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Assessment of Maternal and Perinatal Health after Preterm Prelabor Rupture of Membranes before 32 Weeks in Three Hospitals in Yaoundé, Cameroon

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Abstract

Introduction: The consequences of premature rupture of membranes are most severe when they occur before 32 weeks of pregnancy. The aim of the study was to assess maternal and perinatal health post preterm PROM (PPROM) before 32 weeks gestation in Yaoundé, Cameroon. **Methodology:** We conducted a descriptive cross-sectional study from January to May 2022 in three hospitals in Yaoundé. We included all women admitted for PPROM before 32 weeks. Maternal and perinatal outcomes were evaluated by various parameters including sociodemographics, clinical obstetric data, infections, latency period, mode of delivery and maternal-fetal morbidity and/or mortality. Statistical analyses were performed using SPSS version 15.0, with bivariate analyses to determine associations. We used a 95% confidence interval and an α margin of error of 5%. Differences were considered statistically significant for p values ≤ 0.05. **Results:** Of 48 study participants, we found that the frequency of PPROM before 32 weeks was 2.2%. The mean age was 28.2 ± 6.3 years. Only 25% of study participants had a history of PPROM. Most of the pregnancies were singleton. Only 6.2% of women reported more than 5 ANCs, 93.7% had undergone routine infectious work-up, and 58.3% had pathological pregnancies. The most frequently performed tests were complete blood count CBC (70.8%), c-reactive protein (CRP) (66.7%) and hemoparasite/rapid diagnostic test for malaria (43.8%). Group B Streptococcus was the most common germ isolated via high vaginal swab (HVS) (50%). The frequencies of antibiotic therapy, corticosteroid therapy and tocolysis were 100%, 83.3% and 43.8% respectively. Most women gave birth within 3 days or less. The frequency of

cesarean section was 31.3%. We reported maternal infection in 50% and no maternal morbidity. Perinatal mortality was 52.7%, dominated by early neonatal deaths at 41.8%. **Conclusion:** The maternal prognosis of PPROM before 32 weeks was favorable, while the neonatal prognosis was dismal, with a perinatal death rate of 52.7%.

Keywords

Preterm Premature Rupture of Membranes, 32 Weeks, Yaoundé

1. Background

Fetal membrane rupture before the onset of uterine contractions is designated prelabor rupture of membranes (PROM). When it occurs prior to 37 + 0 weeks gestation it is referred to as preterm PROM (PPROM). Meta-analyses based on data from EPIPAGE and MEDLINE in 2018 reveal that, globally, PPROM complicates 3% of pregnancies, with less than 1% and 0.65% of pregnancies occurring before 34 and 28 weeks, respectively [1]. Preterm birth is the leading cause of neonatal mortality and morbidity worldwide [2], with increasing neonatal morbidity and mortality as gestational age decreases [3]. This tragic event of major clinical importance, particularly when it occurs before 32 weeks of gestation, represents one of the greatest challenges in modern obstetrics, especially in resource limited settings.

The etiology of PPROM is multifactorial, ranging from a structural defect in the membranes due to collagen deficiency or malformation, to the weakening of membranes secondary to inflammatory or infectious processes, and to membrane exposure because of cervical incompetence. Several risk factors predispose to PPROM such as black race, low socioeconomic status, genital tract infection, antepartum bleeding, previous PPROM, polyhydramnios, multiple pregnancy, inadequate antenatal care, acute abdominal trauma and cigarette smoking during pregnancy [4]-[6]. In resource rich settings outcomes post PPROM occurring before 34 weeks have reported an estimated perinatal mortality of 4.8% [7]. A higher perinatal mortality of 22% was reported in a Chinese study on PPROM before 32 weeks gestations [8]. In France, according to Benedetti *et al.*, PPROM occurring before 32 weeks had an estimated perinatal mortality rate of 14.5%, which was higher in multiple pregnancies [9]. Likewise in resource limited settings, hospital-based studies have been carried out and revealed the following: in the Gambia PPROM complications resulted in a perinatal mortality of 8.3% [10], in Cameroon, Pisoh *et al.*, reported unfavorable perinatal outcomes from PPROM at 57.89% [11].

Components of the management of PPROM include the use of corticosteroids for fetal pulmonary maturation; two doses of 12 mg Betamethasone intramuscularly 24 hours apart are typically used or four doses of 6 mg Dexamethasone intramuscularly 12 hours apart. Secondly, prophylactic antibiotics, the goal of which is to decrease the frequency of maternal or fetal infections, thereby delaying labor.

