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ORIGINAL RESEARCH

Bacterial flora of the genital tract in pregnancy and early labour

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Abstract

Background: Bacterial infections of the reproductive tract are common during pregnancy and have been associated with some pregnancy-related morbidities. There is limited information on the prevalence of bacterial infection of the reproductive tract during labour.
Objective: To compare the prevalence of bacterial colonisation of the reproductive tract of pregnant women in early third trimester and early labour, and determine the associated foetal outcome.
Methods: High vaginal swabs were collected from 201 pregnant women with gestational age from 26 to 32 weeks at the antenatal clinic of a Nigerian teaching hospital. The samples were processed to isolate bacterial organisms. Repeat samples were collected in early labour. The foetal outcome was assessed and recorded.
Results: The prevalence of bacterial colonisation was 31.3% in early third trimester and 21.9% in early labour (p = 0.032). *Staphylococcus aureus* was the most prevalent organism isolated. Cefoxitin and imipenem were the most sensitive antibiotics. Women who had positive bacterial cultures in pregnancy had a slightly higher risk of low birth weight babies (RR 1.9, CI 0.9-3.7) and neonatal hospitalization (RR 1.8, CI 0.9-3.4) but without statistical significance (p = 0.05, and p = 0.06 respectively).
Conclusion: The prevalence of bacterial colonisation of the reproductive tract of pregnant women was significantly higher in early third trimester than in early labour. There was no significant difference in pregnancy outcome between women who had positive bacterial cultures and those with negative cultures.

Keywords: Bacterial flora, Early Labour, Early Third Trimester, Foetal Outcome, Genital tract, Sagamu.

Introduction

Genital tract infections are common in pregnancy, especially in sub-Saharan Africa

and other developing countries.[1] Some of these infections are asymptomatic while others present with symptoms such as vaginal irritation or discomfort, vaginal itching, profuse malodorous discharge and dyspareunia.[2] The normal vaginal flora serves as a potent defence against the ascension of pathogenic microorganisms. [3] Lactobacilli, the predominant bacterial flora in the vagina, produce lactic acid and hydrogen peroxide which have some anti-infective properties. [3] Some of the hormonal changes that occur in pregnancy are associated with vaginal mucosal congestion and hypertrophy, and these encourage the growth of pathogenic microorganisms within the vagina. [4] A study has reported that the prevalence of vaginal infection in pregnant women is double the prevalence in non-pregnant women. [5]

Bacterial vaginosis is common in pregnancy. This is a condition in which *Lactobacillus* fails to retain dominance in the vagina, leading to overgrowth of anaerobic species such as *Gardnerella vaginalis, Ureaplasma urealyticum, Mobiluncus* species, *Mycoplasma hominis*, and *Prevotella* species. [6] Other organisms such as *Escherichia coli, Klebsiella, Aerobacter, Proteus, Providencia*, *Pseudomonas*, Facultative anaerobes, *Staphylococci* and *Streptococci* have also been implicated in vaginitis in pregnancy. [7,8]

Clinicians are often concerned about the possibility of some obstetric complications resulting from the bacterial infections of the lower genital tract occurring during an ongoing pregnancy. Some of the reported complications include preterm labour, prelabour rupture of membranes and postpartum endometritis. [6,9,10]

Some of the studies [11,12] on abnormal vaginal flora in pregnancy assessed the prevalence of the specific entity called bacterial vaginosis, without considering other potentially pathogenic bacterial organisms that may have deleterious effects on foetal well-being and pregnancy outcome. Moreover, many of these studies were carried out during the antenatal period; there is limited information on the changes if any, in the prevalence and pattern of bacterial infection in early labour. Therefore, this study sought to compare the prevalence and pattern of bacterial colonisation of the reproductive tract of pregnant women in early third trimester and early labour, to and determine the associated foetal outcome.

