The Prevalence of Group B Streptococcus Colonization in Pregnant Women in Hong Kong

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Abstract

Group B streptococci (GBS) will cause sepsis and meningitis in neonates and infants. Transmissions of infections in neonates are acquired by person-to-person, from mother in utero or during delivery.

The aim of this study was to find out the prevalence of GBS colonization in pregnant women in Hong Kong. The data will draw attention to the importance of GBS colonization during pregnancy.

Urine or vaginal swab specimens were collected with patient informed consent and examined for GBS by direct plating on GBS selective Granada agar and Columbia agar. Colonies with orange pigmentation on Granada agar were identified as GBS. On Columbia agar, GBS was shown as translucent to opaque, flat and glossy colonies with or without zone of hemolysis.

A total of ninety-six specimens were collected at any time of gestation from pregnant women in Hong Kong who received antenatal care in private clinics from September to November 2010. Seventy (73%) were urine specimens. Among all cases, 10 (10.4%) urine and 4 (4.2%) vaginal swabs were GBS positive with a colonization rate of 14.6%.

In conclusion, the GBS colonization rate of 14.6% is higher than the rate (10.4%) performed by another study in Hong Kong in 2009. It is reasonable to include GBS culture for prenatal screening so as to avoid neonatal GBS infection during labor. This study showed that urine specimen is also suitable for testing GBS colonization in pregnant women due to easy collection.

Key words: Group B *streptococcus*, GBS, *Streptococcus agalactiae*, Prevalence

Introduction

Characteristics of GBS

Streptococcus agalactiae is also known as Group B *streptococcus* (GBS) because it was identified as Lancefield Group B in precipitin test among a group of beta-hemolytic *streptococci*. Like other groups of *streptococci*, GBS is catalase-negative and gram-positive beta-hemolytic cocci. GBS readily grows on 5% sheep blood agar at 37℃ for 24-48 hours of incubation with or without 5% carbon dioxide. GBS usually appears as translucent to opaque, flat and glossy colonies which are 3-4 mm in size with or without narrow zone of beta hemolysis on 5% sheep blood agar.[1] GBS can be identified by a negative catalase test, gram-positive cocci in chains, Lancefield group B in latex agglutination test and positive CAMP (Christie, Atkins, and Munch-Petersen) test. Other identification methods include its ability to hydrolyze sodium hippurate broth and resistance to bacitracin.[2] GBS is susceptible to penicillin, amoxicillin, cefazolin, cefotaxime, vancomycin and linezolid. Penicillin is commonly used for intrapartum chemoprophylaxis because of the susceptibility of GBS to the beta-lactam antibiotics. If the women are allergic to penicillin, clindamycin or erythromycin can be used although a resistance rate of 16.7% and 11% respectively was found.[3]

GBS colonization

By far, GBS is considered as cause of sepsis and meningitis in neonates.[4] GBS infection in neonates was rare in 1930s. Since 1970s, neonatal GBS infection had become the major neonatal pathogen worldwide.[5] It was found that the mortality rate on neonates by this invasive pathogen is about 5-10%.[6] GBS is a normal flora found in female genital and lower gastrointestinal tract. About 10-30% of GBS are normally colonized in vagina and rectum of pregnant women worldwide. A study in Hong Kong reported that GBS was colonized in high vagina, low vagina or rectum in 10.4% of pregnant women who received antenatal health check in their clinics.[7] Tsui *et al*. also found that the GBS colonization rate was higher in professional women than in other groups.[7] Maternal colonization can be persistent, intermittent or transient, and by large a major risk factor for neonatal GBS disease.[8]

Neonatal GBS infection

Infections in neonates and infants are acquired by person-to-person transmission from mother in utero or during delivery. Several routes increase transmission: such as previous GBS infection, prematurity, GBS bacteriuria and instrumental delivery. One important piece of evidence that needs to mention is that GBS colonization of genital tract or urinary tract may cause preterm delivery, especially for those pregnant women heavily colonized with GBS.[9] Another study showed that GBS pathogenicity was possibly due to the neonatal prematurity instead of the infection.[10] Moreover, the incidence of preterm delivery between non-colonized and colonized women was significantly different with a rate of 1.7% and 5.7% respectively.

