Prevalence of Group B *Streptococcus* Colonization in Subsequent Pregnancies of Group B *Streptococcus*-Colonized versus Noncolonized Women

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Abstract

Objectives To determine whether group B *Streptococcus* (GBS)-colonized pregnant women have an increased prevalence of GBS colonization in subsequent pregnancies.

Study Design This retrospective cohort study compared the prevalence of GBS colonization in initial and subsequent pregnancies of 158 women with two or more deliveries at a Midwest institution since the initiation of universal screening for GBS.

Results The GBS colonization rate in index pregnancies was 20%. Colonization rate in subsequent pregnancies for initially GBS-colonized women was 42% compared with 19% for women who were not colonized with GBS in the index pregnancy (p = 0.009). The relative risk for GBS-colonized women to be GBS-colonized in subsequent pregnancies was 2.2 (confidence interval = 1.3 to 3.8).

Conclusion Previous GBS colonization is a risk factor for GBS colonization in subsequent pregnancies. Consideration of intrapartum chemoprophylaxis in women with a history of GBS colonization, assuming current colonization status is unknown, warrants further investigation.

Keywords

- ► GBS  
- ► group B *Streptococcus*  
- ► pregnancy  
- ► *Streptococcus agalactiae*

Maternal group B *Streptococcus* (GBS) colonization is a major risk factor for neonatal early-onset GBS disease. In the 1970s, GBS was identified as the leading infectious cause of neonatal morbidity and mortality in the United States, with a mortality rate of up to 50%.1,2 Most early onset GBS disease causes sepsis and pneumonia and, less commonly, meningitis, osteomyelitis, and septic arthritis. In the 1980s intrapartum antibiotics demonstrated an effective means to prevent neonatal disease in GBS-colonized mothers.3 The incidence of early onset disease decreased by 65% during the 1990s.3 The mortality rate of infants with early onset GBS disease decreased from 50% in the 1970s to 4% in the 2000s secondary to improved neonatal treatment.1 Despite these improvements, neonatal GBS remains the leading infectious cause of neonatal mortality.1,2,4,5

The Centers for Disease Control (CDC) published initial recommendations for intrapartum chemoprophylaxis for GBS using either a risk factor-based approach or a universal...
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screening approach in 1996. In the guidelines released in 2002, the CDC recommended universal screening of all pregnant women at 35 to 37 weeks’ gestation, with a risk factor-based approach only if GBS status was unknown at the time of delivery. The most recent guidelines released from the CDC maintain this approach.

The prevalence of GBS found on the vagina, perineum, and rectum of women in the general U.S. population is 10 to 30% with some variation by geographic region. GBS colonization can be transient, chronic, or intermittent and is usually asymptomatic. Persson et al found that GBS screening during the 37th week of gestation was 85% predictive of GBS colonization during labor.

Women who have previously delivered an infant with invasive GBS disease should receive intrapartum chemoprophylaxis, regardless of current colonization status, during all subsequent deliveries. However, the prevalence of GBS colonization in subsequent pregnancies of previously GBS-colonized women without affected neonates has been evaluated in only limited populations, and prior colonization (in the absence of an affected neonate) is not an indication for intrapartum chemoprophylaxis in a subsequent pregnancy. Cheng and colleagues found a 39.2% rate of recurrence of GBS in a subsequent pregnancy; double the baseline colonization rate (18.3%), in a Taiwanese institution. However, Cheng’s study did not include GBS-negative controls. More recently, Turrentine and Ramirez demonstrated a 12-fold increase in GBS colonization in subsequent pregnancies for women colonized with GBS during an index pregnancy compared with controls who were not colonized in the index pregnancy in a clinic population in Texas. Rates of GBS colonization do vary geographically within the United States and worldwide. Therefore, it is unclear whether Turrentine and Ramirez’s results are reproducible in other populations such as our Midwest United States population.

Our objective was to establish the prevalence of GBS colonization in subsequent pregnancies of women previously colonized with GBS versus those not colonized to determine whether previous colonization might represent an independent risk factor for GBS colonization in subsequent pregnancies in a Midwest U.S. patient population.

