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ORIGINAL PAPER / OBSTETRICS

The prevalence of *Group B Streptococcus* rectovaginal colonization and antimicrobial susceptibility pattern in Turkish and Syrian pregnant women

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ABSTRACT

Objectives: Colonization with *Group B Streptococcus* (GBS) during pregnancy can lead to invasive GBS disease (iGBS) in neonates, including meningitis, pneumonia or sepsis, which carries a high mortality risk. American College of Obstetricians and Gynecologists (ACOG) recommends universal GBS screening for all pregnant individuals between 36 0/7 and 37 6/7 weeks of gestation. However, due to the insufficient population-based studies on universal screening and GBS colonization rates in late periods of pregnancy in Türkiye, we aimed to evaluate the prevalence of GBS and its antibiotic resistance to enhance awareness regarding GBS screening and prophylaxis during pregnancy and promote the use of appropriate antibiotics.

Material and methods: This prospective, single-center study was conducted between May 2017 and December 2017 on 518 pregnant women (363 Turkish and 155 Syrian). Vaginal and rectal samples were collected and cultured in Todd–Hewitt broth. Standard microbiological protocols were used to assess GBS colonization and antibiotic susceptibility.

Results: In the study, we found that 10.6% (n = 55) of pregnant women were colonized with GBS asymptomatically. *Group B Streptococcus* colonization rates did not differ significantly between Turkish patients (11%, n = 40) and Syrian patients (9.7%, n = 15) ($p = 0.756$, $p > 0.05$). All patients colonized with GBS were penicillin-sensitive. However, resistance to at least one non-penicillin antibiotic was observed in 42.5% (n = 17) of Turkish patients and 60% (n = 9) of Syrian patients. Although not statistically significant ($p > 0.05$), Syrian patients exhibited relatively higher rates of antibiotic resistance, especially to erythrosine and clindamycin.

Conclusions: In our country, implementing universal screening for asymptomatic GBS in pregnant women, as recommended by the Centers for Disease Control and Prevention (CDC), would be more beneficial than a risk-based screening approach. Given the increased resistance patterns observed in antibiogram results, GBS prophylaxis at delivery, especially in patients with penicillin allergies, should be planned based on antibiotic susceptibility testing.
Keywords: *Group B Streptococcus* (GBS), Group B Streptococcal Infection Prevention, pregnancy, preterm birth

INTRODUCTION

Group B Streptococcus (*Streptococcus agalactiae*), a Gram-positive bacterium, is commonly found in the pharynx, vagina, and gastrointestinal tract and leads to maternal and neonatal infections [1]. Rectovaginal colonization of GBS in pregnant women occurs between 8.7% and 22%, and it complicates pregnancies by causing urinary tract infections, chorioamnionitis, premature rupture of membranes (PROM), endometritis, and bacteremia [2–5]. Furthermore, approximately 50% of women colonized with GBS will transmit the bacteria to their newborns [6]. Neonatal GBS infections are diagnosed in two main groups: early-onset (< 7 days) and late-onset (7 to 28 days) infections. The most common infections in early-onset GBS infection are pneumonia, bacteremia, and sepsis, while in late-onset GBS infection are meningitis, osteomyelitis, and septic arthritis [7, 8].

Over the past two decades, following the recommendations of the Centers for Disease Control and Prevention (CDC) in the United States, there has been a significant reduction in the incidence of early-onset GBS (EOS) infections due to antenatal GBS prophylaxis, decreasing from 1.9 per 1000 live births to 0.23 per 1000 live births [9]. Evidence indicates that a universal culture-based screening strategy is superior to risk-based screening protocols in preventing perinatal and neonatal complications associated with GBS [10].