Currently, there is insufficient data in the literature to suggest superiority of one antibiotic over another, or advocate for mono- or combination-therapy. Thirdly, tocolysis with standard tocolytics are indicated to delay delivery for 48 hours to allow the administration of corticosteroids. Habitually Nifedipine or a β2-agonists are used for tocolysis.

Although there is some data in the literature on prevalence, risk factors and outcome of PPROM in Cameroon, there is no specific information on very preterm cases. A 2022 study by Epee Ngoue *et al.* on the epidemiology of preterm birth over a 5-year period in Yaoundé (Cameroon) revealed a prevalence at 14.8%. However, the study included preterm births up to 36 + 6 weeks gestation [12]. Our study sought to describe maternal and neonatal health surrounding the delivery of very preterm neonates in three tertiary care hospitals in Cameroon, a resource limited setting.

2. Methods

2.1 Study Design and Setting

We conducted a descriptive cross-sectional study with prospective data collection over a 5-month period from January 1st to May 31st, 2022. Our study took place in the Obstetrics and Gynecology, and Neonatology departments of three tertiary health facilities in the city of Yaoundé, which is the capital city of Cameroon with an estimated population of 4,337,000 inhabitants in 2022 [13]. We collected data from the Yaoundé Obstetrics/Gynecology and Pediatrics hospital (YOGPH), Yaoundé Central Hospital (YCH) and Essos Hospital Center (EHC). The neonatology units in all three facilities are equipped with incubators, oxygen wall outlets and oxygen concentrators.

2.2 Study Population

Our study population included women consulted and delivered at facilities for PPROM before 32 weeks gestation within our study period. We received consent from all study participants. Pregnant women with an indeterminable gestational age were excluded.

2.3. Sampling and Sampling Size Determination

We used a consecutive, non-exhaustive sampling of all patients meeting the inclusion criteria during the study period. The minimum sample size was calculated using a formula applicable from a similar descriptive study [9]. Based on the study of Benedetti *et al.* [9], we obtained a minimum sample size of 31 using the formula:

$$n = t^2 \times p \times (1-p) / \mathrm{m}^2$$

where:

n: minimum sample size required to obtain significant results for a given event and risk level;

t: confidence level (the standard value for the 95% confidence level is 1.96);

p: prevalence of women admitted for premature rupture of the membranes between 22 and 32 weeks of pregnancy in a postgraduate university center over a 5-year period (2015 to 2019) made by Benedettia *et al.* in France: 2%.

m: margin of error (standard value 5%).

2.4. Study Procedure

Prior to study onset, we obtained ethical clearance from all Ethical Committees of our study facilities and from our corresponding faculty of medicine and biomedical sciences of the University of Yaoundé 1. Daily recruitment was done by a medical student using medical records during the data collection period. Our questionnaire included sociodemographic data, obstetrical history, history of current pregnancy including laboratory examinations done and comordities applicable to current pregnancy, and management of PPROM with outcomes. The questionnaire was pre-tested prior to use.

We carried out prospective data collection on hospitalized patients with an admission diagnosis of PPROM, they all presented with non-bloody, watery vaginal discharge outside labor with a positive Valsalva maneuver after examination by a mid-wife or attending Ob/Gyn. We determined gestational age using two methods: dating using last menstrual period or by first trimester ultrasonography using cranio-caudal-length measurements. We explained our study to all participants and gave them information about ruptured membranes, and its possible complications.

2.5. Data Collection and Analysis

We entered our data into SPSS (Statistical Package of Social Science) for analysis. We expressed categorical variables in terms of numbers and proportions, and quantitative variables as mean, standard deviation or median and interquartile range. We used bivariate analysis to search for associated factors. We used a 95% confidence interval and an α margin of error of 5%. Differences were considered statistically significant for p values ≤ 0.05.

3. Results

We recruited sixty-two women for PPROM before 32 weeks gestation. We admitted 59 to the OB/Gyn department as 3 declined hospitalization. However, we included only 48 women in our study because 11 declined participation.

3.1. Hospital Prevalence of PPROM before 32 Weeks Gestation

We recorded 59 cases of PPROM before 32 weeks gestation, out of a total of 2732 deliveries, making the hospital frequency in our study 2.2%. (Table 1).

