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MICROBIOLOGICAL PROFILE OF HIGH VAGINAL SWABS AND ANTIBIOTIC SUSCEPTIBILITY PATTERNS IN CASES OF PRETERM PREMATURE RUPTURE OF MEMBRANES AT A TERTIARY CARE CENTER IN SOUTH INDIA

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Structured Abstract

Introduction: Prelabour rupture of membranes (PROM) refers to the spontaneous rupture of foetal membranes before labour begins, irrespective of gestational age. If this occurs prior to 37 weeks, it is termed preterm premature rupture of membranes (PPROM), affecting approximately 3% of pregnancies and contributing to 30–35% of preterm births. Maternal infection remains a significant etiological factor in PPROM, impacting both maternal and neonatal outcomes.

Objective: To assess the clinical and microbiological profile of high vaginal swab (HVS) samples and evaluate antibiotic susceptibility patterns in patients with PPROM at a tertiary care center, along with analysing associated maternal and foetal outcomes.

Methodology: Hospital-based, prospective observational study was conducted over one year following ethical approval. The study included 68 antenatal women admitted with PPROM between 24 and 36+6 weeks of gestation. Relevant clinical and laboratory data, including HVS cultures and neonatal outcomes, were analysed.

Results: HVS cultures were positive in 16.2% of cases. The organisms isolated included Escherichia coli (45.5%), Candida albicans (27.3%), Enterococcus faecalis (18.2%), and Klebsiella pneumoniae (9.1%). All gram-negative isolates exhibited resistance to Ampicillin and third-generation cephalosporins but were sensitive to Piperacillin-Tazobactam, Cefoperazone-Sulbactam, Cefepime, and Meropenem. One Enterococcus faecalis isolate was sensitive to Ampicillin and high-level Gentamicin; both were susceptible to Vancomycin and Linezolid. Among neonates, 10.3% of mothers developed chorioamnionitis and 36.8% of infants required neonatal resuscitation.

Conclusion: PPROM represents a significant risk for preterm birth and associated maternal morbidity such as chorioamnionitis. Early identification of causative organisms and their antibiotic susceptibility patterns is essential for optimizing management and improving maternal-neonatal outcomes. Empirical therapy should be guided by local resistance patterns, with a focus on timely administration of corticosteroids, magnesium sulphate, and appropriate antibiotics.

Keywords: PPROM, preterm birth, high vaginal swab, antibiotic susceptibility, maternal morbidity, neonatal outcomes, antimicrobial resistance, expectant management

Introduction

PROM was characterized by the spontaneous rupture of foetal membranes prior to the onset of labour, with preterm premature rupture of membranes (PPROM) specifically referring to rupture occurring before 37 weeks of gestation [1]. PPROM complicates approximately 1–5% of pregnancies and is responsible for 30–40% of all preterm births[2]. Although the exact mechanisms underlying membrane rupture remain unclear, a substantial body of evidence implicates subclinical ascending infection from the cervix and vagina as a key etiological factor [3,4,5]. The inflammatory response triggered by microorganisms compromises the structural integrity of the foetal membranes, often leading to rupture and preterm delivery through the activation of proinflammatory chemokines, cytokines, and enzymes [6]. Notably, risk factors for PPROM closely mirror those for preterm labour with intact membranes, with cervicovaginal infections playing a predominant role [7]. PPROM most commonly results in spontaneous labour within days, but the loss of the protective barrier increases the chance of intrauterine infection and subsequent adverse outcomes [8].

Microbiological investigations suggest that intrauterine infection may contribute to 25–40% of preterm births, with organisms frequently breaching intact foetal membranes via ascending routes [3,9,10,11]. These infections activate the maternal and foetal immune response, leading to the production of inflammatory mediators and matrix-degrading enzymes, which precipitate both membrane rupture and preterm labour [3,12]. The risk of intrauterine infection is inversely related to gestational age at which PPROM occurs; earlier gestational ages are associated with a higher prevalence of histological chorioamnionitis and worse neonatal outcomes [14,15,16,17]. Complications arising from PPROM include not only prematurity but also significant maternal morbidity such as chorioamnionitis, placental abruption, and sepsis, as well as neonatal risks like sepsis, neurological impairment, and respiratory distress [17].