Methods

This was a prospective longitudinal study conducted at the antenatal clinic and labour ward of the Olabisi Onabanjo University Teaching Hospital (OOUTH), Sagamu, Ogun State, Nigeria from1st of June 2017 to 31st of May 2018. A total of 201 pregnant women with gestational age ranging from 26 weeks to 32 weeks were recruited for the study. Women who took antimicrobials within the preceding two weeks were excluded. The pregnant women were given adequate information on the study and informed written consent was obtained from them. Ethical approval for the study was also obtained from the Health Research Ethics Committee of Olabisi Onabanjo University Teaching Hospital, Sagamu, Nigeria (Reference number OOUTH/HREC/59/2016).

Sample Collection and Processing

With the aid of sterile disposable Cusco's speculum, a vaginal sample was taken from the posterior fornix using a sterile swab stick. The swab stick was appropriately labelled and immediately sent to the Medical Microbiology Laboratory of OOUTH for immediate processing. The swab stick was streaked onto blood agar and MacConkey agar. The inoculated plates were incubated aerobically at 37^{o}C for 24-48 hours. The isolates from the agars were identified based on their colonial morphology. The antibiotic sensitivity pattern was determined using the Kirby-Bauer disc dilution technique. [13] Women with positive bacterial culture were given antibiotics based

on the antibacterial sensitivity pattern of the organisms. This was done following the departmental protocol, which was based on the findings from a systematic review which suggested that treatment programs for colonized pregnant women during antenatal period help to reduce some pregnancy-related morbidities in the general obstetric population. [14] Their spouses were also treated with the same antibiotics.

The women with positive bacterial cultures were also given *Klovinal*® pessary which contained metronidazole, clotrimazole and *Lactobacillus* spores. *Lactobacilli*-containing vaginal probiotics are useful in restoring normal vagina flora. [15] Thereafter, the pregnant women were followed up until they presented in early labour when a repeat high vaginal swab sample was obtained and processed before rupture of membranes. Early labour was defined as cervical dilatation less than 5cm. Pregnancy outcome measures such as the gestational age at delivery, birth weight, Apgar scores of babies at the first and fifth minute and need for neonatal hospitalisation were recorded.

Data management and analysis

Data were analysed using Statistical Package for Social Science (SPSS) windows version 21.0. The socio-demographic characteristics of the participants were presented using frequency tables. Continuous variables were summarized using descriptive statistics such as the mean and standard deviation at 95% confidence interval (CI). Risk ratios (RR) were calculated to assess the effect of bacterial colonisation on pregnancy outcome measures. The level of statistical significance was set at $P<0.05$.

Results

The mean age of the subjects was 29.4±4.8 years while the range was 18-43 years. The modal age group was the 20-29 year age group. Eighty-eight (43.7%) women were nulliparous while 89 (44.3%) had parity of 1-2. The median parity was 1. One hundred and forty (69.6%) women were educated up to tertiary level while 189 (94.0%) were in monogamous marriages (Table I).

Out of the 201 pregnant women sampled in early third trimester, 63 had positive bacterial culture giving a prevalence of 31.3% whereas, in early labour, 44 out of 201 pregnant women had a positive bacterial culture with a prevalence of 21.9%. The prevalence of bacterial colonisation was significantly higher in early third trimester than in early labour ($\chi^2 = 4.598$; $p = 0.032$) (Table II).

The distribution of the bacterial isolates in early third trimester and early labour is depicted in Table III. *Staphylococcus aureus* was the most prevalent organism isolated in early third trimester (60.3%) and early labour (72.7%). *Escherichia coli* accounted for 4.8% of the isolates in early third trimester, but it was not isolated during early labour. *Klebsiella species* were the least predominant bacterial organisms isolated both in early third trimester and in early labour.

The antibiotic sensitivity patterns of the organisms are depicted in Table IV. Cefoxitin and imipenem had the highest sensitivity rates overall. These antibiotics were also the most sensitive against *Staphylococcus aureus.* However, *Klebsiella species* was resistant to these two antibiotics but only sensitive to ciprofloxacin, cefuroxime and ceftriaxone.

