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Prevalence of colonisation by group B streptococcus in pregnant patients in Taguatinga, Federal District, Brazil: a cross-sectional study

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Abstract

Propose Group B streptococcus is responsible for severe infections in neonates resulting from vertical transmission from pregnant women colonized in the anal, perineal or vaginal regions. The identification of colonized patients and use of intrapartum prophylaxis may reduce the risk of neonatal infection.

Methods A cross-sectional study of pregnant women of gestational age between 35 and 37 weeks was conducted. Material was collected from patients for laboratory identification of group B streptococcus. Epidemiological data, including weight, height, body mass index, antibiotic use during pregnancy, pathologies during pregnancy (diabetes, hypertensive diseases, and hypothyroidism), twinning, and others, were also collected from patients.

Results The sample consisted of 501 pregnant women, and the prevalence of group B streptococcus was 14%. The mean age was 29 years, and the mean BMI was 30.7. During pregnancy, 204 patients had some type of infection, and 201 used antibiotics. Ninety-five patients were diagnosed with gestational diabetes mellitus and 74 with some type of hypertensive disease.

Conclusions The prevalence of group B streptococcus observed did not differ from that observed in other studies. None of the factors studied can be considered as risk or protective factors for maternal colonization by group B streptococcus.

Keywords Group B streptococcus · Pregnancy · Prevalence · Colonization · Antibiotics

Introduction

Lancefield group B streptococcus (GBS) (*Streptococcus agalactiae*) is responsible for serious infections such as sepsis, meningitis, and pneumonia in infants up to 1 week of life [1–5]. Neonatal infection results from vertical transmission and is due to maternal colonization of the anal, perineal and/or vaginal regions, and a strong correlation has been observed between maternal GBS (transient or chronic) infections (such as meningitis and pneumonia) and neonatal sepsis [5–9].

GBS infections are not restricted to neonates, but neonates are the most important population affected by severity and magnitude of GBS infection [10]. GBS is estimated to be responsible for 18 infections per 10,000 live births per year [9, 11] and for 35% of early infections in neonates [9]. In addition to neonatal infection, some peri- or postpartum maternal complications, although of low incidence, are attributed to GBS colonization of the genital tract [12], such as bacteremia, urinary tract infection (UTI), mastitis, endometritis, chorioamnionitis, premature labor, and premature membrane rupture [13–15].

The prevalence of maternal colonization by GBS varies according to the region studied. Prevalence rates from 7% have been reported in Bosnia and Herzegovina [16] to more than 33% [17–24]. In Brazil, variations in prevalence between 14 and 28% have also been described [25–32].

Shah et al. have found an association among obesity, ethnicity (black), and GBS infection [1]. In the US, a study

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conducted in the 1990s demonstrated a higher prevalence of GBS in non-whites (including blacks and Hispanics) compared with whites [28]. In Brazil, the influence of ethnicity on GBS colonization has been an interesting question considering the high degree of miscegenation in the population [28]. According to Berardi et al., the risk factors may change according to the gestational age at delivery. A study carried out with neonates of mothers colonized by GBS found that neonatal colonization was associated with maternal non-treatment during the intrapartum period as well as maternal fever and African ethnicity [6]. Many maternal, obstetric, and neonatal factors have been identified as risk factors for maternal colonization, maternal–fetal transmission, and neonatal colonization orinfection. However, these studies have produced contradictory results, and few factors have been sufficiently robust or clinically relevant to establish guidelines for the prevention strategies [10].

GBS may be classified into ten serotypes defined by the presence of capsular polysaccharides (I–IX, including two subtypes of I, a and b). The distributions of these serotypes vary geographically [19, 32–39], those have not changed over at least the last 30 years [10, 35]. As each serotype has a distinct pathogenesis (virulence, progression, and severity), the geographical distribution patterns coincide with disease reports [33]. Thus, the identification of GBS serotypes is important for the development of customized vaccines. However, this process is difficult in countries such as Brazil, where screening is not a routine clinical procedure (because serotyping can only be performed after the collection of biological material), and, therefore, a lack of knowledge about serotype classification and distribution is present in this area [33]. Early neonatal infection is usually attributed to serotypes Ia, II, III, and V, whereas the predominant cause of late infection is serotype III [10].

