

Original Research

Characteristics of maternal cardiac disease and pregnancy outcomes: results from a 4-year observational cohort survey in Central Vietnam

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Abstract

Background: Pregnant women with cardiac diseases present a challenge for both obstetricians and cardiologists, especially in developing countries with limited medical resources. This study aimed to determine the clinical features and pregnancy outcomes of pregnant women with cardiac diseases in Vietnam. **Methods:** In this patient registry descriptive study, pregnant women with heart disease, admitted to the Department of Obstetrics and Gynecology, Hue Central Hospital, Vietnam, between January 2017 and December 2020, were recruited. Pregnant women were classified into the high-risk group if at least one of the following risk clinical features was present: (1) left ventricular ejection fraction (EF) <50%, and (2) New York Heart Association—NYHA classification—NYHA class >II or cyanosis, or (3) left heart obstruction; patients without these risk conditions were categorized into the low-risk group. **Results:** A total of 134 pregnant women were included, with a mean age of 27.8 ± 4.8 years old; 32.1% had mitral valve disease, 23.9% had rhythm disorders, 15.7% had congenital heart disease, 9.0% had aortic valve disease, and 3.0% had both mitral and aortic valve disease. Maternal complications during pregnancy included heart failure (37.3%), irregular heart rhythm (35.8%), thrombosis (0.7%), and valve blockage (0.7%). A total of 66.7% of the high-risk patients underwent cesarean section, 22.2% with therapeutic abortion, and 11.1% with miscarriage. The frequency of gestational age over 35 weeks in the high-risk and low-risk groups were 55.6% and 92.8%, respectively (Odds ratios = 0.097, 95% Confidence Interval: 0.02–0.43, $p < 0.05$). The mean birth weight in the high-risk and low-risk groups was 2800.0 ± 438.2 and 2988.4 ± 390.6 g, $p > 0.05$, respectively. **Conclusions:** Cardiovascular disorders in pregnant women have a higher rate of complications that affect mother and fetus. Risk stratification plays an important role in management during pregnancy and is essential to improve the outcomes in developing countries with limited medical

Keywords: Cardiac disease; Pregnancy; Vietnam

1. Introduction

Millennium Development Goal 5 aimed to decrease the maternal mortality ratio by 75% from 1990 to 2015. However, worldwide maternal death rate only decreased by 45% during this period [1]. Approximately 80% of maternal deaths occur in areas with high birth rate and low access to healthcare. For example, women in sub-Saharan Africa, where health care was rated among lowest in world, have a significantly higher risk of pregnancy-related death than women in North America [2]. Poorly controlled pre-existing cardiovascular ailments, such as pregnancy-related cardiomyopathy and hypertension, are among the conditions that contribute to high maternal mortality in low- and middle-income countries.

In past two decades, cardiac disease was responsible for 10–15% of all pregnancy-related deaths [3,4] and the maternal mortality rate is 9% in developed countries and up to 36% in developing countries [5–7]. In a study reported from India, common maternal complications included iron deficiency (46.2%) and congestive heart failure (19.6%). Of note, 28.2% of newborns required admission to neona-

tal intensive care units, and the perinatal mortality rate was 7.7% [7]. Therefore, pregnancy care must still be optimized, requiring thorough assessment, intensive counseling, and appropriate management.

Cardiovascular disease can either be congenital, acquired, or both, with different patterns of disease between developed and developing countries. Rheumatic heart disease (RHD) is the most common cause of valvular disease in the developing world. In total, 90% of all cardiac disorders in women of childbearing age in non-industrialized regions are of rheumatic origin [4,8,9]. Mitral stenosis, one of the most common valvular lesions in pregnancy. Severe maternal and fetal complications associated with maternal cardiac disease include heart failure, arrhythmia, endocarditis, fetal death, neonatal death, low APGAR (appearance, pulse, grimace, activity, and respiration) score, preterm birth, and small for gestational age [10,11]. Currently, the management of pregnant women with cardiovascular diseases is still a challenge for obstetricians and cardiologists, especially in developing countries with limited medical resources. In Vietnam, cardiovascular disease



(CVD) accounts for 31% of causes of deaths, or approximately 170,000 cases. Despite this, there is still scarce data on the health concerns of pregnant women with cardiac diseases [12]. The present study aimed to determine the characteristics, pregnancy-related complications, and maternal and fetal outcomes of pregnant women with cardiac disease in Vietnam.

