



Research Article

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Current Status of HPV Infection in Pregnant Women in Shanghai and its Effect on Pregnancy Outcomes

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Abstract

Objective: To analyze the current status and genotype distribution of human papillomavirus (HPV) infection in pregnant women, and its effect on pregnancy outcomes, to provide a theoretical basis for formulating perinatal health policies.

Methods: We studied 2654 pregnant women admitted to hospital from September 2022 to August 2024, and collected cervical samples for testing. We collected delivery information of the enrolled pregnant women and data on the newborn infection status for analysis and comparison. We divided the women into the HPV infection and non-infection groups.

Results: The HPV infection rate among the 2654 pregnant women was 16.3%, and high-risk HPV infection was the main type, accounting for 78.0% of the total infections. Among the pregnant women, 539 had neonates who were admitted to our neonatology department after delivery because of various diseases/conditions. There were no significant differences in gestational age, delivery mode, newborn birth weight, onset time, or neonatal disease type between the two groups. The HPV infection group was further divided into the low-risk group, high-risk group, and composite group according to the category of the infected genome. None of the above-mentioned factors were significantly different between these three groups.

Conclusion: HPV infection during pregnancy does not increase the risk of adverse pregnancy outcomes. Therefore, there is no need for excessive treatment for women with HPV infection during pregnancy. Proper prenatal care and follow-up observation can improve the quality of fertility.

Keywords: Pregnancy; HPV; Infection; Newborn

Introduction

The infection rate of human papillomavirus (HPV) in sexually active women in China is 70% to 80% [1]. Female HPV infection is associated with cervical cancer, precancerous lesions, and genital warts [2,3]. Pregnant women may experience physiological changes in hormones, immune function, hemodynamics, and the circulatory system, which increase the risk of HPV infection and postpartum complications, affecting the physical health of newborns [4,5]. In recent years, with the increasing prevalence of HPV infection, the effect of HPV infection on the health of newborns in pregnant women has received increasing attention. Researchers have shown that HPV-DNA can be detected in amniotic fluid, placental tissue, and umbilical vein blood, providing strong evidence for the presence of intrauterine HPV infection [6]. However, there has been little research on the effect of HPV infection on pregnancy outcomes. Therefore, this study

aimed to determine the current status and genotype distribution of HPV infection in pregnant women, and its effect on pregnancy outcomes, to provide a theoretical basis for formulating perinatal health policies.

Methods

Study subjects

We included 2654 pregnant women who were admitted to our hospital from September 2022 to August 2024. This study was approved by the ethics committee of the hospital. All of the patients signed an informed consent form. The inclusion criteria were as follows: single live pregnancy, which was registered in our hospital, and regular checkups were performed before delivery; and there was no sexual activity, vaginal washing, or ointment treatment within 24 hours before sampling. The exclusion

criteria were as follows: severe liver and kidney dysfunction, abnormal heart and lung function, gestational hypertension, or mental illness; the presence of other bacterial infections in the reproductive tract, vaginitis, or sexually transmitted diseases; use of antibiotics or drugs that affected the results of this study within 2 weeks; and poor compliance and inability to cooperate in completing this study. The women were divided into the HPV infection group or the HPV non-infection group.

Sample collection and testing

To collect samples, we used a disposable vaginal dilator to expose the cervix. The cervical brush was then placed at the cervical opening, and the cervical brush was gently rotated clockwise for five turns. The cervical brush was slowly removed and placed into a sampling tube labeled with the patient's number. This tube contained specialized cell preservation solution. The sampling tubes were sent to a PCR laboratory for testing according to the instructions of the Human Papillomavirus (HPV) Typing Test Kit (PCR+ membrane hybridization method; Chaozhou Kaipu Biochemical Co., Ltd.).