The Brazilian National Health Surveillance Agency, based on a standard from the Clinical and Laboratory Standards Institute, recommends the antimicrobial susceptibility test (AST) with the following antibiotics to identify GBS infection: penicillin, clindamycin, erythromycin, and vancomycin, among others. The ability of each antibiotic to kill GBS, as well as other bacteria, varies according to the region or country where it was studied. Even with this variation, the recommendations in most countries are that there is no need to routinely perform the AST. It is important to note that prevention of GBS transmission is based on the assumption of antimicrobial sensitivity in this bacterium [40].

Currently, parturient GBS screening in Brazil is carried out routinely in the private healthcare network; however, there are disparities in the provision of services between the private and public healthcare systems. For many international health monitoring and care agencies, parturient GBS screening is a component of quality prenatal care and important to neonatal outcomes [11, 41]; however, some healthcare organizations do not indicate the test for all pregnant women [42]. In the city of São Paulo, GBS screening is performed by the "Mãe Paulistana" program [13, 43]. Until the beginning of this study, GBS screening in pregnant women was not routine at the Taguatinga Regional Hospital (Hospital Regional de Taguatinga—HRT).

However, even in areas where GBS screening is a part of routine care, there is a low adherence from obstetricians, probably due to the large proportion of surgical deliveries (more than 80%) [44, 45].

Identification of women at risk of GBS transmission and in need of prophylactic antibiotic therapy can reduce the risk of newborn infection by up to 78%. Nevertheless, Dyke et al. reported that 18% of GBS cases occur in neonates from unscreened mothers [3].

The high rates of neonatal mortality represent a challenge to public health in Brazil, and although the risk of death has been reduced with increased access to prenatal care and institutional delivery, the target rates proposed for this indicator in the Millennium Development Goals (MDGs) report have not yet been reached [46–48].

In view of the importance of this topic, the objective of this study was to determine the prevalence of maternal GBS colonization in patients seen at prenatal care services of the HRT, located in the Federal District, Brazil, and possible associated factors and to identify the serotypes and sensitivity profiles to antibiotics used in intrapartum prophylaxis.

Materials and methods

This is a cross-sectional study conducted with pregnant women seen at the outpatient clinic of the Taguatinga Regional Hospital and two Primary Health Units (Taguatinga Health Center 4 and 5) between June 2013 and June 2015. The guidelines from the United State Centers for Disease Control and Prevention (CDC) [11] recommend collecting biological material for GBS screening between the 35th and 37th weeks of pregnancy, although collection can occur earlier when there is risk of preterm birth. Considering, if necessary, extended time for screening for maternal GBS colonization, pregnant women with an initial negative culture were re-evaluated at 4-week intervals until delivery [11].

To estimate prevalence, the minimum sample size required was obtained using a population surveillance scheme [49], considering a GBS frequency of 30% (±5%) [9, 11, 38] in the source population and assuming type I and II errors of 5% and 20%, respectively, and a design effect of 2. These parameters required that at least 490 women needed to be evaluated.

Thus, 519 women older than 18 years of age (and under 18 years of age with guardian consent) who were between

the 32nd and 37th weeks of pregnancy, those who have agreed to participate in the study, signed an informed consent form, and were not undergoing antibiotic therapy were included. Women from whom microbiological samples were not collected and/or were inadequately processed were excluded (18 women excluded). Therefore, the final sample size was 501 women.

Variables studied

The following data were collected to study the factors associated with GBS colonization: GBS status, weight, height, age, parity (number of pregnancies, vaginal deliveries, surgical deliveries, and miscarriages), infections during pregnancy (type of infection and gestational period), use of antibiotics during pregnancy (and which medicine), comorbidities and clinical events during pregnancy (diabetes, hypertensive diseases, twinning, hypothyroidism, or asthma), GBS serotype and bacterial resistance to antibiotics (penicillin, clindamycin, vancomycin, and erythromycin).

Microbiological sample collection and GBS isolation and identification

Microbiological material was collected and processed according to the method proposed by Verani et al. [11] and updated based on Schrag [50] and CDC [51] guidelines. These methods have been previously used in other studies [24, 52, 53]. A combination of vaginal and anal material was used, as recommended by the CDC [11]. To collect the samples, the lower part of the vagina was swabbed (with swab insertion), and the rectum was then swabbed (swab inserted into the rectal sphincter) using the same swab. The collection was performed as an outpatient procedure by a trained professional (physician or nurse). Cervical, perianal, perirectal or perineal samples were not considered acceptable, and speculums were not used for material collection. After collection, the swabs were placed in a nutrient medium for transport (Stuart's Transport Medium). Although the GBS present in the sample can remain viable in the transport medium for several days at room temperature, the samples were processed on the same day as collection. Samples that were stored after 1 day at high ambient temperatures could lead to false-negative results. For the isolation and identification of pathogens, the CDC recommendations included in the same document cited 11 were also followed.

