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Mycoplasma genitalium and preterm delivery at an urban community health center†

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Abstract

Objective—To determine the prepartum prevalence of cervical *Mycoplasma genitaliu* colonization and evaluate prospectively whether colonization is associated with preterm delivery among women from a racial/ethnic minority background with a high risk of delivering a low birth weight newborn and a high prevalence of sexually transmitted infections.

Methods—In a prospective cohort study at an urban community health center in Roxbury, MA, USA, 100 women receiving routine prenatal care for singleton pregnancies were enrolled between August 2010 and December 2011. Endocervical samples were tested for *M. genitalium*, and delivery data were collected.

Results—The prevalence of *M. genitalium* colonization at the first prenatal visit was 8.4%. The incidence of low birth weight was 16.7%. The incidence of preterm delivery among women who were known to have a live birth was 16.7%. The incidence of preterm delivery did not differ with respect to *M. genitalium* colonization. The crude odds ratio for preterm delivery among women with *M. genitalium* colonization versus those without was 1.27 (95% confidence interval, 0.02–14.78).

Conclusion—*M. genitalium* colonization was not associated with preterm delivery among women with a high incidence of low birth weight newborns and preterm delivery, and a high prevalence of sexually transmitted infections.

Keywords

Mycoplasma genitalium; Preterm delivery; Reproductive tract infections

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1. Introduction

Mycoplasma genitalium has been identified in the genital tract of women, and several small studies have estimated that its prevalence is between 2% and 7% among women in the general population [2–4]. Although *M. genitalium* has been strongly associated with non-gonococcal urethritis in men and heterosexual transmission is well established [5], its pathogenic potential in women is not well understood [6]. Limited evidence has demonstrated that there is an association between *M. genitalium* and cervicitis [3,7], pelvic inflammatory disease [8], and endometritis [9] in women; however, these observations have not been confirmed in large population-based studies.

Preterm delivery is one of the leading causes of neonatal morbidity and mortality, but most cases of preterm delivery are idiopathic. In 2010, the overall incidence of preterm birth in the United States was 12.2% and the incidence of low birth weight (<2500 grams) was 8.2% [10]. There are large differences according to race and/or ethnicity, whereby non-Hispanic black women are reported to have the highest incidence of preterm birth (17.5%) and low birth weight (13.6%) [10]. These outcomes have several risk factors in addition to maternal race, including lower socioeconomic position and social stressors [11]; however, the underlying physiologic mechanism for early delivery has not been elucidated, especially at the molecular and cellular level. One proposed mechanism for preterm delivery is an infectious pathway that begins with a reproductive tract infection [11]. Pro-inflammatory cytokines in amniotic fluid have also been associated with preterm labor [12].

The patient population of the Dimock Community Health Center, Roxbury, MA, USA (Dimock Center), consists primarily of women from a minority racial/ethnic background, including recent immigrants and women who identify themselves as African American and Hispanic. The Dimock Center has a high incidence of low birth weight neonates and a high prevalence of sexually transmitted infections. The incidence of low birth weight at the center was 18.6% in 2008 and 14.3% in 2009 (internal data), which is substantially higher than the national average of 8.2% but consistent with the higher incidence of 17.5% seen among non-Hispanic black women nationally [13]. In 2010, the prevalence of *Chlamydia* in the Dimock Center neighborhood (Roxbury, MA) exceeded 1000 cases per 10 000 individuals compared with the national average of 610 cases per 10 000 individuals [13,14].

The aim of the present study was to determine the prepartum prevalence of cervical *M. genitalium* colonization and to evaluate prospectively whether colonization was associated with preterm delivery among pregnant women attending the Dimock Center, who represent a population of women with a high risk of delivering a low birth weight neonate and a high prevalence of sexually transmitted infections.

2. Materials and methods

In a prospective study at the Dimock Center in Roxbury, MA, USA, pregnant women receiving routine prenatal care were enrolled in a pilot study between August 1, 2010, and December 31, 2011. The study was approved by the institutional review board at Beth Israel Deaconess Medical Center, which served as the institutional review board for the Dimock Center, and participants provided verbal informed consent.