3.2. Sociodemographic Characteristics of Study Population

Women between 20 and 25 years accounted for 33.3% of cases (Table 2). The mean age was 28.25 ± 6.34 years, with age extremes of 16 and 39 years (not shown). Most participants lived in an urban location (95.8%) (Table 2).

Table 1. Hospital prevalence of PPROM before 32 weeks gestation.

Hospital	PPROM (n)	Percentage (%)
YOGPH*	16 (n = 899)	1.8
EHC**	20 (n = 869)	2.3
YCH***	23 (n = 964)	2.4
Total	59 (n = 2732)	2.2

*Yaoundé Obstetrics/Gynecology, Pediatric Hospital; **Essos Hospital Center; ***Yaoundé Central Hospital. n = total number of births during study period.

Table 2. Sociodemographic characteristics of study population.

Variables	Number N = 48	Percentage %
Age groups (in years)		
[15 - 20]	3	6.3
[20 - 25]	16	33.3
[25 - 30]	7	14.6
[30 - 35]	13	27.1
[35 - 40]	9	18.7
Place of residence		
Urban	46	95.8
Rural	2	4.2

3.3. Obstetrical History of Study Participants

We sought the parity of participants, and whether there was a history of PPROM. Our study had an equal number of nulli-, primi- and multiparous women. We recorded a history of PPROM in 25% of cases (Table 3).

Table 3. Obstetrical history of study participants.

Variables	Numbers N = 48	Percentage
Parity		
Nulliparous	16	33.3
Primiparous	16	33.3
Multiparous	16	33.3
History of PPROM		
Yes	12	25.0
No	36	75.0

3.4. History of Current Pregnancy of Study Participants

Our study consisted of mostly singleton pregnancies (85.4% of cases). Regarding

antenatal care (ANC) contacts, only 6.2% of our participants had more than five ANC contacts, with an average of 3.42 ± 1.69 contacts and 93.7% completed the requested routine pregnancy workup (Table 4). Completed infectious disease workup is shown in Table 4. HIV screening was the most performed laboratory test (89.6%). Pathologies during pregnancy were recorded in 28 women (58.3%) and included malaria (67.9%), followed by genital tract infections (25.0%), urinary tract infections (14.3%), preeclampsia (4.2%), gestational diabetes and acute gastritis at 2.1% each. Additionally, we observed that infections occurred in the 2nd (39.3%) and 3rd trimesters (39.3%) (Table 4).

Table 4. Characteristics of current pregnancy of study participants.

Variables	Numbers n = 48	Percentage %
Number of antenatal care contacts		
None	6	12.5
1 - 5	39	81.3
6 - 8	3	6.2
Infectious workup		
Done	45	93.7
Not done	3	6.3
Description of exams done		
HIV	43	89.6
Hepatitis B	34	70.8
Syphilis	30	62.5
Hepatitis C	26	54.2
Toxoplasmosis	19	39.6
Rubella	17	35.4
Infection during pregnancy		
Yes	28	58.3
No	20	41.7
Infections during pregnancy	**Numbers (n = 28)**	**Percentage %**
Malaria	19	67.9
Genital tract infection	7	25.0
Urinary tract infection	4	14.3
Preeclampsia	2	4.2
Gestational diabetes	1	2.1
Acute gastritis	1	2.1
Trimester in which infection occurred	**Numbers (n = 28)**	**Percentage %**
T1	7	25.0
T2	11	39.3
T3	11	39.3

3.5. Features Surrounding Membrane Rupture

PPROM occurred mostly between 30- and 32-weeks gestational age (56.3%). The median gestational age was 30 weeks, with lower and upper gestational age limits of 18 and 31 weeks, respectively (Figure 1). We verified fetal heart tones at membrane rupture via auscultation and found none in 4 cases. Other associated symptoms included fever and lower abdominal cramping in 29.2% and 27.1% cases, respectively (Table 5). All participants presented vaginal discharge as the chief complaint, and 56.2% consulted within 12 hours of vaginal discharge (Table 6).

