Original Article

Feto-maternal Outcomes in Women with Congenital Heart Disease

Obst. & Gynae

1. Muhammad Mujtaba Shaikh 2. Khadija Bano 3. Saeeda Mujtaba

1. Senior Registrar of Cardiology, National Institute of Cardiovascular Diseases (NICVD) 2. Asstt. Prof. of Obst. and Gynae, JPMC, Karachi 3. Resident, Obst. and Gynae, JPMC, Karachi

ABSTRACT

Objectives: To determine Pregnancy Outcomes in Women with Congenital Heart Disease.

Study Design: Cross sectional study

Place and Duration of Study: This study was conducated at Obstetrics and Gynaecology ward 9 Jinah Postgraduate Medical Centre Karachi and National Institute of Cardiovascular Diseases (NICVD), from May 2008 and January 2011.

Materials and Methods: All Pregnant women with congenital heart disease presenting at OPD of National Institute of Cardiovascular Diseases delivering at Obstetrics and Gynaecology ward 9 Jinah Postgraduate Medical Centre Karachi were included. Cardiac complications were subdivided into primary and secondary Cardiac events. A primary cardiac event consisted of cardiac death, cardiac arrest, stroke, symptomatic sustained bradyarrhythmia or tachyarrhythmia requiring therapy, or pulmonary edema documented by physical examination or radiography. Decline in ≥2 NYHA functional classes, need for urgent invasive cardiac interventions during pregnancy or within 6 weeks postpartum, and symptomatic nonsustained bradyarrhythmia or tachyarrhythmia requiring therapy were considered secondary cardiac events. Obstetric events consisted of preeclampsia, postpartum hemorrhage, and noncardiac death. Neonatal events were defined as preterm delivery (<37 weeks of gestation), birth weight small for gestational age respiratory distress syndrome, cerebral intraventricular hemorrhage, fetal death or neonatal death. Spontaneous abortion was defined as fetal loss before 20 weeks of gestation.

Result: 36 women with congenital heart disease. Spontaneous abortions occurred in 6 pregnancies at 10.8±3.7 weeks, and 2 underwent elective pregnancy termination. There were no maternal deaths. Primary maternal cardiac events complicated 19.4% of ongoing pregnancies, with pulmonary edema in 16.6% and sustained arrhythmias in 8.3%. Adverse neonatal outcomes occurred in 27.7% of ongoing pregnancies and included preterm delivery (19.4%), small for gestational age (8.33%), respiratory distress syndrome (8.33%), intrauterine fetal demise (2.77%), and neonatal death (2.77%).

Conclusions: Feto-maternal outcome in women with congenital heart disease can be improved further with proper management and counseling.

Key Words: Pregnancy, Congenital heart disease, Delivery.

INTRODUCTION

Heart diseases are the most important non obstetrical causes of maternal deaths during pregnancy, accounting for almost 10% of maternal deaths.[1]Improvement in health care services have allowed more frequent identification of pregnant women with congenital and acquired heart disease.[2]Recent advances in pediatric cardiology and cardiac surgery have enabled increasing numbers of women with congenital heart disease to thrive well into their childbearing years. Although maternal deaths in pregnant women with congenital heart disease are rarely reported,[3,4,5]Maternal heart disease comprises 0.2 to 3% of pregnancies and is responsible for 10 - 25% of maternal deaths,they complicate 1-3% of all pregnancies with congenital defects in 70-80% of the cases.[6,7] So maternal cardiac and neonatal complications are considerable[8,9] We therefore sought to assess outcomes and determine risk factors for adverse maternal and neonatal events in a contemporary cohort of pregnant women exclusively with congenital heart disease Prior studies either have focused on outcomes in women with particular congenital defects[3] or have encompassed all forms of heart disease, including ischemic, hypertrophic, and dilated cardiomyopathies, acquired valve disease, and arrhythmias in women with structurally normal hearts.[8,9]

MATERIALS AND METHODS

All pregnant women with congenital heart disease presenting at National Institute of Cardiovascular Diseases delivering at Obstetrics and Gynaecology ward 9 Jinah Postgraduate Medical Centre Karachi between May 2008 and January 2011. Women with acquired heart disease, primary arrhythmia diagnoses without underlying congenital defects, and isolated mitral valve prolapse were excluded.