Pathogenesis of GBS

If GBS colonized women select vaginal delivery, GBS will infect the skin and mucous membrane of the babies and then cause fatal diseases. The pathogenesis of GBS disease begins with the asymptomatic colonization on the genital tract of pregnant women. There are some virulence determinants for the GBS infectious process.[11] The first step involves the binding of GBS to human epithelial surfaces such as vaginal epithelium, placental membranes, alveolar epithelium, pulmonary endothelium and blood-brain barrier endothelium. The acidic condition of the vaginal mucosa also favors GBS adherence. The second virulence determinant is the penetration of host cellular barriers by a series of processes including intracellular invasion, induction of in-flammation and direct cell lysing by secreting cytolytic enzymes. The next virulence determinant refers to the ability of GBS to escape from the human immunologic attack of immune defense system including the actions of phagocytes, macrophages and neutrophils, antibodies and complements. The immature immune system of neonates also makes them more susceptible to GBS infection because of the deficiency of phagocytic cell function caused by in-effective opsonization. Lastly, GBS can activate inflammatory responses and trigger the fatal host cytokine cascades that can cause vasculopathy and neuronal injury.

Effects on neonates

Early-onset disease (EOD) and Late-onset disease (LOD) are two major syndromes of GBS that may cause sepsis and meningitis in neonates. EOD normally occurs within the first week of life or begins a few hours after birth that may cause severe infection among neonates. LOD occurs on or after 7 days of age and is not as common as EOD. In USA, early onset diseases were found in 0.1% to 0.2% of live births with mortality rate up to 20%.[12] Fatality rates of EOD and LOD were approximately 6.5% and 2.85% respectively.[13]

In Hong Kong, a 37-year-old healthy pregnant woman experienced a premature delivery in early 2010.[14] The main reason of it was due to infection of GBS. The neonate acquired GBS infection from mother and developed to cellulitis after 3 months.

Screening for GBS colonization

Guidelines of the Centers for Disease Control and Prevention (CDC)[15,16] were introduced to reduce the morbidity and mortality of neonates due to GBS infection. They promoted a general prenatal screening for vaginal and rectal GBS colonization of pregnant women at a gestational age of 35-37 weeks. Intrapartum chemoprophylaxis should be given to pregnant women who are colonized with GBS at the time of labour or rupture of the membranes. Previous study followed CDC guidelines found that there was decreased in neonatal GBS infection. The incidence of EOD had reduced by 80% from 2.2 to 0.4 per one thousand live births.[9] GBS carriers receiving intrapartum chemo-prophylaxis reduced by 50% of EOD of infants when compared with women not receiving intrapartum chemoprophylaxis. This result indicated that both neonatal colonization and EOD were reduced for colonized women after intrapartum chemoprophylaxis. However, there was racial difference between black and white infants in the incident rate of EOD. From 2003 to 2005, the rate continued to decrease among white infants (0.26 case to 0.22 case per 1,000 live births) while there was a dramatic increase in EOD among black infants (0.31 to 0.50 per 1,000 live births).[17] A recent study suggested that pregnant women testing for GBS colonization before 35 weeks of gestation prevent GBS infection to baby due to premature delivery.[18]

Another study performed at Thammasat Hospital, Thailand showed that the GBS colonization rate was 16% amongst 406 pregnant women receiving antenatal care.[19] Similar study performed at Ismailia General Hospital, Egypt found that the GBS colonization rate was 25.3% among 150 vaginal swabs collected from pregnant women.[20] A higher prevalence rate was found in developing countries such as United States (15%-25%), Jordon (30%) and Trinidad (31%) whereas Mexico City (4%), Peru (6%), Italy (6.6%), Turkey (8.7%), and Ethiopia (9%) had a lower prevalence rate. This phenomenon indicated that there was geographic difference in GBS colonization. The prevalence rate between Peru and Mexico City were similar, but significantly higher in Brazil (25.6%) although they have similar population. Predominant proportion of women in Brazil may account for the reason of the difference.[21]

On the other hand, a survey done in Houston and Seattle showed that the GBS colonization rate of the African-American women was about 36.7% that was significantly higher than that of the Asian women (14%).[22]

Maternal antibodies transferred from the mother to the fetus can protect it from GBS infection. High maternal antibody level was found effective in such purpose.[9] Although GBS vaccination could be an effective way of preventing GBS infection, it is still under trial stage. Therefore, a fast and accurate method for identification of GBS is necessary for early and efficient diagnosis of GBS infection.