Following receipt of the sample by the laboratory, the vaginal/anal swab was removed from the transport medium and inoculated into enrichment medium (Todd–Hewitt Broth supplemented with 8 µg/mL gentamicin and 15 µg/mL nalidixic acid) and incubated at 35 °C for 18 h. A subculture in a specific chromogenic medium (Plastilabor®, Rio de Janeiro, RJ, Brazil) was then performed for GBS isolation. Cultures showing bacterial growth were identified by morphological evaluation, catalase testing, and Christie–Atkins–Munch–Petersen (CAMP) testing, and the species was identified using the Gram-positive panel from the automated system MicroScan WalkAway, model 96 SI® (Siemens, Malvern, PA, USA).

The catalase test was performed by transferring a colonysuggestive of GBS to a microscope slide with a drop of 3% hydrogen peroxide. The presence of effervescence or production of gas bubbles indicated a positive result. *Staphylococcus aureus* ATCC 25923® served as the positive control, and *Streptococcus pneumoniae* ATCC 49619® served as the negative control.

The CAMP test was performed by streaking *Staphylococcus aureus* ATCC 25923® on a blood agar plate (with 5% defibrinated sheep blood) in a straight line and streaking a strain suggestive of GBS to be identified perpendicular to the other streak without touching it. The arrow-shaped hemolysis between the two streaks indicated the positive CAMP factor produced by GBS.

For serotype identification, the latex agglutination method combined with the ImmuLex® Strepto B test (Statens Serum Institut, Copenhagen, Denmark) was performed according to the manufacturer's recommendations.

Statistical analysis

The prevalence of GBS and 95% confidence interval (CI) were estimated first. The exploratory analysis of the study variables was performed using measures of central tendency and dispersion for continuous variables and simple frequencies for categorical variables. To estimate the association of the exploratory variables and GBS prevalence, simple logistic regression models were fitted with the GBS presence status (negative = 0, positive = 1) as the dichotomous response variable and the following as predictor variables: infection during pregnancy, UTI, acute respiratory infection, use of β-lactam antibiotics after the 32nd week of pregnancy, use of nitrofurantoin, gestational diabetes mellitus (GDM), hypertensive diseases, hypertensive disease-associated GDM, hypothyroidism, twinning, asthma, maternal age, maternal BMI, number of pregnancies, vaginal deliveries, surgical deliveries, and miscarriages. A multiple logistic regression model was then fitted with GBS presence status as the dichotomous categorical response variable and those variables in the univariate model that produced odds ratio (OR) estimates with p values ≤ 0.25 [54] as the predictor variables.

The serotypes in positive cases and their resistance to the antibiotics penicillin, vancomycin, erythromycin, and clindamycin were described using simple frequencies.

The data were compiled and analyzed using IBM SPSS v.23.0, and a significance level of 5% was adopted.

Ethical issues

The research "Colonization of pregnant women by Streptococcus agalactiae in Taguatinga, DF" was approved by Ethical Research Committee of Health Sciences Education and Research Foundation (Comitê de Ética em Pesquisa da Fundação de Ensino e Pesquisa em Ciências da Saúde) in technical advice #080/2012. The present article comes from this research. All women were invited and agreed to participate in the study, and signed an informed consent form.

Results

Among the 501 samples collected, 72 were positive for GBS, which resulted in a prevalence rate of 14.37% (95% CI 11.5–17.65).

The mean age, weight, height, and BMI were 29 years, 78.9 kg, 1.6 m, and 30.7, respectively. The clinical and obstetric characteristics of the samples are described in Table 1.

The health workers who have assessed the patients also had the opportunity to observe and record aspects related to personal and intimate hygiene (subjectively), such as showering before the consultation and whether the patient was wearing clean clothes. Poor hygiene conditions were recorded in 13 women (2.6%).