Interpretation of HPV results

HPV was divided into low-risk and high-risk genotypes. Low-risk genotypes comprised HPV6, 11, 42, 43, 44, and CP8304. High-risk genotypes comprised HPV16, 18, 31, 33, 35, 39, 45, 51, 52, 53, 56, 58, 59, 66, and 68. Composite genotype refers to the combination of low-risk and high-risk genotypes.

Clinical data collection

We collected basic information, such as age, gestational age, HPV test results, and other indicators, of all enrolled pregnant women. We also recorded pregnancy outcomes, such as the delivery method, birth weight, and conditions, such as neonatal jaundice and neonatal infection.

Statistical analysis

SPSS 27.0 statistical software was used to analyze the data. Count data are expressed as the number(%) and constituent ratio. The data were compared using the χ^2 test or Fisher's exact test, and $P < 0.05$ indicates statistical significance.

Results

HPV infection status in pregnant women

Among the 2654 pregnant women, 432 tested positives for HPV, with an infection rate of 16.3%. High-risk HPV infection was the main type, with a high-risk infection rate of 12.7%, accounting for 78.0% of the total infections. A total of 15 high-risk genotypes were detected, and the top five genotypes with the highest infection rates were HPV52, 58, 51, 16, and 39. The low-risk infection rate was 1.6%, accounting for 10.0% of the total infection rate. Six low-risk genotypes were detected, and the top five genotypes with the highest infection rates were HPV CP8304, 42, 6, 43, and 44 (Tables 1 and 2)

Information of neonatal patients

A total of 539 newborns were admitted to the neonatal intensive care unit of our hospital because they had various diseases/conditions. According to the time of onset of the condition, the neonatal patients were divided into early onset (onset within 3 days of birth) and late onset (onset after 3 days of birth). On the basis of the gestational week of delivery, the neonates were divided into premature (gestational week: <37 weeks) or full-term infants (gestational week: 37–42 weeks). The patients were also divided into low birth weight (weight: <2.5 kg) or non-low birth weight (weight: ≥ 2.5 kg) groups (Table 3).

Effect of HPV infection during pregnancy on delivery outcomes

Using data of the women who had their newborns admitted to the neonatal intensive care unit, we examined the effect of HPV infection on gestational age, the delivery mode, newborn birth weight, onset time of the neonatal condition, and neonatal disease type. We found that these variables were not significantly different between the HPV infection group and the HPV non-infection group (Table 4).

Effect of different genotypes of HPV infection on delivery outcomes

We then examined the effect of HPV genotypes on gestational age, the delivery mode, newborn birth weight, onset time of the neonatal condition, and neonatal disease type. There were no significant differences in these variables between the three different genotype groups (Table 5).

Discussion

We studied pregnant women with HPV from a single institution. Our data are representative and can reflect to some extent the current status of HPV infection in pregnant women in Shanghai and its effect on pregnancy outcomes. HPV infection is common in women, and persistent high-risk HPV infection has become a clear high-risk factor for cervical cancer. Low-risk HPV infection is often associated with benign proliferative diseases, such as sexually transmitted diseases (e.g., genital warts), which seriously affect women's physical and mental health [7]. Some studies [8-9] have shown that HPV infection in pregnant women affects pregnancy outcomes and maternal and infant health, but there is currently limited research in China and in other countries. Additionally, no consistent consensus has been reached on how to effectively improve the quality of perinatal health care for pregnant women with HPV and better maintain maternal and infant health.