2. Materials and methods

2.1 Study details and ethics statement

This retrospective descriptive study was performed at the Department of Obstetrics and Gynecology, Hue Central Hospital, a tertiary national hospital in Central Vietnam. A convenience sample of pregnant women with cardiovascular diseases was recruited between January 2017 and December 2020. This study was approved by the Ethics Committee of Hue University of Medicine and Pharmacy, Hue, Vietnam, on May 10, 2016 (approval number H2016/122). All participants provided written informed consent before enrollment in the study. The privacy of all patients enrolled in this study was protected.

2.2 Patient's characteristics and stratification

A detailed protocol was designed to collect essential information directly from patients, physical assessments and from their medical records. After informed consent, baseline data were collected as follows: maternal age, history of previous delivery (gravidity, parity), history of abortion, and reasons for hospitalization (elective and emergency). The condition of the current pregnancy, women's health during pregnancy, and their respective pregnancy outcomes were also assessed by obstetricians, cardiologists, and anesthesiologists.

Cardiovascular functional and clinical evaluations were based on the New York Heart Association (NYHA) functional classification system [13]. The NYHA classifies functional conditions related to heart disease through activity limitations and symptoms. Class I refers to individuals with cardiac disease but without limitations in physical activity; ordinary physical activity does not cause symptoms of heart failure (HF). Class II refers to individuals showing mild symptoms in the context of normal physical activity, but not at rest. Class III refers to individuals with marked limitations in the context of physical activity, comfortable at rest, but showing symptoms of HF in the context of less than ordinary activities. Class IV refers to individuals with HF at rest [14,15]. Cardiac function was evaluated through electrocardiogram and echocardiography, as part of standard clinical care. Heart valve disease was defined based on valve position (mitral, aortic, mitral, and aortic) and valve condition (valve position, fistula, valve stenosis, thrombotic obstruction). Cardiac abnormalities included irregular heart rate, dyspnea, edema, cyanosis, chest pain, dizziness, and HF.

Pregnant women were classified into the high-risk

group if at least one of the following risk features was present: left ventricular ejection fraction <50%, NYHA class III or IV, with cardiac abnormalities, or with heart valve disease. Otherwise, patients with cardiac disease with minimal to no signs and symptoms were categorized into the low-risk group. Exclusion criteria for this study include cases who were lost in following-up or did not admit to Hue Central hospital for delivery.

2.3 Primary outcomes

The primary maternal outcomes included the pregnancy outcomes (cesarean, vaginal delivery, therapeutic abortion, miscarriage/abortion) and the maternal complications. Some of the complications noted were uterine atony, postpartum hemorrhage, dyspnea, arrhythmia, and cardiovascular events, including thromboembolism. Postpartum hemorrhage was defined as increased blood loss of >500 mL after vaginal birth or >1000 mL after cesarean section immediately after birth to 24 hours postpartum [16]. Dyspnea was described as an intense tightening in the chest, air hunger, and difficulty of breathing. Sinus arrhythmia characteristically presented with an irregular heart rate in which the change in the R-R wave interval is greater than 0.12 seconds. Thromboembolism was defined as any systemic arterial thrombotic event, such as a stroke or a transient ischemic attack.

The primary fetal outcomes were as follows: live births, gestational age in weeks, birth weight, APGAR scores (immediately after birth, at 5 minutes, at 10 minutes and in response to resuscitation and in response to resuscitation), and the presence of any congenital defect. Of note, the APGAR scores are based on five categories (Appearance, Pulse, Grimace, Activity, Respiration) evaluated on a scale of 0 to 2. A score of 7 to 10 is regarded as reassuring, 4 to 6 as moderately abnormal, and 0 to 3 as low in the context of full-term and late preterm infants [17].

2.4 Statistical analyses

All statistical analyses were performed using the SPSS (version 20) for Windows (IBM Corp., Armonk, NY, USA). Continuous variables are presented as the mean \pm standard deviation or absolute number and percentage and odds ratios (ORs) with 95% confidence intervals (CIs). The groups were compared using the *t*-test for independent samples. The chi-square or Fisher's exact test were used for comparing categorical variables between high-risk or low-risk, and adverse outcomes. A two-tailed *p*-value lower than 0.05 was considered as statistically significant.

