The Effect of Perinatal GBS Screening and IAP on Maternal and Infant Prognosis

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Abstract—

Objective: *To investigate the effect of perinatal Group B Streptococcus (GBS) infection and intrapartum antibiotic prophylaxis (IAP) regimen on maternal and infant clinical outcome.*

Methods: *From January to December 2023, 626 GBS-positive and 2565 GBS-negative, gestation 35-37 weeks pregnant women were included in the observation and the control groups respectively. We compared the outcomes of the maternal and infant between the two groups.*

Results: *The preterm birth rate and postpartum hemorrhage rate in the observation group were significantly lower than that in the control group. However the incidence of preterm rupture of membranes, the incidence for "placenta pathological examination" critically evaluated by "after- However the incidence of preterm rupture of membranes, the incidence for "placenta pathological examination" critically evaluated by "after- delivery check protocol" and neonatal clinical sepsis in the observation group was significantly higher than that of the control group. There was no statistically significant difference in terms of delivery methods, the incidence of macrosomia, the incidence of neonatal 1'Apgar score. There was no statistically significant difference in terms of delivery methods, the incidence of macrosomia, the incidence of neonatal 1'Apgar score ≤7 and neonatal pneumonia between the two groups.*

Conclusions: *The standardized maternal GBS screening and intrapartum antibiotic prophylaxis (IAP) programme adopted at our hospital was effective in reducing adverse maternal and neonatal outcomes.*

Keywords— Group B Streptococcus (GBS), Neonatal pneumonia, neonatal clinical sepsis, Intrapartum antibiotic prophylaxis(IAP).

I. INTRODUCTION

GBS, also known as Streptococcus lactis, is the leading cause of infection during pregnancy, premature birth and neonatal infections. It is also a common species found in the vagina and rectum of women. Its presence is intermittent, temporary and persistent [1]. However, reproduction in the female vagina is a high-risk indicator for neonatal diseases and premature birth [2]. Normally, there is a balance between the microflora in the vagina and the host's environment. However, if the level of oestrogen rises in the pregnant woman's body, advantageous bacteria such as vaginal glycogen and lactobacilli will proliferate, resulting in a disturbance of the originally balanced microflora in the organism, which is most obvious in the late stage of pregnancy. The edema of the vaginal mucosa and other factors can easily induce GBS infection in the genital tract, leading to adverse pregnancy outcomes and threatening the safety of the newborn.[3] GBS infection is often associated with sepsis, urinary tract infections, endometritis, and fetal infections in pregnant women. Failure to detect GBS in the antenatal period may increase the risk of infection in both the mother and the newborn[4]-[6]. The most common type of GBS infection is early-onset group B streptococcus (EOGBS) in newborns, which manifests itself as an infection within 7 days of birth and is characterized by respiratory symptoms and pneumonia[7]. The incidence of vaginal/rectal GBS in pregnant women is 10-30% [8]. The prevalence of GBS in low-income countries, Africa, and black women is higher, and the incidence of neonatal disease is higher, too [9]-[10].

There are approximately 6,000,000 preterm births and more than 500,000 neonatal deaths due to preterm births worldwide each year.

In order to understand the relationship between GBS infection and pregnancy outcomes, this article uses the GBS detection results of pregnant women in the third trimester to study the impact of GBS bacteria on pregnancy outcomes and neonatal infections to provide clinical reference

II. MATERIALS AND METHODS

2.1 Research subjects:

A total of 3191 singleton pregnant women who gave birth in our hospital from January to December 2023 were analyzed. During the antenatal check-up period between 35 and 37 weeks of pregnancy, vaginal and rectal secretions of pregnant women are collected for DNA testing of group B streptococci. At the same time, vaginal and rectal secretions from pregnant women with threatened preterm labor are also tested for Group B Streptococcus DNA. All pregnant women were divided into observation group (infected with GBS and full IAP, 624 cases) and control group (not infected with GBS, 2565 cases) according to whether they had vaginal GBS infection or not. According to the indications for placental pathological examination at the Department of Obstetrics and Gynecology of Kiang Wu Hospital, including factors such as fever during delivery, preterm birth, maternal or fetal adverse outcomes, the placentas of the two groups of patients after delivery were selectively sent for pathological examination, with 52 cases in the observation group and 125 cases in the control group. The average age of the observation group was 29.72 ± 3.12 years old, the gestational age was 35~41+4 weeks, and the average gestational age was 38.15 ± 2.12 weeks. Primiparous women accounted for 146 cases, and multiparous women accounted for 478 cases. The proportion of vaginal delivery was 66.67%, the proportion of cesarean section was 31.73%, and the proportion of assisted vaginal delivery was 1.6%. The average age of the control group was 30.34 ± 2.82, the gestational age was 28~41+4, and the average gestational age was 38.22 ± 3.12 weeks. Primiparous women accounted for 635 cases and multiparous women accounted for 1930 cases. The proportion of vaginal delivery was 64.17%, the proportion of cesarean section was 34.31%, and the proportion of assisted vaginal delivery was 1.52%. There were no differences between the two groups. After birth, the vital signs were monitored, neonatal pneumonia or neonatal pneumonia was diagnosed according to the diagnostic criteria of the 4th edition of "Practical Neonatology" [11], and the proportion of neonatal infections among the two groups of pregnant women was compared.