The effects of bacterial colonisation in pregnancy and the foetal outcome are depicted in Table V. Women who had positive bacterial cultures in pregnancy had a slightly higher risk of delivering babies with low birth weight (RR = 1.9, CI 0.9-3.7) and babies requiring hospitalisation (RR = 1.8, CI 0.9-3.4). However, these higher risks were not statistically significant ($p = 0.05$, $p = 0.06$ respectively). There was no increased risk of preterm

delivery and Apgar Scores less than 7 in the first and fifth minute, among babies of women with positive bacterial cultures when compared with women with negative bacterial cultures.

Table I: Socio-demographic characteristics of study participants

Characteristics	*Frequency*	*Percentage*
Maternal Age (Years)		
≤19	4	2.0
20-29	98	48.7
30-39	94	46.8
≥40	5	2.5
Parity		
0	88	43.7
1-2	89	44.3
3-4	22	11.0
≥5	2	1.0
Educational level		
Primary or less	8	4.0
Secondary	53	26.4
Tertiary	140	69.6
Type of marriage		
Monogamy	189	94.0
Polygamy	12	6.0
Religion		
Christianity	152	75.6
Islam	47	23.4
Others	2	1.0

Table II: Prevalence of bacterial colonisation

	Culture-positive n (%)	*Culture-negative n (%)*	*Chi-Square*	*p-value*
Pregnancy	63 (31.3%)	138 (68.7%)	4.598	0.032
Early labour	44 (21.9%)	157 (78.1%)		

Table III: Distribution of microbial isolates

Isolates	*Pregnancy (n = 63)*	*Labour (n =44)*
	n (%)	**n (%)**
Staphylococcus aureus	38 (60.3)	32 (72.7)
Streptococcus species	19 (30.1)	11 (25.0)
Escherichia coli	3 (4.8)	0 (0)
Klebsiella species	3 (4.8)	1 (2.3)

Table IV: Antibiotic sensitivity pattern of the isolates

	Antibiotic sensitivity rates (%)							
Isolate	**AMC**	**CIP**	**AUG**	**CXM**	**IMP**	**FOX**	**CRO**	**Total**
Staphylococcus aureus	26 (37.1)	36 (51.4)	40 (57.1)	38 (54.3)	44 (62.8)	45 (64.3)	0 (0.0)	**70**
Streptococcus spp	16 (53.3)	15 (50.0)	20 (66.7)	20 (66.7)	24 (80.0)	22 (73.3)	0 (0.0)	**30**
E. coli	2 (66.7)	3 (100.0)	2 (66.7)	2 (66.7)	0 (0.0)	0 (0.0)	1 (33.3)	**3**
Klebsiella spp	0 (0.0)	3 (75.0)	0 (0.0)	3 (75.0)	0 (0.0)	0 (0.0)	2 (50.0)	**4**
Total	**44 (41.1)**	**57 (53.3)**	**62 (57.9)**	**63 (58.9)**	**68 (63.6)**	**67 (62.6)**	**3 (2.8)**	**107**

AMC-Amoxycillin; CIP- Ciprofloxacin; AUG- Augmentin; CXM- Cefuroxime; IMP- Imipenem; FOX- Cefoxitin; MEM- Meropenem; CRO-Ceftriaxone

Table V: Effects of bacterial colonisation on foetal outcome

Foetal outcome	*Culture-positive (n=44)*	*Culture-negative (n=157)*	*RR (95% CI)*	*p value*
Apgar Score < 7 at 1 minute	6 (13.6%)	30 (19.1%)	0.8 (0.4-1.7)	0.508
Apgar Score < 7 at 5 minute	3 (6.8%)	12 (7.6%)	0.9 (0.3-2.7)	0.933
Preterm delivery	4 (9.1%)	18 (11.5%)	0.9 (0.3-2.2)	0.748
Low birth weight	7 (15.9%)	12 (7.6%)	1.9 (0.9-3.7)	0.05
Hospitalization	8 (18.2%)	15 (9.6%)	1.8 (0.9-3.4)	0.06