In Türkiye, there is no antenatal and/or intrapartum GBS screening guide for pregnant women issued by the Ministry of Health. Universal GBS screening during pregnancy is recommended by national perinatology associations, as well as national obstetrics and gynecology societies, in alignment with the guidelines of the American College of Obstetricians and Gynecologists (ACOG) and CDC [11]. However, universal screening is not routinely implemented by obstetricians at the national level. While risk-based prophylaxis is commonly practiced by many obstetricians, its practise varies significantly across healthcare centers and, in some centers it is not performed at all but, no data available on the feasibility of risk-based prophylaxis. Although different prevalence rates have been reported in the literature regarding Turkish pregnant women, there is a significant lack of data on Syrian pregnant women living in Türkiye, and no study has evaluated GBS antibiotic resistance. There has been a significant increase in resistance to erythromycin and clindamycin, used for GBS prophylaxis, over the past two decades; however, antibiotic resistance may vary by region. Understanding local antimicrobial resistance patterns of GBS strains is crucial for developing the most effective preventive and therapeutic strategies [1]. This study aims to evaluate the prevalence of GBS and its antibiotic resistance to enhance awareness regarding GBS screening and prophylaxis during pregnancy and promote the use of appropriate antibiotics.

MATERIAL AND METHODS

Study design and study population

This prospective, single-center study was conducted at the Gynecology and Obstetrics Clinic of the Health Sciences University Antalya Health Practice and Research Center, from May 2017 to December 2017. We aimed to investigate the prevalence of GBS rectovaginal colonization rates, antimicrobial susceptibility, and risk factors among Turkish and Syrian pregnant women. All pregnant women with a singleton pregnancy between 32 and 37 weeks of gestation who presented to the obstetrics and gynecology clinic were randomly included. We excluded the patients from the study who had received antibiotic treatment within the last 20 days, with suppressed immune systems or using immunosuppressive drugs, pregnant women under the age of 18, and a history of multiple partners during the current pregnancy. Approval for this study was obtained from the institutional Ethics Committee with reference number 6/11 on 30 March 2017. The study adhered to the principles of the Declaration of Helsinki, emphasizing ethical considerations in medical research involving human subjects —

strict adherence to these principles protected all participants' rights, welfare, and confidentiality throughout the study.

Data collection and culture analysis

We documented patients' sociodemographic characteristics, gravidity, parity, gestational age, comorbidities, PROM, and laboratory data.

Rectal and vaginal swabs were collected, and the samples were transferred to the microbiology laboratory in a Todd–Hewitt liquid medium. The broth was incubated at 37°C under aerobic conditions for 18 to 24 hours and subcultured on a sheep blood agar plate with 5% sheep blood. Following incubation, the growth of GBS was analyzed using routine microbiological protocols.

Beta hemolytic colonies that were morphologically compatible with streptococci were analyzed, and their catalase activity was measured. Gram staining was carried out using the catalase (–) streptococci. Under the light microscope, the cocci arranged in chains were identified as streptococci. These colonies were examined for GBS. For this purpose, the CAMP test (*Staphylococcus aureus* ATCC 25923, standard strain) and sodium hippurate test were carried out, and colonization in 6.5% sodium chloride and resistance to bacitracin, trimethoprim, and sulfamethoxazole were analyzed. The isolates were typed using the latex agglutination test (Oxoid™ DrySpot™ Streptococcal Grouping Kit; Thermo Fisher Scientific Inc., MA, USA) and VITEK® 2 GP ID card (bioMérieux, Marcy L'Etoile, France) and confirmed as GBS. The Mueller–Hinton blood agar was used for antibiotic susceptibility testing utilizing the disc diffusion method. The results were interpreted according to the criteria provided by the European Committee on Antimicrobial Susceptibility Testing (EUCAST) for evaluation [12].

Statistical analysis

The statistical analysis was conducted utilizing IBM SPSS Statistics version 25.0 software (IBM et al., USA). The normality distribution of the data was assessed using the Kolmogorov–Smirnov and Shapiro–Wilk tests. Continuous variables were reported as either mean ± standard deviation (SD) or median (min–max), while categorical variables were presented as frequency and number. Independent samples t-test and Mann–Whitney U test were employed for continuous variables to compare the groups. A p-value of less than 0.05 was considered statistically significant, with a 95% confidence interval applied for all analyses.

RESULTS

Our study enrolled 518 pregnant women, comprising 363 Turkish pregnant and 155 Syrian pregnant women. The Turkish patients had a mean age of 27.5 ± 6.3 years (range, 21.2 to 33.8), while the Syrian patients were relatively younger, with a mean age of 23.8 ± 5.1 years (range, 18.7 to 28.9) ($p = 0.001$, $p < 0.05$). We found that asymptomatic GBS colonization in the study population was not associated with maternal age, gravidity, parity, or smoking ($p > 0.05$). The patients' detailed demographic and clinical characteristics are presented in Table 1, providing comprehensive information about the study population.

