An initial survey on the prevalence of group B *Streptococcus* (GBS) among Yemeni pregnant women.

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Research article

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Abstract

Background: Neonatal infection with group B *Streptococcus* (GBS) is still a threat to the life of fetus and mother, especially in developing countries that do not adopt a prenatal screening test policy such as Yemen.

Objective: This study aimed to determine the vaginal colonization rates and antibiotic susceptibility pattern of group B Streptococcus among pregnant Yemeni women.

Methods: We conducted a cross-sectional study over a four-month period involved 210 pregnant women who visited Gaza medical center (a primary health center in Sana'a city, Yemen) at the 35^{th} to 39^{th} gestational weeks. A vaginal swab from each pregnant woman was inoculated in Todd-Hewitt enrichment broth and after 24h incubation; the subculture on a 5% human blood agar plate was performed from inoculated Todd-Hewitt enrichment broth. All positive cultures identified as group B streptococcus were subjected to antibiotic susceptibility test using the disk-diffusion method.

Results: Out of 210 recruited pregnant women, 23 (10.95%) were GBS vaginal carriers. All isolates showed no resistance to penicillin, ampicillin, levofloxacin, cefotaxime, and vancomycin. However, we observed decreased sensitivity to clindamycin (82.8%) and tetracycline (30.5%).

Conclusion: Based on the study results; approximately eleven out of every 100 pregnant women were vaginal colonized by GBS in Sana'a governorate. Beta-lactam antibiotics remain the drug of choice for treatment and prophylaxis of GBS infections. Therefore, we recommend implementing a screening policy to detect GBS in Yemeni pregnant women.

Introduction

The year 2016 marks the implementation of the united nations sustainable development goals (SDGs) [1]. One of these seventeen goals is to enhance mother, neonate, and child health and plans to end mother and child deaths from preventable diseases [1]. To achieve these goals, neonatal fatalities in each nation should be about 12 per 1000 live births by 2030 [2, 3]. In general, infectious diseases are considered an important cause of maternal, neonatal, and childhood mortality in low and middle-income countries [4, 5]. Despite the falling in maternal mortality with substantial variation among countries and within countries globally [6, 7], it is still high especially in low industrial base and Human Development Index (HDI) countries. In 2017, about 295 thousand women died during pregnancy or after giving birth. Ninety-four percent of these deaths occurred in countries of low and lower middle income countries, and most of them could have been prevented [8]. Maternal infection is a significant and possible etiology of worldwide maternal death. Worldwide, between 2003 and 2009, It was estimated that maternal infections caused around 10.7% (5.9–18.6%) (261 000) of mother deaths [9]. Maternal health and neonatal health are closely related. Between 2000 and 2015, 9 of the 10 causes of infant death most rapidly reduced were infectious diseases [4]. Among preterm birth and neonatal encephalopathy, it is found that infectious diseases play a role as an important primary contributor to them, whereas both preterm and neonatal

encephalopathy are leading causes of neonatal mortality and subsequent adverse outcomes worldwide [10, 11, 12]. In 2013, 3.257 million (51.7%) of the 6.3 million under-five children's deaths were due to infectious diseases, and 2.761 million (44%) died during delivery [4]. The current global strategy has become the trend towards detecting dangerous bacteria causing possible infection either to prevent or to treat the newborn with a suitable antibiotic.

