

Association of Urinary Tract Infection with Premature Rupture of Membrane

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Abstract

Original Research Article

Background: Premature rupture of membrane (PROM) and preterm PROM (PPROM) are closely related terms which are the major cause of maternal and fetal mortality and morbidity. PROM occurs 10% of all pregnancies. Urinary tract infections (UTI) are the most common bacterial infections of pregnancy. **Objective:** To find out the association of urinary tract infection with PROM among hospital admitted patients. **Methods:** This prospective observational study was carried out at Department of Gynecology and Obstetrics, Combined Military Hospital (CMH), Dhaka, Bangladesh. A total of 100 patients of PROM were included following selection criteria. Their urine culture was done. Maternal and fetal outcomes were recorded accordingly. **Results:** Mean(\pm SD) age of the study women was 27.10 \pm 4.49 years. The prevalence of PROM was highest at 34 weeks of gestational age (28%), followed by 39 weeks (26%), 33 weeks (22%), 32 weeks (20%) and 30 weeks (4%). Among total study participants, 74% were preterm PROM and 26% were term PROM. Out of 100 PROM women 16 patients developed UTI. Most of the cases of UTI were showed no growth of organisms on urine culture (84%), while 12% urine sample showed growth of Escherichia Coli (E. Coli), followed by Streptococcus (2%), Candida (1%), Anaerobes (1%). The association between PROM types and UTI occurrence was statistically significant ($p=0.001$). Among the study women, 6% developed puerperal sepsis, 5% developed chorioamnionitis and 2% developed disseminated intravascular coagulation (DIC). Regarding fetal outcomes; 85% were live birth, 15% were still birth; of them, 59% were premature baby, 55% had birth weight less than 2.5 kg and APGAR score at 5 minutes of 80% babies was <7 . **Conclusion:** This study revealed that prevalence of UTI in PROM is 16%. Advance gestational age is strongly associated with a higher risk of UTI in PROM patients. Puerperal sepsis, chorioamnionitis and DIC were the maternal complications; while still birth, prematurity, low birth weight were the fetal consequences in PROM.

Keywords: Maternal and fetal Complications, Pregnancy, Premature Rupture of Membrane (PROM), Urinary Tract Infection (UTI).

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1. INTRODUCTION

Premature rupture of membrane (PROM) is defined as rupture of the membrane and loss of amniotic fluid prior to the onset of labor in pregnancies [1]. PROM occurs in approximately 10% of all pregnancies [2]. It was estimated that PROM is responsible for 30 to 40% of preterm deliveries which is one of the most common underlying causes of perinatal death [1-3]. Preterm premature rupture of membrane (PPROM) is referring to when PROM occurs before 37 weeks of gestation [1-3].

One of the most common complications of preterm PROM is premature delivery [4]. The latent period, which is the time from membrane rupture until delivery, generally is inversely proportional to the gestational age at which PROM occurs [4]. When PROM occurs too early, surviving neonates may develop sequelae such as mal-presentation, cord compression, oligohydramnios, necrotizing enterocolitis, neurologic impairment, intraventricular hemorrhage, and respiratory distress syndrome [5, 6]. The etiology of PROM is largely

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unknown, the possible causes are either reduction of membrane strength or an increase in intrauterine pressure or both [6]. It may be associated with an incompetence cervix, unstable lie, polyhydramnios possibly bacteriuria especially beta-streptococci infection [5-7]. It was reported that the fetal membranes and the maternal uterine lining (decidua) respond to various stimuli including membrane stretching and infection of the reproductive tract [6]. Asymptomatic bacteriuria (ASB), occurring in 2–11% of pregnancies, is a major predisposition to the development of pyelonephritis and UTI which are associated with obstetrical complications, such as preterm labor and low birth weight infants [6, 7]. There is also evidence that rupture of fetal membranes and premature delivery associated with colonization of the uro-genital tract by group B streptococci, Chlamydia trachomatis, Neisseria gonorrhoeae and the organisms that cause bacterial vaginosis (vaginal anaerobes, Gardnerella vaginalis, Mobiluncus species and genital mycoplasmas) [6, 7]. PROM is a major cause of maternal and fetal mortality and morbidity. It is a preventable disease in most of the cases. Proper evaluation in early pregnancies at initial visits of antenatal care to find out any source of infection, could prevent PROM and its consequences in many situations. The process is in turn, responsible for many preventable infant deaths. Antibacterial therapy when used in the expectant management of preterm PROM is associated with prolongation of pregnancy and a reduction in the maternal and fetal morbidity. Proper diagnostic facilities, adequate monitoring facilities, a standard protocol of management can prevent the PROM along with improvement of the maternal and fetal outcomes. In this background this study was aimed to evaluate the association of urinary tract infection (UTI) with premature rupture of membrane among hospitalized patients.