3. Results

3.1 Patients' characteristics

A total of 134 patients were included in the study. Table 1 shows the patient characteristics, divided into the low-risk and high-risk groups. The mean age of the pregnant women was 27.8 ± 4.8 years old with range of 19–45 years

Table 1. Characteristics of pregnant women with cardiovascular diseases enrolled in this study.

Characteristics	Total	High-risk	Low-risk	<i>p</i> -value
	n (%)	n (%)	n (%)	
Age				
<20	1 (0.7)	-	1 (0.8)	
20–29	92 (68.7)	8 (88.9)	84 (67.2)	
30–39	39 (29.1)	1 (11.1)	38 (30.4)	0.061
≥40	2 (1.5)	-	2 (1.6)	
Mean ± SD (Min–Max)	27.8 ± 4.8 (19–45)	27.3 ± 4.0 (22–36)	27.8 ± 4.9 (19–45)	
Parity				
No previous pregnancy	58 (43.3)	2 (22.2)	56 (44.8)	0.553
With at least 1 previous pregnancy	76 (56.7)	7 (77.8)	69 (55.2)	
Number of previous abortions				
No previous abortions	28 (57.1)	3 (100.0)	25 (54.3)	0.302
With at least 1 previous abortion	21 (42.9)	-	21 (45.6)	
Reason for admission				
Elective	71 (53.0)	7 (77.8)	64 (51.2)	0.123
Emergency	63 (47.0)	2	61 (48.8)	

SD, standard deviation.

old. Total 76.1% ($n = 102$) of pregnant women had no history of abortion, while 23.9% ($n = 32$) had at least one abortion.

The study participants had various cardiovascular diseases. There were 9 pregnant women in the high-risk group and 125 women in the low-risk group. Mitral valve defect is the most common cardiovascular disease in both groups, with 55.6% ($n = 5$) for the high-risk group and 30.4% ($n = 38$) for the low-risk group. Among the women in the high-risk group, 2 (22.2%) of them had mitral valve with aortic valve defects, and 2 (22.2%) had other cardiovascular disease. On one hand, the low-risk group had 32 (25.6%) with rhythm disorders, 21 (16.8%) with congenital heart disease, 12 (9.6%) with aortic valve defect, 2 (1.6%) with mitral valve plus aortic valve defects, and 20 (16.0%) with other cardiovascular disease.

In both high-risk and the low-risk groups, 37.3% ($n = 50$) of the pregnant women had heart failure. As expected, all women in the high-risk group had heart failure as compared with those in the low-risk group at 32.8% ($n = 41$). Other information regarding the maternal cardiovascular conditions among the two groups are in Table 2.

Table 3 shows the different interventions used by the pregnant women to manage their cardiovascular conditions. A total of 3 (33.4%) women in the high-risk group used medication for the treatment of cardiac diseases, while 75 (60.0%) used medication in the low-risk group.

3.2 Maternal and fetal outcomes

In total, 66.7% ($n = 6$) of the high-risk patients underwent cesarean section, while 33.3% had therapeutic or spontaneous abortion. Among the high-risk women, 11.1%

had premature delivery before the 37th week, compared to 4.0% in the low-risk group. Additionally, the rates of abortion were 33.3% and 3.2% in high- and low-risk women, respectively. These differences were statistically significant with $p < 0.05$ (Table 4). There is only 1 case with postpartum hemorrhage that happened after cesarean section, which accounts for 0.8%.

The average birth weight of the neonates of the pregnant women was 2800.0 ± 438.2 g in the high-risk group and 2988.4 ± 390.6 g in the low-risk group ($p > 0.05$). In the early assessment, low APGAR score (< 7) was detected in 1 (11.1%) neonate in the high-risk group as compared with the 11 (8.8%) neonates in the low-risk group. However, the APGAR scores of all neonates improved (≥ 7 points) 5 min after birth. There are 13 cases (9.7%) with preterm birth, and it is statistically significant (p value: 0.005). No case of fetal anomalies is recorded.

4. Discussion

Cardiovascular disease is strongly associated with maternal mortality and morbidity in pregnancy [18]. In fact, approximately 20.5% of all maternal deaths are secondary to cardiac disorders [19]. Vietnam is currently ranked as a lower-middle-income country with limited medical resources. The tendency for late diagnosis poses a challenge in the management of pregnant women with cardiac diseases. Other factors include the lack of infrastructure and medicines for pregnant women [20].