Group B *Streptococcus (Streptococcus agalactiae)* bacteria colonize the female reproductive and gastrointestinal tracts without symptoms. Around 20 to 30% of healthy women carry group B *Streptococcus*, and can transmit the organism to their neonate. The consequences of maternal and fetal infections with group B *Streptococcus* range from asymptomatic colonization to septicemia that cause life-threatening newborn diseases, such as meningitis, pneumonia, and septic shock [13]. Worldwide, there is a considerable variation in the prevalence of GBS vaginal colonization, ranging from high (35%) in the Caribbean to a much lower prevalence (13%) and (11%) in Southern Asia and Eastern Asia, respectively [14]. Variation of prevalence was also reported in different Arab countries. In Jordan, the maternal vaginal colonization by Group B Streptococcus was 19.5 % [15], while the rates were lower in Saudi Arabia, Egypt, and the United Arab Emirates, 15.0%, 11.3%, and 10.1% respectively [16–18]. As we stated before, GBS infection can lead to maternal death, stillbirth, and neonatal death [19–22]. Besides, neurological impairment may result among survival neonates and infants after GBS infection [23]. GBS has been implicated in adverse pregnancy outcomes, including preterm labour and an increase in neonatal encephalopathy [24, 25]. Yemen is one of the developing world countries and its population is vulnerable to many diseases, including bacterial diseases. Up to date, there is no data about the prevalence of GBS among pregnant Yemeni women in spite that GBS is an important perinatal pathogen. Therefore, this study aimed to estimate group B *Streptococcus* prevalence among pregnant Yemeni women in Sana’a city, Yemen.

Methodology

Study design, population, and sitting

We conducted a 4-monthe cross-sectional (from June to September, 2019) to determine the prevalence of GBS vaginal colonization and antibiotic susceptibility profile among Yemeni pregnant women at 35th -39th gestational weeks who attended Gaza medical center in Sana’a city, Yemen. Written informed consent was provided for each participant for participation decision. Pregnant women who were not within the range of 35th -39th gestational weeks, on antibiotic therapy, diabetic, and those who had urinary tract infections were excluded.

Vaginal swab samples were collectoted from two hundred and ten pregnant women at 35th -39th gestational weeks who attended Gaza medical center in Sana’a city, Yemen. All microbiological procedures (culture, identifying bacteria, and antibiotic susceptibility testing) were carried out in the I Lab (a private modern medical laboratory).

Sample size

The sample was calculated using OpenEpi.com (an open-source web tool) based on an expected prevalence of 15% (according to other regional previous studies) at a confidence level of 95% and an accepted marginal error of 5%. Thus, the calculated sample was 196 participant and our study involved 210 pregnant women in anticipation of excluding any participant that did not meet the criteria of participation.

Specimen and data collection

After the participant consent, a trained nurse carried out vaginal swabing by rotating a sterile swab against the vaginal introitus wall, according to CDC recommendations [26]. The swabs were inoculated into Amies transport medium, properly labeled, and transferred immediately to the microbiology laboratory (the private I Lab). A structured questionnaire in Arabic that includes information regarding age, education level, previous gestations, previous miscarriages, previous antibiotic use, diabetes, and other chronic diseases was used via face-to-face interview for each participant.

Specimen culture and bacterial identification

The obtained vaginal swab samples were inoculated into culture tubes containing Todd-Hewitt broth with gentamicin (8µg/mL) and nalidixic acid (15µg/mL). Inoculated tubes were incubated at 37°C for 24h, then subcultured on 5% human blood agar plates and incubated at 37°C for 24h. The isolated colonies on human blood agar plates were identified as GBS by the following criteria: colony morphology, Gram staining, hemolysis, catalase, and CAMP test [27]. The results were interpreted by an expert microbiologist at the University of Science and Technology.

Antibiotic susceptibility testing

Antibiotic susceptibility testing for penicillin, ampicillin, levofloxacin, cefotaxime, clindamycin, vancomycin, and tetracycline was performed for all GBS isolates using the Kirby-Bauer test (disk diffusion method) on Mueller-Hinton agar with 5% human blood according to CLSI guidelines [28].

Research ethics

The approval to conduct this study was obtained from the University of Science and Technology medical research ethics committee, NO (ECA/UST191).

Data analysis

The results were tabulated and analyzed by IBM SPSS Statistics version 23 for Windows® (IBM Corp., Armonk, NY, USA). Descriptive statistics included frequencies and cross-tabulation; however, the significance of difference was tested by Chi-square and Fisher exact tests. The significance level (P-value) of less than 0.05 was considered significant.