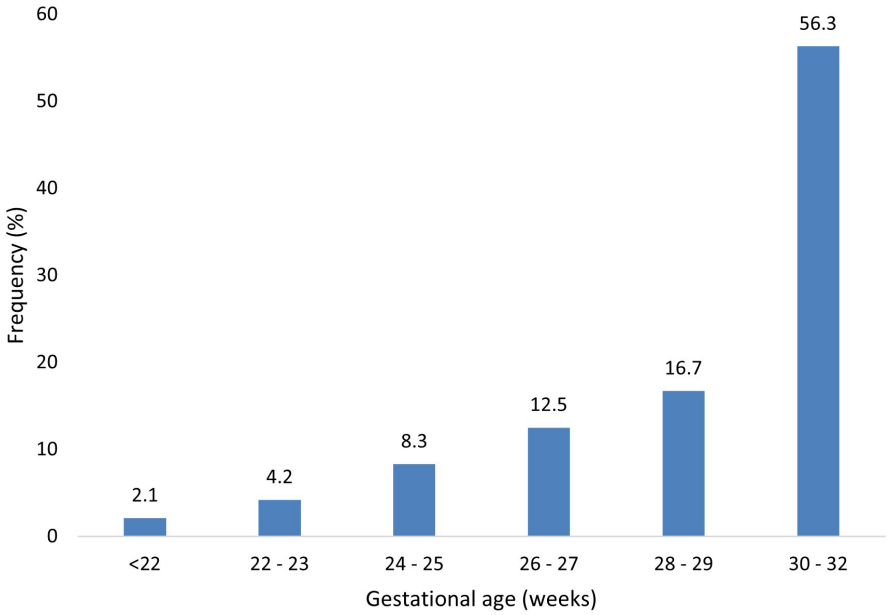

Figure 1. Gestational age at rupture of membranes.

Table 5. PPROM presentation characteristics.

Fetal heart tones		
Absent	4	8.3
Present	44	6.3
Associated symptoms		
None	21	43.8
Fever	14	29.1
Lower abdominal cramps	13	27.1

3.6. Work-Up Done on Admission

Although all study participants had been requested specific examinations on admission, only 34 did all examinations requisitioned. However, all participants did the malaria and CRP tests. A high vaginal swab was done by only 6 participants. The most frequently performed examinations were the complete blood count (CBC) (70.8%), C-reactive protein (CRP) (66.7%) and hemoparasite (HP) and the

rapid diagnostic test (RDT) for malaria (43.8%). Of the CBCs done, we reported anemia most frequently (82.4%), followed by leukocytosis (52.9%). CRP and malaria screening tests were positive in 66.7% and 33.3% of cases, respectively (Table 7). Of the 6 who did the high vaginal swab (HVS), 3 were positive and 3 negative (Table 7). The only pathogen isolated in all positive HVS cases was group B streptococcus.

Table 6. Chief complaint and time elapsed prior to consultation.

Variables	Numbers N = 48	Percentage%
Presenting complaint		
Clear vaginal discharge	48	100.0
Time elapsed before consultation (in hours)		
Less than 12	27	56.2
12 – 18	6	12.5
>18	15	31.3

Table 7. Admission work-up of study participants.

Variables	Numbers	Percentage%
Hemoglobin concentration (g/dL) (n = 34)		
[8 - 10]	9	26.5
[10 - 12]	19	55.9
>12	6	17.6
Leucocytosis (n = 34)		
Yes	18	52.9
No	16	47.1
CRP* (n = 48)		
Positive	27	56.3
Negative	21	43.7
Hemoparastie/RDT (n = 48)**		
Positive	7	33.3
Negative	14	66.7
High vaginal swab (n = 6)		
Positive	6	50.0
Negative	6	50.0

*C-reactive Protein; **Rapid Diagnostic Test for *Plasmodium falciparum.*

Forty-five women were able to afford an obstetrical ultrasound on admisson. We noted oligohydramnios and anhydramnios in 84.4% and 8.0%, respectively. Fetal cardiac activity was absent in 13.3% of cases (Table 8).

Table 8. Ultrasonographic findings on admission.

Variables	Number (n = 48)	Percentage%
Obstetrical ultrasound done		
Yes	45	93.8
No	3	6.2
Amniotic fluid characteristics		
Normal	3	6.7
Oligohydramnios	38	84.4
Anhydramnios	4	8.0
Fetal cardiac activity N = 45		
Absent	6	13.3

Table 9 shows management modalities of PPROM, which included use of antibiotics, corticosteroids, and tocolytics. The frequencies of antibiotherapy, corticotherapy and tocolysis were 100%, 83.3% and 43.8% respectively. Antibiotics were prescribed as monotherapy in 66.7% of cases. Amoxicillin (47.9%) and ceftriaxone (37.5%) were the two main antibiotics prescribed alone or in combination (Tables 9-12/not shown). Regarding the latency period, 52.1% of women had given birth within 3 days of PPROM. The median latency period was 3 days, with extremes of 0 and 28 days. Fifteen women delivered by emergency caesarean section (31.2%), with the main indication being non-reassuring fetal status (Table 10).