According to epidemiological data in China, the HPV infection rate is 13.5% among healthy women, and sexually active women have the highest HPV infection rate [10]. The peak age of HPV infection is approximately 20 years old, and a second peak of HPV infection occurs at approximately 40–45 years old. This study showed that the HPV infection rate among pregnant

women was 16.3%, which is higher than the previously reported healthy women. Possible reasons for this finding are as follows. Pregnancy is a specific physiological state, and in the mother, the body's tolerance to the fetus is increased by regulation of her own immune mechanism to ensure a smooth pregnancy. However, the mother's ability to resist and handle infections is decreased in pregnancy. Physiological changes, such as increased cervical blood supply, migration of the squamous cell border area, active proliferation of basal cells, and increased vaginal secretions, in pregnant women provide more favorable conditions for HPV growth. This weakened immune system and proliferation of the basal cell layer of cervical squamous epithelium in pregnant

women causes HPV gene replication to become active, which increases the HPV detection rate. The HPV infection rate among pregnant women in this study is lower than that in the southern region (24.3%) and in the eastern region (21.9%) of China [11]. Since the HPV vaccine was launched in China in 2017, the Shanghai government has strengthened the popularization and promotion of HPV and related diseases through various means, increased people's awareness and willingness to receive the HPV vaccine, and continuously improved the HPV vaccination rate and coverage rate among eligible women in Shanghai. Therefore, these factors could explain the lower HPV infection rate in our region than in the other regions.

Table 1: HPV Infection Status in Pregnant Women

	Number of infected individuals	infection rate	constituent ratio
Low risk	52	2.00%	12.00%
High risk	337	12.70%	78.00%
composite	43	1.60%	10.00%

*Composite genotype refers to the combination of low-risk and high-risk genotypes.

Table 2: Distribution of HPV genotypes in pregnant women

HPV type	HPV genotype	Number of cases	Proportion (%)
High risk	16	47	9.9
	18	12	2.5
	31	14	2.9
	33	12	2.5
	35	7	1.5
	39	39	8.2
	45	8	1.7
	51	49	10.3
	52	103	21.6
	53	31	6.5
	56	29	6.1
	58	54	11.3
	59	22	4.6
	66	19	4
	68	31	6.5
	Total	477	100
Low risk	11	6	5.9
	42	27	26.5
	43	12	11.8
	44	11	10.8
	6	13	12.7
	CP8304	33	32.4
	Total	102	100

*Each HPV genotype was counted separately in individuals with complex infections.

Table 3: Information of neonatal patients

Project	Classification	Number of cases	Proportion (%)
Gestational age	Premature baby	158	29.3
	Full-term child	381	70.7
Delivery method	Vaginal delivery	271	50.3
	Cesarean section	268	49.7
Birth weight	Low birth weight	148	27.5
	Non-low birth weight	391	72.5
Onset time	Early onset	190	35.3
	Late onset	349	64.7
Disease type	pneumonia	160	29.5
	jaundice	233	43
	Low birth weight	68	12.5
	respiratory distress	49	9
	premature birth	3	0.6
	others	29	5.4

*Other diseases include congenital hepatic artery fistula, congenital anal atresia, congenital duodenal stenosis, etc.

Table 4: Comparison of delivery outcomes between infected and non-infected groups

		non infected	infected	chi-square	P
Gestational age	Premature baby	133	25	2.09	0.148
	Full-term child	300	81		
Delivery method	Vaginal delivery	217	54	0.023	0.51
	Cesarean section	216	52		
Birth weight	Low birth weight	124	24	1.537	0.215
	Non-low birth weight	309	82		
Onset time	Early onset	149	41	0.68	0.41
	Late onset	284	65		
Disease type	pneumonia	126	34	0.361	0.548
	jaundice	185	48	0.227	0.634
	Low birth weight	58	10	1.212	0.271
	respiratory distress	40	9	0.058	0.81
	premature birth	3	0		1
	others	24	5	0.114	0.736

Table 5: The impact of different genotypes of HPV infection on delivery outcomes.