2.2 Research methods:

2.2.1 Specimen collection:

During prenatal check-up, swab specimens from pregnant women between 35 and 37 weeks of pregnancy are collected according to the 2002 CDC guidelines. Insert a sterile cotton swab into the lower 1/3 of the vagina and rotate it once to collect vaginal secretions. Use the same swab to insert it into the anal sphincter at a position 2 to 3 cm and rotate it to collect rectal secretions. Put the swab back into the sterile swab tube, seal it and send it for inspection. GBS DNA testing was performed using the BD Max system.

The placental culture method is to tear open the chorionic membrane and amniotic membrane under sterile conditions after delivery of the placenta, and wipe the chorion or amniotic membrane several times with a sterile spatula. Put the swab back into the sterile swab tube, seal and send for inspection for bacterial culture.

2.2.2 GBS DNA detection:

Place the swab after collecting the specimen into 5ml of Lim broth (Todd-Hewitt broth with 10ug/ml colistin and 15ug/ml nalidixic acid), incubate at 37 degrees for 18-24 hours, and then use The BD MAX system uses fully automated real-time polymerase chain reaction (PCR) technology for GBS DNA detection.

2.2.3 IAP:

According to the RCOG 2017 guidelines[12]: for preterm pregnant women with unknown GBS status, vaginal and rectal GBS samples should be taken on admission and treated with penicillin; preterm pregnant women in labour should be treated with penicillin until delivery, and preterm pregnant women who are not in labour should stop penicillin treatment and wait for the results of the GBS test. If GBS-positive, or if the result is not available before the onset of labour, IAP treatment is started at the time of labour; if GBS-negative, there is no need for prophylaxis. If the pregnancy is not in labor but the pregnant woman reaches 35 to 37 weeks or the GBS- negative result exceeds 5 weeks, GBS screening should be performed again. Pregnant

women with known GBS- positive preterm labor should receive penicillin treatment for 48 hours during tocolysis, and IAP treatment during labor until delivery. Adequate IAP is defined as delivery more than 4 hours after intravenous penicillin, or ampicillin, or cefazolin. Inadequate IAP is defined as treatment with penicillin or benzylpenicillin, or cefazolin for less than 4 hours, or treatment with other antibiotics (e.g., clindamycin, vanillin). No IAP means that no antibiotics were used. In our hospital, we follow the RCOG guidelines for IAP in GBS DNA-positive pregnancies, with antibiotic prophylaxis after rupture of membranes or after labour, and the antibiotic of choice is Cefazolin. For elective caesarean section, cefazolin is routinely used for prophylaxis.

2.3 Statistical analyses

SPSS 22.0 statistical software was used for data processing. Measures of normal distribution were expressed as mean±standard deviation (x±s), count data were expressed as number of cases and percentage (%), and comparisons between groups were made using the X^2 test. $p<0.05$ was taken as the difference was statistically significant.

III. RESULTS:

3.1 Detection of Group B Streptococcal Infections in Pregnant Women and Completion of IAP

Of the 3191 pregnant women, 626 were GBS positive (19.62%) and 2565 were negative (80.38%).Of the 626 GBS positive pregnant women, 624 completed adequate IAP according to the 2017 RCOG guideline, and 2 had no IAP after delivery by women who had a normal labour on admission to the hospital. Adequate IAP reached 99.36% (624/626).

3.2 Comparison of the mode of delivery between the two groups of pregnant women

During January to December 2023, total number of singleton pregnancies delivered in our hospital was 3191, out of which 2565 were GBS negative (control group), with 64.17% (1646/2565) of normal delivery rate, 34.31% (880/2565) of caesarean section rate and 1.52% (39/2565) of assisted delivery rate. There were 624 cases of positive GBS at the same time in our hospital (observation group), with a positive rate of 19.61% (626/3192); the rate of normal delivery was 66.67% (416/624), cesarean section rate was 31.73% (198/624), and assisted delivery rate was 1.6% (10/624). There was no statistically significant difference in the mode of delivery between the two groups (P>0.05).