In view of the importance of GBS infection from mother to neonates from the above literature review, it is worthy to conduct a similar research to reveal the status in Hong Kong and find a way to reduce such incidence with a simple and convenient examination method.

Materials and Methods

Specimen collection

In this study, 96 pregnant women at any time of gestation were recruited from private doctors in Hong Kong from September to November 2010. All pregnant women met the inclusion and exclusion criteria set in this study. The inclusion criteria were 1) Pregnant women at any age of gestation. 2) No evidence of GBS infection. 3) Signed consent forms after the informed consent process. The exclusion criterion was 1) Pregnant women who received antibiotics within one week before specimen collection. The specimens were recruited by the help of referral doctors. We explained to the doctors the recruitment methods employed and in turn the doctors explained to their patients. Relevant information sheet outlining the nature of the research, request form and informed consent form were given to the doctors. Urine, vaginal swabs or rectal swabs were collected by the responsible doctors or the volunteers. The responsible doctors recorded the doctor's contact information, their reference number and patient's information including age, weeks of gestation and the expected mode of delivery, any recent use of antibiotic, and date and time of specimen collection in request form and the informed consent form. Specimens together with the request form, and informed consent form were delivered to the laboratory preferably within the same day. An official report was given to the responsible doctor within 4 days. The flow of specimen collection, processing and reporting is outlined in Figure 1. The results of the study would not affect the normal clinical management of doctors to the patients. The entire study was approved by the Edinburgh Napier University Research Ethics & Governance Committee.

Culture method

Direct plating on both Granada agar and Columbia blood agar was employed in this study. This method was recommended for optimal GBS screening in a previous study.[23] Specimens, whatever urine, vaginal swabs or rectal swabs, were directly inoculated onto the Granada agar (bioMerieux Ref. 43 712) for direct screening. At the same time, they were inoculated into the conventional Columbia agar (5% sheep blood) (bioMerieux Ref. 43 041) for a parallel run. GBS positive control strains (ATCC 12403 and ATCC 27591) and negative control strains (ATCC 29212: *Enterococcus faecalis* and ATCC 25922: *Escherichia coli*) were inoculated into both Granada agar and Columbia agar (Figure 2 - 5) for ensuring the performance of both agar media. Anaerobic incubation was achieved by putting all agar media into a CO_2 incubator with 5% CO_2 or by using GENbag (bioMerieux Ref. 45 534) for normal incubator. All agar media were incubated at 37°C for 18-24 hours. All negative cultures will be reincubated for an additional 18-24 hours and re-examined.

Identification methods for GBS

Various identification methods or testing for GBS were used in previous studies.[7,10,19,23-28] Some preliminary and screening tests include gram staining, catalase test and GBS morphology on cultural agar plates.[1] Other confirmatory tests include latex agglutination test, CAMP (Christie, Atkins, and Munch-Petersen) test and molecular identification test (Table 1). Each of them tests for different characteristics of GBS. Basically, GBS is gram-positive cocci in chains, negative for catalase test, belongs to Lancefield group B in latex agglutination test