Materials and Methods

This retrospective cohort study evaluated the GBS colonization status of all women with two or more consecutive deliveries at the same institution beginning with the initiation of universal screening for GBS in June 2002 and continuing through May 2007, and was approved by the local Institutional Review Board. All patients evaluated in the study received prenatal care at the Wright-Patterson Medical Center Perinatal Clinic after the hospital adopted the 2002 CDC recommendation to perform universal screening for GBS between 35 and 37 weeks’ gestation with vaginal and rectal swabs.

A comprehensive labor and delivery log maintained within the department was used to identify potential patients for inclusion in the study. Patients were eligible for inclusion in the study if they received prenatal care and had two or more consecutive deliveries at the Wright-Patterson Medical Center after the onset of universal screening for GBS in 2002. Laboratory and demographic data were maintained in and extracted from a comprehensive electronic database (Composite Health Care System versions I and II; SAIC, Inc., McLean, VA). Chart, laboratory, and delivery data were reviewed on potential patients. Women were excluded from the study if they did not deliver two or more infants at or beyond 23 weeks’ gestation from separate pregnancies, did not have GBS cultures performed during both pregnancies, or if they received prenatal care but did not ultimately deliver at our center.

Data regarding the index pregnancy were collected retrospectively in most cases. Data were collected prospectively through continued chart review during the ongoing subsequent pregnancies and deliveries after the initiation of our study in 2005.

Demographic data collected included patient’s age, gravidity, parity, interval between deliveries, gestational age at time of delivery, birth weight, body mass index (BMI), tobacco use, maternal race, the presence of any maternal or neonatal complications, GBS colonization for each pregnancy, and method of diagnosis for GBS colonization (urine versus vaginal/rectal swabs).

Included patients were grouped according to their colonization status during the first pregnancy and delivery at our medical center (“positive” indicating colonized with GBS or “negative” meaning not colonized with GBS). An a priori sample size estimate determined that 31 GBS-positive patients would be required to detect a difference of 50% in colonization rates of subsequent pregnancies assuming a power of 80% with α of 0.05 and a population prevalence rate of 20%. All patients with two or more consecutive deliveries at our institution who met the inclusion criteria were sequentially included until 31 women colonized with GBS in the index pregnancy with available cultures for both pregnancies were collected. This occurred in May 2007, thus indicating the conclusion of our study cohort.

The colonization status for subsequent pregnancies were evaluated and compared. In some cases, more than one GBS culture was obtained during one pregnancy. Any growth of GBS from any culture (urine or vaginal/rectal) obtained during the pregnancy resulted in categorizing the patient as “positive” regardless of order or type of cultures obtained. The prevalence of GBS colonization in subsequent pregnancies for each group was compared using the Fischer exact test. Additional statistical analyses were performed as appropriate using Student t test (continuous data, normal distribution), Fischer exact test (dichotomous, nonnormally distributed data), and chi-square test for trend. Statistically significant was defined as p < 0.05. Statistical analysis was performed with the Graph Pad In-Stat 3.0 software program (GraphPad Software, Inc; La Jolla, CA).

Results

One hundred sixty-five women had two or more pregnancies resulting in two or more consecutive deliveries at our
institution between June 2002 and May 2007. Six women had three deliveries during this time, and 159 had two deliveries. Seven women had no record of GBS testing in one or both of their pregnancies, providing 158 women in the final study cohort. Thirty-one (20%) women were colonized with GBS during the index pregnancy and delivery and 127 (80%) were not, similar to the general population.\(^1,2,5,6\)

The six women with three deliveries during the study period were all negative for GBS in the first pregnancy. The groups did not differ with regard to age, gravidity, parity, gestational age at delivery, birth weight, BMI, tobacco use, nor race during the index delivery (►Table 1). Women colonized with GBS in the index pregnancy had a slightly longer interval between pregnancies that was statistically significant (►Table 1).