Whether the patients presented with some type of infection during pregnancy was determined, and positive results were obtained for 204 (40.7%) patients. Of the patients with infections, 201 (98.5%) were treated, 2 were not (1%), and 1 had no information (0.5%). Table 2 shows the distribution of infections during pregnancy, use of antibiotics, and diseases or clinical conditions.

The association between the clinical characteristics of the patients and the presence of colonization by GBS (Table 3) was also determined. As the treatment of choice for GBS is β-lactam antibiotics, its use during pregnancy was analyzed at any time period ($p = 0.55$) and after the 32nd gestational

Table 1 Clinical and obstetric characteristics of women evaluated in the study

	Mean (± SD)	Median (IIQ)	EGB	
			−	+
Age (years)	29 (6.7)	30 (9.0)	29.3	28.9
Weight (kg)	78.9 (16.2)	77.7 (20.9)	79.1	77.9
Height (m)	1.6 (0.7)	1.6 (0.1)	1.6	1.6
BMI[a]	30.7 (5.8)	30.3 (7.5)	30.9	29.8
	n 501 (%)	% Cumulate		
No of pregnancies				
1	138 (27.5%)	27.5%	115	23
2	141 (28.1%)	55.6%	117	24
3	105 (21%)	76.6%	94	11
4	56 (11.2%)	87.8	47	9
5[e+]	61 (12.2%)	100%	56	5
No. of vaginal deliveries				
0	284 (56.6%)	56.6%	241	43
1	114 (22.8%)	79.4%	97	17
2–4	97 (19.3%)	98.7%	85	12
5[e+]	6 (1.2%)	100%	6	0
No. of surgical deliveries				
0	352 (70.3%)	70.3%	296	46
1	97 (19.4%)	89.7%	86	11
2[e+]	52 (10.3%)	100%	47	5
No. of abortions				
0	377 (75.2%)	75.2%	321	56
1	87 (17.4%)	92.8%	76	11
2–3	34 (6.8)	99.4%	29	5
4–5	3 (0.6%)	100%	3	0

[a] *BMI* body mass index

Table 2 Distribution of infections, the use of antibiotics, and diseases during pregnancy

	n (%)	Cumulate (%)
Infection during the pregnancy		
Urinary tract infection (UTI)	162 (79.5%)	79.5
Acute respiratory infection (ARI)	16 (7.8%)	87.3
Other infections	6 (2.9%)	90.2
Uninformed	20 (9.8%)	100
Use of antibiotics		
Cephalexin	128 (63.7%)	63.7
Amoxicilin	21 (10.4%)	74.1
Nitrofurantoin	20 (10%)	84.1
Other antibiotics	19 (9.4%)	93.5
Uninformed	13 (6.5%)	100
Comorbidities and clinical situations		
Gestational diabetes mellitus (GDM)	95 (28.2)	28.2
Hypertensive diseases[a]	74 (22%)	50.2
GDM associated with hypertensive diseases	25 (7.4%)	57.6
Hypothyroidism	18 (5.3%)	62.9
Twin pregnancy	17 (5%)	67.9
Asthma	13 (3.9)	71.8
Other pathologies	95 (28.2%)	100

[a]Hypertension and preeclampsia

Table 3 Associations between colonization by GBS and multiple covariates in simple and multiple logistic regression models

	OR (MRLS[a])	valor-p (MRLS[a])	OR (MLRM[b])	IC95% (MLRM[b])
Infection during the pregnancy	0.91	0.73	–	–
UTI	0.90	0.74	–	–
ARI	0.85	0.83	–	–
Use of β-lactam antibiotics during the pregnancy	0.84	0.55	–	–
Use of β-lactam after the 32nd week of pregnancy	0.94	0.89	–	–
Use of nitrofurantoin	0.65	0.57	–	–
GDM	0.81	0.51	–	–
Hypertensive diseases	0.62	0.18[c]	0.34	0.33, 1.47
GDM associated with hypertensive diseases	0.48	0.24[c]	–	–
Hypothyroidism	0.99	0.99	–	–
Twin pregnancy	0.60	0.28	–	–
Asthma	–	–	–	–
Age of the mother	1.01	0.57	–	–
BMI	1.03	0.15[c]	0.98	0.69, 1.08
Pregnancies	1.18	0.08[c]	1.13	0.94, 1.37
Vaginal deliveries	1.14	0.27	–	–
Surgical deliveries	1.34	0.13[c]	1.19	0.78, 1.79
Abortions	1.08	0.67	–	–

[a]Simple logistic regression model

[b]Multiple logistic regression model

[c]Variables that were taken to multiple models due to the input criterion ($p \leq 0.25$) without being statistically associated with the outcome in simple models

week ($p = 0.89$), considering that colonization is transitory. We also analyzed the presence of infections during pregnancy, UTIs (which was the most frequent infection), GDM, and hypertensive diseases and found OR p values of 0.73, 0.74, 0.51, and 0.18, respectively, which were not statistically significant.