Table 9. Management of PPROM.

Treatment administered	Numbers	%
Antibiotherapy	**48**	**100,0**
Monotherapy	32	66.7
Combincation therapy	16	33.3
Specific antibiotic prescribed		
Amoxicillin	23	47.9
Ceftriaxone	18	37.5
Amoxicillin-clavulanic acid	9	18.8
Metronidazole	4	8.3
Gentamicin	4	8.3
Ampicillin	2	4.2
Corticotherapy	**40**	**83.3**
Betamethasone	33	82.5
Dexamethasone	7	17.5
Tocolysis	**21**	**43.8**
Nifedipine	21	100.0

Table 10. Latency period and mode of delivery.

Variables	Number (n = 48)	Percentage %
Latency period in days	25	52.1
≤3		
4 - 7	15	31.3
8 - 14	5	10.4
15 - 21	1	2.1
22 - 28	2	4.1
Mode of delivery		
Emergency cesarean	15	31.2
Spontaneous vaginal	24	50
Induced vaginal	9	18.8

Table 11. Maternal and fetal outcomes post PPROM

Variables	Numbers N = 48 or 49	Percentage %
Maternal complications		
Yes	24	50
No	24	50
Neonatal complications		
Yes	40	81.6
No	9	18.4
Neonatal death		
Yes	23	46.9
No	26	53.1

Maternal complications occurred in 50% of cases, whereas 81.6% of neonates had complications. We did not record any maternal deaths, however, 46.9% neonates died (Table 11).

Table 12. Bivariate analysis of maternal factors associated with newborn survival

Maternal variables				
Time elapsed to consultation (hours)	Neonates alive	Neonates deceased	Odds Ratio	p-value
Less than 12	20 (80.0 %)	7 (30.4 %)	4.44	0.001
12 - 18	0 (0%)	6 (26.1 %)	0.91	0.58
More than 18	5 (20.0 %)	10 (43.5 %)	0.33	0.77
Gestational age (weeks)				
<28	3 (12.0 %)	13 (56.5 %)	0.91	0.63
≥28	22 (88.0 %)	10 (43.5 %)	2.60	0.002

Maternal factors associated with newborn survival were time elapsed to consultation less than 12 hours (OR: 4.44; P < 0.003) and PPROM after 28 weeks of gestation (OR: 2.6; P < 002) (**Table 12**).

4. Discussion

Our research consisted in assessing maternal and perinatal health post PPROM before 32 weeks gestation in three referral hospitals in the city of Yaoundé. We carried out an analytical cross-sectional study that included 48 women. The frequency of PPROM in the hospitals was 2.2%. This frequency is similar to a study of Charlotte Benedetti *et al.* [9] carried out in France in 2019, which showed a PPROM frequency of 2% between 22 and 32 weeks gestation. However, our results are higher than those obtained in Australia in 2017 which reported PPROM at 1.8% for gestational age less than 34 weeks [14]. In a resource limited setting similar to ours (Gambia) the frequency of PPROM was reported 1.3% [10]. Although the frequencies are similar in both resource rich and resource limited settings, frequencies of the latter refer to hospitals and are not nationwide like in the French study. One could therefore infer that our frequency would likely be higher if a nationwide analysis was carried out.

The socio-demographic profile of participants in our study participants revealed that one third of them were between 20 and 25 years, with a mean age of 28.25 ± 6.34 years. The age in our study was lower than that determined in Israel and China which were 32.7 ± 6.1 years and 32.0 ± 5.1 years, respectively [15] [16]. On the other hand, our results were like two studies in Egypt and South Africa which revealed a mean age of 27.1 ± 3.5 years in Egypt [17] and median of 27 years in South Africa [18]. This suggests that pregnant women admitted for PPROM in resource rich countries are older than those in Africa. This difference can be explained by the fact that, according to Eurostat 2021, the average of women birthing their first child was 31 years in Europe [19]. Age at first childbirth is lower in Africa, between 20 and 25 [20]. Most women lived in an urban setting consistent with our study which took place in 3 reference hospitals in Yaounde, Cameroon. In terms of obstetrical history there was an equal number of nulli-, primi-, and multiparous women. Antenatal contacts were substandard with 93.8% of participants reporting 5 or less contacts, consistent with inadequate ANC in resource limited settings as shared by Ekholuenetale *et al.* [21]. A similar observation was made in Cameroon by Pisoh *et al.* in 2021 [11].