Women were recruited when they presented for an initial prenatal visit before 16 weeks of gestation. Eligibility criteria included age 18–45 years, singleton pregnancy, intention to continue the pregnancy, English or Spanish speaking, and willing and able to give informed consent. Women were ineligible if they had received a prophylactic cerclage before enrollment or had taken antibiotics for any reason in the 6 weeks preceding enrollment. Cervical and vaginal swabs were collected at the initial prenatal visit. Medical, sexual, and

obstetric history, and the results of routine clinically ordered prepartum tests were abstracted from medical records.

A rayon-tipped swab (Copan Diagnostics, Murrietta, CA, USA) was used to collect an endocervical sample and placed in 1.5 mL of 2-SP medium as described [15]. *M. genitalium* present in the sample was detected via polymerase chain reaction. DNA extraction for the conventional 16S rRNA gene polymerase chain reaction was performed as described [16]. All samples and results were coded with a study identifier such that the testing laboratory was blind to clinical information and the treating clinicians were blind to *M. genitalium* status. The *M. genitalium* results were not available to the treating clinician or the participant because this is not part of routine obstetric care at the Dimock Center and because the samples were batched and tested at a laboratory not approved for clinical care at the Dimock Center. Bacterial vaginosis was detected by a Gram stain using criteria developed by Nugent et al. [17].

The primary outcome was preterm delivery defined as delivery at more than 24 weeks but less than 37 weeks of gestation [11]. Gestational age was determined by the last menstrual period and confirmed by ultrasound performed at 6 to 16 weeks of gestation. If the participant was unsure of her last menstrual period, or the last menstrual period and ultrasound were discrepant by more than 7 days, gestational age was determined from the first-trimester ultrasound scan. Low birth weight was defined as less than 2500 g [11].

Data were analyzed with SAS version 9.3 (SAS Institute, Cary, NC, USA) and are presented as median and interquartile range (IQR) or number (percentage). Comparisons between groups used the Mann–Whitney U test for continuous variables or the χ^2 or Fisher exact test for categorical variables. The risk of preterm delivery was calculated with exact logistic regression and is reported as an odds ratio with 95% confidence intervals (CIs). Variables that differed with respect to *M. genitalium* colonization status and were thought to influence the risk of preterm delivery (maternal age, and history of preterm delivery and induced abortion), in addition to race or ethnicity given its known association with preterm delivery, were considered as potentia confounders. Variables that had an appreciable effect on the odds ratio were retained in the model. All tests were 2-sided and a P value of less than 0.05 was considered to be statistically significant.

3. Results

During the study period, 100 women were eligible for the study and agreed to participate. *M. genitalium* samples could not be processed by the laboratory for 5 women, who were subsequently excluded from the analysis. The median age at enrollment was 25.0 years (IQR, 22.0–30.0 years). Approximately half (52.6%) of the participants were non-Hispanic black, 28.4% were Hispanic, 9.5% were white, and 9.5% were of other or unknown race or ethnicity. The median gestational age at the initial visit was 8.1 weeks (IQR, 7.1–9.9 weeks). The prevalence of previous preterm delivery was 14.7%. Table 1 summarizes the baseline characteristics of the cohort.

The prevalence of *M. genitalium* colonization at the first prenatal visit was 8.4%. Participants who were colonized with *M. genitalium* at enrollment were younger than those without evidence of *M. genitalium* (P=0.03). Although the differences did not reach significance, women colonized with *M. genitalium* were more likely to have a history of preterm delivery (P=0.09) and induced abortion (P=0.08).

There were no differences in the prevalence of sexually transmitted infections at enrollment with respect to *M. genitalium* colonization (all infections, P>0.47; Table 2). Six (75.0%) of the women who tested positive for *M. genitalium* also tested positive for bacterial vaginosis

compared with 41.4% of the women without *M. genitalium* colonization; however, the difference was not significant (P=0.33).

Fourteen women transferred care to another clinic during the pregnancy; as a result, delivery outcomes were available for 81 (85.3%) of the 95 women for whom *M. genitalium* colonization status was known. Among these 81 women, there were 9 (11.1%) spontaneous and 6 (7.4%) induced abortions. The remaining 66 women delivered a viable neonate.

The incidence of preterm delivery among the 66 women known to have a live birth was 16.7% (Table 3); the incidence of preterm delivery did not differ with respect to *M. genitalium* colonization. The crude odds ratio for preterm delivery among women with *M. genitalium* colonization compared with those without was 1.27 (95% CI, 0.02–14.78). The only variables that met the criteria for potential confounders were maternal age and history of preterm delivery. When adjusted for maternal age and history of preterm delivery, the odds ratio was 1.34 (95% CI, 0.02–18.59). The incidence of low birth weight was 16.7%.