Baseline data collected before pregnancy or at the first prenatal visit were retrospectively recorded , including cardiological, surgical, echocardiographic records. Variables included age, height, weight, ethnicity, educational and marital status, cigarette and/or alcohol consumption, medications, obstetric history, medical

history (eg, diabetes, pulmonary disease, systemic and/or pulmonary thromboembolic disease), cardiac diagnoses and surgical procedures, prior cardiac history (eg, heart failure, endocarditis, arrhythmia), New York Heart Association (NYHA) functional class, blood pressure, heart rate, oxygen saturation, maximum oxygen uptake (mL/kg per minute), laboratory values (eg, blood urea nitrogen, creatinine, hematocrit), echocardiographic assessment including Doppler quantification of obstructive and regurgitant lesions and systolic pulmonary artery pressure estimates. Follow-up data were obtained from clinical visits throughout pregnancy and the puerperium and included changes in medication, NYHA functional class, provision of high-risk care, onset of cardiac care, and formal genetic counseling.

Cardiac, obstetric, and neonatal events were classified according to previously proposed definitions determined by Siu and colleagues.[8] Cardiac complications were subdivided into primary and secondary events. A primary cardiac event consisted of cardiac death, cardiac arrest, stroke, symptomatic sustained bradyarrhythmia or tachyarrhythmia requiring therapy, or pulmonary edema documented by physical examination or radiography. Decline in ≥2 NYHA functional classes, need for urgent invasive cardiac interventions during pregnancy or within 6 weeks postpartum, and symptomatic nonsustained bradyarrhythmia or tachyarrhythmia requiring therapy were considered secondary cardiac events. Obstetric events consisted of preeclampsia, defined as sustained systolic or diastolic blood pressure ≥140 or ≥90 mm Hg, respectively, with concurrent proteinuria; postpartum hemorrhage, defined as estimated blood loss >500 mL for vaginal delivery or >1 L for cesarean delivery accompanied by a ≥10 g/L drop in hemoglobin or requiring transfusion; and noncardiac death. Neonatal events were defined as preterm delivery (<37 weeks of gestation), birth weight small for gestational age (<10th percentile), respiratory distress syndrome, cerebral intraventricular hemorrhage, fetal death (≥20 weeks of gestation), or neonatal death (within the first month after birth). Spontaneous abortion was defined as fetal loss before 20 weeks of gestation.

The validity of a previously proposed maternal cardiac risk index from the Cardiac Disease in Pregnancy (CARPREG) investigators,[8] generated in a cohort of women with a variety of congenital and acquired forms of heart disease, was tested in the study population. One point was assigned for each of the following variables: arrhythmia or prior cardiac event (heart failure, transient ischemic attack, or stroke before pregnancy); baseline NYHA functional class III or IV or cyanosis (oxygen saturation <90%); systemic heart obstruction (atrioventricular valve area of the subaortic ventricle <2 cm^2, aortic valve area <1.5 cm^2, or peak outflow tract gradient of the subaortic ventricle >30 mm Hg); and subaortic ventricular ejection fraction <40%.

Dichotomous variables are presented as percentage and continuous variables as mean±SD or median and range depending on their distribution. Given that each woman could have >1 pregnancy, analyses took into consideration the nonindependent nature of the data structure. Generalized estimating equations were used to produce regression marginal models for cluster sampling data by specifying link and distribution functions. Univariate and multivariate predictors of cardiovascular, neonatal, and obstetric events were assessed. In validating the previously proposed CARPREG index, actual versus expected primary cardiac event rates were compared by χ^2 goodness-of-fit tests. A generalized estimating equation model that controlled for the CARPREG index assessed the additional predictive ability of candidate risk factors for adverse maternal cardiac risk. Two-tailed probability values <0.05 were considered statistically significant. Statistical testing was performed with the use of SPSS software Version 12.

RESULTS

Baseline Characteristics: During the study period, women with congenital heart disease between 20 and 40 years of age were seen in the outpatient division of the NICVD hospital. Of these women, 36 had pregnancies at age 27.7±6.1 years. Underlying congenital heart lesions and maternal baseline characteristics are summarized in Tables 1 and 2, respectively. Gestational age at the first prenatal visit was 12.8±7.9 weeks. Overall, 41% of pregnancies were considered planned. Cardiology counseling before pregnancy in 20%.

Qualifying cardiac events occurred in 25.0% of ongoing pregnancies and were limited to heart failure with pulmonary edema, symptomatic arrhythmias, and need for urgent invasive intervention Table 2. There were no maternal deaths. Four patients experienced deterioration by 1 NYHA functional class. One patient with Turner syndrome, surgically repaired aortic coarctation, and normal biventricular systolic function had a troponin leak in the setting of preeclampsia with hemolysis, elevated liver enzymes, and low platelets (HELLP) syndrome. She had invasive monitoring to assist with volume management during hospitalization.