Current guidelines emphasize a balance between expectant management and intervention. The American College of Obstetricians and Gynaecologists (ACOG) recommends expectant management with intravenous antibiotics, corticosteroids, and group B Streptococcus prophylaxis for pregnancies less than 34 weeks, with prompt delivery thereafter [18]. Prompt recognition and management of infection are critical, as microbial invasion of the amniotic cavity and subsequent inflammatory responses significantly affect both maternal and neonatal outcomes. Identification of local microbiological patterns and antibiotic sensitivity profiles is therefore essential to inform effective clinical decision-making, minimize complications, and improve prognosis for both mother and child. Given the strong association between intrauterine infection and the occurrence and outcome of PPROM, timely identification of causative organisms and their antibiotic susceptibility patterns is crucial for guiding effective management. Local surveillance of microbial profiles and resistance trends enables targeted empirical therapy, reduces inappropriate antibiotic use, and may help limit the development of antimicrobial resistance. As patterns of microbial colonization and resistance may vary geographically, ongoing research is essential to optimize protocols for prevention, early intervention, and improved maternal and neonatal care in PPROM. This study was undertaken to characterize the microbiological spectrum of high vaginal swabs and to determine antibiotic susceptibility patterns among women with PPROM at our tertiary care center, aiming to inform evidence-based clinical practice and enhance perinatal outcomes.

Methods

1.Study design and setting: This hospital-based prospective observational study was conducted over one year following Institutional Ethics Committee approval at the Departments of Obstetrics & Gynaecology and Microbiology of a tertiary care center in South India. The study population comprised antenatal women admitted with preterm premature rupture of membranes (PPROM) between 24+0 weeks and 36+6 weeks' gestation. Using a sequential sampling approach, 68 eligible

participants were enrolled after obtaining informed written consent. Inclusion criteria were all pregnant women presenting with PPROM within the specified gestational window; exclusions were intrauterine foetal demise at presentation and antibiotic exposure within seven days prior to the onset of leaking per vagina.

2: Clinical procedures and microbiological methods: At presentation, a detailed history, general examination, and obstetric assessment were performed. PPROM was confirmed on sterile speculum examination by visualization of amniotic fluid pooling in the posterior fornix and/or leakage through the cervical os, with or without the Valsalva maneuver. High vaginal swabs were collected from the posterior fornix using a double-swab technique under aseptic precautions to minimize contamination. One swab was used for direct microscopy; the second was inoculated onto blood agar, chocolate agar, and MacConkey agar. Plates were incubated for 24–48 hours, and isolates underwent species identification and antibiotic susceptibility testing per laboratory protocol. An electronic case-record proforma captured baseline variables (age, parity, socioeconomic status, past obstetric history), comorbidities (e.g., gestational hypertension, diabetes, anemia, thrombocytopenia), investigations (ultrasonography, complete blood count, C-reactive protein), antimicrobial therapy, latency period, delivery details and indications, and maternal outcomes (chorioamnionitis, sepsis, placental abruption, postpartum hemorrhage, retained placenta, operative delivery). Neonatal data included gestational age, birth weight, antenatal corticosteroid and magnesium sulphate administration, Apgar scores, NICU admission, and complications (neonatal death, sepsis, respiratory distress syndrome, early-onset seizures, intraventricular hemorrhage, necrotizing enterocolitis). Mothers and infants were followed until hospital discharge.

3.Data management and analysis: Data were entered in Microsoft Excel and analysed using SPSS version 27. Categorical variables were summarized as frequencies and percentages, and continuous variables as mean with standard deviation. Group comparisons for categorical variables were performed using the chi-square test. Statistical significance was set at $p < 0.05$.

Results

1. Socio demographic and clinical characteristics

		Frequency	Percentage
Age	≤30	50	73.5
	>30	18	26.5
Economic status	BPL	51	75
	APL	17	25
BMI	18.5-23	9	13.2
	23-27.5	39	57.4
	27.5-31	14	20.6
	31-35	6	8.8
Parity	Primi	32	47.1
	Multi para	36	52.9
History of PPROM	Yes	5	7.4
	No	63	92.6
History of PTVD	Yes	10	14.7
	No	58	85.3
Anemia	Nil	21	30.9
	Mild (Hb 10-10.9)	40	58.8
	Moderate (Hb 7-10)	7	10.3
GHTN	Yes	9	13.2
	No	59	86.8
GDM	MNT	14	20.6
	OHA	8	11.8
	Insulin	5	7.4

	pre gestational DM	1	1.5
	Nil	40	58.8
Bronchial asthma	Yes	8	11.8
	No	60	88.2
Thyroid diseases	Yes	10	14.7
	No	58	85.3
	Total	68	100

