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Original Research Article

Urinary Infection is Predictor of Preterm Labor Pain

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Abstract:

Background: Preterm labor, or labor before 37 completed weeks of gestation, is a major contributor to neonatal morbidity and mortality globally. Growing evidence encompasses urogenital infections, i.e., asymptomatic urinary tract infections (UTIs) and genital tract colonization, as causes of preterm delivery.

Aim: To evaluate the association between urogenital infections and preterm labor in pregnant women.

Methodology: This prospective case-control study was conducted in Department of Obstetrics and Gynaecology in Banas Medical College and Research Institute, Gujarat, India, enrolling 70 antenatal women (35 in control and case groups). Case Group I was women with preterm labor (26–37 weeks) while Control Group II was term pregnancy (≥37 weeks) without any history of preterm labor. Clinical examination, urine culture, and high vaginal swab (HVS) smears were microbiologically examined. Statistical analysis was done with SPSS v27, and $p < 0.05$ was considered significant.

Results: Urogenital infections were much more frequent in the case group (37.1%) than in controls (17.1%) ($p = 0.027$). Urine and HVS isolated infections were also more frequent among cases. Gram stain revealed greater microbial diversity among the case group with a higher percentage of Gram-negative bacilli and yeast-like organisms. Poor antenatal care and prior history of unfavorable pregnancy outcome were more frequently observed in preterm cases.

Conclusion: The study demonstrates that preterm labor is closely linked with urogenital infection. Preterm delivery can be reduced and neonatal health improved by early diagnosed and treated asymptomatic infection in pregnancy, especially in women who receive poor antenatal care.

Keywords: Antenatal Care, Gram Staining, Preterm Labor, Urinary Tract Infection, Vaginal Infection.

Introduction

Preterm labour is characterised by ˙the initiation of labour before 37 full weeks of gestation and is a primary contributor to infant morbidity and death globally. The WHO projected that 9.6% of all births, almost 13 million, in 2005 were premature. Africa and Asia comprised over 11 million [1]. Evidence indicates that infection contributes to the pathophysiology of preterm labour and delivery [2]. Lockwood [3] observed that almost 50% of spontaneous preterm births were linked to ascending genital tract infections. In 2001, Chhabra and Patil [4] reported that 14% and 28% of patients in premature labour exhibited positive urine and cervical cultures, respectively. In vivo and in vitro investigations have demonstrated that ascending lower genital tract infections result in premature labour [5]. The invasion of decidua by bacteria from the lower genital tract correlates with the recruitment of leukocytes, subsequently leading to cytokine production that initiates prostaglandin synthesis in the amnion, chorion, decidua, and myometrium [6]. This results in uterine contractions, cervical dilation, membrane exposure, and the introduction of germs into the uterine cavity. The localised activity of lower genital tract bacteria generates enzymes such as sialidase or mucinase, which compromise the protecting cervical mucosa, hence facilitating bacterial invasion of the upper genital system.

Asymptomatic urinary tract infections are prevalent during pregnancy and are associated with premature birth. Untreated asymptomatic bacteriuria in pregnant women may result in acute cystitis and pyelonephritis in 20–40% of instances. The occurrence of a urinary tract infection may signify aberrant vaginal flora due to the colonisation of the vagina by the same pathogens present in the urine [7]. In 1989,

Romero et al. [8] determined in their study that non-bacteriuric individuals faced around two-thirds the risk of low birth weight and half the risk of preterm delivery compared to untreated symptomatic bacteriuria patients, and that antibiotic therapy decreased the risk of low birth weight. Identifying and treating patients with genitourinary infections before clinical manifestation can minimise the incidence of preterm labour, hence reducing morbidity and death in neonates delivered to these mothers. Consequently, detecting and treating infections linked to preterm labour is a very promising domain for treatments aimed at preventing adverse newborn outcomes. This prospective case-control research aimed to investigate the correlation between preterm labour and urogenital infections.

Methodology

Study Design: The purpose was ‘to investigate the association of urinary and vaginal infections with preterm labor. The study ensured informed written consent from all participants after explaining the procedures in the language they best understood.

