

Analysis of Cardiac Functional Status and Factors Influencing Adverse Pregnancy Outcomes in Pregnant Women with Combined Heart Disease

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Abstract: *Objective:* To investigate the cardiac function of pregnant women with complicated heart disease during pregnancy and the factors influencing the adverse pregnancy outcome. *Methods:* A total of 162 cases of pregnant women with complicated heart disease admitted to the Beijing Anzhen Hospital from October 2021 to December 2023 were selected to compare the occurrence of adverse pregnancy outcomes in pregnant women with complicated heart disease at different levels of cardiac function and to analyze the single and multi factors leading to adverse pregnancy outcomes in pregnant women with complicated heart disease. *Results:* Among 162 pregnant women with combined heart disease in pregnancy, the highest percentage of heart disease type was congenital heart disease (80/49.38%), and the lowest percentage was other (9/5.56%); the overall incidence of adverse pregnancy outcomes in pregnant women with combined heart disease in pregnancy with cardiac function grades of 3–4 cardiac function (30/68.18%) was higher than that in pregnant women with combined heart disease in cardiac function grades of 1–2 (40 /33.90%) ($P = 0.000$); age, marital status, hypertension, and past history of all pregnant women were not statistically significant ($P > 0.05$); gestational age, type of heart disease, and cardiac function grading were statistically significant ($P < 0.05$), and these factors were all independent risk factors for adverse pregnancy resolution in pregnant women with combined heart disease ($P < 0.05$). *Conclusion:* The overall incidence of adverse pregnancy outcomes was higher in pregnant women with heart disease than in those with heart disease grades 1–2, and the number of pregnancies, the type of heart disease, and heart function grades were all independent risk factors for adverse pregnancy outcomes in pregnant women with heart disease.

Keywords: Pregnancy; Pregnant women; Heart disease; Cardiac function; Adverse pregnancy outcome

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1. Introduction

Combined heart disease in pregnancy is a serious pregnancy comorbidity that involves the health and safety of both the pregnant woman and the fetus. With the change in lifestyle and the improvement of medical care, the incidence of combined heart disease in pregnancy shows an increasing trend year by year. Combined heart disease in pregnancy poses a serious threat to the health of both the pregnant woman and the fetus,

making clinical management and prognostic assessment of this population critical ^[1]. Cardiac disease can be one of the leading causes of maternal mortality and affects the adaptive capacity of the cardiovascular system during pregnancy, leading to poor pregnancy outcomes. However, there are relatively few studies related to preoperative cardiac functional status and its influence on adverse pregnancy outcomes ^[2]. Therefore, this article provides an in-depth analysis of the cardiac functional status and factors influencing adverse pregnancy outcomes in pregnant women with complicated heart disease, intending to provide clinicians with a deeper understanding and guidance, which in turn will help to improve the health of the pregnant woman and the fetus.

2. Materials and methods

2.1. General data

A total of 162 cases of pregnant women with combined heart disease in pregnancy admitted to the Beijing Anzhen Hospital from October 2021 to December 2023 were selected, with ages ranging from 21 to 42 years old and a mean age of 28.82 ± 3.65 years old, while pregnancies ranging from one to four, with a mean number of pregnancies 1.58 ± 0.31 .

Inclusion criteria: (1) In the state of pregnancy; (2) Diagnosed with heart disease by electrocardiogram or ultrasound; (3) Signed the informed consent form and agreed to participate in this study; (4) Complete clinical data.

Exclusion criteria: (1) Women who were not pregnant or had terminated pregnancy; (2) Pregnant women with non-cardiac disease; (3) Suffering from serious complications such as hepatic and renal insufficiency, hematologic disorders, malignant tumors, etc.; (4) Incomplete clinical data; (5) Those who were unwilling to sign the informed consent form or were unable to comply with the study regulations.

2.2. Methods

All patients underwent routine obstetric examination, and clinical data such as age, marital status, pregnancy, type of heart disease, cardiac function grading, hypertension, and past history were collected. Cardiac function grading was performed according to the grading standards of the American College of Cardiology in New York. Compare the occurrence of adverse pregnancy outcomes in pregnant women with complicated heart disease under different grades of cardiac function, and analyze the single factors and multifactors leading to adverse pregnancy outcomes in pregnant women with complicated heart disease.

2.3. Observational indicators

- (1) The type of heart disease in pregnant women with complicated heart disease;
- (2) The occurrence of adverse pregnancy outcomes in pregnant women with complicated heart disease at different levels of cardiac function;
- (3) Single and multi-factors leading to adverse pregnancy outcomes in pregnant women with complicated heart disease.