4. Discussion

In the present cohort of women with a high incidence of low birth weight neonates and preterm delivery, and a high prevalence of sexually transmitted infections, the prevalence of *M. genitalium* colonization was similar to previous findings among high-risk women [2]. The incidence of preterm delivery among women in the present study was higher than that in the general population, similar to previously documented incidences in other predominantly non-Hispanic black populations [10]. However, *M. genitalium* colonization did not seem to be associated with preterm delivery in the present population of women.

Several reproductive tract infections, such as bacterial vaginosis and *Chlamydia trachomatis*, have been associated with preterm delivery [18,19]. The mechanism underlying reproductive tract infection leading to preterm delivery is thought to be secondary to the ascending pathogen, which causes an inflammatory cascade and disrupts the choriodecidual space [20]. Research in murine models has demonstrated that *M. genitalium* might establish long-term infection of the female upper reproductive tract [21]. Other work suggests that *M. genitalium* infection can ascend and might result in permanent damage and occlusion of the fallopian tubes [22].

Studies that have failed to show an association between *M. genitalium* and adverse pregnancy outcomes have been conducted in low-risk populations with a low prevalence of *M. genitalium*[23]. Some of those studies were case–control studies that recorded *M. genitalium* status at presentation for delivery [24]. Although the present study was carried out prospectively in a high-risk population of pregnant women, it also failed to show an association between *M. genitalium* and preterm delivery. Interestingly, a similar prospective study found an association between genital *Mycoplasma hominis* colonization and preterm delivery [25].

In the present study, women who were colonized with *M. genitalium* were significantly younger than those who were not colonized. Although the difference was not significant, women who were colonized with *M. genitalium* were more likely to have had a history of preterm delivery and induced abortion.

The study has several strengths. It has helped to describe the prevalence of *M. genitalium* in a population who are at high-risk for both preterm delivery and sexually transmitted infections. In addition, 100% of the women who met the eligibility criteria agreed to participate in the study. However, the study also has limitations. There was a greater than expected loss to follow-up, perhaps due to the high-risk profile of the population. The loss to

follow-up and sample size limited the power to detect an association between *M. genitalium* and preterm delivery; however, this was a pilot study and was not powered to detect small effects.

In summary, the present results do not support the hypothesis that cervical *M. genitalium* colonization is a risk factor for preterm delivery. Given the low prevalence of *M. genitalium* colonization, and the limited power of the present pilot study, it is possible that there might be a modest association between preterm delivery and *M. genitalium* colonization that was not detected. The higher prevalence of *M. genitalium* colonization in younger women, in addition to the potential association between *M. genitalium* colonization and history of preterm delivery and induced abortion, deserves further investigation.

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Table 1

Baseline characteristics of the study population [a]

Characteristic	All women (n=95)	*Mycoplasma genitalium*		*P* value
		Positive (n=8; 8.4%)	Negative (n=87; 91.6%)	
Age at EDD, y	25.0 (22.0–30.0)	22.0 (21.5–23.0)	25.0 (23.0–31.0)	0.03
Race/ethnicity				0.42
White	9 (9.5)	2 (25.0)	7 (8.1)	
Black/African American	50 (52.6)	5 (62.5)	45 (51.7)	
Hispanic	27 (28.4)	1 (12.5)	26 (29.9)	
Other	2 (2.1)	0 (0.0)	2 (2.3)	
Unknown	7 (7.4)	0 (0.0)	7 (8.1)	
Smoking status				0.64
Never smoked	63 (66.3)	5 (62.5)	58 (66.7)	
Past smoker	9 (9.5)	0 (0.0)	9 (10.3)	
Quit during pregnancy	12 (12.6)	2 (25.0)	10 (11.5)	
Current smoker	11 (11.6)	1 (12.5)	10 (11.5)	
Gravidity	1 (1.0-4.0)	3.0 (1.5-6.0)	2.5 (1.0-4.0)	0.51
Prior obstetric history				
Spontaneous abortion	17 (17.9)	1 (12.5)	16 (18.6)	>0.99
Induced abortion	41 (43.2)	6 (75.0)	35 (40.7)	0.08
Intrauterine fetal death	0 (0.0)	0 (0.0)	0 (0.0)	—
Neonatal death	0 (0.0)	0 (0.0)	0 (0.0)	—
Ectopic pregnancy	1 (1.1)	0 (0.0)	1 (1.2)	>0.99
Previous preterm birth	14 (14.7)	3 (37.5)	11 (12.8)	0.09

Abbreviation: EDD, estimated date of delivery.