Study Area: The study was carried out in the Department of Obstetrics and Gynaecology, Banas Medical College and Research Institute, Palanpur, Gujarat, India for one year

Sample Size: A total of 70 antenatal women were enrolled in the study. The sample size was calculated based on an assumed 7% prevalence of urogenital infections among antenatal women without preterm labor and 30% among those with preterm labor, with 95% confidence and 80% power, using SPSS statistical software (version 27). Although the calculated sample size was 35 per group, due to practical considerations, the study enrolled 70 participants.

Inclusion and Exclusion Criteria

Inclusion Criteria:

- Women with singleton pregnancies.
- Case Group I: Antenatal women admitted with ‘threatened or established preterm labor (with or without rupture of membranes) between 26 and 37 completed weeks of gestation.
- Control Group II: Antenatal women attending the OPD for routine check-up at 37 or more weeks of gestation, without any history of preterm labor. These women were matched to the case group for age (teenage, 20–30 years, >30 years) and parity (primigravida or multigravida).

Exclusion Criteria:

- Women with twin or higher-order multiple pregnancies.
- Women with antepartum hemorrhage.

Procedure: Preterm labor was diagnosed using ACOG criteria (1997), which included the presence of at’ least ‘four uterine contractions in 20 minutes or eight in 60 minutes, along with progressive cervical changes (dilatation >1 cm and effacement ≥80%). Threatened preterm labor was defined similarly but with cervical dilatation <1 cm and effacement <80%. Rupture of membranes was confirmed using a per speculum examination and litmus paper test. All participants underwent detailed clinical evaluations, including medical, obstetric, and infection history, with particular attention to prior urogenital infections and preterm deliveries. Gestational age was determined using Naegele's formula based on the last menstrual period or first’ trimester ultrasound.

General physical, systemic, and obstetrical examinations were conducted for each participant. Two sterilized swabs were collected from the posterior vaginal fornix using a Cusco or Sims speculum prior to the first vaginal examination. These were sent for Gram staining and culture-sensitivity testing. Additionally, a midstream urine sample was collected for cytological and culture-sensitivity examination. All specimens were sent to the Microbiology Department under aseptic precautions and cultured using standard methods on blood agar and MacConkey’s agar. Plates were incubated at 37°C for 24 to 48 hours, and isolates were identified using conventional techniques. Women with preterm labor were managed using tocolytics (if required), steroids (if <34 weeks gestation), and antibiotics (cephalosporins) in cases of membrane rupture. Antibiotic therapy was modified as per culture sensitivity reports.

Statistical Analysis: Data were analyzed using SPSS version v.27. Descriptive statistics summarized categorical variables as frequencies and percentages. The Chi-square (χ^2) test assessed associations between urogenital infections and preterm labor. A p-value <0.05 was considered statistically significant. Odds ratios (OR) with 95% confidence intervals (CI) were calculated to determine the strength of association. All analyses were conducted at a 95% confidence level with 80% study power.

Result

Table 1 presents the demographic characteristics of 70 participants, equally divided into Case Group I and Control Group II (35 each). A statistically significant difference was observed in the number of antenatal visits between the groups ($\chi^2 = 17.55$, $p = 0.00$), with most women in the case group being unbooked (33 vs. 19 in control), indicating poor antenatal care among cases. Socioeconomic status, based on the Modified Kuppuswamy scale, showed no significant difference ($p = 0.735$), with both groups similarly distributed across categories. A borderline significant difference was noted in the history of preterm labor (PTL) or abortion ($\chi^2 = 3.817$, $p = 0.05$), where 6 women in the case group had such a history compared to 2 in the control

group. BMI distribution did not differ significantly (p = 0.084), although underweight status was slightly more common in the case group. Employment status showed no meaningful difference between groups (p = 0.767), with most participants in both groups being non-working.