Among the 68 women with PPROM, most were young and socioeconomically disadvantaged: 73.5% were aged ≤30 years and 75% belonged to below-poverty-line households. The cohort was predominantly overweight by Asian BMI thresholds, with 57.4% in the 23–27.5 range, 20.6% in 27.5–31, and 8.8% in 31–35; only 13.2% had a BMI of 18.5–23. Parity was balanced, with 47.1% primigravidae and 52.9% multipara. A previous history of PPROM was uncommon (7.4%), while 14.7% reported a prior preterm vaginal delivery. Mild anemia was frequent (58.8%), with 10.3% having moderate anemia and 30.9% showing no anemia. Gestational hypertension was present in 13.2%, thyroid disorders in 14.7%, and bronchial asthma in 11.8%. Regarding glycemic status, 41.2% had diabetes in pregnancy (20.6% managed with medical nutrition therapy, 11.8% with oral hypoglycemic agents, 7.4% with insulin, and 1.5% with pregestational diabetes), while 58.8% had no diabetes. Overall, the study population comprised predominantly young, overweight women from lower. Overall, the cohort was predominantly young, socioeconomically disadvantaged, and overweight, with a high prevalence of mild anemia and notable rates of pregnancy-related comorbidities (gestational hypertension, thyroid disease, asthma) and glucose intolerance.

2.Maternal outcome

		No	Percentage
Mode of delivery	Vaginal delivery	57	83.8
	LSCS	11	16.2
Induction status	Yes	27	47.4
	No	30	52.6
Indication for LSCS	Stage 1 FGR	1	9.1
	First degree CPD	2	18.2
	Previous CS	6	54.5
	NRFHR	2	18.2
PPROM to delivery interval	<6 hours	18	26.5
	6-12 hours	11	16.2
	12-18 hours	5	7.4
	18-24 hours	4	5.9
	24-72 hours	12	17.6
	72 hours- one week	11	16.2
	>1 week	7	10.3
PPH	Yes	7	10.3
	No	61	89.7
Maternal pyrexia	Yes	5	7.4
	No	63	92.6
Foul smell in liquor	Yes	2	2.9
	No	66	97.1
UTI following 2 weeks of admission	Yes	38	55.9
	No	30	44.1

Vaginitis	Yes	41	60.3
	No	27	39.7
Chorioamnionitis	Yes	7	10.3
	No	61	89.7
Total count	4000-11000	11	16.2
	11001-20000	51	75
	>20000	6	8.8
CRP	Positive	38	55.9
	Negative	30	44.1

According to Table 2, the majority of women had vaginal deliveries (83.8%), while 16.2% underwent caesarean section, most commonly for previous caesarean (54.5%), followed by first-degree cephalopelvic disproportion (18.2%) and non-reassuring foetal heart rate (18.2%); a single case was for stage 1 foetal growth restriction (9.1%). Labor was induced in 47.4% of cases. The PPROM-to-delivery interval was variable: 26.5% delivered within 6 hours, 16.2% within 6–12 hours, 7.4% within 12–18 hours, 5.9% within 18–24 hours, 17.6% within 24–72 hours, 16.2% within 72 hours to one week, and 10.3% after more than one week. Maternal morbidity was generally low but notable for infection-related indicators. Postpartum hemorrhage occurred in 10.3%, maternal pyrexia in 7.4%, and clinical chorioamnionitis in 10.3%. Only 2.9% had foul-smelling liquor. However, post-admission infectious morbidities were frequent: urinary tract infection within two weeks was documented in 55.9% and vaginitis in 60.3%. Haematological and inflammatory markers supported an inflammatory milieu, with leucocytosis common (75.0% had total counts 11,001–20,000 and 8.8% >20,000) and C-reactive protein positive in 55.9%. These findings indicate that while vaginal birth predominated and most women delivered within 72 hours, a substantial subset experienced prolonged latency. Infection was the principal maternal complication, reflected in high rates of UTIs, vaginitis, leucocytosis, and CRP positivity, whereas severe intrapartum complications were less frequent.