We detected GBS positivity in 11% of Turkish patients (40/363) and 9.7% of Syrian patients (15/155) in rectovaginal samples ($p = 0.756$, $p > 0.05$). We did not identify a significant relationship between GBS colonization and obesity, maternal age, parity, smoking, comorbidities, antibiotic usage, body temperature at the time of sample collection for culture, and PROM ($p > 0.05$). In Turkish patients, chronic diseases ($p = 0.001$, $p < 0.05$) and pregnancy-induced diseases such as gestational diabetes, urinary tract infection, and gestational hypertension ($p = 0.048$, $p < 0.05$) were more prevalent. Detailed clinical and laboratory data for both patient groups are provided in Table 2, providing further analytical support.

Group B Streptococcus isolates exhibited 100% susceptibility to penicillin, linezolid, and tigecycline. We observed resistance to at least one non-penicillin antibiotic in 42.5% (17 of 40) of Turkish patients and 60% (9/15) of Syrian patients ($p > 0.05$). In our study, 12.5% of Turkish patients were resistant to erythromycin, 27.5% to clindamycin, 7.5% to levofloxacin, and 5% to moxifloxacin. Among Syrian patients, 20% were resistant to erythromycin, and 46.6% were resistant to clindamycin. Detailed antibiogram results for both patient groups are illustrated in Figure 1.

DISCUSSION

This study presents the first data on GBS carriage among Syrian pregnant women. With the increasing population of Syrian pregnant women in our country, associated maternal and neonatal health risks remain uncertain. This research addresses the lack of data on GBS carriage among Syrian pregnant women residing in this geographic region, offering valuable insights for public health considerations.

Our study findings indicate that 11% of Turkish patients and 9.7% of Syrian patients in the study cohort were colonized with rectovaginal GBS. The prevalence of GBS carriers in

pregnant women can vary based on factors such as race, geographic regions, and sociocultural determinants [13, 14]. We did not observe a significant difference between these two groups living in the same geographic region. In a meta-analysis of 78 studies involving 73 791 pregnant women conducted by Gaurav et al. [3], the prevalence of GBS was found to be 22.4% in Africa, 19.7% in the United States, 16.7% in the Eastern Mediterranean, 19% in Europe, 11.1% in Southeast Asia, and 13.3% in the Western Pacific region. In Turkish pregnant women, GBS prevalence has been reported to range from 6.5% to 32%, and this variation could be attributed to demographic characteristics, sociocultural determinants, sampling techniques, the type of culture media used, and geographical regions [15–18]. Our study provides reliable results with ideal rectovaginal sampling techniques, the use of broth-enriched culture media, a relatively large sample size, and exclusion criteria that could affect colonization.

Obesity, smoking, maternal age, education, parity, and PROM, which have been defined as risk factors in some studies [19–24], did not show a significant association with asymptomatic GBS colonization in our study. The impact of these factors on GBS colonization presents variable outcomes or may be attributed to the limited sample size of our study. Further investigations involving a larger patient cohort are necessary to reach more conclusive results regarding the relationship between GBS and risk factors. Moreover, the weak association between risk factors and GBS colonization underscores the potential superiority of a risk-based approach over universal prenatal screening in reducing the incidence of early-onset GBS neonatal infections.

American College of Obstetricians and Gynecologists recommends universal GBS screening for all pregnant individuals between 36 0/7 and 37 6/7 weeks of gestation. Women with positive vaginal-rectal cultures for GBS during this period should receive appropriate intrapartum antibiotic prophylaxis unless a cesarean delivery is performed in the absence of ruptured membranes [11]. The standard antibiotic used worldwide for GBS prophylaxis is IV penicillin G. Penicillin G is a cost-effective and widely available antibiotic with a narrow spectrum targeting gram-positive bacteria [25]. In our study, all GBS subtypes were sensitive to penicillin, consistent with some other studies [26, 27]. The absence of resistance to β-lactam antibiotics in GBS strains among the study population, with no risk of anaphylaxis in Turkish and Syrian pregnant women, supports the continued use of penicillin as the first-line intrapartum prophylaxis against *S. agalactia*. For pregnant with penicillin allergies, first-generation cephalosporins (cefazolin), macrolides (erythromycin), lincosamides (clindamycin), and glycopeptides (vancomycin) are recommended for prevention, but their