The most common adverse cardiac event was pulmonary edema, documented in 6 pregnancies. All episodes of heart failure responded to medical therapy that included diuretics, except for the patient with mixed aortic valve disease and increasing aortic stenosis (gradient >100 mm Hg) who underwent urgent aortic valve replacement at 20 weeks of gestation. Intrauterine fetal demise occurred on the third postoperative day.

Table No.1: Distribution by Primary Type of Congenital Heart Disease

Congenital Lesion	No. (%)
Septal defect	**11** (3.96)
Atrial septal defect (ASD)	6 (2.16)
Unoperated (ASD)	4 (1.44)
Surgically repaired (ASD)	2 (0.72)
Ventricular septal defect (VSD)	5 (1.8)
Unoperated (VSD)	1 (0.36)
Surgically repaired (VSD)	4 (1.44)
Right-sided obstructive lesion	**5** (1.8)
Pulmonary stenosis, unoperated	3 (1.08)
Pulmonary stenosis valvotomy	2 (0.72)
Left-sided obstructive lesion	**5** (1.8)
Aortic stenosis	5 (1.8)
Unoperated	2 (0.72)
Transcatheter valvuloplasty	2 (0.72)
Aortic valve replacement	1 (0.36)
Aortic coarctation	**4** (1.44)
Tetralogy of Fallot after repair	**5** (1.8)
Patent ductus arteriosus	**6** (2.16)

Table No.2: Cardiac, Obstetric, and Neonatal Outcomes

	No. (%)
Aborted pregnancy	8 (22.0)
Spontaneous	6 (16.6)
Induced	2 (5.5)
Maternal cardiac event	9 (25.0)
Primary	7 (19.4)
Pulmonary edema	6 (16.6)
Sustained symptomatic arrhythmia requiring therapy	1 (2.77)
Cerebrovascular accident	0 (0)
Cardiac arrest	0 (0)
Cardiac death	0 (0)
Secondary	9 (12.5)
Change in NYHA class by ≥2	0 (0.0)
Need for urgent invasive intervention	4 (5.6)
Nonsustained symptomatic arrhythmia requiring therapy	6 (8.3)
Obstetric event	8 (22.0)
Preeclampsia	2 (5.5)
Postpartum hemorrhage	3 (8.33)
Noncardiac maternal death	0 (0)
Neonatal event (at least 1 of the following)*	10 (27.7)
Preterm delivery	7 (19.4)
Small for gestational age	3 (8.33)
Respiratory distress syndrome	3 (8.33)
Intrauterine fetal demise	1 (2.77)

Symptomatic arrhythmias was documented in 2 pregnancies, 1 of which were supraventricular and sustained. A patient with repaired tetralogy of Fallot had a 17-beat run of ventricular tachycardia on Holter monitoring requested for palpitations and dizziness. Sustained ventricular tachycardia was not inducible on an electrophysiological study at 22 weeks of gestation, and β-blocker therapy was initiated.

In further analyses of independent risk factors for primary or secondary cardiac events, smoking was associated with pulmonary edema (odds ratio [OR], 9.5; 95% CI, 1.8 to 50.5; P=0.0082) and symptomatic arrhythmias (OR, 9.0; 95% CI, 1.6 to 52.0; P=0.0140). Similarly, subpulmonary ventricular dysfunction and/or severe pulmonary regurgitation was predictive of both symptomatic arrhythmias (OR, 6.9; 95% CI, 1.1 to 42.1; P=0.0358) and pulmonary edema (OR, 4.6; 95% CI, 1.2 to 17.9; P=0.0283). This latter association persisted after adjustment for subaortic ventricular systolic dysfunction (OR, 4.1; 95% CI, 1.0 to 16.1; P=0.0486).

Obstetric and Neonatal Events: Eigh pregnancies (22.0%) were aborted: 6 (16.6) spontaneously and 2 (5.5) electively. 4 spontaneous abortions occurred in the first trimester and 2 in the second trimester, at a mean of 10.8±3.7 weeks. Univariate predictors of spontaneous abortion were maternal hypertension (OR, 17.8; 95% CI, 1.4 to 218.3; P=0.0247), antiplatelet agent (OR, 7.3; 95% CI, 1.6 to 33.4; P=0.0100), and antiarrhythmic medication (OR, 5.3; 95% CI, 1.2 to 23.0; P=0.0249). All 2 pregnancies were singletons.