GBS colonization rates in the subsequent pregnancy for those women who were not colonized during the index pregnancy maintained a distribution similar to the general population, with 24 women (19%) colonized with GBS in the subsequent pregnancy and 103 women (81%) remaining not colonized. In comparison, 13 (42%) of the initially GBS-colonized women were also colonized in the subsequent pregnancy, and 18 (58%) were not colonized in the subsequent pregnancy. This difference in subsequent GBS colonization was statistically significant (\(p = 0.009; \text{Fig. 1}\)). The relative risk for a woman who was initially GBS-colonized to be GBS-colonized in a subsequent pregnancy was 2.2 (confidence interval [CI] = 1.3 to 3.8).

A subgroup analysis of those women colonized with GBS in the index pregnancy was performed to determine whether any differences in demographics impacted the likelihood of being GBS-colonized in the subsequent pregnancy (►Table 2). There were no differences in demographics among GBS-colonized women who were GBS-colonized in the subsequent pregnancy versus those who were not (►Table 2).

Among the 31 GBS-positive women in the index pregnancy, a chi-square test for trend was performed to determine whether specific time intervals between deliveries may have impacted likelihood of GBS colonization in the subsequent pregnancy. Subgroups assessed for trend included subsequent delivery within 18 months (\(n = 7\)), 18 through 24 months (\(n = 6\)), 24 through 30 months (\(n = 6\)), 30 through 36 months (\(n = 9\)), and greater than 36 months (\(n = 3\)). The subset of women with the subsequent delivery occurring 18 to 24 months after the index delivery demonstrated the greatest likelihood of GBS colonization in the subsequent pregnancy (50% compared with 40% for all other groups combined). However, this difference was not statistically

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### Table 1 Demographics of Study Subjects at Index Pregnancy by GBS Status

<table>
<thead>
<tr>
<th></th>
<th>GBS-Negative ((n = 127))</th>
<th>GBS-Positive ((n = 31))</th>
<th>(p) Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)(^a)</td>
<td>27.7 (±4.9)</td>
<td>25.8 (±4.8)</td>
<td>0.06</td>
</tr>
<tr>
<td>Gravidity(^b)</td>
<td>2 (1–8)</td>
<td>2 (1–5)</td>
<td>0.89</td>
</tr>
<tr>
<td>Parity(^b)</td>
<td>0 (0–4)</td>
<td>1 (0–2)</td>
<td>0.93</td>
</tr>
<tr>
<td>Gestational age at delivery (wk)(^a)</td>
<td>39.5 (±1.3)</td>
<td>39.7 (±1.1)</td>
<td>0.54</td>
</tr>
<tr>
<td>Birth weight (g)(^a)</td>
<td>3477 (±541)</td>
<td>3487 (±449)</td>
<td>0.93</td>
</tr>
<tr>
<td>Interval between index and subsequent delivery (mo)(^a)</td>
<td>22.9 (±6.8)</td>
<td>26.3 (±7.9)</td>
<td>0.03</td>
</tr>
<tr>
<td>BMI (kg/m(^2))(^b)</td>
<td>25.1 (±4.2)</td>
<td>27.4 (±5.4)</td>
<td>0.07</td>
</tr>
<tr>
<td>Tobacco use (%)</td>
<td>7.1</td>
<td>0</td>
<td>0.20</td>
</tr>
<tr>
<td>Race, % ((n))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>71% (90)</td>
<td>65% (20)</td>
<td>0.52</td>
</tr>
<tr>
<td>Black</td>
<td>5% (6)</td>
<td>3% (1)</td>
<td>1.00</td>
</tr>
<tr>
<td>Other</td>
<td>9% (11)</td>
<td>19% (6)</td>
<td>0.11</td>
</tr>
<tr>
<td>Undocumented</td>
<td>15% (20)</td>
<td>13% (4)</td>
<td>0.99</td>
</tr>
</tbody>
</table>

GBS, group B Streptococcus; BMI, body mass index.
\(^a\)Mean values with standard deviation are reported.
\(^b\)Median values with range are reported.