Table 3 Microbiological Characteristics

		No	%
High vaginal swab	Normal vaginal flora	57	83.8
	Positive	11	16.2
Microbiome isolated	Escherichia coli	5	45.5
	Enterococcus faecalis	2	18.2
	Klebsiella pneumoniae	1	9.1
	Candida albicans	3	27.3
	Total	68	100

According to Table 3, majority of high vaginal swabs demonstrated normal vaginal flora (83.8%), indicating that overt pathogenic colonization at the time of sampling was uncommon. Nonetheless, 11 swabs (16.2%) were culture-positive, revealing a focused spectrum of organisms with clinical relevance in PPROM. Escherichia coli accounted for nearly half of the positive isolates (45.5%), underscoring the prominence of gram-negative bacilli in ascending genital tract colonization and their known association with intra-amniotic infection and early-onset neonatal sepsis. Candida albicans was the second most frequent isolate (27.3%), highlighting the contribution of fungal colonization in a subset of cases, which may be more prominent in settings with antibiotic exposure or glycemic dysregulation, though causality cannot be inferred from these data. Enterococcus faecalis (18.2%) and Klebsiella pneumoniae (9.1%) were less common but clinically pertinent given their potential for antimicrobial resistance and involvement in urinary and genital tract infections.

Taken together, the culture positivity rate of 16.2% suggests that routine HVS culture may identify a targeted group at higher risk for infectious morbidity, even when most patients exhibit normal flora. The predominance of E. coli among positives supports empiric coverage for gram-negative organisms in suspected infection, while the detection of Enterococcus and Klebsiella argues for local antibiogram-informed choices rather than broad-spectrum escalation. The presence of C. albicans in over a quarter of positive cultures warrants cautious interpretation: while colonization is common and not always pathogenic, it may influence symptomatic vaginitis and potentially latency management if clinical signs of infection are present. Overall, these microbiological findings reinforce the need for context-specific antimicrobial strategies and emphasize that negative cultures do not exclude subclinical infection, given the limitations of culture-based methods and the possibility of anaerobes or fastidious organisms not captured by routine media.

Table 4 Antibiotic susceptibility pattern of gram-negative bacteria for 6 cases of E-coli and Klebsiella

	Ampicillin	Amoxicillin clavulanic acid	Third Generation Cephalosporins	Cefepime	Piperacillin+ Tazobactam	Meropenem	Cefoperazone+ sulbactum
Sensitive	0	2	0	1	6	6	6
Resistant	6	4	6	5	0	0	0
Total	6	6	6	6	6	6	6

Among six gram-negative isolates (E. coli and Klebsiella), high resistance was observed to ampicillin (100%) and third-generation cephalosporins (100%), with substantial resistance to cefepime (83.3%) and amoxicillin–clavulanic acid (66.7%). In contrast, all isolates were sensitive to piperacillin–tazobactam, meropenem, and Cefoperazone–sulbactam (100% each). Overall, the pattern suggests likely ESBL production with preserved susceptibility to β-lactam/β-lactamase inhibitor combinations (piperacillin–tazobactam, Cefoperazone–sulbactam) and carbapenems, arguing against empirical use of ampicillin or third-generation cephalosporins in similar cases and supporting escalation to PTZ/CFP-SUL or carbapenems when severe infection is suspected, guided by institutional policies.

Table 5 Antibiotic susceptibility pattern of Enterococcus faecalis

	Ampicillin	**HLG**	**Linezolid**	**Vanco**
Sensitive	1	1	2	2
Resistant	1	1	0	0
Total	2	2	2	2

Among two Enterococcus faecalis isolates, susceptibility was mixed to ampicillin and high-level gentamicin (HLG), with 50% sensitive and 50% resistant to each, indicating variable beta-lactam activity and uncertain synergy with aminoglycosides. In contrast, both isolates were uniformly susceptible to linezolid and vancomycin (100%), supporting these agents as reliable options for serious Enterococcus infections in this cohort while reserving them per stewardship principles.

Table 7 Requirement of Antenatal corticosteroids

	Frequency	**Percentage**
1 dose	10	19.6
2 doses covered	41	80.4
Total	51	100

Of 51 eligible women, 80.4% received a complete antenatal corticosteroid course (two doses), while 19.6% received only a single dose—indicating high, but not universal, completion of steroid coverage for foetal lung maturation.

Table 8 Requirement of Magnesium sulphate for Neuroprotection

	Frequency	Percentage
Yes	11	36.7
No	19	63.3
Total	30	100

Among 30 eligible cases, 36.7% received magnesium sulphate for foetal neuroprotection, while 63.3% did not—suggesting just over one-third met criteria or were administered therapy within the indicated window.