2.4. Statistical methods

Statistical processing was performed with SPSS 20.0, and count data were expressed as a rate (%) and compared using the χ^2 test. The influencing factors of adverse pregnancy outcomes in pregnant women with complicated heart disease were analyzed by single-factor and multivariate logistic regression.

3. Results

3.1. Type of heart disease

As shown in **Table 1**, among the 162 pregnant women with complicated heart disease in pregnancy, the highest percentage of heart disease types was congenital heart disease (80/49.38%), and the lowest percentage was other (9/5.56%).

Table 1. Types of heart disease

Type of heart disease	Congenital heart disease	Valvular heart disease	Functional heart disease	Others
Number of cases	80 (49.38%)	61 (37.65%)	12 (7.41%)	9 (5.56%)

3.2. Comparison of adverse pregnancy outcomes in pregnant women with heart disease in different cardiac function grades

As shown in **Table 2**, the overall incidence of adverse pregnancy outcomes in pregnant women with combined heart disease in pregnancy with a cardiac function grading of 3–4 (30/68.18%) was higher than that in pregnant women with a cardiac function grading of 1–2 (40/33.90%) ($P = 0.000$).

Table 2. Comparison of adverse pregnancy outcomes in pregnant women with combined heart disease in pregnancy with different cardiac function classifications [n (%)]

Adverse pregnancy outcomes	Grade 1–2 ($n = 118$)	Grade 3–4 ($n = 44$)	χ^2	P
Cesarean section	15 (12.71)	10 (22.73)	-	-
Induced abortion	12 (10.17)	7 (15.91)	-	-
Postpartum hemorrhage	10 (8.47)	12 (27.27)	-	-
Birth defects	3 (2.54)	1 (2.73)	-	-
Total incidence	40 (33.90)	30 (68.18)	21.333	0.000

3.3. Univariate analysis of adverse pregnancy outcomes in pregnant women with combined heart disease in pregnancy

As shown in **Table 3**, age, marital status, hypertension, and past history of all pregnant women were not statistically significant ($P > 0.05$); the number of pregnancies, type of heart disease, and cardiac function grading were statistically significant ($P < 0.05$).

Table 3. Univariate analysis of adverse pregnancy outcomes in pregnant women with combined heart disease in pregnancy [n (%)]

Influencing factors	Normal pregnancy outcome ($n = 92$)	Undesirable pregnancy outcome ($n = 70$)	χ^2	P
Age				
Below 35 years	80 (86.96%)	56 (80%)	1.428	0.232
35 years and above	12 (13.04%)	14 (20%)		
Marital status				
Married	85 (92.39%)	60 (85.71%)	1.887	0.170
Unmarried	7 (7.61%)	10 (14.29%)		

Table 1 (Continued)

Influencing factors	Normal pregnancy outcome (n = 92)	Undesirable pregnancy outcome (n = 70)	χ^2	P
Frequency of pregnancy				
1–2 times	65 (70.65%)	30 (42.86%)	12.663	0.000
3–4 times	27 (29.35%)	40 (57.14%)		
Type of heart disease				
Congenital heart disease	55 (59.78%)	25 (35.71%)	10.040	0.018
Valvular heart disease	29 (31.52%)	32 (45.71%)		
Functional heart disease	4 (4.35%)	8 (11.43%)		
Others	4 (4.35%)	5 (7.15%)		
Heart function grading				
Grade 1–2	82 (89.13%)	36(51.43%)	28.562	0.000
Grade 3–4	10 (10.87%)	34(48.57%)		
Hypertension				
Yes	21 (22.83%)	13(18.57%)	0.434	0.510
No	71 (77.17%)	57(81.43%)		
Past history				
Yes	32 (34.78%)	26(37.14%)	0.202	0.653
No	60 (65.22%)	42(65.86%)		

3.4. Multivariate analysis of adverse pregnancy outcomes in pregnant women with combined heart disease in pregnancy

As shown in **Table 4**, the number of pregnancies, type of heart disease, and cardiac function classification were all independent risk factors for adverse pregnancy resolution in pregnant women with combined heart disease ($P < 0.05$).

Table 4. Multivariate analysis of adverse pregnancy resolution in pregnant women with combined gestational heart disease

Influencing factors	Regression coefficient	Standard error	Wald χ^2	P	Ratio (95% CI)
Frequency of pregnancy	0.825	0.316	5.021	0.026	2.345 (1.216–4.257)
Type of heart disease	0.926	0.426	6.635	0.032	2.486 (1.035–4.689)
Heart function classification	0.932	0.431	6.589	0.015	2.461 (1.124–5.359)

4. Discussion

Heart disease in pregnancy is defined as abnormal cardiac function or structural disease that occurs in pregnant women during pregnancy [3]. These cardiac problems may be due to the worsening of pre-existing cardiac conditions during pregnancy or may be due to cardiac dysfunction as a result of physiologic changes during pregnancy. These cardiac diseases may worsen during pregnancy and increase the risk to both the mother and the fetus, such as heart failure, arrhythmias, and thrombosis. Therefore, attention must be paid to the management of heart disease in pregnancy [4,5].

