean ± SD of 28.66 ± 6.65 years and a median of 29 years. The most common age group was 18–30 years, representing 64%, followed by the 18–30-year group in 32% of cases, and the > 40-year group in 4% of cases. The gestational age of studied cases with PROM varied from 26 to 40 weeks with mean ± SD was 34.02 ± 4.01 weeks. L.S.C.S was reported in 86% women while 14% of them showed NVD, nullipara was reported in 24% women, 26 % of them was primipara, and 50% was multipara, 100% of women was reported with leakage of water from vaginal, 3% had diabetes, no women reported with vaginal discharge, 39% had PROM, 61% had pPROM, 100% had 1 foetuses, mean time between PROM and delivery was 4.36 **±** 6, and mean time between PROM and sampling was 13.79 **±** 10.82.

Our results showed that the gestational age of studied cases with PROM varied from 32 to 40 weeks, with a mean ±SD of 34.02± 4.01 weeks. L.S.C.S was reported in 86% women while 12% of them showed NVD, and 2% showed discharged

In our study, we found that positive culture (bacterial growth) was reported in 11% women while 89% of them showed no bacterial growth. Those women who reported bacterial growth, 5% of them had gram +ve cocci (Staph Aureus), 4% had gram -ve bacilli (E. coli), and 2% of cases had gram + ve cocci (Staph. Heamolyticus).

Our results showed that there wasn't statistically significant relation among culture's results and age, gestational age, parity, complaint, associated medical condition, pPROM/PROM, number of foetuses, time between PROM and delivery, time between PROM and sampling (hours), fetal outcome and maternal outcome ($p > 0.05$), while there was statistically significant relation among culture's results and mode of delivery (Caesarean delivery) ($p < 0.05$).

Our results contrast with those of **Dars et al. (2014)** who reported that out of 100 mothers, 26% had PROM of < 24 hrs duration and 74% had > 24 hrs of duration. Maternal outcomes in 16 cases of PROM findings revealed septicemia in 12% of cases and chorioamnionitis in 12% of cases. Fetal outcome in 27 cases of PROM revealed prematurity in 5% cases, fetal distress in 4% cases, cord compression in 5% cases, necrotizing enterocolitis in 2% cases, hypoxia in 9% cases, and pulmonary hypoplasia in 2% cases.

Also, **Wolde et al. (2024)** who reported that regarding fetal outcome in women with PROM, 30.65% of neonates had respiratory distress syndrome, 8.06% had meconium aspiration syndrome, and 27.42% were referred to NICU.

We found that the mean age of women in negative culture was 28.27 ± 6.51 years, while the mean age in positive culture was 31.82 ± 7.24 years. There wasn't a statistically significant relationship among culture's results and age ($p = 0.105$). Our results showed that the mean gestational age in women in negative culture was 34.24 ± 3.39 weeks, while the mean gestational age in positive culture was 32.27 ± 4.38 weeks. There wasn't a statistically significant relationship between culture's results and gestational age ($p = 0.138$).

Along with our results, **Wang et al. (2024)** investigated the clinical value of cervical secretion culture in pregnant women with PROM in predicting maternal and fetal outcomes. They reported an insignificant difference between positive and negative cultures regarding age and gestational age. Mycoplasma and bacterial positivity were detected in 13% of all positive cultures, which was higher than that in the control group (8% and 6%, respectively), and the difference was statistically significant ($p < 0.05$). The authors found that ~~m~~ycoplasma and bacterial positivity were detected in 13% of all positive cultures, which was higher than that in the control group (8% and 6%, respectively), and the difference was statistically significant ($p < 0.05$).

Recommendations: It is recommended that future studies to be conducted. Infection may be a pre-existing factor in women, as presented by PROM. This highlights the importance of controlling genitourinary and other infections in pregnant women.

Conclusion

PROM may develop due to bacterial infections. Factors such as maternal risk factors; rupture length, gestational age, and local epidemiology can affect its prevalence. Diagnostic tests like amniotic fluid analysis can help identify infections, causative infective pathogens, and guide treatment.

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