Our study population is composed of 134 pregnant women with cardiovascular disease with a mean age of 27.8 ± 4.8 years old. Among them, 68.7% of the sample population are women aged 20–29 years old. Several studies from

Table 2. Maternal cardiovascular conditions in high-risk and low-high-risk women.

Maternal condition	Total	High-risk group	Low-risk group	p-value	Odds ratio (95% CI)
	n (%)	n (%)	n (%)		
Heart failure (NYHA Classification)	50 (37.3)	9 (100.0)	41 (32.8)	0.000	-
Grade I	11 (22.0)	1 (11.1)	10 (24.4)		
Grade II	36 (72.0)	5 (55.6)	31 (75.6)		
Grade III	3 (6.0)	3 (33.3)	-		
Grade IV	-	-	-		
Thrombosis	1 (0.7)	1 (11.1)	-	0.068	-
Irregular heart rhythm	48 (35.8)	5 (55.6)	43 (34.4)	0.187	2.38 (0.608–0.934)
Valve blockage	1 (0.7)	1 (11.1)	-	0.253	-

NYHA, New York Heart Association; CI, confidence interval.

Table 3. History of interventions in risk-stratified women with cardiovascular disease.

Intervention	Total	High-risk group	Low-risk group
	n (%)	n (%)	n (%)
Mitral valve replacement	22 (16.4)	2 (22.2)	20 (16.0)
Aortic valve replacement	6 (4.5)	-	6 (4.8)
Aortic and mitral valve replacement	5 (3.7)	2 (22.2)	3 (2.4)
Medication	78 (58.2)	3 (33.4)	75 (60.0)
Other interventions	23 (17.2)	2 (22.2)	21 (16.8)

South Africa and the Middle East have reported a mean age at valve replacement of 24–30 years old [21–23]. Therefore, patients of reproductive age with mechanical valve replacement should be closely monitored for the possibility of pregnancy and monitored until childbirth.

Most patients in our study (53.0%) were electively hospitalized to induce labor in line with recommendations from cardiologists and obstetricians. This management allows for better care, particularly prenatal counseling, planned birth, and postpartum care based on a multidisciplinary approach, including the collaboration of obstetricians and cardiologists [24–26]. The remaining cases were admitted to the hospital in labor and had to undergo emergency cesarean section, without regard for the obstetric outcome from vaginal delivery.

Mitral valve replacement is the most frequent valve replacement intervention (16.4%) in the women enrolled in this study, followed by aortic valve replacement (4.5%) and the replacement of both valves (3.4%). A report by the European Registry on Pregnancy and Heart Disease found that mitral stenosis and/or regurgitation were the most common types of valvular disorders (63%), followed by aortic valve disease (23%) [27]. Similar findings were reported by Nassar *et al.* [28] and by Ayad *et al.* [24]. Therefore, our data are consistent with those in previous reports. Women with mechanical prosthetic heart valves are recommended to be treated with long-term anticoagulation to prevent the severe consequences of valve thrombosis and systemic embolic complications. The use of those interventions may cause complications throughout pregnancy, labor, and birth, es-

pecially in patients who require surgery. The safety of both the fetus and the mother must be considered in selecting an anticoagulant.

Most women in this study were classified under NYHA Class II heart failure patients (72.0%, n = 36/50). In a study by Robertson *et al.* [6], conducted in 559 women with heart disease in Canada, most women with heart disease (88%) were stratified as NYHA functional Class I patients; 10% were stratified as Class II and 2% as Class III patients. This difference may come from the global problem of cardiovascular disease extending into the developing world [29] and especially with different income class between countries, limitation of medical care and medical resources.

In high-risk patients, elective cesarean section should be performed to prevent hemodynamic instability. Van Hagen *et al.* [14] found out that among pregnant patients with mechanical valve replacement, 45% had cesarean section, and 52% had vaginal birth. The reported cesarean section rates vary in literature, ranging from 50% to 88% [25,30–32]. In 2014, Chumpathong *et al.* [31] reported that the rate of cesarean section was about 80% (140/175 cases) in 175 pregnant women with heart diseases in Thailand. However, other studies reported that the cesarean section rate was only 50% in France and 51% in Korea [30,32]. Our management was different than that conducted in other studies in the literature, as most of the patients underwent cesarean section, and no cases of vaginal birth in the high-risk group were observed. This difference is due to the clinical management of the obstetrician, in addition to the recommendation

Table 4. Maternal outcomes in high-risk and low-risk pregnant women with cardiovascular disease.