The obstetrical history revealed that 25% of the women had a history of PPROM in a previous pregnancy, consistent with another hospital based study in Cameroon which revealed a similar result in 2021 [11]. Scientific literature reports one of the risk factors for PPROM as a history of PPROM. Our study revealed that infections occurred with equal levels in the 2nd and 3rd trimesters of pregnancy, with a small percentage in the 1st trimester. This may confer some benefit to the fetus as it is at greatest risk in the 1st trimester. Based on our study results 93.7% of participants completed the panel of routine pregnancy work-up that was re-

quested. HIV serology was the most common examination done because it is done free of charge (rapid screening test). In terms of infections that occurred during pregnancy, in order of decreasing frequency, malaria, genital infection and urinary tract infection were reported. The presence of similar pathologies in pregnancy was also reported in unpublished theses by Keita in Mali and Tsimanga in the Democratic Republic of Congo, in 2009 and 2015, respectively [22] [23]. These data are justifiable in our context as malaria in pregnancy is a frequent pathology since the disease is endemic in Cameroon. Genitourinary and urinary tract infections and the non-treatment thereof have been observed as a major risk factor for PPROM [24]. These infections are potential reservoirs of bacteria that ascend to the membranes where they cause localized inflammation. Bacteria produce several proteolytic enzymes, such as collagenase and gelatinase, which can cause local weakening of the membranes.

In our study membrane rupture between 30 and 32 weeks (56.3%) was most common, with a median gestational age of 30 weeks. PPROM before 21 weeks was recorded in 2.1% of cases, consistent with the fact that the incidence of PPROM increases progressively with gestational age [25]. Majority of our study participants consulted within 12 hours (56.7%) of PPROM. The chief complaint was a clear fluid discharge from the vagina (64.6%). This is the most common presenting complaint of women with rupture of membranes. While some of our study subjects reported spontaneous PPROM in 93.8% of cases, others reported rupture after prolonged exertion and trauma, one of which occurred after a brawl and the other post coitus. Traumatic events as a plausible cause of rupture of membranes have been reported previously [26]. Additionally, a thesis by Cissé *et al.* reported 3% cases of post-traumatic PROM, with two post-coital cases and one case after an attempt at voluntarily terminating the pregnancy [27].

On admission 8.3% of participants had absent fetal heart activity. This result is higher than that reported by Keita *et al.* that reported 5.9% cases of absent fetal heart tones [22]. This difference is possibly due to Keita *et al.*'s larger sample size (102 vs. 48), plus in our study we found associated findings that could possibly impact fetal well-being, such as retroplacental hematoma, umbilical cord prolapse and low-lying placenta (not shown).

In terms of management, all women hospitalized in our study received antibiotic therapy in line with recommendations of several obstetrics and gynecology societies worldwide, as many studies have reported prolonged pregnancy with antibiotics use in cases of PPROM [6] [15] [16]. Monotherapy was the most common modality, with oral amoxicillin as the main antibiotic (47.9%). Amoxicillin is a broad-spectrum antibiotic, with good penetration of the genital tract and amniotic fluid. In our limited-resource context multiple antibiotics may result in non-compliance due to financial constraints. However, we report that 33.3% of study participants received bi-antibiotic therapy. Combination therapy was shown to be more effective than monotherapy in a 2017 Canadian study by Lu *et al.* [28]. Corticosteroids were administered in 83.3% of cases in our study. All women did not

receive corticosteroids because some were admitted with PPROM in the context of intrauterine fetal demise. Regarding the choice of steroid, betamethasone was mostly used (82.5%). Some women were administered dexamethasone, primarily due to absence of betamethasone at drug stores. We tocolysed 43.8% of participants in our study with nifedipine, currently considered first-line therapy due to fewer side effects and a better safety profile compared with other agents [29].