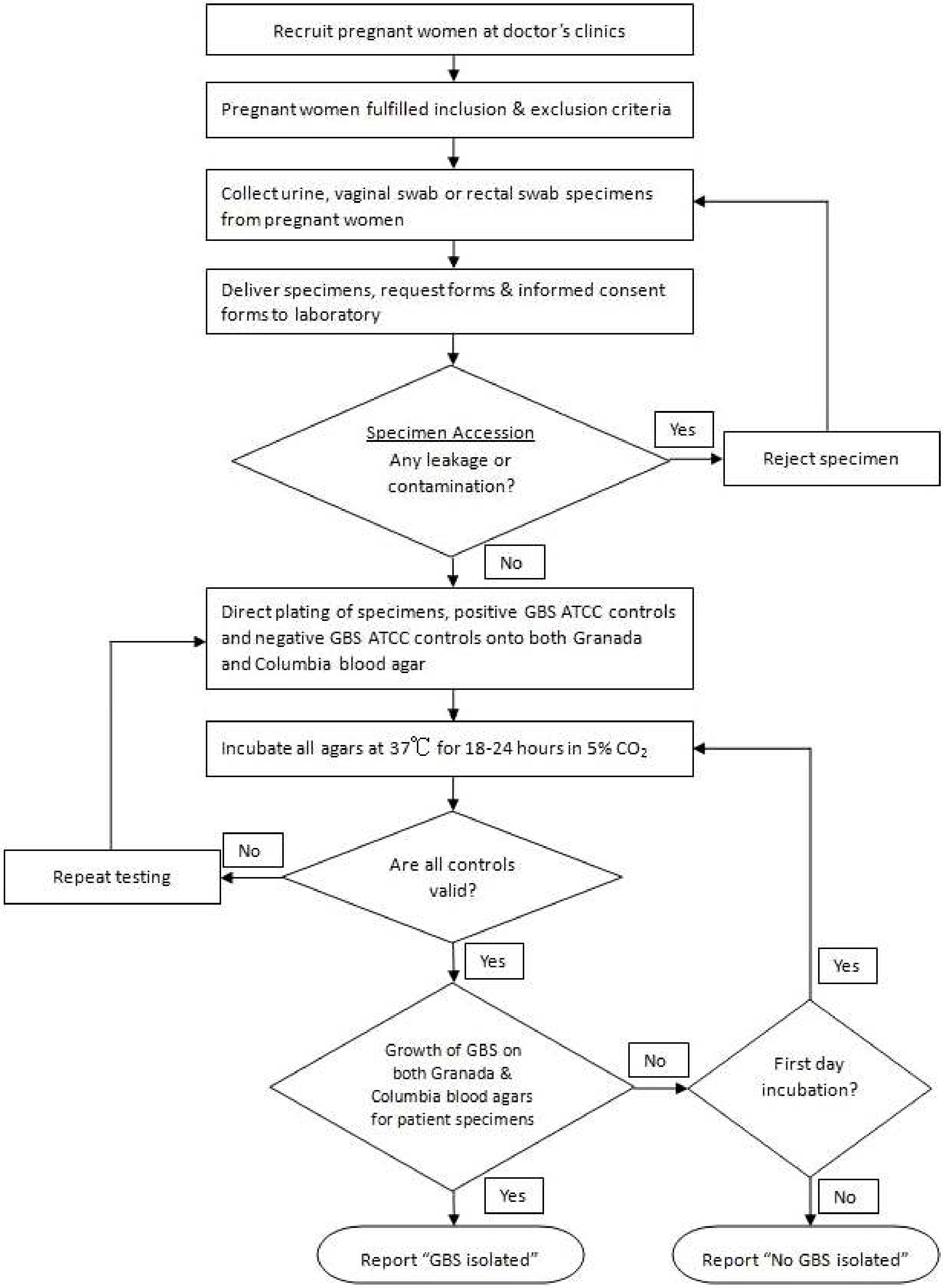

Figure 1. Specimen collection, processing and reporting for GBS culturing.

Figure 2. Appearance after 24 hour incubation of (Upper): *Streptococcus agalactiae* (GBS) - ATCC 12403 and (Lower): *Enterococcus faecalis* – ATCC 29212 on Granada agar.

Figure 3. Appearance after 24 hour incubation of (Upper): *Streptococcus agalactiae* (GBS) - ATCC 27591 and (Lower): *Escherichi coli* – ATCC 25922 on Granada agar.

Figure 4. Appearance after 24 hour incubation of (Upper): *Streptococcus agalactiae* (GBS) - ATCC 12403 and (Lower): *Enterococcus faecalis* – ATCC 29212 on Columbia agar (5% sheep blood).

Figure 5. Appearance after 24 hour incubation of (Upper): *Streptococcus agalactiae* (GBS) - ATCC 27591 and (Lower): *Escherichi coli* – ATCC 25922 on Columbia agar (5% sheep blood).

Table 1. A summary of GBS identification methods used by different studies.

Research Study	Catalase test	Gram stain	CAMP test	Latex agglutination
Tsui *et al.*[7]	★	★	★	
Tor-Udom *et al.*[19]	★	★	★	★
Hansen *et al.*[27]	★	★	★	★
Tamayo *et al.*[28]	★			★
Blanckaert *et al.*[23]				★
Joshi *et al.*[10]				★

and positive for CAMP test.[1]

Gram stain: The cell wall of GBS contains thick peptidoglycan with numerous teichoic acid cross-linkages that can trap the crystal violet (e.g., appears purple) and resist alcohol decolorization of gram stain reagents and this is called gram-positive. Under microscope with high power field, GBS looks like blue or purple beads (i.e. cocci) arranged in chains.[1] Gram stain is the most commonly employed microbiological techniques to distinguish gram-positive bacteria from gram-negative bacteria and cocci from bacilli. Gram stain can also act a primary screening test to distinguish *Streptococci* from *Staphylococci* (gram-positive cocci arranged clusters like grapes). However, gram stain cannot be used as confirmatory test and therefore there are confirmatory tests for corresponding bacteria.