There were single intrauterine fetal demises occurring at 26 weeks of gestation in a patient with a stenotic bicuspid aortic. The only neonatal death also occurred in this patient's prior pregnancy. That pregnancy was complicated by premature rupture of membranes at 24.5 weeks of gestation requiring urgent cesarean delivery for chorioamnionitis. The neonate expired 9 days after delivery from complications of prematurity.

Nine pregnancies (25.0 %) were delivered by cesarean, and 18 (50.0%) had successful vaginal deliveries. All patients without an obstetric contraindication attempted a trial of labor. 12 vaginal deliveries were spontaneous, whereas 06 were assisted by forceps or vacuum. All cesarean deliveries were performed for routine obstetric indications:

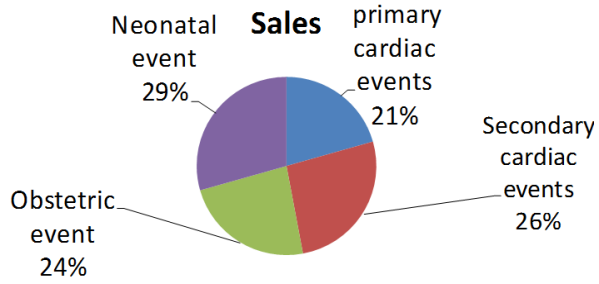

Figure:

DISCUSSION

As an increasing number of women with congenital heart disease contemplate pregnancy, caregivers are faced with the difficult task of estimating maternal and

fetal risks to counsel patients regarding safety issues and plan antenatal care.[2,3,4] In the absence of local data, recommendations are often based on comprehensive clinical assessments with speculations as to how particular underlying cardiac substrates are likely to respond to physiological changes imposed by pregnancy. This study examines pregnancies in women exclusively with congenital heart disease.

The spontaneous abortion rate of 16.6% of clinically recognized pregnancies is likely underestimated because those occurring before medical attention and referral are not tabulated. Nevertheless, this rate is consistent with those described in women without heart malformations, in whom the incidence of miscarriage is 12% to 15% for clinical pregnancies and 17% to 22% if early pregnancy losses are included.[10] Associations between miscarriages, hypertension,[11] and aspirin[12] have been previously reported.

The primary cardiac event rate of 19.4% observed in this study is comparable to the 23.5% incidence described in a large cohort of pregnant women with heart disease, of whom 19.1% had underlying congenital heart malformations.[9] Siu et al[8] reported a 13% incidence of primary cardiac events. This lower event rate may be explained in part by differences in study populations because 22% of women had acquired forms of heart disease and 4% had structurally normal hearts with arrhythmias. In addition, lower-risk patients are less likely to be referred to a tertiary care center.

As in the present study, the most common cardiac complications have consistently been congestive heart failure followed by arrhythmias.[8,9] Responses to medical therapy have generally been favorable. Among risk factors for adverse cardiac outcomes, advanced NYHA functional class and prior history of heart failure have been previously described.[8] Detrimental effects of smoking on cardiovascular hemodynamics are well known and include increases in heart rate, systemic vascular resistance, systemic arteriolar resistance, blood pressure, pulmonary artery pressure, pulmonary vascular resistance, right and left atrial pressures, and arrhythmias.[13]

Neonatal complications occurred in 27.7% of pregnancies, comparable to the 20% reported in CARPREG.[8] In both studies, premature births were the most common events, followed by birth weight small for gestational age and respiratory distress syndrome. Identified risk factors including smoking during pregnancy, cyanosis, and maternal systemic heart obstruction were similar in both studies.

During the course of pregnancy, hormonally mediated changes result in an increase in blood volume, red blood cell mass, and heart rate.[14] Systolic subaortic ventricular function decreases near term and early postpartum because of reduced contractility and decreased preload.[15] Interestingly, different degrees of chamber enlargement in systemic and pulmonary circulations have been observed. Moreover, the additional volume load on a subpulmonary ventricle exposed to hemodynamic or hypoxic stress and surgical scars may predispose to such cardiac complications as atrial or ventricular arrhythmias.[16] Indeed, the association between ventricular arrhythmias and severe pulmonary regurgitation with subpulmonary ventricular dilation is well established in patients with repaired tetralogy of Fallot.[16]

