

# Perinatal and neonatal outcomes of maternal heart diseases

N. Aka, Ş. Arpacı, F. Vural, G. Köse

Obstetrics and Gynecology Department, Haydarpaşa Numune Teaching Hospital, Istanbul (Turkey)

## Summary

**Aims:** To explore the perinatal and neonatal outcomes of patients with heart diseases. **Materials Methods:** Retrospective case control analysis was carried out among 10,527 deliveries, 188 pregnancies complicated by cardiovascular disease (CVD) compared with pregnancies without CVD for obstetric outcomes from January 2000 to December 2012. The effect of cardiac functional classification (NHYA) on maternal and neonatal complications was explored. **Results:** The incidence of CVD in pregnancy was 1.78%. About 80.3% had rheumatic heart disease (RHD). Maternal and neonatal mortality rate was 1.06% and 2.13 %, respectively. The obstetric outcomes of women in NHYA class I / II were similar to normal group. Vaginal delivery was the preferred way of birth unless deterioration of cardiac functions as in the cases of NHYA class III/IV. NHYA class III/IV had significantly decreased birth weight, premature birth, and increased maternal-neonatal mortality ( $p < 0.05$ ). **Conclusion:** RHD is still prevalent. The cardiac functional capacity predicts maternal and neonatal outcomes.

**Key words:** Maternal heart disease; Perinatal outcomes; Neonatal outcomes; Rheumatic fever; Pregnancy.

## Introduction

The incidence of pregnancies complicating cardiovascular disease (CVD) has been increased because of the rising prevalence of risk factors such as diabetes, hypertension, obesity, and the improvements in treatment strategies resulting in the growing number of women with heart disease reaching childbearing age [1-4]. Nearly 0.2% to 4% of all pregnancies is complicated by CVD [1-3]. Among heart disease complicating pregnancy, congenital heart disease (CHD) is the most common in developed countries, whereas rheumatic heart disease (RHD) is predominant in developing countries [2, 5, 6].

Pregnancy causes significant changes in the cardiovascular system to meet the metabolic demands of the mother and fetus. Changes in the circulatory systems commence in the first trimester and peak in the second trimester. The most profound changes occur during birth and the early postpartum period. Therefore, the increased circulatory burden in pregnancy may decompensate or unmask previously asymptomatic cardiac diseases [2, 6, 7].

CVD is the most common non-obstetric cause of morbidity and mortality during pregnancy [2]. Preconceptional counseling and management of pregnancy with CVD are important to decrease perinatal mortality and morbidity [1, 2, 6, 7]. Maternal and neonatal events are highly correlated, and women with heart disease have an increased risk of adverse outcomes in pregnancy [2]. However, perinatal mortality and prevalence of cardiac diseases vary in the literature because of the heterogeneity of the population and heart diseases. In this paper, the

authors investigated the various types of heart disease complicating pregnancy and the effect of cardiac functional classification (NHYA) on maternal and neonatal complications in a tertiary center.

## Materials and Methods

This retrospective case-controlled study was conducted in Haydarpaşa Numune Teaching Hospital in Istanbul. This tertiary center, and the Siyami Ersek Cardiovascular Surgery Hospital, which is one of the largest cardiology hospital in Turkey, are located in the same health complex and work collaboratively.

A total of 10527 deliveries occurred from January 1, 2000 to December 31, 2012 in the present center. Among these deliveries, 188 singleton pregnancies that were complicated by cardiac disease were included in the study. This study was approved by the Haydarpaşa Teaching Hospital Ethical Committee.

The hospital records were evaluated retrospectively. Women age, parity status, spontaneous abortion, prior cardiac event, cardiac lesion, cyanosis, medication, acute rheumatic fever (ARF) prophylaxis, New York Heart Association (NYHA) functional class, and co-morbid conditions were recorded. All pregnancies underwent laboratory evaluation of blood count, biochemistry, electrocardiography, echocardiography and antenatal obstetric ultrasonography.

Women with isolated mitral valve prolapse (moderate or mild mitral regurgitation) or who lost antenatal follow-up, and who labored in another center were excluded. Arrhythmia cases were included if symptomatic sustained arrhythmia required treatment before pregnancy [6,7].