[a]Values are given as number (percentage) or median (interquartile range) unless otherwise indicated.

Table 2

Infectious disease prevalence at enrollment [a]

Test	All women (n=95)	*Mycoplasma genitalium*		*P* value
		Positive (n=8)	Negative (n=87)	
Chlamydia				0.47
Positive	6 (6.3)	1 (12.5)	5 (5.8)	
Negative	88 (92.6)	7 (87.5)	81 (93.1)	
Not done	1 (1.1)	0 (0.0)	1 (1.2)	
Gonorrhea				>0.99
Positive	1 (1.1)	0 (0.0)	1 (1.2)	
Negative	93 (97.9)	8 (100.0)	85 (97.7)	
Not done	1 (1.1)	0 (0.0)	1 (1.2)	
Bacterial vaginosis				0.33
Positive	42 (44.2)	6 (75.0)	36 (41.4)	
Negative	33 (34.7)	1 (12.5)	32 (36.8)	
Not done	12 (12.6)	1 (12.5)	11 (12.6)	
Indeterminate	8 (8.4)	0 (0.0)	8 (9.2)	
Syphilis				>0.99
Positive	1 (1.1)	0 (0.0)	1 (1.2)	
Negative	94 (99.0)	8 (100.0)	86 (98.9)	

[a] Values are given as number (percentage) or median (interquartile range) unless otherwise indicated.

Table 3

Prepartum and neonatal outcomes [a]

Outcome	All women (n=81) [b]	*Mycoplasma genitalium*		*P* value
		Positive (n=7)	Negative (n=74)	
Pregnancy outcome				
Spontaneous abortion	9 (11.1)	1 (14.3)	8 (10.8)	0.58
Induced abortion	6 (7.4)	1 (14.3)	5 (6.8)	0.43
Live birth [c]	66 (81.5)	5 (71.4)	61 (82.4)	0.61
Labor [c]				>0.99
Yes	61 (92.4)	5 (100.0)	56 (91.8)	
No	5 (7.6)	0 (0.0)	5 (8.2)	
Onset of labor [c]				
Spontaneous	43 (70.5)	5 (100.0)	39 (67.9)	0.31
Induced	18 (29.5)	0 (0.0)	18 (32.1)	
Delivery mode [c]				0.58
Vaginal	52 (78.8)	5 (100.0)	47 (77.1)	
Cesarean	14 (21.2)	0 (0.0)	14 (23.0)	
Preterm delivery [c]				>0.99
Yes	11 (16.7)	1 (20.0)	10 (16.4)	
No	55 (83.3)	4 (80.0)	51 (83.6)	
Chorioamnionitis [c]	4 (6.1)	1 (20.0)	3 (4.9)	0.28
Gestational age, wk [c]				0.96
Median (IQR)	39.0 (37.0–39.0)	39.0 (38.0–39.0)	39.0 (37.0–39.0)	
Range	24.0–42.0	35.0–40.0	24.0–42.0	
Birth weight, g [c]				0.89
Median (IQR)	3082.5 (2665.0– 3510.0)	3245.0 (3080.0– 3380.0)	3075.0 (2665.0– 3525.0)	
Range	710–4260	2040–3468	710–4260	
Low birth weight [c]	11 (16.7)	1 (20.0)	10 (16.4)	>0.99
Apgar score 1 min [c]				0.09
Median (IQR)	9.0 (8.0–9.0)	8.0 (6.0–8.0)	9.0 (8.0–9.0)	
Range	2.0–9.0	3.0–9.0	2.0–9.0	
Apgar score 5 min [c]				
Median (IQR)	9 (9.0–9.0)	8.0 (8.0–9.0)	9.0 (9.0–9.0)	0.008
Range	3.0–9.0	8.0–9.0	3.0–9.0	

Abbreviation: IQR, interquartile range.

[a] Values are given as number (percentage) or median (interquartile range) unless otherwise indicated.

[b] Prepartum and neonatal data were available only for 81 women who did not transfer their care from the Dimock Center.

[c] Data are presented for only the 66 women who had a live birth at the Dimock Center.