2. METHODOLOGY

This prospective observational study was carried out at the Department of Gynecology and Obstetrics, Combined Military Hospital (CMH), Dhaka, Bangladesh, from July 2012 to December 2012. This study was approved by ethical review committee, CMH, Dhaka, Bangladesh. A total of one hundred (100) patients with premature rupture of membrane (PROM) were included by purposive sampling technique following selection criteria.

2.1. Study population

A total of one hundred (100) women, who were hospitalized with premature rupture of membrane [PROM (preterm or term)] in the Department of Gynecology and Obstetrics, CMH, Dhaka, Bangladesh enrolled as the study population. PROM was diagnosed by history that is patients complain of sudden gush of fluid per-vaginally and sterile speculum examination to inspect the liquor escaping out through the cervix with

coughing and straining and detection of p^H by litmus or Nitrazine paper test.

2.2. Eligibility criteria

Inclusion criteria

Patients with following characteristics were included in this study-

- Pregnant women with primi / multi-gravida
- Pregnancy more than 28 weeks duration
- Spontaneous rupture of membrane before initiation of labour.
- Clinically proved no vaginal infection (Bacterial vaginosis and candidiasis).

Exclusion criteria

Patients with following features were excluded from the study-

- High risk patients as pregnancy with cardiac disease, pregnancy with diabetes mellitus, pregnancy with any risk factors [like- vaginal infection (bacterial vaginosis and candidiasis) polyhydramnios, multiple pregnancy].
- Patients with previous operation in the cervix, incompetence of the cervix, history of previous PROM, hemorrhage in current pregnancy.
- Any fetal anomaly.

2.3. Study procedure

After Institutional Review Board (IRB) approval, diagnosed patients of PROM (preterm or term) who fulfilled the inclusion and exclusion criteria were selected as study population. Informed written consent was taken from each patient prior to enrollment. Their relevant medical history, physical and clinical examinations were done. Then urine culture and sensitivity test of each study patient was done following standard procedure. Maternal and early fetal out comes were recorded accordingly.

2.4. Statistical analysis

Data were processed and analyzed using a windows-based software Statistical Package for Social Science (SPSS) version- 26. Quantitative data were expressed as mean with standard deviation (\pm SD), qualitative data were expressed as frequency and percentage. The statistics used to analyze the data was descriptive statistics. Chi-squared (χ^2) test was performed to analyze the data. A p value <0.05 was assigned for statistical significance.

3. RESULTS AND OBSERVATIONS

This study was intended to correlate the urinary tract infection (UTI) with premature rupture of membrane (PROM) among 100 patients. The mean(\pm SD) age of the study subjects was 27.10 \pm 4.49 years and most of the study patients were in age group between 26 - 30 years. It was found that mean(\pm SD) gestational age of the study patients was 32.54 \pm 2.03 weeks. Of them; 26(26%) patients were at 39 weeks of gestation, 28(28%) were at 34 weeks, 22(22%) were at

33 weeks, 20(20%) were at 32 weeks, and 4(4%) patients were at 30 weeks of gestation. Data analysis revealed that; half of the pregnant women [50(50%)] were 2nd gravida, 26(26%) were nullipara and 24(24%) were multipara. Among total study population; 64(64%) patients had taken regular antenatal check-up and 36(36%) were in irregular antenatal check-up. It was observed that, 74% of study population was preterm PROM and 26% was term PROM. Among total study

women; spontaneous labour was started in 68(68%) women, rest 32(32%) women needed induction of labour. In this study, on the basis of drainage/amount of liquor; 62(62%) patients had slight liquor and 38(38%) patients had profuse liquor. Regarding the methods of delivery; majority [76(76%)] of the baby was delivered by vaginal delivery, only 24% cases needed caesarean section (Table-1).