Discussion

Bacterial infections of the lower genital tract in pregnancy are common and are often thought to be associated with adverse pregnancy outcomes. [16, 17] This longitudinal study assessed the bacterial colonisation rates in the early third trimester and early labour, and the findings show a statistically significant decrease in the prevalence of bacterial colonisation in early labour. However, women who had positive bacterial cultures in early labour did not have statistically significant increased risks of adverse pregnancy outcomes when compared with women with negative bacterial cultures.

The prevalence of bacterial colonisation in early third trimester was 31.3%. This is similar to the reported prevalence of 34.3% in Benin, Nigeria and 28.1% in India. [16,18] There is very limited data on the prevalence of genital infection in labour. [3] However, this study shows that the prevalence of bacterial colonisation was significantly higher in early third trimester than in early labour. A previous study done in Brazil had reported a higher rate of vaginal infections among women in labour at term when compared to women in preterm labours. [3]A possible explanation for the significant reduction in bacterial colonisation rates in early labour in this study could be the effect of the treatments offered to the women in early third trimester based on the results of vaginal swab cultures.

Staphylococcus aureus was the most predominant bacterial organism isolated in the women. A similar finding had earlier been reported. [7,16] The other organisms such as *Streptococcus species, Escherichia coli* and *Klebsiella species* have also been reported by other authors as being commonly isolated from the genital tracts of pregnant women.[16,19,20] The susceptibility pattern of *Staphylococcus aureus* has an important implication for the empirical use of antibiotics in pregnant women with suspected lower

genital tract infections. It is reassuring to note that cefuroxime and Augmentin® which are part of the commonly prescribed antibiotics for pregnant women due to their safety profile are also among the most effective antibiotics against the bacteria isolated.

The findings from this study indicate that bacterial colonisation in early labour was not associated with poor pregnancy outcome. Although there was a slight increase in the risk of low birth weight babies and the need for neonatal hospitalisation, these were not statistically significant. It should, however, be noted that colonisation in early labour may also indicate persistent antenatal colonisation. Some earlier studies have reported an increased risk of poor foetal outcomes in women with bacterial colonisation of the genital tract.[4,17,21] The lack of significant adverse pregnancy outcome in colonised women reported in this study may also reflect colonisation with less virulent strains of bacteria. It has been postulated that virulent strains of bacteria were more likely to be associated with clinical infection than less virulent colonisers and this may explain the diverse clinical outcomes between studies. [22] It may also be hypothesised that re-infection with less virulent strains of bacteria may occur following the initial treatment with effective antibiotics during the antenatal period. Subclinical infections with these less virulent organisms are often not associated with adverse pregnancy outcomes. There is also evidence to suggest that treatment programs for colonised pregnant women during antenatal period reduce the risks of preterm births and preterm low birth weight. [14]

One limitation of this study is the failure to do post-treatment vaginal swabs for those women that were treated in early third trimester; therefore, it was difficult to differentiate between persistent infection and re-infection in women that had positive cultures in early labour. Also, the study did not assess pregnancy outcomes concerning specific bacterial organisms. These are potential areas for future research.

Conclusion

There is a high prevalence of bacterial colonisation of the reproductive tract of pregnant women in Olabisi Onabanjo University Teaching Hospital, Sagamu, Nigeria, with the rate significantly higher in early third trimester than in early labour. This study found no significant difference in pregnancy outcome between women who had vaginal colonisation with potentially pathogenic bacteria and those not colonised.

Authors' Contributions: SOAO conceived the study, SOAO and AAA designed the study, AAA, OAA, OAO, ABA, AAK, LAI managed the literature search and gathered data. OKS and AAA analysed the data, AAA wrote the first draft of the manuscript. All authors read and approved the final manuscript.
Conflict of interest: None declared.
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