A total of 376 women without cardiac disease were selected from deliveries during the same week of labour of women with CVD. The control selection was performed by 1:2 ratio among maternal age and gestational weeks matched births. Women with labor complications, diabetes, hypertension, or any known medical disease or known obstetric pathology; multiple pregnancies,

Table 1. — *The distribution of cardiac lesions in CHD and AHD.*

	Diagnosis	n	%
CHD (n=23)	ASD	5	21.7
	VSD	10	43.4
	MVP	5	21.7
	PS	2	8.8
	Tetralogy of Fallot	1	4.4
AHD (n=165)	Arrhythmia	9	5.5
	Ischemic heart disease	3	1.8
	Cardiomyopathy	2	1.2
	Rheumatic heart disease	151	91.5
	I. Mitral stenosis	75	49.6
	II. Mitral regurgitation	40	26.5
	III. Aortic regurgitation	2	1.4
	IV. Aortic stenosis	-	-
	V. Multiple valvular heart disease	34	22.5

and congenital anomalies were excluded from the control group. The remaining 343 women accepted for control group.

The main measure outcomes were maternal and neonatal complications. Maternal outcomes were cardiac complications and mortality. Neonatal outcomes were defined as birth week, birth weight, and neonatal death. Firstly, maternal and neonatal outcomes were compared between case and control group. Secondly women with heart disease were stratified as NYHA functional status for the comparison of obstetric outcomes.

Statistical evaluation was conducted with SPSS 16.0. A *p*-value < 0.05 was accepted as statistically significant. All data were evaluated in 95% confidence interval. Descriptive statistics were expressed in absolute numbers and percentages for nominal data, and continuous variables were expressed as mean values and standard deviations. The control and case group were compared using independent *t*-test for normally distributed variables and  $\chi^2$ -test (or Fisher's exact test if appropriate) for categorical variables.

## Results

### *CVD and RHD prevalence in pregnancy*

The women were aged between 16 and 46 years. The mean age was  $25.6 \pm 5.5$  years. The rate of maternal heart disease was 1.78 % among 10,527 deliveries. About 12.2 % (n=23) of patients had CHD, and 87.8% (n=165) had acquired heart diseases (AHD). Among CHD, VSD (n=10) was the most common type (43.4%). Among AHD, RHD (n=151, 91.5%) with mitral stenosis (n=75, 49.6%) was the most common type. Thirty women had prior cardiac valvular surgery. The details of the cardiac lesions are listed in Table 1. According to the NYHA classification, most of the cases were in class I (n=75, 39.8%) and class II (n=88, 46.8%). About 19 cases were in class III (10.2%), and six cases were in class IV (3.2%).

### *Maternal and neonatal complications*

Maternal cardiac complications were cardiac failure (n=5, 2.6%), pulmonary edema (n=2, 1.06%), arrhythmia (n=8, 4.2%), hypertension (n=10, 5.3%), preeclampsia (n=4, 2.1%),

Table 2. — *The comparison of perinatal outcomes in case (CVD) and control (normal) groups.*

	Case Mean $\pm$ SD	Control Mean $\pm$ SD	<i>p</i>
Age (years)	27.16 $\pm$ 5.51	26.16 $\pm$ 5.64	0.087
Gravidity	2.30 $\pm$ 1.52	2.06 $\pm$ 1.16	0.222
Parity	1.59 $\pm$ 1.17	1.56 $\pm$ 0.79	0.272
Abortion (spontaneous)	1.18 $\pm$ 0.39	1.00 $\pm$ 0.00	0.054
Medical abortion	1.06 $\pm$ 0.26	1.18 $\pm$ 0.60	0.779
Birth weight (grams)	3021.24 $\pm$ 611.63	3278.94 $\pm$ 465.28	0.001
1. Min. Apgar score	7.36 $\pm$ 1.65	8.26 $\pm$ 1.15	0.001
5. Min. Apgar score	8.96 $\pm$ 1.77	9.63 $\pm$ 0.58	0.001
Hospitalisation (days)	2.37 $\pm$ 1.51	1.58 $\pm$ 0.89	0.001
Hemoglobin (gr/dl)	11.12 $\pm$ 1.13	11.15 $\pm$ 1.06	0.812
Hematocrit (%)	33.84 $\pm$ 3.10	33.75 $\pm$ 2.86	0.776
Birth week	37.70 $\pm$ 2.60	39.01 $\pm$ 1.16	0.001
Neonatal mortality	4 (2.13 %)	0	-