Catalase test: Some organisms (e.g. *Staphylococcus aureus*) produce a peroxidase that slowly catalyzes the breakdown of hydrogen peroxide with evolution of oxygen bubbles. GBS does not produce the peroxidase and so it is negative for catalase test. Besides gram stain, catalase test is therefore commonly used to distinguish *Streptococci* from *Staphylococci*. However, catalase test is not a specific test for *Staphylococci*. Other bacteria such as *Micrococci,* the Family *Enterobacteriaceae, Listeria, Corynebacteria diphtheria* and *Mycobacterium tuberculosis*, etc. are also positive for catalase test.[1]

Lancefield precipitin test: Most beta-hemolytic *streptococci* possess group specific antigens that can be extracted and identified with group specific antisera. When this technique is applied to latex agglutination test, latex particles conjugated to group specific antisera will bind to the corresponding antigen to result in visible clumping of the latex particles. *Streptococcus agalactiae* belongs to Lancefield group B and that is why we call it Group B *Streptococcus*.[1]

***CAMP test*:** Certain organisms (including GBS) produce a diffusible extracellular protein (CAMP factor) that acts synergistically with the beta-lysin of *Staphylococcus aureus* to cause enhanced lysis of red blood cells, referred to as the CAMP reaction.[1] The CAMP test was commonly used as a presumptive identification for GBS in various studies.[7,19,24,25,27] The CAMP test is performed by streaking a beta-lysin-producing *Staphylococcus aureus* strain in a straight line across the middle of a sheep blood agar plate, and then the suspected *Streptococcus* strain is inoculated perpendicular to, without touching, the *Staphylococcus* inoculum. The agar plate is incubated at 37℃ preferably in anaerobic condition. A positive CAMP reaction is confirmed by the production of a distinct area of hemolysis near the beta-lysin-producing *Staphylococcus.* The CAMP test was found to be a simple, rapid and reliable means of presumptive identification of GBS. However, the performance could be affected by many factors such as using of only sheep blood agar plate, using of young colonies of beta-lysin-producing *Staphylococcus* and using of suitable thickness of blood agar plate.[29]

In this study, a presumptive identification of GBS was done by showing as orange characteristic colonies[28] on the Granada agar whereas *Enterococcus faecalis* and *Escherichia coli* were shown as white colonies on the Granada agar instead. On Columbia agar (5% sheep blood), GBS was shown as translucent to opaque, flat and glossy colonies with narrow zone of beta haemolysis or non-haemolytic.[1] All controls must indicate growth with corresponding colour, size and shape (Figure 2 - 5) before proceeding to reporting of patient results in this study. Moreover, GBS must be grown on both Granada agar and Columbia agar (5% sheep blood) so as to report a positive result. Otherwise, repeat testing was performed.

Data analysis

The prevalence of GBS colonization (%) in pregnant women was evaluated by dividing the number of confirmed positive cases by the total number of enrolled cases.

Main resources needed

i. The testing should be performed in a microbiology laboratory with essential equipment for bacterial culturing
ii. Amies agar gel swabs and sterile urine container for specimen collection
iii. Granada agar (bioMerieux Ref. 43 712)
iv. Columbia agar (5% sheep blood) (bioMerieux Ref. 43 041)
v. Positive controls: ATCC 12403 or ATCC 27591 GBS control strains
vi. Negative controls: ATCC 29212: *Enterococcus faecalis* and ATCC 25922: *Escherichia coli* control strains

Results

The results of this study are summarized in Table 2. Ninety-six specimens were collected at any time of gestation from pregnant women in Hong Kong who received antenatal care in private clinics from September to November 2010. Seventy (73%) were urine specimens. Among all cases, 10 (10.4%) urine and 4 (4.2%) vaginal swab were GBS positive with a colonization rate of 14.6%.