Results

Participant characteristics

The study included 210 pregnant women with a mean age (26.14 ± 5.28 years) ranging from 16 to 38 years who attended to Gaza medical center, at Sana'a, Yemen between the 35 th and 39th weeks of gestation.

Colonization rate

The results of this study showed that 23 pregnant women (10.95%) with 95% CI (6.95% to 14.95%) were positive for vaginal colonization by group B *Streptococcus* based on cultures in Todd-Hewitt broth and on 5% human blood agar plates and other identification tests mentioned in methodology. The mean age of pregnant women with positive GBS vaginal colonization was (26.47 ± 6.5 years), whereas it was (26.1 ± 5.12 years) for the rest of the participants. The mean gestational age of pregnant women with positive GBS vaginal colonization was (37.17 ±1.34 weeks), whereas it was (36.91 ± 1.08 weeks) for the rest of the participants, and this means that there is no correlation between the factors (patients'age and gestational age) and the GBS vaginal colonization.

Risk factors

The results of the statistical analysis of the risk factor variables (parity, previous abortions, and educational level) showed that there were no statistical significance differences (P-value 0.05) between the two groups of participants (positive and negative group B *Streptococcus* vaginal colonization) as shown in (table 1).

Table 1: Association between GBS vaginal colonization and Parity, Previous Abortions, and Educational level.

	Colonization				
	Yes		No		P-value
	N	%	N	%	
Parity					0.517
0	2	18.20%	9	81.80%	
1	5	12.50%	35	87.50%	
2	3	5.80%	49	94.20%	
3 or more	13	12.10%	94	87.90%	
Previous Abortions					0.82
No	17	11.30%	134	88.70%	
	6	10.20%	53	89.80%	
Educational level					0.565
Basic	7	8.60%	74	91.40%	
Illiterate	8	14.80%	46	85.20%	
Secondary	8	11.60%	61	88.40%	
University	0	0.00%	6	100.00%	

Antibiotic susceptibility testing

An antibiotic susceptibility test was performed for all 23 identified GBS isolates. All isolates were sensitive to penicillin, ampicillin, levofloxacin, cefotaxime, and vancomycin, while the sensitivity of bacteria to clindamycin and tetracycline decreased to be 82.8% and 30.5% respectively, (table 2).

Table 2: Antibiotic susceptibility testing results of GBS isolates

Antibiotic		N	%
Penicillin	I	0	0.00%
	R	0	0.00%
	S	23	100.00%
Ampicillin	I	0	0.00%
	R	0	0.00%
	S	23	100.00%
Levofloxacin	I	0	0.00%
	R	0	0.00%
	S	23	100.00%
Cefotaxime	I	0	0.00%
	R	0	0.00%
	S	23	100.00%
Clindamycin	I	2	8.60%
	R	2	8.60%
	S	19	82.80%
Vancomycin	I	0	0.00%
	R	0	0.00%
	S	23	100.00%
Tetracycline	I	5	21.70%
	R	11	47.80%
	S	7	30.50%

I = intermediate, R = resistant, and S = sensitive

Discussion

Although pregnant women must be screened for GBS as part of routine prenatal care, no problem estimation and no official Yemeni guidelines regarding GBS in pregnant women have been established. This cross-sectional study was conducted on 210 Yemeni pregnant women to investigate the prevalence rate of vaginal colonization by GBS for the first time in Yemen. The present study revealed that 10.95% of Yemeni pregnant women were vaginally colonized with GBS. This result is consistent with the findings of several similar studies from developing countries where the GBS vaginal colonization ranged from 10–15%. For instance, it was 11.8% in Iran [29], 10.4 % in Ethiopia [30], 14% in Cameroon [31], and 15% in Bangladish [32]. However, GBS vaginal colonization in other countries was reported to be less than that of our. For example, it was 8.2% in China [33], 7.6% in Saudi Arabia [34]. and 2%in India [35]. Additionally, higher colonization rates were reported in other countries. It was 26% in Brazil [36], 19.5% in Jordan [15], and 30.9% in South Africa [37]. The variation of colonization rates among different studies is attributed to