Management methods	High-risk group	Low-risk group	<i>p</i> -value
	n (%)	n (%)	
Caesarean section	6 (66.7)	114 (91.2)	
Caesarean section due to cardiac problems	5 (55.6)	57 (45.6)	
Caesarean section due to obstetric problems	-	21 (16.8)	
Caesarean section due to cardiac and obstetric problems	1 (11.1)	36 (28.8)	<i>p</i> = 0.053
Therapeutic abortion	2 (22.2)	2 (1.6)	
Miscarriage/Abortion	1 (11.1)	2 (1.6)	
Vaginal delivery	-	7 (5.6)	
Gestational age at birth (weeks + days)			
<22 ⁰	3 (33.3)	4 (3.2)	
22 ⁰ -34 ⁺⁶	-	-	
35 ⁰ -36 ⁺⁶	1 (11.1)	5 (4.0)	<i>p</i> = 0.005
37 ⁰ -40 ⁺⁶	5 (55.6)	116 (92.8)	

of cardiologists. Well-equipped cardiopulmonary resuscitation facilities were not available. This shortage can limit the capabilities of obstetricians to cope with management during childbirth.

In our study, neonates with early Apgar scores <7 in the high-risk and low-risk groups were 11.1% and 8.8%, respectively. Of note, no case of asphyxia was observed at the 5-minute assessment. These findings were close to those reported by Van Hagen, highlighting 8% of infants with asphyxia [14]. On the other hand, Sliwa *et al.* [33] reported 2% of fetal mortality, 21.7% of premature birth, and 0.7% of neonatal mortality. In fact, different studies report different perinatal mortality rates, from 1.7% [22] to 13.4% [24,34]. Our data revealed better outcomes with an average gestational period from 37 to 41 weeks in both high- and low-risk mothers. Altogether, these results highlight the appropriate management of women with cardiovascular disease, especially mechanical heart valve replacement during pregnancy in our hospital. Importantly, almost all women were cared for by cardiologists with an algorithm for anticoagulation therapy during pregnancy.

Heart failure related to labor and delivery is one of the most severe obstetric complications. Both obstetric and cardiac complications depend on the clinical symptoms and pulmonary arterial pressure during pregnancy. Subbaiah *et al.* [35] reported 14 women with severe and 16 with mild pulmonary arterial hypertension (PAH). Women with severe PAH had a significantly higher incidence of cardiac complications than women with mild PAH [35]. Additionally, it was reported that the fetal risk is higher in women classified as NYHA Class III/IV during pregnancy [11,36,37]. In this study, we reported a lower incidence of maternal complications than reported in other studies, such as postpartum bleeding (0.8%) and infection (2.4%). Only one case with postpartum bleeding (0.8%) happened after cesarean section, and no cases of hemor-

rhage were recorded after vaginal delivery. However, this may be due to the limited sample size of patients with NYHA Class III (2.4%). This said, our results suggest that the elective indication of cesarean section with careful pre- and post-operation monitoring can result in better outcomes.

The main limitation of the present study is its study design. We are unable to draw conclusions about the effectiveness of different management strategies from a descriptive study. We are also unable to formulate an optimal protocol for the pregnant patients with mechanical valve placement. Furthermore, the sample size was limited in this study. Therefore, comparison analysis was also statistically limited and generalizations cannot be done.

5. Conclusions

In summary, our results show that in Vietnam, the management of pregnant women with cardiac diseases, especially mechanical heart valve replacement, is still challenging. Pregnant women with cardiac diseases in Vietnam are quite in young age, almost cases had no history of abortion and half of them are nulliparous. These women had various cardiovascular diseases and mitral valve defect is the most common cardiovascular disease. Heart failure rate is considerable in these pregnant women. With quite high rate of cesarean section, the maternal and neonatal complications are not worth considering. Risk stratification plays an important role in the management during pregnancy, with better outcomes.

Author contributions

MTL, MTT, and QVT designed the research study. MTT, TNNT performed the data recruitment and analysis. TNNT, DTT, MTL, QVT and QHVN supervised the research. All authors contributed to editorial changes in

the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate

This study was approved by the Ethics Committee of the Hue University of Medicine and Pharmacy, Hue, Vietnam, on May 10, 2016 (approval number H2016/122). All participants provided written informed consent before enrollment in the study. The privacy of all patients enrolled in this study was protected.

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Conflict of interest

The authors declare no conflict of interest.

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