Table- 1: Basic data of the study population (N=100)

Variables	Number of patients (n)	Percentage (%)
Age (years)		
<20	12	12
20 – 25	26	26.0
26-30	48	48.0
31-35	14	14.0
Mean ± SD	27.10 ±4.49 years	
Range (minimum-maximum)	18-35 years	
Gestational age in weeks		
30 weeks	04	4.0
32 weeks	20	20.0
33 weeks	22	22.0
34 weeks	28	28.0
39 weeks	26	26.0
Mean ± SD	32.54 ±2.03 weeks	
Parity		
Nullipara	26	26.0
Para 1	50	50.0
Multipara	24	24.0
Antenatal check-up		
Regular	64	64
Irregular	36	36
Type of PROM		
Preterm	74	74.0
Term	26	26.0
Onset of labour		
Spontaneous	68	68
Induced	32	32
Drainage of liquor		
Slight	62	62.0
Profuse	38	38.0
Method of delivery		
Vaginal delivery	76	24.0
Caesarean section	24	76.0

Among total 100 PROM patients; urinary tract infection (UTI) was found in 16 patients at different gestational age (Figure- 1).

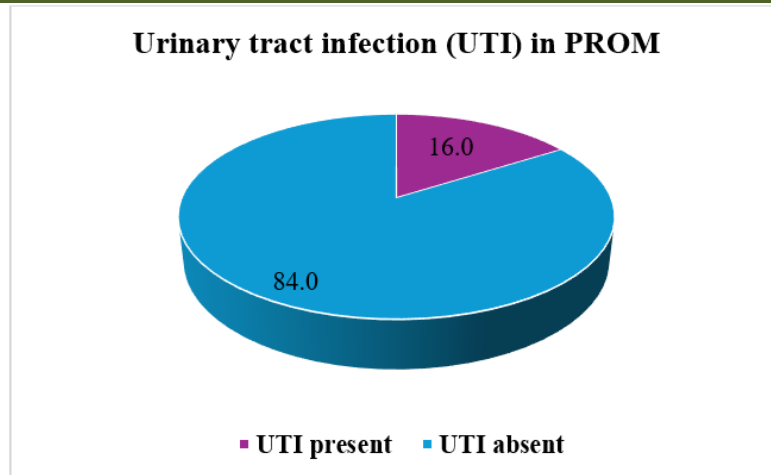


Figure- 1: Prevalence of UTI among patients with PROM (N=100)

The urine culture reports of the study PROM patients revealed that; 84(84%) patients have no growth of bacteria in their urine sample. Only 16 patients had growth of organisms in their urine; of them 12(75%)

patients had growth of *E. Coli*, 2(12.5%) patients had group B *Streptococcus*, 1(6.3%) patient had *Candida* and another 1(6.3%) patient had Anaerobes in urine culture (Figure- 2).

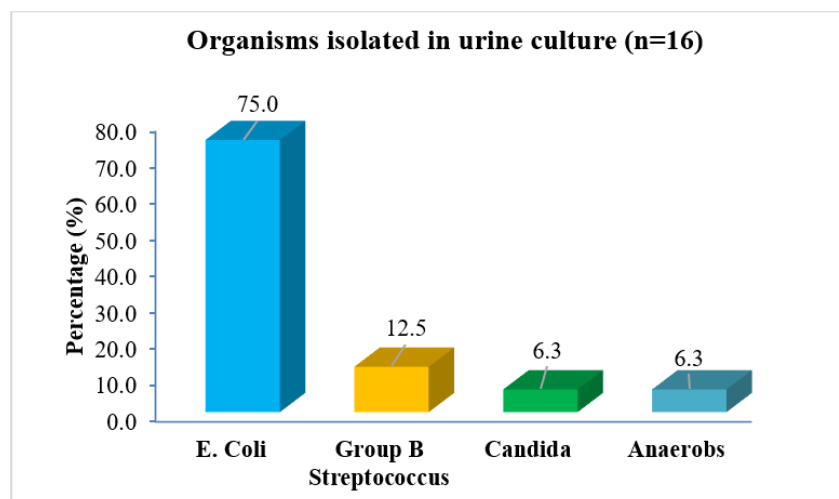


Figure- 2: Distribution of isolated organisms in urine culture among UTI cases (n=16)

Table 2 shows a significant link between urinary tract infection (UTI) and the type of premature rupture of membranes (PROM). Among patients with UTI, 62.5% had term PROM, compared to only 19.1% in those without UTI. The odds ratio (OR= 7.083, p=

0.001) indicates that women with UTI were about 7 times more likely to have term PROM. This suggests that UTI is strongly associated with term rather than preterm PROM.

Table- 2: Association of UTI with PROM (N=100)

Type of PROM	UTI Cases (n=16) n (%)	No UTI Cases (n=84) n (%)	OR ratio	p-value
Term	10 (62.5%)	16 (19.1%)	7.083	0.001
Preterm	6 (37.8%)	68 (80.9%)		

About maternal outcomes; in this study 13 pregnant women with PROM had developed different complications, of them 5 women had chorioamnionitis,

6 had puerperal sepsis, 2 had disseminated intravascular coagulation (DIC) and rest 87 women had no problem (Table- 3).