3.3 Comparison of adverse birth outcomes between the two groups of pregnant women

In the observation group, the incidence of preterm delivery was 0.8% (5/624), preterm rupture of membranes was 18.43% (115/624), postpartum haemorrhage was 3.04% (19/624), macrosomia was 2.72% (17/624), and the incidence of newborns with 1'APGAR ≤ 7 points was 1.92% (12/624). In the control group, the preterm birth rate was 3.90% (100/2565), the preterm rupture of membranes rate was 11.93% (306/2565), the postpartum haemorrhage rate was 5.26% (135/2565), the birth rate of macrosomia was 2.03% (52/2565), and the incidence of 1'APGAR ≤7 points in newborns was 2.33% (60/2565). The rates of preterm delivery and postpartum haemorrhage in the observation group were lower than those in the control group, and the differences were statistically significant (P<0.05). However, the incidence of preterm rupture of membranes and the incidence of newborns with 1'APGAR≤7 were higher in the observation group than in the control group, and the difference was statistically significant (P<0.05). The difference in the incidence of macrosomia was no statistically significant (P>0.05), as shown in Table 1.

TABLE 1
COMPARISON OF DELIVERY AND NEONATAL OUTCOMES BETWEEN THE TWO GROUPS OF PREGNANT WOMEN

	Observation group n (%)	Control group n (%)	X^2 value	P value
Premature births	5(0.8%)	100(3.90%)	6.723	0.008
Premature rupture of membranes	115(18.43%)	306(11.93%)	5.002	0.021
Postpartum hemorrhage	19(3.04%)	135(5.26%)	6.237	0.009
Macrosomia	17(2.72%)	52(2.03%)	0.813	0.323
1’APGAR≤7分	12(1.91%)	60(2.33%)	0.394	0.53
Neonatal pneumonia	39(6.23%)	146(5.69%)	0.27	0.6
Neonatal infection	57(9.11%)	125(4.87%)	16.75	0

3.4 Pathological and bacterial culture results of placenta in the two groups

In the 52 cases of observation group, 34 cases of placenta umbilical cord inflammation were examined after delivery. Among them, there were 18 cases of placenta umbilical cord inflammation alone, 7 cases of placenta umbilical cord inflammation + premature rupture of membranes, 5 cases of placenta umbilical cord inflammation + fever, and 4 cases of placenta umbilical cord inflammation + premature rupture of membranes + fever. All placentas sent for pathological examination were negative for bacterial culture. There were 0 cases of confirmed chorioamnionitis, but 9 cases of placenta pathology showed inflammation with fever, which was presumed to be chorioamnionitis. In the control group, 125 cases of postnatal placenta pathology were examined, and there were 64 cases of placenta umbilical cord inflammation, among which 19 cases of placenta pathology showed inflammation with fever, which was deduced to be chorioamnionitis. All placentas sent for pathological examination were negative for bacterial culture. Comparison of placenta umbilical cord inflammation and placenta umbilical cord inflammation with fever between the two groups, the observation group had a higher incidence rate, and the difference was statistically significant (P<0.05), shown in Table 2.

TABLE 2
COMPARISON OF PLACENTAL BACTERIAL CULTURE AND PLACENTAL PATHOLOGY CASES (%) BETWEEN THE TWO GROUPS

	Observation group	Control group	X^2 value	P value
Delivery evaluation was normal and pathology was not sent	574（91.7%）	2440（95.1%）	10.676	0.001
After assessment, send for pathological analysis	52（8.3%）	125（4.9%）	2.541	0.001
Placenta and umbilical cord inflammation	34(65.4%)	64(51.2%)	6.19	0.013
Placental pathology showed inflammation accompanied by fever	9(17.3%)	19(15.2%)	2.838	0.092
Bacterial culture positive	0（0%）	0（0%）		
Confirmed HCA	0（0%）	0（0%）		

3.5 Neonatal outcomes

A total of 3,191 newborns were delivered by singleton pregnant women in 2023. 626 newborns in the GBS-positive group developed neonatal pneumonia in 6.23%.The incidence of neonatal pneumonia between the GBS- positive group and the negative group had a *P* value >0.05, and there was no statistical difference. Complicated neonatal infections accounted for 9.11%, and all were diagnosed as clinical infections [13], that is, no positive bacteria were cultured in the microbiological culture of the neonatal blood laboratory. *The P* value of the incidence rate of neonatal infection between the GBS positive group and the negative group was <0.05, and there was a statistical difference. From the review, 37 of the 57 neonatal infection cases had both clinical manifestations and elevated C- reactive protein. The other 20 cases had no clinical symptoms and only had elevated C- reactive protein.