Table 4 shows the distribution of serotypes and antimicrobial resistance. The most frequent serotype was Ia (49%), followed by V, II, and Ib, (31, 9, and 7.5%, respectively). The Ia serotype also presented the highest rate of antimicrobial resistance, with ten samples resistant to erythromycin (30.3%) and one that was also resistant to clindamycin (3.0%). The second serotype with the highest number of resistance cases was V, with approximately 24% of the samples resistant to erythromycin, but none resistant to the other antibiotics tested. The resistance rates were 29% for erythromycin and 4.3% for clindamycin. All GBS isolates resistant to clindamycin were also resistant to erythromycin, and no resistance to penicillin or vancomycin was found among the isolates.

Discussion

The prevalence of maternal colonization by GBS varies according to the region studied and is approximately between 15 and 30% both in Brazil and in abroad [19–32]. Busetti has found a prevalence of GBS in pregnant women between the 35th and 37th weeks of gestation of approximately 18% [4]. Other studies indicated that, on an average, 30% of women are colonized by GBS [9, 11, 38]. Thus, the estimated prevalence for Taguatinga (14.4%), the site of this study, apparently does not differ from the estimates reported in the literature.

It was not possible to determine the influence of ethnicity on GBS colonization because the entire sample consisted of non-white patients, according to medical records and professional observations during data collection. However, although the population was mixed, this factor does not seem to have influenced the result because the prevalence in Taguatinga approached that of countries with predominantly white populations, such as Lithuania [19] and Switzerland [23].

Table 4 Distribution of GBS serotypes and antimicrobial resistance

	n(%)	Erythromycin resist *n* (%)	Clindamycin resist *n* (%)
Ia	33 (49%)	10 (30.3%)	1 (3.0%)
Ib	5 (7.5%)	1 (20%)	–
II	6 (9%)	1 (16.7%)	1 (16.7%)
III	1 (1.5%)	1 (100%)	–
V	21 (31.3%)	5 (23.8%)	–
VIII	1 (1.5%)	–	–
Not identified[a]	–	2	1

[a]Since the denominator is unknown, the percentages cannot be determined

As the gastrointestinal tract is the primary GBS reservoir and the main source for vaginal colonization, hygiene habits or sexual practices may increase the risk of vaginal colonization [10]. Few patients included in the sample (2.6%) presented poor hygiene conditions, according to the information from the professionals who saw them at the time of delivery. It is worth noting that this is a subjective condition most of the time and, therefore, difficult to calibrate.

The percentage of patients who used antibiotics during pregnancy was nearly 41%, which may be because treatment can be initiated without laboratory confirmation when only one symptom of infection is present. As the treatment of choice for GBS is β-lactam antibiotics, the association between the use of these drugs during pregnancy and the presence of GBS was tested, and an OR of 0.84 (0.49, 1.46) was estimated. Thus, there was no significant association between β-lactam drugs and the presence of GBS. Because maternal colonization by GBS is transient, the association between the use of β-lactam drugs after the 32nd week of pregnancy was also determined [OR = 0.94 (0.39, 2.23)] and was similar to the previous conclusion described above. In this study, none of the factors studied (infections during pregnancy, use of antibiotics, hypertensive diseases, or GDM) had an influence on the presence of GBS.

Treatment with antibiotics does not eliminate GBS colonization but rather only reduces it. In intrapartum treatment, this reduction aims to decrease vertical transmission. Therefore, the use of antibiotics during pregnancy, at any time, or the presence of other clinical conditions cannot be used as protective or risk factors for GBS colonization.