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**Figure 1** Group B Streptococcus (GBS) status in subsequent pregnancy. Women are grouped according to colonization in the index delivery (GBS-negative or GBS-positive). Within each group, distribution of colonization in the subsequent delivery (GBS-negative or GBS-positive) is shown.
significant \((p = 0.45)\), GBS colonization rates in the subsequent pregnancy were statistically similar among all groups \((p = 0.80)\).

Six of the 31 women (19\%) colonized with GBS in the index pregnancy were diagnosed by urine culture as opposed to vaginal and rectal swabs. Three of these women were also GBS-colonized in the subsequent pregnancy, and three were not. In our population, women were not more likely to be GBS-positive in a subsequent pregnancy if the initial diagnosis was made by urine culture \((relative\ risk = 1.25, CI = 0.5\ to \ 3.2, \ p = 0.68)\).

Six patients had three deliveries each during the study period. Among this subset of women, all were initially negative for GBS, and 5 (83\%) were negative for the second pregnancy. One (17\%) became colonized in the second pregnancy and subsequently was not colonized in the third. One (20\%) of the five patients who were not colonized during the second pregnancy became GBS-colonized during the third pregnancy. For statistical analysis, when assigning outcome for these six women, all were categorized according to the outcome of the pregnancy immediately subsequent to the index pregnancy \(i.e.,\ the\ second\ pregnancy\ during\ the\ study\ period\) rather than the data of the third pregnancy.

There were no cases of neonatal early onset GBS disease during the study period.

### Discussion

Our study suggests that GBS colonization of the vagina, rectum, and/or urine is a risk factor for GBS colonization in subsequent pregnancies. Women colonized with GBS in an index pregnancy are 2.2 times more likely to be colonized with GBS in future pregnancies. Age, gravidity, parity, gestational age at delivery, birth weight, interval between index and subsequent deliveries, BMI, tobacco use, and race are not predictors of this recurrent colonization.

Our findings support the findings in Cheng et al’\textquotesingle s study of a Taiwanese population \(39\%\) recurrence and Turrentine and Ramirez\’s study of a Texas population \(53\%\) recurrence.\(^8\)\(^\text{-}\)\(^10\) Cheng et al’\textquotesingle s study found only the time interval of less than 12 months between pregnancies and quantity of GBS colonization to be risk factors for recurrence.\(^9\) Turrentine and Ramirez\’s study evaluated the impact of GBS bacteriuria on recolonization. The recurrence rate was higher for those women with GBS bacteriuria but not statistically different from vaginal and rectal cultures.\(^10\) Our study did not find that GBS diagnosed by urine culture would be more likely to result in recurrent colonization, although the number of subjects identified by urine culture was also small in our study and may have lacked power to detect such a difference.

Theoretically, the length of time between deliveries could impact the colonization rate in subsequent pregnancies. Cheng et al did find that an interval of less than 12 months between pregnancies impacted the recurrence rate of GBS and other intervals did not.\(^9\) Our study did not find any trend when the interval between deliveries was evaluated as an independent variable. It is interesting that the greatest rate of colonization in a subsequent pregnancy was noted when subsequent delivery occurred within 18 to 24 months after the index pregnancy. However, given the small number of patients in each group, our analysis may have lacked power to detect such a difference in other intervals. The effect of time

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**Table 2** Demographic Comparison among Subset of GBS-Colonized Women in the Index Pregnancy by GBS Status in Subsequent Pregnancy \((n = 31)\)