IV. DISCUSSIONS

The GBS positivity rate in our hospital was 19.46%. In the 1970s, GBS was an important cause of perinatal infection and neonatal death. The implementation of perinatal GBS infection prevention guidelines can significantly reduce the rate of neonatal EOGBS infection, for example, the rate of EOGBS infection in the United States, from 0.4% in 1970, gradually reduced to 0.18% in 1990, and then dropped to 0.023% in 2015[14]. In China, due to the lack of comprehensive screening of pregnant women for GBS, the p roportion of newborns with EOGBS is still high, reaching 0.94%[15]. CDC guidelines recommend screening pregnant women for GBS at 35-37 gestation and IAP in positive pregnant women. However, there are still 2-10% of pregnant women who do not have IAP due to false-negative screening[16]. In recent years, our hospital has implemented **GBS** infection prevention strategies for perinatal pregnant women in accordance with RCOG 2017 and CDC guidelines. The IAP rate of positive pregnant women is as high as 99.36%.

There was no significant difference in the proportion of vaginal delivery, caesarean and assisted deliveries between the observation group and the control group. **GBS** was positive and predisposed to premature rupture of membranes, chorioamnionitis and endometritis. Most of the patients in the observation group underwent IAP to avoid infection during pregnancy. In this study, premature rupture of membranes, placenta umbilical cord inflammation and placenta umbilical cord

inflammation with fever were significantly higher in the observation group than in the control group, but the rates of preterm delivery and haemorrhage were significantly lower. Meanwhile, the preterm birth rate in the observation group was also slightly lower than the 1.21% reported in the 2017 meta-analysis[17]. This may be due to the fact that intrauterine infections are not easily detected at the initial stage and most of the control group was not given prophylactic antibiotics, which led to contraction weakness and postpartum haemorrhage. There is no difference in the prevalence of histological chorioamnionitis (HCA) in premature infants between the GBS - positive group and the GBS-negative group [18]. Although the rates of placenta umbilical cord inflammation and placenta umbilical cord inflammation with fever were significantly higher in the observation group than in the control group, there were no cases of confirmed chorioamnionitis in all the placentas sent for pathological analysis. This may be related to the high rate of standardised and adequate IAP in our hospital.

Similar to domestic and foreign literature reports, there was no statistically significant difference in the mode of delivery and the rate of macrosomia between the observation group and the control group[19]-[20]. The proportion of neonates born with 1' APGAR ≤7 was not statistically significant compared to the control group. It has been reported in the literature[21]-[23] that the incidence of neonatal respiratory distress is higher in GBS-positive cases without IAP than in negative cases, suggesting that IAP is effective in improving poor neonatal outcome. In the present study, none of the neonates born to the two groups of pregnant women had positive blood cultures, and no neonate was diagnosed with EOGBS. There was no difference in the incidence of neonatal pneumonia between the GBS-positive and negative groups, but the incidence of concurrent neonatal infections (clinical type of infection) was higher in the observation group than in the control group. From the 57 neonatal infections reviewed, 37 cases had both clinical manifestations and elevated C-reactive protein. The other 20 cases had no clinical signs and only elevated C-reactive protein. This shows that we are a little more lenient in the diagnosis and treatment of GBS-positive neonates, and we may consider introducing the Neonatal Infection Scale (NIS)[27] into our clinical practice in the future.

GBS is a rare infection in immunocompetent adults but carries a high risk in newborns with immature immune systems. 40-70% of mothers carrying GBS will infect their newborns, and 1-2% of these newborns will become infected. When GBS comes into contact with the amniotic cavity or placenta, amnionitis or chorioamnionitis may occur, leading to preterm labour and stillbirth[24]. A study on how GBS crosses the placenta barrier to cause chorioamnionitis when it infects the chorionic villus found that GBS can adhere to and invade chorionic villus and amniotic epithelial cells[25]. Chorioamnionitis can cause direct fetal lung damage[26], without the need for bacterial invasion of the lungs.

Our hospital currently recommends that pregnant women be screened for Group B Streptococcus at 36 to 37 + 6 weeks of gestation according to ACOG 2019 guidelines, with the goal of reaching the 5- week window period to 41 weeks of gestation; if the test exceeds 5 weeks, repeat testing is required [28]. In the future, it is planned to further study the 57 cases of neonatal infection, their mothers' medical history, delivery process and maternal infection status

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