and cardiac death (n=2, 1.06%). Maternal non-cardiac complications were postpartum hemorrhage (n=2, 1.06%), severe anemia (n=10, 5.3%), and wound infection (n=6, 3.19%). The majority of the cardiac complications were in NYHA III/IV class. Two maternal mortality cases (1.06%) were noted in the CVD group. The first mortal case was VSD accompanied by Eisenmenger's syndrome and the pulmonary emboli was the cause of mortality. The other case was uncorrected MS with NYHA class III symptoms with pulmonary edema and referred to our clinic during labour. Both cases died in coronary intensive care unit in early postpartum period.

Neonatal complications were decreased Apgar scores, birth weight and birth week and increased mortality. The 80 babies were small for gestational age (42.5%), 31 babies were premature delivery (16.4%), 40 babies were admitted to neonatal intensive care unit (21.2%), neonatal mortality was 2.13% (n=4), and two babies had cardiac anomalies (1.06%).

### *The comparison of pregnancies with and without heart disease*

Pregnancies complicating by CVD increased risk of materno-fetal complications compared to normal controls. The personal characteristics, obstetric history, hospitalization, and perinatal neonatal outcomes are presented in Table 2. The CVD group had a significantly increased duration of hospitalization, maternal and neonatal mortality. Apgar scores, birth weight, and birth week were significantly decreased in CVD group (*p* = 0.001).

The CHD, AHD and prior cardiac surgery had similar maternal and neonatal outcomes (*p* > 0.05).

### *Perinatal outcomes in women with CVD according to NYHA classification*

The comparison of perinatal outcomes of pregnancies with heart diseases according to NYHA classification is

Table 3. — *The comparison of perinatal outcomes according to NYHA functional classification.*

	Class I	NYHA Class II	Class III/IV	<i>p</i>
Birth weight (grams)	3114.74± 628.37	3075.88± 498.90	2508.33± 720.98	0.001
1-min Apgar score	7.57±1.68	7.42±1.48	6.44±1.91	0.034
5.-min Apgar score	8.91±2.20	9.25±0.83	8.00±2.45	0.027
Birth week	37.98±2.67	37.94±1.86	35.89±3.88	0.006
Neonatal mortality	2 (2.67%)	0	2 (8%)	0.035
Maternal mortality	0	0	2(8%)	-

shown in Table 3. The cases in NYHA class III/IV had decreased birth weight, premature delivery, decreased Apgar scores, and increased perinatal mortality and cesarean deliveries ( $p < 0.05$ ). Neonatal mortality rate was 2.13% (4/188) in the CVD group, 8% (2/25) in NYHA class III/IV group, and 1.23 % (2/163) in the NYHA class I/II group.

Maternal mortality rate was 1.06% (two cases) in the CVD group; all the cases were in NYHA class III/IV group (8%). The birth week and weight, Apgar scores, type of delivery, and maternal mortality rates were similar for patients in NYHA class I/ II and those with normal pregnancies. The neonatal mortality in NYHA class I/II was slightly increased (1.23%).

#### Delivery

The cesarean section (C/S) rates of normal population, NYHA I, NYHA II, and NYHA III/IV were 31.5%, 37.3%, 38.6%, and 64 %, respectively. NYHA class I/II and control groups had similar vaginal delivery rates and vaginal route was the primary mode of delivery. NYHA III and IV patients had significantly increased C/S rates. The most of the cases in NYHA III/IV were secondary to obstetric causes or emergency C/S due to cardiac deterioration of maternal or fetal distress.