<table>
<thead>
<tr>
<th></th>
<th>GBS-Negative in Subsequent Pregnancy ((n = 18))</th>
<th>GBS-Positive in Subsequent Pregnancy ((n = 13))</th>
<th>(p) Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)(^a)</td>
<td>25 (± 4.4)</td>
<td>26.9 (± 5.3)</td>
<td>0.27</td>
</tr>
<tr>
<td>Gravidity(^b)</td>
<td>2 (1–3)</td>
<td>2 (1–5)</td>
<td>0.95</td>
</tr>
<tr>
<td>Parity(^b)</td>
<td>1 (0–2)</td>
<td>1 (0–2)</td>
<td>0.95</td>
</tr>
<tr>
<td>Gestational age at delivery (wk)(^a)</td>
<td>39.5 (± 1.2)</td>
<td>39.9 (± 1.0)</td>
<td>0.50</td>
</tr>
<tr>
<td>Birth weight (g)(^a)</td>
<td>3474 (± 426)</td>
<td>3511 (± 522)</td>
<td>0.92</td>
</tr>
<tr>
<td>Interval between index and subsequent delivery (mo)(^a)</td>
<td>26.4 (± 8.1)</td>
<td>26.2 (± 8.0)</td>
<td>0.92</td>
</tr>
<tr>
<td>BMI (kg/m(^2))(^a)</td>
<td>28.6 (± 5.6)</td>
<td>25.6 (± 4.7)</td>
<td>0.15</td>
</tr>
<tr>
<td>Tobacco use (%)</td>
<td>0</td>
<td>0</td>
<td>N/A</td>
</tr>
</tbody>
</table>

GBS, group B Streptococcus; BMI, body mass index; N/A, not applicable.
\(^a\)Mean values with standard deviation are reported.
\(^b\)Median values with range are reported.
intervals between deliveries on subsequent colonization with GBS would be interesting to further evaluate with a larger study population.

The patients in our study were active duty military service women, wives or daughters of service members in the military, or veterans of the military. This represents a major strength of our study in that our population had equal and affordable access to comprehensive health care in a closed system regardless of economic standing, age, or education. This military health care system population is advantageous to study because the majority of our beneficiaries have relocated to an area based on military assignment and represent a diverse population of women from several geographic locations rather than an isolated population. Another strength of our study is the design when compared with previous investigations. Cheng et al’s study did not include a concurrent analysis of GBS-negative women and Turrontine and Ramirez’s study examined one GBS-negative patient for each GBS-positive patient identified. In contrast, our study included all patients (GBS-positive and GBS-negative) from the study period in the analysis, thus minimizing selection bias and providing a complete comparison between GBS-positive and GBS-negative women.

Our study has some limitations that should be acknowledged. Although the prevalence of GBS colonization in the initial pregnancies of our study group is similar to the general population, our study evaluated a population of patients in a single institution. This study was conducted over a relatively short period of time, and it is unclear whether a longer interval between pregnancies may have altered the GBS colonization rates observed in the subsequent pregnancies. Finally, although we did observe a difference in GBS colonization rates between the groups, there was no observed difference in early onset neonatal GBS infection, as there were no cases observed in our study population.

The CDC and the American College of Obstetricians and Gynecologists (ACOG) recommend chemoprophylaxis in patients with unknown GBS colonization status if they develop temperature in labor of greater than 100.4°F, the gestational age is less than 37 weeks in labor, or they have ruptured membranes greater than 18 hours. GBS bacteriuria in the current pregnancy or a history of delivering an infant with GBS bacteriuria in the current pregnancy or a history of delivering an infant with early onset GBS disease are also indications for chemoprophylaxis that negate the need for GBS screening. Risk factors previously identified but not included as specific indications for intrapartum chemoprophylaxis include African-American background, young maternal age, and GBS vaginal or rectal colonization during the first trimester of pregnancy. Likewise, prior GBS colonization without an affected infant is not an indication for chemoprophylaxis based on the current guidelines. Although neither the CDC nor ACOG currently recommend independent treatment of these women, it is unclear whether these patients would benefit from chemoprophylaxis.

Recent studies show that most pregnant women in the United States are screened for GBS colonization prior to labor. However, Rodriguez et al reported that despite 95% of women being screened, only 80% of cultures were performed at the appropriate gestational age. Goins et al found that although screening was performed in 85% of women, 26% of tests were performed prior to the 35 to 37 weeks’ gestation as recommended by the CDC. Thus, some women will present in labor at term with an unknown colonization status. In such cases, knowledge of colonization status in prior pregnancies may be helpful in determining a patient’s individual risk for colonization. Any potential benefit for intrapartum chemoprophylaxis in previously GBS-colonized women, particularly if the current GBS colonization status is unknown, should be evaluated further, as should the cost-effectiveness of rescreening this population of women.

Note
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References


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