several factors, such as the site of swaping (vaginal, rectal or both), different numbers of participants, different personal hygiene behaviours, different sexual practices behaviours, antibiotic use, and different ways to isolate bacteria. In this study the prevalence was less than other studies owing to that we did not obtain approval from participants to take rectal swabs. Other possible factors are religion and culture belives, personal hygiene, sexual practices, and antibiotic use. By analyzing the relationship of different variables (parity, previous abortions, and educational level) with vaginal group B *Streptococcus* colonization, we did not find significant relationship between these variables and vaginal colonization (Table 1). This finding conforms to the findings of other research, such as [15, 29, 38, 39]. In the twentieth century the excessive use of antibiotics has heightened fear of raised concerns regarding the emergence of bacterial antibiotic resistance [40]. Therefore, earlier studies have also been performed to find out the sensitivity of group B *Streptococcus* and its resistance to various antibiotics [41–43]. According to the results of this study, the antibiotic sensitivity profile of GBS was as follows; all isolates were sensitive to penicillin, ampicillin, levofloxacin, cefotaxime, and vancomycin. These findings are close to those of other studies, such as [44] done in Nigeria, [45] in Saudi Arabia, and [30] in Ethiopia. Generally, Penicillin as yet the drug of choice for prophylaxis and treatment of GBS colonization in pregnant women. Thus, our results is consistent with different studies regarding the sensitivity to penicillin [30, 43, 45, 46]. Our study findings do not correspond to the Ethiopian research results where the highest resistance was observed against penicillin [47]. Women who were penicillin-allergic clindamycin is recommended for GBS prophylaxis during labor [42]. Group B *Streptococcus* resistance rate to different antibiotics have been detected to be increased in many regions of the world, including Europe [48], North America [49], and South America [50]. In the last 10 years, GBS strains had exhibited resistance to other antibiotics, including erythromycin and clindamycin [51]. Clindamycin and/or erythromycin resistance has already been notified earlier, ranging from 0.7–51.3% for erythromycin and from 1.7 to 50% for clindamycin. [52, 53]. Resistance rate of GBS to clindamycin in the current study was 8.6% and this rate is close to clindamycin resistant rate (5.1%) in Saudi Arabia [45]. The different antibiotic sensitivity rates of group B *Streptococcus* among different studies are due to many factors, such as antibiotics misuse, self-treatment with antibiotics, different isolated strains. The high sensitivity rates of GBS to members of beta-lactam family as well as its increased resistance to other antibiotics supports the pivotal role of penicillin and ampicillin as the first-line for intrapartum treatment to prevent neonatal early-onset infection by GBS.

Conclusion And Recommendation

We conclude that 11% of pregnant Yemeni women carrying GBS bacteria in their vaginal environment. Also, all GBS isolates were sensitive to beta-lactam antibiotics, and thus penicillin remains the first choice for treatment and prophylaxis at the prenatal period in women who carry these bacteria and do not show allergy to penicillin. We recommend routine prenatal GBS screening among pregnant women in the third trimester in Yemen. We also recommend conducting extensive epidemiological studies that include other cities to detect the extent prevalence of GBS among pregnant mothers in Yemen in order to develop an appropriate preventive strategy.

Declarations

- Ethics approval and consent to participate (approved from research ethics committee of the University of Science and Technology in Sana'a city, NO: (ECA/UST191)
- Consent for publication (Not applicable)
- Availability of data and materials (The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request)
- Competing interests (we declare that we have no competing interests)
- Funding (no funding)
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