efficacy has not been measured in controlled studies [10, 25]. Approximately 10% of individuals with penicillin allergies are estimated to have immediate hypersensitivity reactions to cephalosporins as well [25]. The rates of GBS isolates resistant to clindamycin or erythromycin *in vitro* have increased in the last 20 years [1, 25]. In our study, 12.5% of Turkish patients were resistant to erythromycin, 27.5% to clindamycin, 7.5% to levofloxacin, and 5% to moxifloxacin. GBS isolates from Syrian patients showed a higher resistance trend to erythromycin (20%) and clindamycin (46.6%), suggesting that antibiotic susceptibility testing before intrapartum prophylaxis could benefit Syrian pregnant women with severe penicillin allergies.

Over the past two decades, following the recommendations of CDC in the United States, there has been a significant reduction in the incidence of early-onset GBS infections due to antenatal GBS prophylaxis. The incidence of EOS was 0.32–0.97 per 1000 live births in Europe, comparable to reports from the USA (1.08/1000) and Australia (0.67/1000) [28] . However, its incidence remains higher in developing countries, where data is scarce [29], the epidemiological data from a limited number of studies about EOS in Türkiye are insufficient. In a recent study from Türkiye, the rate of culture-proven early-onset sepsis was found to be 0.12% [30]. Although the frequency of EOS is not as frequent as in developed countries, more prospective studies related to the prevelance of EOS are needed and the rates of EOS will decrease further with universal GBS screening and GBS prophylaxis.

Nevertheless, it is essential to acknowledge the limitations of this study. Firstly, the research was conducted with relatively few patients, which may not represent the entire pregnant population. A larger sample size would have provided more reliable and accurate results. Secondly, the study did not conduct subgroup analysis for GBS colonization, which may limit understanding potential differences or antibiotic susceptibility relationships among different GBS subgroups. Vancomycin is administered in cases where patients are allergic to penicillin and second-line antibiotics prove ineffective. And the other limitation of this study is the lack of investigation into vancomycin resistance patterns. Nonetheless, while vancomycin remains largely effective, two cases of vancomycin resistance in GBS have been documented in the literature [31]. Despite this, vancomycin continues to be considered safe and effective for use in cases of non-penicillin antibiotic resistance.

CONCLUSIONS

In conclusion, all patients colonized with GBS were penicillin-sensitive; however, a high resistance trend to erythromycin and clindamycin was particularly noted in the isolated

GBS strains from Syrian patients. In our country, implementing universal screening for asymptomatic GBS in pregnant women, as recommended by the CDC, would be more beneficial than a risk-based screening approach. Given the increased resistance patterns observed in antibiogram results, GBS prophylaxis at delivery, especially in patients with penicillin allergies, should be planned based on antibiotic susceptibility testing.

Article information and declarations

Data availability statement

Raw data were generated at the University of Health Sciences Antalya Health Practice and Research Hospital . Derived data supporting the findings of this study are available from the corresponding author Emine Kirtis on request.

Ethical statement

This study was approved by the University of Health Sciences Antalya Health Practice and Research Hospital Ethics Committee with Approval No: 6/11, Date: 30.03.2017

Author contributions

Aysel Uysal prepared the study draft and agreed to contribute significantly to the design. Emine Kirtis, Yesim Cekin, and Gul Alkan Bulbul contributed to analyzing and interpreting data regarding the project. Burak Karadag, Emine Kirtis, and Gul Alkan Bulbul critically reviewed the study for important intellectual content and approved the final published version.

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Conflict of interest

The authors declare that they have no potential conflict of interest regarding this article's investigation, authorship, and/or publication.

Supplementary material

None.