#### Discussion

The prevalence of CVD complicating pregnancies in this retrospective cohort was 1.78% and RHD remains dominant. Maternal heart diseases are associated with adverse obstetric outcomes such as prematurity, low birth weight, and maternal and neonatal mortality. The majority of the maternal and fetal complications were observed in NYHA class III/IV. This study demonstrated that functional capacity of the heart determines pregnancy outcomes.

Heart diseases are heterogeneous groups of diseases either congenital or acquired, so the prevalence of the types of disease differs among countries [2, 5, 6]. According to the present 13-year results, RHD remains the dominant cardiac disease complicating pregnancies with valvular

lesions (80.3%) Moreover, mitral stenosis is the most common lesion (49.6%), consistent with the observations of other studies from developing countries [8-19]. Acute rheumatic fever and RHD are significant public health concerns around the world and also in Turkey [17-19]. At least 15 million people are estimated to be living with RHD [20]. These results suggested the importance of developing strategies to prevent ARF and RHD.

Several studies have assessed the maternal and fetal outcomes of pregnant patients with heart disease. Maternal heart disease is associated with an increased risk of both maternal and neonatal complications. The hemodynamic imbalance, placental insufficiency, and drugs may compromise fetal growth [5, 7, 21-25]. Many other studies addressed the importance of risk stratification and functional classification on obstetric outcomes [24, 25]. One of the largest series was performed by Siu *et al.* that studied 562 pregnant women, with valvular heart disease [6]. In their subsequent study [7], evaluated the prospective longitudinal study of pregnancy outcomes in women with heart disease and found neonatal outcomes in 302 pregnancies. They found increased incidence of neonatal complications such as preterm delivery, fetal growth restriction, respiratory distress syndrome, and neonatal death. Similarly in the present cohort, women with CVD had increased risk of neonatal complications such as small for gestational age (42.5%), premature delivery (16.4%) neonatal intensive care unit need (21.2%), and neonatal mortality (2.13%). The study by Wasim *et al.* [14] and by McFaul *et al.* [23] found that NYHA III/IV symptoms were the determinants of adverse fetal and maternal outcomes [14, 23]. Siu *et al.* showed multiple gestations, anticoagulation therapy in pregnancy, left ventricular obstruction, NYHA class III/IV, and maternal age as the predictors of adverse neonatal outcome [7]. The present results similar to previous searches that cardiac performance and status effects outcomes. The CVD group had adverse obstetric outcomes compared to normal group and functional class predicts the outcome. The perinatal outcomes were similar for patients in NYHA class I/ II and those with normal pregnancies. However, NYHA III and IV patients had significantly decreased birth week, birth weight, and Apgar scores ( $p < 0.05$ ).

Severe pulmonary hypertension, severe mitral or aortic stenosis, left ventricular dysfunction ( $< 30\%$ ), Marfan's syndrome with aortic root dilatation, and previous peripartum cardiomyopathy with impaired left ventricular function were the high risk cardiac lesions [2]. Eisenmenger's syndrome has a 50% mortality rate in the pregnant women with CVD [26, 27]. Two mortality in the present series were high-risk cardiac lesions with NYHA class III/IV. It is strongly suggested that prenatal counseling should be done before planning pregnancy and pregnancy should be prohibited in high-risk conditions. One of the other components of prenatal counseling is off-



spring risk of congenital cardiac anomaly. In the present cohort, two offsprings had cardiac anomaly. Therefore, this issue should also be discussed with patients.

The preferred mode of delivery is the vaginal route, with spontaneous onset of labor and provision of effective pain relief [2, 28]. In the present study population, women in the NHYA class I/II and control groups had similar vaginal delivery rates and vaginal route was the primary mode of delivery. However, women in NHYA III/IV had significantly increased C/S rates. Most of the cases were emergency operations secondary to poor cardiac performance or fetal distress that necessitated early delivery. This result is similar to previous reports [29, 30].