In our study, pulmonary edema complicating pregnancy was associated with subpulmonary ventricular dysfunction and/or severe pulmonary regurgitation independent of subaortic ventricular systolic function. Previously demonstrated right to left ventricular interactions may be amplified in congenitally malformed hearts. Whereas deeper myocardial fiber layers are separated, superficial layers encircling normal right and left ventricles are shared.[17] Moreover, right ventricular volumes may modulate left ventricular indices of diastolic compliance.[18]

CONCLUSION

In a large single-center cohort of pregnant women with congenital heart disease, maternal cardiac and neonatal complications were considerable. Despite this high maternal cardiac complication rate, with careful surveillance and prompt recognition of symptoms, an overall favorable response to therapy was noted, with no maternal deaths. A multidisciplinary approach that includes availability of high-risk obstetric care, specialized cardiology assessment and follow-up, and genetic counseling is recommended for women with congenital heart disease contemplating pregnancy.

REFERENCES

1. Asghar F, Kokab H. Evaluation and Outcome of Pregnancy Complicated by Heart Disease. JPMA 2005;55:416.
2. Wasim T, Siddiq S, Amer W, Majrroh A. Foetomaternal outcome of pregnancy with cardiac disease. JPMA 2008;58:175.
3. Shime J, Mocarski EJ, Hastings D, Webb GD, McLaughlin PR. Congenital heart disease in pregnancy: short and long-term implications. Am J Obstet Gynecol 1987;156: 313–322.
4. Daliento L, Somerville J, Presbitero P, Menti L, Brach-Prever S, Rizzoli G, Stone S. Eisenmenger syndrome: factors relating to deterioration and death. Eur Heart J 1998; 19: 1845–1855.
5. Presbitero P, Somerville J, Stone S, Aruta E, Spiegelhalter D, Rabajoli F. Pregnancy in cyanotic congenital heart disease: outcome of mother and fetus. Circulation 1994; 89: 2673–2676.
6. Dobbenga - Rhodes YA, Preive AM. Assesment and evaluation of women with cardiac disease during pregnancy. J perinat Neonatal Nurs 2006; 20: 295-302.

7. Montoya ME, Karnath BM, Ahmad M. Endocarditis during pregnancy. South Med J 2003;96:1156.
8. Siu SC, Sermer M, Colman JM, Alvarez AN, Mercier LA, Morton BC, et al. Prospective multicenter study of pregnancy outcomes in women with heart disease. Circulation 2001;104: 515–521.
9. Avila WS, Rossi EG, Ramires JA, Grinberg M, Bortolotto MR, Zugaib M, et al. Pregnancy in patients with heart disease: experience with 1,000 cases. Clin Cardiol 2003;26:135–142.
10. Garcia-Enguidanos A, Calle ME, Valero J, Luna S, Dominguez-Rojas V. Risk factors in miscarriage: a review. Eur J Obstet Gynecol Reprod Biol 2002; 102: 111–119.
11. Li DK, Liu L, Odouli R. Exposure to non-steroidal anti-inflammatory drugs during pregnancy and risk of miscarriage: population based cohort study. BMJ 2003;327: 368–373.
12. Skold AC, Danielsson BR. Developmental toxicity in the pregnant rabbit by the class III antiarrhythmic drug sotalol. Pharmacol Toxicol 2001; 88: 34–39.
13. Walsh RA. Effects of maternal smoking on adverse pregnancy outcomes: examination of the criteria of causation. Hum Biol 1994;66: 1059–1092.
14. Siu SC, Colman JM. Heart disease and pregnancy. Heart. 2001; 85: 710–715.
15. Mone SM, Sanders SP, Colan SD. Control mechanisms for physiological hypertrophy of pregnancy. Circulation 1996; 94: 667–672.
16. Gatzoulis MA, Balaji S, Webber SA, Siu SC, Hokanson JS, Poile C, et al. Risk factors for arrhythmia and sudden cardiac death late after repair of tetralogy of Fallot: a multicentre study. Lancet 2000; 356: 975–981.
17. Redington AN. Right ventricular function. Cardiol Clin 2002; 20: 341–349.
18. Paul Khairy, David W. Ouyang, Michael J. Landzberg. Pregnancy Outcomes in Women with Congenital Heart Disease. Circulation 2006;113: 517-524.

Address for Corresponding Author:
Dr. Muhammad Mujtaba Shaikh
B- 20 second floor, Naveed Cottage,
Gulistan-e-Johar, Block-17,
Karachi
E-mail: drmujtabashaikh8@gmail.com
Cell No. 03333189810