		Low risk	High risk	composite	chi-square	P
Gestational age	Premature baby	2	21	2	2.437	0.296
	Full-term child	16	62	3		
Delivery method	Vaginal delivery	8	44	2	0.686	0.71
	Cesarean section	10	39	3		
Birth weight	Low birth weight	4	18	2	0.905	0.636
	Non-low birth weight	14	65	3		
Onset time	Premature baby	9	30	2	1.201	0.549
	Full-term child	9	53	3		
Disease type	Vaginal delivery	3	30	1	2.927	0.231
	Cesarean section	11	35	2	2.201	0.333
	Low birth weight	1	8	1	0.974	0.614

	Non-low birth weight	2	6	1	1.182	0.554
	others	1	4	0	0.278	0.87

Among the 432 pregnant women with HPV infection, high-risk infection was the main type, accounting for 78.0% of the total infections, while low-risk infection accounted for 10.0%. Gong et al. [12] investigated the HPV infection and typing of 11,396 women. They found that high-risk HPV infection accounted for 78.7%, which is consistent with our results, while low-risk HPV infection accounted for 21.3%, which is slightly higher than that in our study. There may be two reasons for this discrepancy between studies. First, the research subjects were different between studies. The research subjects in our study were pregnant women, while those in Gong et al.'s study were non-pregnant women. Second, in the analysis of the ratio of HPV genotypes in this study, 10% were the composite type, which was simultaneous infection with high-risk and low-risk genotypes, but this particular genotype was not reported in the literature.

HPV can be transmitted not only through sexual activity, but also through vertical transmission, leading to HPV infection in the offspring [13], but the transmission mechanism is currently unclear. HPV-DNA has been detected in amniotic fluid, placental tissue, and umbilical vein blood, providing strong evidence for the presence of intrauterine HPV infection. HPV infection during pregnancy is generally believed to be associated with adverse pregnancy outcomes. Zhang et al. [14] conducted an analysis and study on 1557 pregnant women in the Nanjing area. They found that HR-HPV-infected women had a higher frequency of adverse pregnancy outcomes, such as premature birth and premature rupture of membranes, than uninfected women. Fei et al. [15] found that the incidence of fetal distress, premature rupture of membranes, and fetal growth restriction in the HPV-positive group was 14.29%, 16.07%, and 14.29%, respectively, which was significantly higher than that in the HPV-negative group (3.57%, 3.57%, and 1.79%, respectively). However, some researchers believe that there is no clear link between HPV infection during pregnancy and pregnancy outcomes. In 2011, Skoczynski et al. [16] proposed that there was no conclusive evidence linking spontaneous abortion to HPV infection. In 2017, scholar Ambuhl [17] proposed that HPV infection did not increase the incidence of adverse pregnancy outcomes, and there was no significant statistical difference in premature birth rates between the HPV infection group and the control group. Liao Qi et al. [18] conducted a study on 449 pregnant women and found that there was no significant statistical difference in obstetric complications and adverse neonatal outcomes between the HPV infected and uninfected groups during pregnancy. In this study, using data of the women who had their newborns admitted to the neonatal intensive care unit, we examined the effect of HPV infection on gestational age, the delivery mode, newborn birth weight, onset time of the neonatal condition, and neonatal disease type. We found that these variables were not significantly different between the HPV infection group and the HPV non-infection group. We

then examined the effect of HPV genotypes on gestational age, the delivery mode, newborn birth weight, onset time of the neonatal condition, and neonatal disease type. There were no significant differences in these variables between the three different genotype groups.

In summary, this study suggests that HPV infection during pregnancy does not increase the risk of adverse pregnancy outcomes. Therefore, women with HPV infection during pregnancy do not require excessive treatment. Proper prenatal care and follow-up observation are necessary to improve the quality of fertility.

Declarations

Ethics approval and consent to participate

This research has been performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. This study was approved by the Ethics Committee of the Shanghai First Maternity and Infant Hospital affiliated to Tongji University. (Reference number: KS29413; Date: 23/11/2021). Written informed consent was obtained from the participants and from the parents/legal guardian of the eligible infants before recruitment.

Availability of data and materials

The datasets used and/or analyzed during the current study available from the corresponding author on reasonable request.

Competing interest

The authors report no conflict of interest. All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest.

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