The findings show that the number of women that used antibiotics was very much reduced in both groups. The 4.2% detected in GBS + and the 5.6% in GBS-, besides the fact of not being representatives, they do not have enough strength to detect differences. This does not allow us to make more inferences about the finding, even more considering the probability of non-specific uses of antibiotics in EGB.

All the patients included in the study received the test results (negative or positive) and were instructed to maintain this information together with their record for evaluation by the obstetrician regarding intrapartum prophylactic treatment [11]. There was no need to repeat the screening test for GBS in patients who were screened before the 35th week of gestation because all of these pregnant women had preterm deliveries.

In this study, a small percentage of serotype III infections (1.5%) was found, unlike other studies where serotype III was the most prevalent serotype [21, 31, 36, 37]. However,

almost 82% of colonization were caused by only three serotypes (Ia, V, and III), which seemed to be similar to the values reported in other studies.

Ueno et al. did not observe GBS penicillin resistance; however, approximately 13% and 9% of the tests conducted showed resistance to erythromycin and clindamycin, respectively [55]. Other studies also investigated resistance rates both in Brazil and abroad and found rates ranging 14–52% for erythromycin and between 14 and 41% for clindamycin [16, 17, 19, 23, 29, 32, 36, 37, 56, 57]. Dutra et al. found resistance rates to erythromycin and clindamycin of 3 and 4%, respectively, but the isolates were mainly from urine samples and not vaginal–anal swabs [34]. Fröhlischer et al. observed an association between GBS resistance to clindamycin and erythromycin and serotype [36]. None of these studies found GBS resistance to penicillin or vancomycin. Other studies found resistance to only one of the antibiotics (erythromycin or clindamycin) [19, 26, 31].

In the present study, 29% of the GBS isolates were resistant to erythromycin, which was similar to other results reported in the literature. The isolates had a lower resistance to clindamycin (4.3%) when compared with results from studies conducted outside of Brazil [23, 37, 56] but similar to the results reported by other Brazilian studies [31, 34].

Fröhlischer et al. indicated that a large portion (70%) of invasive cases of GBS was caused by serotypes III and V. Although serotype III was only identified once in the present study, this isolated case presented resistance to erythromycin, but this finding could be attributed to chance given the small number of occurrences [36].

Because of the high degree of resistance to erythromycin, this antibiotic is not recommended as the first choice for the intrapartumtreatment of GBS [58] and is not included in the list of antibiotics recommended by the MMRW (morbidity and mortality weekly report) protocol [11]. Vancomycin is the drug of choice for the prophylactic treatment of GBS. However, the use of vancomycin is not risk free and may be associated with the development of antibiotic resistance [23].

Thus, the first choice for the treatment of GBS is penicillin, and for allergic patients, it is necessary to know the bacterial sensitivity profile of the isolated strain [52]. In a sample of 501 patients, only 2 reported allergies to penicillin. This small number of allergic patients reduced the cost of the sensitivity test, facilitated and expedited the laboratory results, considering that the sensitivity test can increase the performance time by approximately 24–48 h and represent 80% of the total cost of the examination.

Most of the samples (40%) used antibiotics at some time during pregnancy, and the most commonly used antibiotics were β-lactam drugs. Despite not finding GBS resistant to penicillin and vancomycin, the indiscriminate use of these drugs can lead to bacterial resistance [50] due to several factors such as induction of resistance or natural selection of resistant microorganisms.

Conclusions

The prevalence of GBS estimated for Taguatinga did not differ from the findings reported in the literature, and none of the variables studied were associated with maternal colonization by GBS. Despite the large number of pregnant women undergoing antibiotic therapy at some time during pregnancy, this should be discarded for GBS screening because the antibiotic, regardless of the class, does not influence maternal colonization. Therefore, it is essential that all pregnant women must be screened for GBS in a timely manner and that those with positive cultures be considered for or to receive intrapartum prophylaxis with the appropriate antibiotic aiming to reduce the risk of transmission to the newborn.

The GBS serotypes differed from those described in the literature; however, the bacterial resistance resembled that already described. Screening of pregnant women colonized by GBS is an essential component to ensure the health of the mother and baby. However, the antimicrobial susceptibility test is apparently necessary only for pregnant women who are allergic to penicillin or have some other clinical condition that makes it impossible to use this antibiotic because it is the first choice for intrapartum prophylaxis in the presence of GBS.

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Compliance with ethical standards

Conflict of interest The authors declare that there are no conflicts of interest in this study.

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