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Table 1. Demographic and clinical characteristics of the patient groups

	Turkish patients (n = 363)	**Syrian patients (n = 155)**	**p value**[‡]
Age, years	27.5 ± 6.3	23.8 ± 5.1	0.001
BMI, kg/m^2	28.9 ± 4.7	25.6 ± 3.2	0.001
Gravidity	2 (1–8)	2 (1–9)	0.011
Parity	1 (0–6)	0 (0–7)	0.075
Curettage	0 (0–2)	0 (0–1)	0.014
Education status, n (%)			
Primary school	248 (68.3)	134 (86.4)	0.001
High school	80 (22)	15 (9.7)	
University	35 (9.6)	6 (3.9)	
Smoking, n (%)	48 (13.2)	9 (5.8)	0.014
Planned pregnancy, n (%)	282 (77.6)	110 (71)	0.117
Previous surgery*, n (%)			
No surgery	250 (68.8)	135 (87)	0.001
Cesarean section	68 (18.7)	17 (11)	
Other	45 (12.3)	3 (1.9)	

Unless otherwise stated, data are given in mean ± standard deviation, median (min–max), or number and percentage; *previous surgery; ‡chi-square test is used for categorical variables, the independent samples t-test is used for comparing two independent groups, and the Mann–Whitney U test is used for comparing two independent groups; BMI — body mass index

Table 2. Clinical and laboratory data of the patient groups

Variable	Turkish patients (n = 363)	Syrian patients (n = 155)	p value‡
Hemoglobin, g/dL	11.9 ± 0.9	11.6 ± 1	0.001
Body temperature, °C	36.5 ± 0.2	36.5 ± 0.1	0.503
PROM, n (%)	45 (12.4)	15 (9.7)	0.454
Chronic disease, n (%)			
None	327 (90.1)	155 (100)	0.001
Hypertension	5 (1.4)	0	
Diabetes	4 (1.1)	0	
Other	27 (7.4)	0	
Gestational diabetes, n (%)	15 (4)	1 (0.6)	0.048
Urinary tract infection, n (%)	49 (13.5)	44 (28.4)	0.001
Gestational hypertension, n (%)	14 (3.9)	1 (0.6)	0.048

Data are given in mean ± standard deviation, or number and percentage unless otherwise stated; ‡chi-square test for categorical variables, independent samples t-test, and Mann–Whitney U test for comparing two independent groups; PROM — premature rupture of membranes

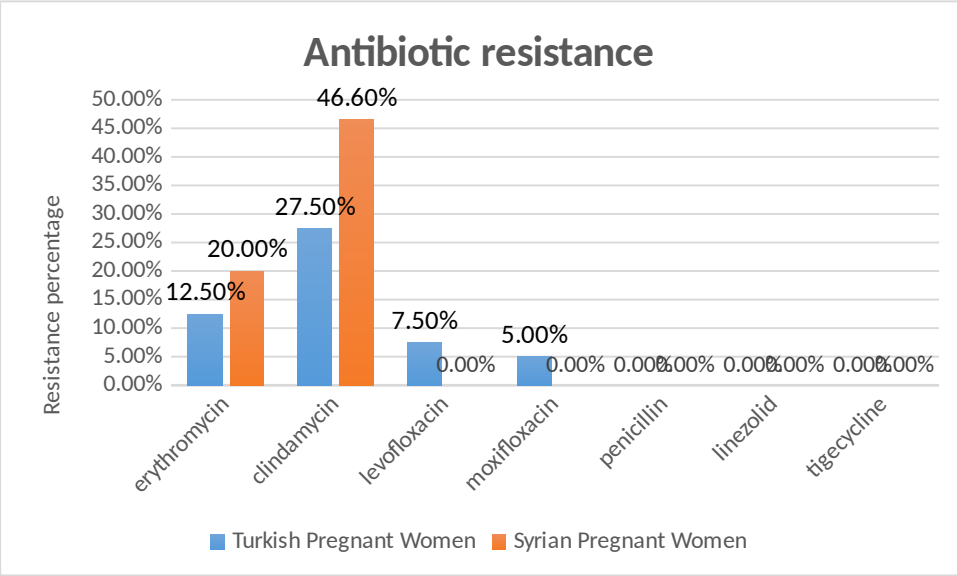

Figure 1. Antibiogram results of the *Group B Streptococcus* isolated from Turkish and Syrian pregnant women