Table- 3: Distribution of maternal outcomes among the study women (N=100)

Maternal Outcomes	Number of patients (n)	Percentage (%)
Chorioamnionitis	05	05
Puerperal sepsis	06	06
DIC	2	2
No problem	87	87

In context of fetal outcomes; it was observed that, 85% was live birth and 15% was still birth. Among 85 live births; 26% was mature baby, 59% was premature baby and 8% baby had intrauterine growth retardation (IUGR). In birth weight categories; 55% of babies had

<2.5 kg and 30% >2.5 kg. In Apgar score at 1 minute; 10% of babies had <7 score and 75% had >7 score. In Apgar score at 5 minutes; 80% of babies had <7 score and 05% had >7 score (Table- 4).

Table- 4: Distribution of fetal outcomes among the study population (N=100)

Fetal outcomes	Number (n)	Percentage (%)
Live birth	85	85
Still birth	15	15
Mature	26	26
Premature	59	59
IUGR*	08	08
Birth weight		
<2.5 kg	55	55
>2.5 kg	30	30
APGAR** score at 1 minute		
<7	10	10
>7	75	75
APGAR score at 5 minutes		
<7	80	80
>7	05	05

*IUGR= Intra uterine growth retardation; **APGAR= Appearance, Pulse, Grimace, Activity and Respiration (A quick test performed on a new born baby at 1 minute and 5 minutes after birth)

4. DISCUSSION

Premature rupture of membrane (PROM) is a high-risk state for preterm labour and is the major cause of perinatal morbidity and mortality. PROM is often associated with ascending infection from the vagina due to loss of barrier. It was reported that prolonged PROM could be an independent risk factor for neonatal sepsis [8]. Urinary tract infection (UTI) in pregnancy is a common and serious problem, if untreated that can lead to pyelonephritis, preterm labour or neonatal sepsis [9]. This prospective observational study was carried out at the Department of Gynecology and Obstetrics, Combined Military Hospital (CMH), Dhaka, Bangladesh, over a period of 6 months from July 2012 to December 2012. Total 100 cases of PROM were taken by purposive sampling technique. The mean(\pm SD) age of the study women was 27.10 \pm 4.49 years. Of them, 12% was age group <20 years, 26% was age group 20-25 years, 48% was age group 26-30 years and 14% was age group 31-35 years. In a couple of previous studies found mean(\pm SD) age of the patients with PROM was 26.2 \pm 5.8 years [10] and 25.73 \pm 5.1 years [11], which were consistent with this current study.

Regarding gestational age, this study showed that 28% patients were in 34 weeks, 26% patients were in 39 weeks, 22% patients were in 33 weeks, 20% patients were in 32 weeks and 4% patients were in 30 weeks of gestation. Mean(\pm SD) gestational age of the study patients was 32.54 \pm 2.03 weeks. In accordance Rahman *et al.* showed mean gestational age of their study population having PROM was 34.05 \pm 4.28 weeks [12]. While Major *et al.* found mean gestational age at diagnosis of rupture of membranes was 23.7 weeks, which was much lower than this current study [13].

This study found that; 26% of the study population was nullipara, 50% was in 2nd gravida and 24% was multipara. While in a previous study 50% pregnant women had zero parity, 28.33% women had only one parity and 21.67% had 2 to 5 parities [11]. In contrast Kilpatrick *et al.* reported that 61.8% had no parity among their study population [10]. The plausible reason of this variation may be difference in selection criteria and sampling technique. This study found 74% of patients had preterm delivery and 26% had term delivery. In this context, Major *et al.* identified that no significant difference was exist between preterm delivery and term delivery in premature rupture of membrane

[13]. In another study Ziaei *et al.* determined that bacterial vaginosis is a common vaginitis in term pregnancy, but they could not find any relationship between bacterial vaginosis and premature rupture of membranes at term [14]. This study showed 68% labour pain was started spontaneously. In a similar study Dudley *et al.* found 57% was spontaneous delivery [15]. The current study showed 76% of patients had vaginal delivery and 24% had caesarean section. This finding was comparable with a related previous study [13]. This study found 16% of PROM patients have urinary tract infection; that was consistent with similar previous studies [10-12,16]. Regarding maternal outcomes among total study women showed that, 5% study women had chorioamnionitis, 6% had puerperal sepsis and 2% developed DIC. This result was supported by a couple of previous studies [13-17]. In context of fetal outcomes; 85% was live birth and 15% was stillbirth. Of them; 26% was mature baby, 59% was premature baby and 8% baby had IUGR. In birth weight categories; 55% of babies had <2.5 kg and 30% >2.5 kg. In APGAR score at 1 minute; 10% of babies had <7 score and 75% had >7 score. In APGAR score at 5 minutes; 80% of babies had <7 score and 05% had >7 score. These findings were an agreement of several similar previous studies [17-19].