In terms of delivery, all cases of PPROM in our study resulted in preterm delivery. Most occurred between 28- and 32-weeks gestation (45.8%). This is slightly higher than that reported by Tsafir *et al.* where the predominant gestational age at delivery varied between 32 and 34 weeks (40.4%) after PPROM that occurred between 22 and 32 weeks. This difference may be explained by the fact that in their inclusion criteria Tsafir *et al.* only considered singleton pregnancies, which would have favored a longer latency period [15]. The latency period in our study was less than seven days in 83.4% cases, of which 52.1% was less than three days, with a median latency period age of three days. This result is like that of Gopalani *et al.* in 2004 USA, which estimated that 39% cases of PPROM delivered after 48 hours and 68% after 7 days. However, our result is lower than that obtained by Pasquier *et al.* where 60% delivered within 48 hours and 87% within 7 days of PPROM [30]. This difference may be explained by the presence of an exclusion criterion that limited Pasquier's study to premature ruptures occurring between 32- and 33-weeks' gestation.

In our study, most women gave birth vaginally (68.8%) while the remainder underwent a caesarean section. Our cesarean birth rate is higher than that reported by Kayem *et al.*, which reported cesarean deliveries at less than 29% of the total. On the other hand, our rate is lower than that of Pasquier *et al.* at 43%, with a mean gestational age of 30 weeks [30] [31]. In the literature c-sections are typically indicated for the usual obstetrical indications. In our study, the c-section rate was mostly due to non-reassuring fetal status.

Our study showed that maternal complications were chorioamniotitis in 20.8% of cases and endometritis in 6.3%. This is like that of Lieman *et al.* in 2005, who found a 21% incidence of clinical chorioamniotitis for PPROM occurring between 28 - 32 weeks [32]. These results are lower than those found by Tsafir *et al.* in PPROM between 32 and 34 weeks (17.4%) [15]. The occurrence of chorioamniotitis may be explained by the fact that amniotic fluid contains a variety of anti-infectious cytokines, and the loss of this amniotic fluid weakens the mother's ability to resist infection, thus aggravating intrauterine infections. Moreover, the incidence of chorioamniotitis increased significantly with decreasing gestational age. Tsafir *et al* observed an inverse correlation between gestational age at PPROM and a high probability of chorioamniotitis, in line with several studies in the literature. We also reported fetal complications. We recorded 10.9% intrauterine fetal deaths. Our percentage is slightly higher than that of Paumier *et al.* who recorded 8.4% of deaths in the antenatal period for the same study population [33]. The study by Pasquier *et al.* reported a stillbirth percentage of 4.49% for pregnancies

between 24 and 34 weeks of gestation [30]. This difference can be justified by the fact that over one third of the women in our study had PPROM at less than 22 weeks, and 60% of our participants who presented with IUFD had come for consultation late. Pasquier's study extends to 34 weeks gestation; therefore the newborns were closer to term than in ours, and consequently have less complications and a better prognosis. Other neonatal complications included infections and occurred in 79.6% of cases. These results are comparable to those of Liu *et al.* in China, who reported a neonatal infection rate of 72.06% [8]. These results are also in line with those of Stewart *et al.* in South Africa, who reported sepsis in 46% of cases [18]. It is likely that the infectious risk is high because, in addition to PPROM, newborns were exposed to other factors that can result in infection, like prolonged rupture of membranes, maternal infection in pregnancy, stained amniotic fluid, placental or funicular pathology.

Bivariate analyses of maternal factors associated with newborn survival showed that newborns from pregnancies with PPROM before 32 weeks are 4 times more likely to survive if born after 27 weeks' gestation (OR: 4.90; $P < 0.03$). This result is like a study also carried out in Cameroon by Njom Nlend *et al.* which reported that after 28 weeks gestation, premature babies are more likely to survive (95% CI: 15.1 - 19.7; $P \leq 0.001$) [34]. This is possible because neonates born before this gestational age are considered extremely premature and are not only subject to complications of extreme prematurity itself but also exposure to other infections, reducing their chances of survival. Additionally, newborns whose mothers sought medical care within 12 hours of PPROM had a better chance of survival (OR: 5, 65; $P < 0.002$). This result is similar to that of Mulongo Mbarambara *et al* who found that newborns born to mothers who consulted within 12 hours were twice as likely survive (OR: 2.15; CI: 1.20 - 5.12; $P< 0.0043$) [35]. This could be explained by the fact that at a delay of less than 12 hours, the risk of amniotic fluid contamination is not yet accentuated .

5. Conclusion

Preterm prelabor rupture of membranes remains a challenge in modern obstetrics. Although maternal outcomes are encouraging with no mortality recorded, neonatal morbidity and mortality persist significantly. Management in resource-limited settings is challenging and requires continued efforts to improve these health indicators.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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