The major limitation of the present study was its retrospective nature. To minimize patient selection bias for control group, age, and gestational week matched women without known medical or obstetric problems were included. The records did not have smoking status, obesity, and gestational diabetes. Therefore, the *p*-value could not reflect the effects of confounding factors on maternal and neonatal outcome. Despite limitations, the present data with cardiac functional classification was well-recorded and had a large population with RHD. However, prospectively designed studies with cardiac risk stratification are needed

## Conclusion

RHD is still prevalent. The functional capacity of the heart determines pregnancy outcomes. Maternal cardiac status affects fetal status such as low birth weight and prematurity. Pulmonary hypertension is the major risk factor affecting maternal mortality. The majority of women in NHYA class I and II can go through pregnancy and labor without a specific intervention. However, women with NYHA III/IV symptoms are associated with adverse perinatal outcomes. All patients' antenatal care and labour management necessitate multidisciplinary team approach.

## References

- [1] Weiss B.M., von Segesser L.K., Alon E., Seifert B., Turina M.I.: "Outcome of cardiovascular surgery and pregnancy: a systematic review of the period 1984–1996". *Am. J. Obstet. Gynecol.*, 1998, 179, 1643.
- [2] European Society of Gynecology (ESG), Association for European Paediatric Cardiology (AEPC), German Society for Gender Medicine (DGesGM), Regitz-Zagrosek V., Blomstrom Lundqvist C., Borghi C., et al.: "ESC Committee for Practice Guidelines. ESC Guidelines on the management of cardiovascular diseases during pregnancy: the Task Force on the Management of Cardiovascular Diseases during Pregnancy of the European Society of Cardiology (ESC)". *Eur. Heart J.*, 2011, 32, 3147.
- [3] Lewis, G.: "The Confidential Enquiry into Maternal and Child Health (CEMACH). Saving Mothers' Lives: reviewing maternal deaths to make motherhood safer - 2003-2005". The Seventh Report on Confidential Enquiries into Maternal Deaths in the United Kingdom. London: CEMACH, 2007.
- [4] Khairy P., Ionescu-Ittu R., Mackie A.S., Abrahamowicz M., Pilote L., Marelli A.J.: "Changing mortality in congenital heart disease". *J. Am. Coll. Cardiol.*, 2010, 56, 1149.
- [5] Stangl V., Schad J., Gossing G., Borges A., Baumann G., Stangl K.: "Maternal heart disease and pregnancy outcome: a single-centre experience". *Eur. J. Heart Fail.*, 2008, 10, 855.
- [6] Siu S.C., Sermer M., Colman J.M., Alvarez A.N., Mercier L.A., Morton B.C., et al.: "Prospective multicenter study of pregnancy outcomes in women with heart disease". *Circulation*, 2001, 104, 515.
- [7] Siu S.C., Colman J.M., Sorensen S., Smallhorn J.F., Farine D., Amankwah K.S., et al.: "Adverse neonatal and cardiac outcomes are more common in pregnant women with cardiac disease". *Circulation*, 2002, 105, 2179.
- [8] Engin-Üstün Y., Çelen Ş., Özcan A., Sanisoğlu S., Karaahmetoğlu S., Gül R., et al.: "Maternal mortality from cardiac disease in Turkey: a population-based study". *J. Matern. Fetal Neonatal Med.*, 2012, 25, 2451.
- [9] Sawhney H., Aggarwal N., Suri V., Vasishta K., Sharma Y., Grover A.: "Maternal and perinatal outcome in rheumatic heart disease". *Int. J. Gynaecol. Obstet.*, 2003, 80, 9.
- [10] Davies G.A., Herbert W.N.: "Assessment and management of cardiac disease in pregnancy". *J. Obstet. Gynaecol. Can.*, 2007, 29, 331.
- [11] Koregol M., Mahale N., Nayak R., Bhandary A.: "Maternal and perinatal outcomes of pregnancies complicated by cardiac disease". *J. Turkish-German Gynecol. Assoc.*, 2009, 10, 30.
- [12] Scirica B.M., O'Gara P.T.: "Valvular heart disease in pregnancy". *Curr. Cardiol. Rep.*, 2006, 8, 83.
- [13] González Maqueda I., Armada Romero E., Díaz Recasens J., García De Vinuesa P.G., García Moll M., González García A., et al.: "Practice Guideline of Spanish society of cardiology for the management of cardiac disease in pregnancy". *Rev. Esp. Cardiol.*, 2000, 53, 1474.
- [14] Wasim T., Amer W., Majrooh A., Siddiq S.: "Foetomaternal outcome of pregnancy with cardiac disease". *J. Pak. Med. Assoc.*, 2008, 58, 175.
- [15] E.S. Abdel Haby., M. El-Shamy., A-A. El-Fifai., H. Goda., A. Abdel Samad.: "Maternal and perinatal outcome of pregnancies complicated by cardiac disease". *Int. J. Obstet. Gynecol.*, 2005, 90, 21.
- [16] Bhatla N., Lal S., Behera G., Kriplani A., Mittal S., Agarwal N., Talwar K.K.: "Cardiac disease in pregnancy". *Int. J. Obstet. Gynecol.*, 2003, 82, 153.
- [17] Özer N.: "Valvular heart disease epidemiology: a Turkish perspective". *Arch. Turk. Soc. Cardiol.*, 2013, 41, 11.
- [18] Saraçlar M., Ertuğrul A., Özme Ş.: "Akut romatizmal ateş insidansı ve romatizmal kalp hastalıkları prevalansı". *Türk. Kardiyol. Dern. Ars.*, 1978, 7, 50.
- [19] Beyazova U., Benli D., Beyazova M.: "Akut romatizmal ateş görülme sıklığı". *Çocuk. Sağ. Hast. Der.*, 1987, 2, 76.
- [20] Seckeler M.D., Hoke T.R.: "The worldwide epidemiology of acute rheumatic fever and rheumatic heart disease". *Clin. Epidemiol.*, 2011, 2, 67.
- [21] Shime J., Mocarski E.J., Hastings D., Webb G.D., McLaughlin P.R.: "Congenital heart disease in pregnancy: short- and long-term implications". *Am. J. Obstet. Gynecol.*, 1987, 156, 313.
- [22] Whittemore R., Hobbins J., Engle M.: "Pregnancy and its outcome in women with and without surgical treatment of congenital heart disease". *Am. J. Cardiol.*, 1982, 50, 641.
- [23] McFaul P.B., Dornan J.C., Lamki H., Boyle D.: "Pregnancy complicated by maternal heart disease: a review of 519 women". *Br. J. Obstet. Gynaecol.*, 1988, 95, 861.
- [24] Hameed A.B., Goodwin T.M., Elkayam U.: "Effect of pulmonary stenosis on pregnancy outcomes – a case-control study". *Am. Heart J.*, 2007, 154, 852.
- [25] Ouyang D.W., Khairy P., Fernandes S.M., Landzberg M.J., Economy K.E.: "Obstetric outcomes in pregnant women with congenital heart disease". *Int. J. Cardiol.*, 2010, 144, 195.