Table9 Neonatal outcome

		No	%
Gestational age at delivery	24 weeks-27 weeks 6 days	3	4.4
	28 weeks-31 weeks 6 days	27	39.7
	32 weeks-35 weeks6 days	28	41.2
	36 weeks-36 weeks 6 days	10	14.7
Apgar score at 1 minute	≤3	2	2.9
	4-6	23	33.8
	7-10	43	63.2
Birth weight (Kg)	<1	2	2.9
	1-1.5	18	26.5
	1.5-2.0	20	29.4
	2.0-2.5	24	35.3
	>2.5	4	5.9
Neonatal sepsis	Present	25	36.8
	Absent	43	63.2
Respiratory Distress Syndrome	Present	36	52.9
	Absent	32	47.1
Necrotising Enterocolitis	Yes	11	16.2
	No	57	83.8
Resuscitation Required	Yes	25	36.8
	No	43	63.2
Ventilator Support	Yes	27	39.7
	No	41	60.3
Duration in NICU (days)	<7	29	42.6
	7-14	17	25
	14-21	6	8.8
	21-28	6	8.8
	>28	10	14.7
Neonatal death	Yes	2	2.9
	No	66	97.1
	Total	68	100

In this PPROM cohort (n=68), delivery was concentrated in the moderate-to-late preterm period, with 80.9% occurring between 28 and 35+6 weeks and a smaller proportion at the extremes (4.4% at 24–27+6 weeks; 14.7% at 36–36+6 weeks). Accordingly, early neonatal condition was generally

favourable: two-thirds achieved 1-minute Apgar scores of 7–10, while one-third fell in the transitional 4–6 range and only 2.9% were severely depressed (≤3), suggesting that most infants responded to routine or brief supportive measures. The birth-weight distribution reflects a predominantly low-birth-weight population, with the largest strata at 2.0–2.5 kg (35.3%) and 1.5–2.0 kg (29.4%), and over a quarter in the 1.0–1.5 kg category; very low birth weight (<1.0 kg) was uncommon (2.9%), consistent with the relatively small proportion of very early preterm births. Despite this gestational age profile, neonatal morbidity remained substantial: respiratory distress syndrome affected over half (52.9%), aligning with the expected burden of surfactant deficiency in late and moderate preterm infants, and culture- or clinically defined sepsis was observed in 36.8%, a finding that is biologically plausible in the context of membrane rupture and perinatal inflammation. Necrotizing enterocolitis occurred in 16.2%, which is notable for a cohort with comparatively few very early preterm births and may reflect additive risks from antenatal infection, antibiotic exposure, or feeding interruptions. Correspondingly, 36.8% required delivery-room resuscitation and 39.7% needed ventilatory support, underscoring significant early respiratory compromise. Length of hospitalization was heterogeneous: while 42.6% were discharged within 7 days, approximately 40% required stays beyond two weeks, and 14.7% exceeded 28 days, indicating a meaningful resource burden. Nevertheless, short-term survival was high, with 97.1% discharged alive and a neonatal mortality of 2.9% (2 deaths). Taken together, these findings depict a PPROM population largely delivering in the late/moderate preterm window with corresponding low-birth-weight profiles, substantial respiratory and infectious morbidity, and low mortality—patterns consistent with the pathophysiology of PPROM and supportive of targeted perinatal strategies (e.g., timely antenatal corticosteroids, judicious antibiotics, and structured respiratory support) to mitigate early neonatal complications.

		Gestational age							
		24 weeks-27 weeks 6 days		28 weeks-31 weeks 6 days		32 weeks-35 weeks6 days		36 weeks- 36 weeks 6 days	
		No	%	No	%	No	%	No	%
Clinical signs of sepsis	Yes	3	100	13	48	7	25	2	20
	No	0	0	14	52	21	75	8	80
Resuscitation required	Yes	2	66.7	17	63	5	18	1	10
	No	1	33.3	10	37	23	82	9	90
Necrotising enterocolitis	Yes	2	66.7	7	26	2	7.1	0	0
	No	1	33.3	20	74	26	93	10	100
Ventilator support	Yes	3	100	15	56	6	21	3	30
	No	0	0	12	44	22	79	7	70
Duration in NICU (days)	<7	0	0	8	30	17	61	4	40
	7-14	1	33.3	7	26	4	14	5	50
	14-21	0	0	3	11	2	7.1	1	10
	21-28	2	66.7	2	7.4	2	7.1	0	0
	>28	0	0	7	26	3	11	0	0
Total		3	4.4	27	39.7	28	41.2	10	14.7