Discussions

In Hong Kong, the problem of GBS colonization in pregnant women has not been adequately studied. This may be due to the unfamiliarity of this bacterium among Hong Kong people. The objective of this study is to find out the prevalence of GBS colonization in pregnant women in Hong Kong and improve their overall health status by giving them a message to aware of the importance of this bacterial infection especially in both pregnant women and neonates. In this study, the prevalence of GBS colonization in pregnant women in Hong Kong was 14.6% that is higher than another study (10.4%) reported in 2009.[7] A lot of factors that may account for the difference of GBS colonization rate and they are worthy of having a discussion here.

Sample size

Due to limited time (3 months) for sample collection and limited financial support from the university, this study could only afford for not more than 100 samples. The final number of samples collected in this study was 96 that is only one tenth (N=952) of the study by Tsui *et al*.[7] Other similar studies worldwide had sample size of 300,[24] 300,[25] 406,[19] 1,142,[23] 702,[30] and 1,250.[31] A large sample size will definitely give us a more representative and significant data. That is one of the limitations of this study that needs to be improved.

Inclusion and exclusion criteria

As mentioned before, this study implemented inclusion and exclusion criteria just like CDC's guidelines[15,16] and the study by Tor-Udom *et al*[19]. However, many studies did

Table 2. Specimen types and GBS colonization rate.

Total number of pregnant women at any gestation age	No. of GBS isolates	Prevalence of GBS colonization (%)	Specimen distribution (GBS colonization rate %)		
			Urine	Vaginal swab	Rectal swab
96	14*	14.6	70 (10.4%)	26 (4.2%)	0

* 10 urine & 4 vaginal swabs

not mention it. The study by Tsui *et al*. stated that there were no exclusion criteria.[7] However, this could probably affect the GBS colonization rate. In terms of the differences in specimen types (urine, vaginal and rectal swabs vs high & low vaginal and rectal swabs) and consideration of antibiotic effect on testing results (No evidence of GBS infection and no antibiotic treatment within one week before specimen collection vs no exclusion criteria) between this study and the study by Tsui *et al*.[7] respectively, further study is needed to find out their effect on prevalence of GBS colonization.

Specimen types, specimen collection and culturing methods

Different specimen collection and culturing methods and combination of them were adopted by previous researchers worldwide. CDC recommended the collection of both vaginal and rectal swabs with the use of selective enrichment broth and then subcultured onto non-chromogenic agar.[15,16] The guidelines also recommended the use of cultural media with colour change in the presence of GBS. It is also one of the aims of this study to evaluate whether Granada agar could be a fast, simple, economical and reliable cultural medium for prenatal screening so as to avoid neonatal GBS infection during labor. Tamayo *et al*. also supported the screening for GBS colonization especially in asymptomatic pregnant women so that intrapartum chemoprophylaxis can be applied before delivery of fetus.[28]

Three previous studies collected urine specimens for screening of GBS colonization.[26,28,32] Turrentine and Ramirez[26] found that women with prior GBS colonization have higher risk of recurrence in subsequent pregnancy. Therefore, they suggested treating pregnant women with intrapartum chemoprophylaxis during term labor if their GBS status is unknown but having previous history of GBS colonization. The study performed by Wood and Dillon[32] discovered group B streptococcal bacteriuria was very common in pregnant women. That is why urine specimen was suggested for screening of GBS colonization in this study. In view of the distribution of specimen types in this study (Table 2), most of the specimens received from participated pregnant women of this study were urine (N=70) although they could choose to collect vaginal swabs (N=26) or rectal swabs (N=0) instead. The results may be due to the reason that urine is more convenient and easy to collect. Therefore, urine specimen is probably a suitable specimen in testing of GBS colonization in pregnant women.

Tsui *et al*. collected vaginal and rectal swabs enriched by Todd Hewitt broths containing nalidixic acid and gentamicin and then subculture onto Columbia agar (5% sheep blood).[7] This method of collecting both vaginal and rectal swabs enriched in a selective broth medium, with subculture onto solid media, was commonly used as the standard method for evaluation of GBS colonization. Recently, different media for detection of GBS colonization were used.