- [26] Wang H., Zhang W., Liu T.: "Experience of managing pregnant women with Eisenmenger's syndrome: maternal and fetal outcome in 13 cases". *J. Obstet. Gynaecol.*, 2011, 37, 64.
- [27] Madazli R., Sal V., Cift T., Guralp O., Goymen A.: "Pregnancy outcomes in women with heart diseases". *Arch. Gynecol. Obstet.*, 2010, 281, 29.
- [28] Vasu S., Stergiopoulos K.: "Valvular heart disease in pregnancy". *Hellenic J. Cardiol.*, 2009, 50, 498.
- [29] Karamlaou T., Diggs B.S., McCrindle B.W., Welke K.F.: "A growing problem: maternal death and peripartum complications are higher in women with grown-up congenital heart disease". *Ann. Thorac. Surg.*, 2011, 92, 2193.
- [30] Hidano G., Uezono S., Terui K.: "A retrospective survey of adverse maternal and neonatal outcomes for parturients with congenital heart disease". *Int. J. Obstet. Anesth.*, 2011, 20, 229.

Address reprint requests to:

F. VURAL, M.D.

Orhan mah. Bağtepe sok.

Erenkayapark Evleri A2-2 Bağçeşme-İZMİT

41100 Kocaeli (Turkey)

e-mail: fisunvural@yahoo.com.tr