Stratified by gestational age at delivery, adverse neonatal outcomes showed a clear inverse gestation–risk gradient. Among the earliest births (24–27+6 weeks; n=3), clinical sepsis and need for ventilator support were universal (100%), two-thirds required delivery-room resuscitation, and two-thirds developed necrotizing enterocolitis (NEC). Length of stay was prolonged: 66.7% remained in NICU for 21–28 days and none were discharged within a week. In the 28–31+6-week group (n=27), risk remained high but attenuated: clinical sepsis was present in 48%, ventilatory support in 56%, and resuscitation in 63%; NEC occurred in 26%. NICU stay exceeded two weeks for 37% (26% >28 days),

while 30% were discharged within 7 days. Outcomes improved substantially at 32–35+6 weeks (n=28): sepsis fell to 25%, ventilator support to 21%, resuscitation to 18%, and NEC to 7.1%; 61% were discharged within 7 days and only 11% stayed >28 days. The most favourable profile was observed at 36–36+6 weeks (n=10), with sepsis in 20%, ventilator support in 30%, resuscitation in 10%, and no NEC; 40% were discharged within 7 days and none required >28 days. This table demonstrate a stepwise reduction in infectious morbidity, respiratory support needs, and NEC with advancing gestational age, accompanied by shorter NICU stays, reinforcing the well-established dose–response relationship between gestational maturity and early neonatal outcomes in PPROM.

Discussion

In this PPROM cohort, most deliveries occurred in the moderate-to-late preterm window (80.9% between 28 and 35+6 weeks), yielding a predominantly low-birth-weight population. Immediate condition was generally reassuring, with 63.2% achieving 1-minute Apgar scores of 7–10 and only 2.9% ≤3. Nonetheless, early morbidity was substantial: respiratory distress syndrome (52.9%), clinical or suspected sepsis (36.8%), and necrotizing enterocolitis (16.2%). One-third required delivery-room resuscitation (36.8%) and nearly two-fifths needed ventilator support (39.7%). Lengths of stay show wide variation —42.6% discharged within 7 days, 17.6% stayed 14–28 days, and 14.7% remained >28 days—while survival to discharge was high (97.1%; neonatal mortality 2.9%).

Stratification by gestational age demonstrated a clear inverse risk gradient consistent with prior analyses: the earliest infants (24–27+6 weeks) had the highest burdens—universal ventilator uses and clinical sepsis, two-thirds requiring resuscitation and developing NEC, and uniformly prolonged NICU stays. Risk attenuated stepwise at 28–31+6 weeks (sepsis 48%, ventilator 56%, NEC 26%, 26% staying >28 days) and improved further at 32–35+6 weeks (sepsis 25%, ventilator 21%, NEC 7.1%, 61% discharged <7 days). The most favourable outcomes were at 36–36+6 weeks (sepsis 20%, ventilator 30%, no NEC, shorter stays). Taken together, the cumulative findings across days highlight that, in PPROM, advancing gestational maturity is strongly associated with reductions in infectious and respiratory morbidity and shorter hospitalization, supporting perinatal strategies that safely prolong gestation while ensuring timely antenatal corticosteroids, judicious antibiotics, and structured respiratory support.

Vaginal infections are strongly associated with increased risks of preterm labour and premature rupture of membranes (PROM). Prior Indian studies have consistently identified Escherichia coli, Enterococcus faecalis, Staphylococcus aureus, Klebsiella pneumoniae, and Candida albicans as prevalent organisms linked to PPROM [6,57,58,60,71]. In addition, sexually transmitted pathogens such as Chlamydia trachomatis, Neisseria gonorrhoeae, Trichomonas vaginalis, and Group B Streptococcus have been implicated in the pathogenesis of PPROM, and bacterial vaginosis is recognized as an important predisposing factor[59].