Table 1: Demographic data (N = 70; 35 in each group)				
Parameter	**Case Group I (n=35)**	**Control Group II (n=35)**	**χ^2**	**p value**
Antenatal visits				
Booked	2	16	17.55	0
Unbooked	33	19		
Modified Kuppuswamy's SE scale status			1.277	0.735
Upper	5	6		
Upper middle	10	11		
Lower middle	8	6		
Upper lower	7	5		
Lower	0	1		
Past H/O PTL or abortion			3.817	0.05
Present	6	2		
Not present	29	33		
BMI			6.661	0.084
Normal	20	23		
Obese	2	2		
Overweight	10	9		
Underweight	3	1		
Work				
Working	4	3	0.088	0.767
Not working	31	32		

Table 2 shows the overall presence of urogenital infections among the two groups: Case Group I and Control Group II, each consisting of 35 women. In Case Group I, 13 participants (37.1%) tested positive for urogenital infections, compared to only 6 participants (17.1%) in the Control Group II. The chi-square (χ^2) value is 4.887 with a p-value of 0.027, indicating a statistically significant difference between the two groups. This suggests that urogenital infections were significantly more common in the case group than in the control group.

Table 2: Overall presence of urogenital infection				
Urogenital infections	**Case Group I**	**Control Group II**	**χ^2**	**p value**
Positive	13 (37.1%)	6 (17.1%)	4.887	0.027
Negative	22 (62.9%)	29 (82.9%)		

Table 3 presents the distribution of urogenital infections among women in Case Group I and Control Group II, each comprising 35 participants. In both groups, 1 individual (2.9%) tested positive for both urine and high vaginal swab (HVS) infections. However, a higher percentage of women in the case group showed isolated infections, with 14.3% testing positive for urine infections compared to 2.9% in the control group, and 20.0% testing positive for HVS infections versus 11.4% in the control group. Notably, a larger proportion of women in the control group (82.9%) had no infection, compared to 62.9% in the case group. The chi-square test yielded a value of 7.62 with a p-value of 0.05, indicating a statistically significant difference in the distribution of urogenital infections between the two groups at the 5% level of significance. This suggests that urogenital infections were more prevalent in the case group.

Table 3. Details of urogenital infections				
Presence of infection	**Case Group I (n = 35)**	**Control Group II (n = 35)**	**χ^2**	**p value**
Both +ve	1 (2.9 %)	1 (2.9 %)	7.62	0.05
Urine +ve	5 (14.3 %)	1 (2.9 %)		
HVS +ve	7 (20.0 %)	4 (11.4 %)		
None	22 (62.9 %)	29 (82.9 %)		

Table 4 presents the Gram staining results of high vaginal swab smears from two groups: Case Group I (n = 13) and Control Group II (n = 6). Among the case group, Gram-positive cocci were observed in 6 samples, while no Gram-positive bacilli were detected. In contrast, Gram-negative bacilli were found in 4 cases, with no coccobacilli identified. Additionally, yeast-like organisms were present in 3 cases. In the control group, Gram-positive cocci and bacilli were identified in 2 and 1 samples, respectively. Gram-negative bacilli and coccobacilli were each observed in 1 sample, and yeast-like organisms were found in 1 control subject. Overall, Gram-positive cocci were more frequent in both groups, but a greater diversity and number of Gram-negative organisms and yeast-like cells were observed in the case group, suggesting a more varied microbial profile among women with positive findings in the case group.

Table 4: Gram staining of high vaginal swab smear

		Case Group I (n = 13)	Control Group II (n = 6)
Gram +ve	Cocci	6	2
	Bacilli	0	1
Gram -ve	Bacilli	4	1
	Coccobacilli	0	1
	Yeast like	3	1

Discussion

The present study highlights significant associations between antenatal care status and the presence of urogenital infections among pregnant women. A notable finding was the statistically significant difference in antenatal visit patterns between the case and control groups. Most women in the case group were unbooked (94.3%), indicating inadequate antenatal care utilization, which has been linked in previous literature to higher risks of obstetric complications, including infections (Batra et al., 2016) [9]. The lack of regular monitoring may predispose these women to untreated or undetected urogenital infections. In the Case Group, urinary tract infection was identified in 15.38% (8/52), which was 2.67 times more than the control group, where it was observed in 5.77% (3/52). This indicates that women in preterm labour experienced a 2.67-fold higher prevalence of urinary tract infections compared to those with term pregnancies. Our findings align with those of Pandey et al. [10], who documented a urinary tract infection prevalence of 20.34% among women in preterm labour, and McPheeters et al. [11], who reported 17.1% in women with preterm labour and 10.9% in those without. In our study, positive high vaginal swab cultures were seen in 23.08% (12/52) of the Case Group and 15.38% (8/52) of the Control Group. Lajos et al. [12] observed that the prevalence of endocervical colonisation is 14.20% in cases of preterm labour or early rupture of membranes.