This study found that 84% of patients had no growth of organisms in their urine culture. While 16% had growth of organisms; of them 12% patients had growth of *E. coli*, 2% had group B *Streptococcus*, 1% had *Candida* and another 1% had growth of *Anaerobes* in urine culture. In accordance Schultz *et al.* found 14% had growth of *E. Coli*, 2% group positive *Bacilli*, 3% group negative *Bacilli*, 4% other organisms and 15% unspecified or unknown organism in urine culture [20]. Urinary tract infection (UTI) is one of the common and serious clinical problems in pregnancy. Without proper management UTI in pregnancy may complicated; that can lead to pyelonephritis, preterm labor and neonatal infection [12]. It was reported that there was no significant association between PROM and UTI [13]. There is scarcity of information regarding this issue. All previous studies focused mainly on the association of PROM with maternal and fetal outcomes [21, 22, 23]; while one study found that preterm labor associated with PROM is more frequently caused by infection of the genital tract rather than UTI [24]. This current study found that 16% patients with PROM have urinary tract infection. We analyzed the distribution of UTI among PROM patients across term and preterm. The association between gestational age (term versus preterm) and UTI occurrence was statistically significant ($p= 0.001$), indicating that the risk of UTI varies by gestational age. This suggests that later gestational age may be linked to a higher risk of UTI in PROM patients.

5. CONCLUSION

This study was undertaken to determine the bacteriological assessment of urine among patients with

premature rupture of membrane (PROM). Premature rupture of membrane with urinary tract infection may culminate into chorioamnionitis or DIC which is often associated with adverse maternal and fetal outcomes. This study found that 16% women with PROM have urinary tract infection with *E. coli*, group B *Streptococcus*, *Anaerobes*, and *Candida* organisms. This study revealed that UTI is strongly associated with term rather than preterm PROM. Therefore, early diagnosis and proper management of UTI in PROM patients can prevent adverse maternal and fetal outcomes.

Limitations of the study

It was a single center study with relatively small sample size. Moreover, due to lack of logistic supports to investigate and exclude other infective causes of PROM.

Recommendations

All pregnant women should be assessed for UTI by urine R/M/E and C/S at the first antenatal visit. High risk pregnant women like dysuria, frequency of micturition and foul-smelling vaginal discharge should be assessed for UTI and other infectious causes of PROM. Appropriate antibiotics should be given prophylactically for prevention of intrapartum infection (Chorioamnionitis) in case of PROM with UTI. All preterm and term PROM patients should have at least one urine R/M/E and C/S report to exclude UTI or asymptomatic bacteriuria.

Conflicts of interest: The authors declared that there is no conflict of interest regarding this publication.

REFERENCES

1. Deering SH, Patel N, Spong CY, Pezzullo JC, Ghidini A. Fetal growth after preterm premature rupture of membranes: is it related to amniotic fluid volume?. *The Journal of Maternal-Fetal & Neonatal Medicine*. 2007 Jan 1;20(5):397-400.
2. Ameye L, De Brabanter J, Suykens JA, Cadron I, Devlieger R, Timmerman D, Spitz B, Van Huffel S. Predictive models for long term survival after premature rupture of membranes. In 2005 IEEE Engineering in Medicine and Biology 27th Annual Conference 2006 Jan 17 (pp. 4622-4625). IEEE.
3. Esim E, Turan C, Unal O, Dansuk R, Cengizglu B. Diagnosis of premature rupture of membranes by identification of β -HCG in vaginal washing fluid. *European Journal of Obstetrics & Gynecology and Reproductive Biology*. 2003 Mar 26;107(1):37-40.
4. Smith GN, Rafuse C, Anand N, Brennan B, Connors G, Crane J, Fraser W, Gratton R, Moutquin JM, Scott H, Schneider C. Prevalence, management, and outcomes of preterm prelabour rupture of the membranes of women in Canada. *Journal of Obstetrics and Gynaecology Canada*. 2005 Jun 1;27(6):547-53.
5. Schucker JL, Mercer BM. Midtrimester premature rupture of the membranes. In *Seminars in*