They include Columbia Colistine Nalidixic Acid Agar (CNA), chromogenic agar, i.e. CHROMagar StrepB agar or Strepto B ID agar, and Granada agar. In 1970s, the use of a selective medium by adding different concentrations of nalidixic acid and gentamicin into sheep blood agar, similar to CNA agar that we use today, was suggested.[33] Although, most gram-negative enteric bacteria and staphylococci are inhibited by the antibiotics, the overgrowth of especially *Proteus* species on blood agar makes it difficult to isolate and identify GBS. However, the recent development of chromogenic agar and Granada agar can solve this problem. The chromogenic agar is a selective and differential medium for aerobic isolation of GBS by showing as pink colonies from GBS. For Granada agar, GBS grows on it and synthesizes a unique orange pigment. Other bacteria are either inhibited or showing as different colours for both chromogenic agar and Granada agar. Since then, different combinations of agar media with or without selective broth enrichment for GBS culturing were studied so as to find out which is the best GBS detection method.

El Aila *et al*. collected both vaginal and rectal swabs and then inoculated directly onto CNA agar.[25] Besides, subculturing onto both CNA agar and Granada agar were performed from Lim Broth after overnight incubation. They found that the combination of Lim broth enrichment and subculture onto Granada agar was more sensitive than other combinations. Another similar study performed by El Aila *et al*. collected rectovaginal, vaginal and rectal swabs and then inoculated onto CNA agar, Granada agar and chromogenic agar with and without Lim broth enrichment.[24] They showed that rectovaginal sampling was most sensitive that detected all GBS positive women. Moreover, direct plating on Granada agar or chromogenic agar could be a sensitive, specific and rapid method for GBS detection. Their findings were in line with the study performed by Tazi *et al*[34]. For evaluation among CHROMagar Strep B, Granada, Columbia horse blood and CNA agar, it was found that CHROMagar Strep B agar gave the best performance. CHROMagar Strep B agar produced the unique colour of GBS sooner than that of Granada agar.[35] Later on, Poisson *et al*. suggested a detection method with higher sensitivity by Lim broth enrichment before subculturing onto chromogenic agar.[36] Recently, the Poisson's method was evaluated by El Aila *et al*. and compared with the method of real-time PCR (qPCR) after Lim broth enrichment, and found a further increase in sensitivity.[37]

In fact, the use of Granada agar / medium for GBS culturing were appreciated by many previous studies because of its advantages of selective ability, fast turn-around-time, ease of use, and high sensitivity and specificity.[23-25,28,30,38,39] Moreover, the interference caused by the growth of *Proteus* and *Enterococci* on blood agar plate can be overcome by the characteristic and unique orange colonies on Granada agar plate that are easily observed even when only few colonies are present. The method of direct plating onto both Granada agar and

Columbia agar (5% sheep blood) in this study or direct plating onto Granada agar only were also adopted and recommended by Blanckaert *et al.*[23] and El Aila *et al.*[24] respectively. They found that this method was not only a rapid GBS detection method but also as sensitive and specific as the CDC recommended method of Lim broth enrichment and then subculture onto non chromogenic agar. They are the reasons why we choose Granada agar for GBS culturing in this study.

Implementation of controls

One of the merits of this study is the implementation of both positive (ATCC 12403 and ATCC 27591 GBS control strains) and negative (ATCC 29212: *Enterococcus faecalis* and ATCC 25922: *Escherichia coli* control strains) controls per every batch of samples. The functions of controls are to confirm the validity of testing results, exclude the chance of having false negative and false positive results, and also evaluate the technical competence of the responsible technical staff. However, it was found that most of the similar studies did not mention the use of controls. For the sake of a good laboratory practice, it is one of very important practices in clinical testing.

Conclusion

From the point of view of a health care provider, patient care is the most important thing that we have to provide to our customers. It is therefore worthy to do another similar study that is more comprehensive with representative sample size, accurate, efficient and effective methods, and comparison of all related specimen types. This aims to remind the public of the importance of GBS diseases in pregnant women and neonates until vaccination to GBS is available in the market.

In conclusion, the GBS colonization rate of 14.6% in this study was higher than the rate (10.4%) performed by another study in Hong Kong in 2009. It is reasonable to include GBS culture for prenatal screening so as to avoid neonatal GBS infection during labor. Granada agar has its advantages of being a rapid, sensitive and specific method with results available as fast as within 24 hours and it was therefore widely used as a medium for screening of GBS colonization. Most of the specimens received were urine probably it is more convenient and easy to collect. This study showed that urine specimen is also suitable for testing GBS colonization in pregnant women.

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