Although socioeconomic status, BMI, and employment status were not significantly different between the groups, a borderline association with a past history of preterm labor or abortion suggests a potential underlying reproductive health vulnerability in the case group. This aligns with earlier studies suggesting that prior adverse pregnancy outcomes may correlate with increased risk of infection and complications in subsequent pregnancies (Goldenberg et al., 2008) [13]. Chhabra and Patil [14] observed a 14% incidence of urinary infections and a 28% prevalence of cervical colonisation in women experiencing premature labour. The preterm cohort exhibited a urinary tract infection rate of 13.46% and a genital tract infection rate of 21.15%, with one individual testing positive for both cultures, aligning with the findings of Chhabra and Patil [4]. The most often identified bacteria in urine culture was E. coli, whereas Enterococcus faecalis was predominant in high vaginal swabs. In Control Group II, urinary tract infection was seen in 1 (1.92%), a positive high vaginal swab culture in 6 (11.54%), and both conditions in 2 (3.84%) women.

The prevalence of urogenital infections was significantly higher in the case group (37.1%) compared to controls (17.1%), as reflected by a statistically significant chi-square value ($p = 0.027$). This supports the hypothesis that urogenital infections may be a contributing factor to adverse pregnancy outcomes such as preterm labor. Detailed distribution of infections further confirmed this, with higher rates of isolated urine (14.3%) and high vaginal swab infections (20%) in the case group. These findings are consistent with the work of Hillier et al. (1995) [15], who found that bacterial vaginosis and other genital tract infections significantly increase the risk of preterm delivery. Our findings validate and expand upon the current information about the correlation between urinary tract infections during pregnancy and negative pregnancy outcomes. Numerous prior meta-analyses and observational studies have documented same results, underscoring the considerable influence of UTIs on maternal and newborn health. A meta-analysis conducted by Yan et al. [16] revealed a pooled odds ratio of 1.31 for the correlation between urinary tract infections and preeclampsia. A comprehensive evaluation by Wulandari et al. [17] indicated a 1.54-fold increase in the probability of low birth weight in children born to pregnant women with urinary tract infections

(UTIs) compared to those without UTIs. Smaill and Vazquez [18] examined the correlation between urinary tract infections (UTIs) and abortion, finding an elevated incidence of abortion in pregnant women with UTIs. These data, aligned with our results, emphasise the strength of the correlation between UTIs and negative pregnancy outcomes across various demographics and contexts.

Gram staining data revealed that Gram-positive cocci were the most commonly observed organisms in both groups, yet the case group exhibited a greater microbial diversity, with more Gram-negative bacilli and yeast-like organisms. The presence of yeast and Gram-negative organisms, often associated with symptomatic or recurrent infections, may indicate subclinical infections in the case group that go unnoticed due to lack of routine antenatal screening (Romero et al., 1989) [8].

The study underscores the importance of regular antenatal care and early screening for urogenital infections in pregnancy. Timely identification and treatment of these infections could significantly reduce the risk of complications, particularly in women with limited access to healthcare services. Further research with larger sample sizes and microbiological cultures is recommended to strengthen these findings and develop targeted intervention strategies.

Conclusion

This study highlights a significant association between urogenital infections and preterm labor, emphasizing that such infections are more prevalent among women with inadequate antenatal care. A notably higher proportion of preterm labor cases tested positive for urinary and genital tract infections compared to term pregnancies, suggesting that undiagnosed or untreated infections may play a critical role in triggering early labor. The microbial diversity observed in the case group, especially the presence of Gram-negative bacilli and yeast-like organisms, further supports the possibility of ascending infections contributing to preterm birth. These findings align with existing literature indicating that urinary tract infections and bacterial colonization of the genital tract increase the risk of preterm delivery, low birth weight, and other adverse outcomes. The study underscores the necessity for routine screening and timely treatment of asymptomatic urogenital infections during pregnancy. Strengthening antenatal care services and promoting early diagnosis can play a crucial role in reducing neonatal morbidity and mortality linked to preterm labor.

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