- perinatology 1996 Oct 1 (Vol. 20, No. 5, pp. 389-400). WB Saunders.
6. Parry S, Strauss JF. Premature rupture of the fetal membranes. *New England Journal of Medicine*. 1998 Mar 5;338(10):663-70.
7. Regan JA, Chao S, James LS. Premature rupture of membranes, preterm delivery, and group B streptococcal colonization of mothers. *American journal of obstetrics and gynecology*. 1981 Sep 15;141(2):184-6.
8. Drassinower D, Friedman AM, Običan SG, Levin H, Gyamfi-Bannerman C. Prolonged latency of preterm premature rupture of membranes and risk of neonatal sepsis. *American journal of obstetrics and gynecology*. 2016 Jun 1;214(6):743-e1.
9. Morgan KL. Management of UTIs during pregnancy. *MCN: The American Journal of Maternal/Child Nursing*. 2004 Jul 1;29(4):254-8.
10. Kilpatrick SJ, Patil R, Connell J, Nichols J, Studee L. Risk factors for previable premature rupture of membranes or advanced cervical dilation: a case control study. *American journal of obstetrics and gynecology*. 2006 Apr 1;194(4):1168-74.
11. Khan S, Khan AA. Study on preterm pre mature rupture of membrane with special reference to maternal and its fetal outcome. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology*. 2016 Aug 1;5(8):2768-75.
12. Rahman MN, Liligoly RD, Pangastuti N. Urinary tract infection in premature rupture of membrane (PROM): an academic hospital based study. *Journal of the Medical Sciences (Berkala ilmu Kedokteran)*. 2019 Jan;51(1):31-5.
13. Major CA, Kitzmiller JL. Perinatal survival with expectant management of midtrimester rupture of membranes. *American journal of obstetrics and gynecology*. 1990 Sep 1;163(3):838-44.
14. Ziaei S, Sadrkhanlu M, Moeini A, Faghihzadeh S. Effect of bacterial vaginosis on premature rupture of membranes and related complications in pregnant women with a gestational age of 37–42 weeks. *Gynecologic and obstetric investigation*. 2006;61(3):135-8.
15. Dudley J, Malcolm G, Ellwood D. Amniocentesis in the management of preterm premature rupture of the membranes. *Australian and New Zealand journal of obstetrics and gynaecology*. 1991 Nov;31(4):331-6.
16. Gahwagi MM, Busarira MO, Atia M. Premature rupture of membranes characteristics, determinants, and outcomes of in Benghazi, Libya. *Open Journal of Obstetrics and Gynecology*. 2015;5(09):494.
17. Dars S, Malik S, Samreen I, Kazi RA. Maternal morbidity and perinatal outcome in preterm premature rupture of membranes before 37 weeks gestation. *Pakistan journal of medical sciences*. 2014 May;30(3):626.
18. Caughey AB, Robinson JN, Norwitz ER. Contemporary diagnosis and management of preterm premature rupture of membranes. *Reviews in obstetrics and gynecology*. 2008;1(1):11.
19. Taylor JO, Garite TJ. Premature rupture of membranes before fetal viability. *Obstetrics and gynecology*. 1984 Nov 1;64(5):615-20.
20. Schultz R, Read AW, Straton JA, Stanley FJ, Morich P. Genitourinary tract infections in pregnancy and low birth weight: case-control study in Australian aboriginal women. *British Medical Journal*. 1991 Nov 30;303(6814):1369-73.
21. Karat C, Madhivanan P, Krupp K, Poornima S, Jayanthi NV, Suguna JS, Mathai E. The clinical and microbiological correlates of premature rupture of membranes. *Indian journal of medical microbiology*. 2006 Oct 1;24(4):283-5.
22. Muglia LJ, Katz M. The enigma of spontaneous preterm birth. *New England Journal of Medicine*. 2010 Feb 11;362(6):529-35.
23. Sheiner E, Mazor-Drey E, Levy A. Asymptomatic bacteriuria during pregnancy. *The journal of maternal-fetal & neonatal medicine*. 2009 Jan 1;22(5):423-7.
24. Pararas MV, Skevaki CL, Kafetzis DA. Preterm birth due to maternal infection: causative pathogens and modes of prevention. *European Journal of Clinical Microbiology and Infectious Diseases*. 2006 Sep;25(9):562-9.