The percentage of types of heart disease in pregnancy varies according to regional and population differences, but in general, congenital heart disease is the most common type of heart disease in pregnancy, as found in this study, among 162 pregnant women with combined heart disease in pregnancy, the highest percentage of types of heart disease was congenital heart disease (80/49.38%), followed by valvular heart disease (61/37.65%), while other types of heart diseases such as cardiomyopathy and arrhythmias accounted for a relatively small percentage (9/5.56%).

This study found that the overall incidence of adverse pregnancy outcomes in pregnant women with combined heart disease in cardiac function class 3–4 (30/68.18%) was higher than that in pregnant women with cardiac function class 1–2 (40/33.90%) ($P = 0.000$), which demonstrated that the cardiac function class would have an adverse impact on the outcome of combined heart disease in pregnancy, and specifically, the higher the cardiac function class, the higher the risk of heart disease. The higher the cardiac function classification, the more likely it is to lead to the occurrence of adverse pregnancy outcomes. This is consistent with the study by Jin *et al.* [6]. This is mainly due to the following reasons: Firstly, as the cardiac function classification increases, the function of the pregnant woman's heart gradually decreases, and the heart's pumping ability is weakened. During pregnancy, the amount of circulating blood in pregnant women increases, meaning the heart needs to bear a greater burden. For pregnant women with poor cardiac function, the heart is unable to cope with this additional burden effectively, making it easy to develop heart failure [7,8]. Secondly, pregnant women with higher cardiac function classification have a higher demand for oxygen supply to the heart. When the heart's ability to supply oxygen is weakened, it may lead to insufficient oxygen supply to the placenta. This not only affects the normal development of the fetus but may also trigger fetal distress, increasing the risk of preterm labor and fetal death *in utero* [9]. Additionally, as cardiac function deteriorates, pregnant women's tolerance to medications decreases, making the medications needed to treat heart disease potentially have adverse effects on the fetus, thus increasing the risk of adverse pregnancy outcomes. Furthermore, pregnant women with high cardiac function classification may experience more intense hemodynamic changes, leading to uneven distribution of blood in the body, which affects the nutritional supply to the fetus and the elimination of metabolic wastes, thereby increasing the risk of adverse pregnancy outcomes. Moreover, pregnant women with high cardiac function classification tend to be under greater psychological stress due to physical discomfort and concern about the disease. This stress can affect the pregnant woman's mood and quality of sleep, further aggravating the burden on the heart and increasing the risk of adverse pregnancy outcomes.

The present study also pointed out that the number of pregnancies, type of cardiac disease, and cardiac function grading were all independent risk factors for adverse pregnancy resolution in pregnant women with combined heart disease ($P < 0.05$). The number of pregnancies is defined as the number of pregnancies a pregnant woman has had, and along with the increase in the number of pregnancies, the pregnant woman's body undergoes physiologic and anatomical changes over multiple pregnancies, which may lead to a gradual increase in cardiac burden. Coupled with this, cardiac problems that may have developed during previous pregnancies, such as perinatal cardiomyopathy or hypertensive disorders of pregnancy, may recur or worsen in subsequent pregnancies, thereby increasing the risk of adverse pregnancy outcomes. Different types of heart disease may have different levels of severity and rates of progression. Some heart diseases, such as congenital heart disease, may result in severe damage to the structure or function of the heart, thereby increasing the risk of adverse pregnancy outcomes. Moreover, some heart diseases may require specific treatments and management strategies, such as medications or surgical interventions, which may adversely affect the pregnancy and increase the risk of adverse pregnancy outcomes. The higher the cardiac function classification, the worse the pregnant woman's heart's ability to pump blood, which may lead to poor circulation and affect the supply of nutrients and

waste elimination from the fetus. In addition, as the cardiac function grading increases, the pregnant woman's heart is less able to cope with the physiologic changes of pregnancy and is prone to heart failure or other cardiac events, thus increasing the risk of adverse pregnancy outcomes. This is consistent with the findings of Zheng *et al.* [10].

In conclusion, the overall incidence of adverse pregnancy outcomes was higher in pregnant women with combined heart disease of cardiac function class 3–4 than in those with cardiac function class 1–2, and the number of pregnancies, type of heart disease, and cardiac function class were all independent risk factors for adverse pregnancy resolution in pregnant women with combined heart disease.

Disclosure statement

The authors declare no conflict of interest.

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