In this study, high vaginal swab cultures were positive in 11 cases. Escherichia coli was the most frequently isolated organism (7.35%), aligning with findings from Singh[58] et al. and Beevi[60] et al., where E. coli predominated. Enterococcus faecalis was identified in 2.94% of cases, contrasting with higher rates reported by Ramita[18] et al. (39%) and Ambalpady[6] et al. (17.3%). Klebsiella pneumoniae was isolated in 1.4% of cases, compared with 13% in Ramita[18] et al. and 4.8% in Rani[19] et al. Candida albicans accounted for 4.4% of isolates in this cohort, whereas Beevi [19]et al. reported Candida species in 1.9%. Although several prior studies [21,22] have reported Staphylococci and Group B Streptococci , these organisms were not isolated in the present series . Antibiotic susceptibility patterns among Gram-negative isolates demonstrated uniform resistance to ampicillin and third-generation cephalosporins, the commonly used first-line agents in PPROM at our facility; however, all isolates were susceptible to piperacillin–tazobactam and cefoperazone–sulbactam, with amoxicillin–clavulanic acid susceptibility observed in 2 isolates (33.3%). All Gram-negative isolates were also susceptible to tier-2 agents, including cefepime and meropenem. These findings underscore a critical mismatch between empirical therapy and local resistance patterns. Comparable literature reports

variable susceptibility: Ambalpady [6] et al. found E. coli to be highly sensitive to amikacin (94.44%), cefoperazone–sulbactam (88.89%), piperacillin–tazobactam (88.89%), and cefepime (83.33%); Singh[21]et al. similarly reported high E. coli susceptibility to cefoperazone–sulbactam (80%). Beevi [19] et al. noted that K. pneumoniae (4.8%) was highly sensitive to gentamicin (100%), amikacin (100%), and cefoperazone–sulbactam (100%) and resistant to cephalosporins.

Among Gram-positive isolates, two Enterococcus faecalis strains were identified; one was susceptible to ampicillin and high-level gentamicin, and both were susceptible to vancomycin and linezolid (tier-2 agents). Consistent with our observations, Singh [20]. et al. reported E. faecalis in 19.6% of PPROM cases with universal susceptibility to vancomycin and high resistance to ampicillin.

Maternal and neonatal outcomes in PPROM are largely determined by gestational age at membrane rupture and delivery, necessitating vigilant maternal–foetal surveillance under expectant management. In this cohort, 30 patients experienced PPROM before 32 weeks, and 38 after 32 weeks. The majority were aged 21–30 years (66.2%), with 57.4% categorized as overweight (BMI 23–27.5) according to WHO criteria for Asian women, and 47.1% were primigravidae. As reported by Bouvier[21] et al., BMI, primiparity, and shortened cervical length are important risk factors for PPROM; additionally, tailored corticosteroid protocols and the use of tocolysis have been recommended, and PPROM was associated with higher rates of >28-day NICU admission in their analysis. In our study, overall neonatal mortality was 2.9%.

Gestational age–stratified outcomes revealed a pronounced inverse relationship between maturity and morbidity. Among neonates delivered before 32 weeks, 71.4% of mothers exhibited clinical signs of chorioamnionitis. In this gestational subgroup, 60% of infants required resuscitation and 66.6% needed ventilator support. Marked morbidity burdens were observed: 88.8% developed necrotizing enterocolitis and 64% had clinical signs of sepsis. Hospitalization was prolonged, with 80% requiring NICU stays >28 days and 50% requiring stays of 14–21 days. These findings are directionally concordant with Abebe[22] et al., who reported a preterm PROM rate of 2.2% and a perinatal mortality rate of 206 per 1,000, with gestational age at delivery determining low 5-minute Apgar scores (adjusted odds ratio (AOR) = 7.23). Inability to administer antenatal steroids (AOR = 8.23), earlier GA at membrane rupture (AOR = 4.61), and GA at delivery (AOR = 4.32) were associated with NICU admission, and early-onset neonatal sepsis was significantly influenced by GA at membrane rupture (AOR = 5.9)

Taken together, the microbiological profile in this cohort—dominated by E. coli with notable resistance to ampicillin and third-generation cephalosporins—supports revisiting empirical antibiotic protocols for PPROM in line with local antibiograms. The gestational age–dependent gradient in neonatal outcomes underscores the dual imperatives of safely prolonging pregnancy where feasible and ensuring timely administration of antenatal corticosteroids, judicious antibiotic therapy, and structured respiratory support. Alignment of practice with evolving regional resistance patterns and risk-based perinatal strategies is likely to reduce infectious complications, respiratory morbidity, and NICU resource utilization in PPROM.

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